SCHEME OF EXAMINATION

&

SYLLABI

for

Bachelor of Technology / Master of Technology (Dual Degree Programmes)

Scheme and Syllabus

for

a. **Computer Science and Engineering Major Discipline**
b. **Information Technology Major Discipline**
c. **Electronics and Communication Engineering Major Discipline**

1st Year Common Scheme and Syllabus, 2nd year Scheme and Syllabus and Scheme of Studies framework for higher semesters)

Offered by

University School of Information, Communication & Technology at the GGSIPU University Campus, Dwarka

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

Guru Gobind Singh Indraprastha University
Sector 16C, Dwarka, Delhi – 110 078 [INDIA]
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Applicable from Batch Admitted in Academic Session 2021-22 Onwards

Approval History:

1. First year Scheme and Syllabus approved by BoS 31/10/2021.

2. First year Scheme and Syllabus approved by AC Subcommittee on 22/11/2021.

3. First year Scheme and Syllabus approved by Academic Council on 22/02/2022 vide agenda item AC 52.11.

4. 2nd year Scheme and Syllabus approved by BoS 10/09/2022

5. Minor Modification in BS113 and BS108 approved by BoS on 10/09/2022 w.e.f. Academic Session 2022-23. And, the same approved in AC subcommittee on dt. 14.09.2022.

6. Inclusion of Basic Engineering Chemistry I and Basic Engineering Chemistry II papers in lieu of Engineering Chemistry I and Engineering Chemistry II for admitted students in the 1st year, for students who did not study chemistry at 10+2 level, approved by BoS on 10 /09/2022,w.e.f academic session 2022-23. And, the same approved in AC subcommittee on dt. 14.09.2022.

7. Inclusion of lateral entry guidelines and bridge course with effect from lateral entry admissions in the year 2022-23 (regular batch 2021-22) approved by BoS on 10/09/2022. And, the same approved in AC subcommittee on dt. 14.09.2022.

8. Correction in the marking scheme of BS110 approved by the BoS on 10/09/2022 with retrospective effect from Academic Session 2021-22. And, the same approved in AC subcommittee on dt. 14.09.2022.

9. Scheme and syllabus of 3rd and 4th year approved by BoS on 24/08/2023 . And, the same approved in AC subcommittee on dt. 29/09/2023 for batch admitted in A.S. 2021, and 2022 (in the first year / regular batch and the corresponding lateral entry admissions).

10. The marking scheme for all non-NUES papers (theory/practical) to be as:

    1. Teachers Continuous Evaluation: 40 marks
    2. Term end Theory Examinations: 60 marks

w.e.f from the batch of A.S.: 2023-24 onwards (for lateral entry this provision shall be applicable from admissions through lateral entry from admissions in the academic session 2024-25). The syllabus remains the same. This provision was approved by the BoS on 24/08/2023. And, the same approved in AC subcommittee on dt. 29/09/2023 w.e.f. from A.S 2023-24.

Vision of the School

Create high-quality engineering professionals

Mission of the School

To serve humanity by creating professionally competent, socially sensitive engineers with high ethical values who can work as individuals or in groups in multicultural global environments.

Introduction

This document describes the curriculum of the Bachelor of Technology part of the Dual Degree (Bachelor Technology / Master of Technology) Programmes that are offered at the University School of Information, Communication and Technology in its own campus (not at the affiliated institution of the University). In the event of any difficulty of implementation, and / or interpretation of any clause of the document, the same may be brought to the notice of Dean of the University School of Information Communication and Technology. The decision of the Dean, University School of Information Communication and Technology shall be final and implemented to resolve the issue. The same shall be put up in the subsequent meeting of the Board of Studies of the University School of Information Communication and Technology for its approval. If the decision of the Board of Studies of the University School of Information Communication and Technology is at variance with the decision taken earlier by the Dean of the School, the decision of the Board shall be effective from the date of the approval by the Board of Studies. In the interim period (between the approval of the Dean, of the School and the Board of Studies approval), the decision already taken by the Dean of the school shall stand.

The textbooks recommended by AICTE vide its public notification (Annexure 1) and its amendments from time to time, may be utilized by the concerned teachers for teaching of subjects in any discipline (as relevant).

The Outcome Based Education Framework implementation was approved by the BoS. The framework as decided by the APC and of the school is shall be implemented w.e.f batch of Academic Sessuion 2023-24.

The marking scheme for all non-NUES papers (theory/practical) to be as:

1. **Teachers Continuous Evaluation: 40 marks**
2. **Term end Theory Examinations: 60 marks**

w.e.f from the batch of A.S.: 2023-24 onwards (for lateral entry this provision shall be applicable from admissions through lateral entry from admissions in the academic session 2024-25). For earler batch (regular) admitted in the year 2021-22 and 2022-23 (and corresponding lateral entry admissions), the marking scheme for all non-NUES papers (theory/practical) to be as defined within this document, that is, NUES papers out of 100, Theory to have 25 marks for Teachers Continuous Evaluation and 75 marks for term end examinations while the corresponding bifurcation for practicals/projects/dissertation to be 40:60.

Programme Outcomes

1. ***Engineering Knowledge*** (**PO01**): Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. ***Problem Analysis*** (**PO02**): Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. ***Design/Development of Solutions*** (**PO03**): Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. ***Conduct Investigations of Complex Problems*** (**PO04**): Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:
    a. that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;
    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    d. which need to be defined (modelled) within appropriate mathematical framework; and
    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.
5. ***Modern Tool Usage*** (**PO05**): Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. ***The Engineer and Society*** (**PO06**): Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. ***Environment and Sustainability*** (**PO07**): Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. ***Ethics*** (**PO08**): Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. ***Individual and Team Work*** (**PO09**): Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. ***Communication*** (**PO10**): Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. ***Project Management and Finance*** (**PO11**): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. ***Life-long Learning*** (**PO12**): Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course / Paper Group Codes:
BS: Basic Science
HS: Humanities, social science, management
ES: Engineering Science
MC: Mandatory courses
PC: Programme Core, that is course / paper offered in the discipline of the programme as a compulsory paper.
PCE: Programme Core Elective, that is elective course / paper offered in the discipline of the programme.
EAE: Emerging Area Elective offered by school
OAE: Open area elective offered by other school or open / emerging area elective offered by the school. This allows the student to have two minor specializations also.
Note: The papers offered by USICT as open elective shall only be offered in the Dwarka Campus of the University. Students studying at the Dwarka Campus of the University only are eligible for these papers, subject to the rules of the USICT.

Definitions:
Batch: The batch of the student shall mean the year of the first time enrolment of the students in the programme of study in the first semester. Lateral entry students admitted in the 3rd semester / 2nd year shall be designated as students admitted in the previous batch as they are admitted one year later. A student re-admitted in a programme of study in a lower / later batch shall be considered as the student of the original batch for the purpose calculation of duration of study.

Programme of study shall mean Bachelor of Technology.

Major specialization shall mean the discipline in which the student is admitted / upgraded or transferred.

Minor specialization shall mean the specializations earned through the EAE or OAE route subject to fulfilment of requirements specified in the scheme of study for the concerned minor specialization.

Paper / Course shall be treated as synonyms. A paper is one unit of curriculum taught, in general, in one particular semester, having upto 4 credits (for papers with

Acronyms:
APC: Academic programme committee comprising of all faculty of the school and as defined in the implementation rules.
BoS: Board of Study of the school, USICT.
USICT: University School of Information, Communication and Technology.
L: Number of Lecture hours per week
T/P: Number of Tutorial / Practical Hours per week
C: Number of credits assigned to a course / paper
COE: Controller of Examinations of the Examinations Division of the University.
SGPA/CGPA: Semester/Cumulative Grade Point Average.
NUES: No term end examination shall be held. The evaluation shall be conducted as per the scheme of examinations as described in the scheme of study.

NOTE: THE CURRENT DOCUMENT DEFINES THE SCHEME OF THE FIRST 4 YEARS (8 SEMESTER) CORRESPONDING TO THE BACHELOR OF TECHNOLOGY PART OF THE BACHELOR OF TECHNOLOGY / MASTER OF TECHNOLOGY PART OF THE DUAL DEGREE PROGRAMMES OFFERED BY USICT AT THE DWARKA CAMPUS OF THE UNIVERSITY. THE CURRENT DOCUMENT DEFINES THE SCHEME AND SYLLABUS FOR THE FIRST AND SECOND YEAR ONLY.

FIRST YEAR

Common Scheme and Syllabus for

Bachelor of Technology / Master of Technology (Dual Degree Programmes)

In

a. **Computer Science and Engineering - Major Discipline**
b. **Information Technology - Major Discipline**
c. **Electronics and Communication Engineering - Major Discipline**

In light of the eligibility condition specified in the **AICTE Process Handbook 2022-23** (Page Nos 89 and 90), the **Basic Engineering Chemistry - I (BS-117)** shall be offered in lieu of **Engineering Chemistry – I (BS109)** and **Basic Engineering Chemistry – II (BS116)** shall be offered in lieu of **Engineering Chemistry – II (BS104),** to students admitted from Academic Session 2022-23 (in the 1st Semester). This shall be offered only to students who have not studied Chemistry at 10+2 Level and are admitted to the following disciplines only:

1) Computer Science and Engineering (CSE)
2) Information Technology (IT)
3) Electronics and Communications Engineering (ECE)

Note: The corresponding practical paper codes shall be unchanged.
(Addition from Academic Session 2022-23)

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ICT101	Programming for Problem Solving	3	-	3
ES	ICT103	Electrical Science	3	-	3
ES	ICT105	Engineering Mechanics	3	-	3
HS	HS107	Communication Skills-I	3	-	3
BS	BS109# Or BS117	Engineering Chemistry – I Basic Engineering Chemistry – I	3	-	3
BS	BS111	Engineering Mathematics – I	4	-	4
BS	BS113	Engineering Physics – I	3	-	3
HS/MC	LLB115*****	Indian Constitution	2	-	2
Practical/Viva Voce					
ES	ICT151	Programming for Problem Solving Lab.	-	2	1
ES	ICT153	Engineering Graphics-I	-	2	1
ES	ICT155	Electrical Science Lab.	-	2	1
BS	BS157	Engineering Chemistry-I Lab	-	2	1
BS	BS159	Engineering Physics - I Lab	-	2	1
Total			**24**	**10**	**29**

***NUES : Comprehensive evaluation by the teacher concerned out of 100.**

#The students who have not studied Chemistry at 10+2 level shall be offered BS-117 in lieu of BS-109, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

Group	**Code**	**Paper**	**L**	**P**	**Credits**
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club / Institution's Innovation Council*			2

***NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs / Institution's Innovation Council, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall undergo training or participate in the activities for the period of 3rd semester to 6th semester only. (Note: Innovation council added in from AS 2023-24 onwards)

Second Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES		School Specific Engineering Science Paper**			3
HS	HS102	Communication Skills – II	3	-	3
BS	BS104% Or BS116	Engineering Chemistry – II Basic Engineering Chemistry – II	3	-	3
BS	BS106	Engineering Mathematics - II	4	-	4
BS	BS108	Engineering Physics-II	3	-	3
BS	BS110	Probability and Statistics for Engineers *** (Only for regular batch 2021, and 2022)	3	2	4
BS	BS110T	Probability and Statistics for Engineers (Regular batch 2023 onwards)	3	-	3
HS/MC	ICT114*	Human Values and Ethics	1	-	1
BS/MC	EMES112	Environmental Studies	4	-	4
Practical/Viva Voce					
ES	ICT152	Engineering Graphics-II Lab.	-	2	1
BS	BS156	Engineering Chemistry – II Lab	-	2	1
BS	BS158	Engineering Physics –II Lab	-	2	1
BS	BS110P	Probability and Statistics for Engineers (Regular batch 2023 onwards) Lab.	-	2	1
One paper from the following#:					
ES	ICT154	Workshop Technology		2	1
ES	ICT160	Programming in Python		2	
ES	ICT162	Modern Workshop Practice (Intoduced from AS 2023-24)		2	
Total			**24**	**10**	**29**

*NUES: Comprehensive evaluation by the teacher out of 100, no term end examination shall be held.

%The students who have not studied Chemistry at 10+2 level shall be offered BS-116 in lieu of BS-104, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

Either Workshop practice or Programming in Python paper shall be offered to the students by the school. If Workshop Technology paper is offered it shall be considered as a Theory paper otherwise Workshop practice shall be considered as practical paper

** School Specific Engineering Science Paper in this semester shall be one of the papers from the list below or any paper (approved by the Board of Studies of the School) decided by the Academic Programme Committee of the School to be offered in the first year/second semester.

Second Semester Open Elective from the School					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
	Open Elective Papers				
ES	ICT116	Introduction to Manufacturing Process	3	-	3
ES	BS118	Industrial Chemistry	3	-	3
ES	BT120	Introduction to Biotechnology	3	-	3

*** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet **as internal marks out of 25 and external marks out of 75 (50 theory and 25 practicals)** (amended in 2022 for batch of 2021). This paper shall be offered to students of regular batch of AS 2021-22 and 2022-23 (and corresponding lateral entry batch) (Line added in 2023).

SYLLABUS OF FIRST YEAR

for

- **a. Computer Science and Engineering Major Discipline**
- **b. Information Technology Major Discipline**
- **c. Electronics and Communication Engineering Major Discipline**

Offered by

University School of Information, Communication & Technology at the GGSIPU University Campus, Dwarka

PaperCode: ICT101	Paper: Programming for Problem Solving	L	T/P	C
PaperID: 164101		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers, files, union and structures to develop algorithms and programs in 'C'.
4:	To impart knowledge about how to approach for dividing a problem into sub-problems and solve the problem in 'C'.

Course Outcomes (CO):

CO1:	Ability to develop simple algorithms for arithmetic and logical problems and implement them in 'C'.
CO2:	Ability to implement conditional branching, iteration and recursion and functions in 'C'
CO3:	Ability to use arrays, pointers, union and structures to develop algorithms and programs in 'C'.
CO4:	Ability to decompose a problem into functions and synthesize a complete program using divide and conquer approach in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme. Algorithms: Representation using flowcharts, pseudocode.

Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements. Interconversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions. [10Hrs]

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays.

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. [10Hrs]

Unit III

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings

Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self referential structures, unions, typedef, enumerations.

File handling: command line arguments, File modes, basic file operations read, write and append.
Scope and life of variables, multi-file programming.
C99 extensions. 'C' Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h [10Hrs]

Unit IV

Basic Algorithms: Finding Factorial, Fibonacci series, Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Find the square root of a number, array order reversal, reversal of a string, two-way merge sort, stacks, queues, single –link linked list, Binary search tree. [10Hrs]

Textbooks:

1. *How to solve it by Computer* by R. G. Dromey, Prentice-Hall India EEE Series, 1982.
2. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Programming Logic & Design* by Tony Gaddis, Pearson, 2nd Ed. 2016.
2. *Programming Logic and Design* by Joyce Farrell, Cengage Learning, 2015.
3. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
4. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
5. *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
6. *How to Design Programs* by Matthias Felleisen, Robert Bruce Findler, Matthew Flatt, and Shriram Krishnamurthi, MIT Press, 2018.
7. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).
8. *ISO/IEC 9899:1999. International Standard for Programming Languages – C (ISO/IEC 9899)* by American National Standards Institute, Information Technology Industry Council, 2000 (C99).
9. *INCITS/ISO/IEC 9899-2011.American National Standard for Programming Languages 'C'*by American National Standards Institute, Information Technology Industry Council, 2012 (C11).

PaperCode: ICT103	**Paper: Electrical Science**	**L**	**T/P**	**C**
PaperID: 164103		**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge of the basics electrical engineering.
2:	To impart knowledge of the working of RLC circuits.
3:	To impart basic knowledge about filters and magnetic circuits.
4:	To impart basic knowledge about electrical machines.

Course Outcomes (CO):

CO1:	Ability to understand and use Kirchpff's Laws to solve resistive circuit problems.
CO2:	Ability to analyse resistive, inductive and capacitive circuits for transient and steady state sinusoidal solutions.
CO3:	Understand the first order filters and magnetic circuits.
CO4:	Understand the design of electrical machines.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	3	3	3	-	-	-	1	1	1	2
CO2	3	3	3	3	3	-	-	-	1	1	1	2
CO3	3	3	3	3	3	-	-	-	1	1	1	2
CO4	3	3	3	3	3	-	-	-	1	1	1	2

Unit - I

DC Circuits: Passive circuit components, Basic laws of Electrical Engineering, Temperature Resistance Coefficients. voltage and current sources, Series and parallel circuits, power and energy, Kirchhoff's Laws, Nodal & Mesh Analysis, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Time domain analysis of first Order RC & LC circuits. [10Hrs]

Unit – II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections. [10Hrs]

Unit - III

D. C. Generators & Motors: Principle of operation of Generators & Motors, Speed Control of shunt motors, Flux control, Rheostatic control, voltage control, Speed control of series motors.

A. C. Generators & Motors: Principle of operation, Revolving Magnetic field, Squirrel cage and phase wound rotor, Starting of Induction motors, Direct on line and Star Delta starters, Synchronous machines. [10Hrs]

Unit - IV:

Transformers: Construction and principle of operation, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Measuring Instruments: Electromagnetism, Different Torques in Indicating instruments, Moving Iron Instruments: Construction & Principle, Attraction and Repulsion type; Moving Coil instruments: Permanent Magnet type; Dynamometer type Instruments. [10Hrs]

Textbooks:

1. *Electrical Engineering Fundamentals* by Vincent Del Toro, PHI (India), 1989

References:

1. *An Introduction to Electrical Science* by Adrian Waygood, Routledge, 2nd Ed. 2019.
2. *Electrical Circuit Theory and Technology* by John Bird, Elsevier, 2007.
3. *Principles and Applications of Electrical Engineering* by Giorgio Rizzoni, MacGraw-Hill, 2007.

4. *Electrical Engineering* by Allan R. Hambley, Prentice-Hall, 2011.
5. *Hughes Electical & Electronic Technology* by Edward Hughes revised by Hohn Wiley, Keith Brown and Ian McKenzie Smith, Pearson, 2016.
6. *Electrical and Electronics Technology* by E. Hughes, Pearson, 2010.
7. Basic Electrical Engineering by D.C. Kulshrestha, McGraw-Hill, 2009.
8. Basic Electrical Engineering by D. P. Kothai and I.J. Nagrath, McGraw-Hill, 2010.

PaperCode: ICT105	Paper: Engineering Mechanics	L		T/P	C
PaperID: 164105		3		-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge to solve problems pertaining to force systems, equilibrium and distributed systems.
2:	To impart knowledge to solve problems of friction and engineering trusses.
3:	To impart knowledge to deal with the problems of kinematics and kinetics of particle
4:	To impart knowledge to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO):

CO1:	Ability to solve problems pertaining to force systems, equilibrium and distributed systems.
CO2:	Ability to solve problems of friction and engineering trusses.
CO3:	Ability to deal with the problems of kinematics and kinetics of particle
CO4:	Ability to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*		*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	1		1	2
CO2	3	3	3	3	2	-	-	-	1	1		1	2
CO3	3	3	3	3	2	-	-	-	1	1		1	2
CO4	3	3	3	3	2	-	-	-	1	1		1	2

Unit I

Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line, Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems.

Equilibrium: Force body diagram, equations of equilibrium and their applications to engineering problems, equilibrium of two force and three force members.

Distributed Forces: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, polar moment of inertial. [10Hrs]

Unit II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section and graphical method.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat pivot and collar bearing, friction in flat belts. [10Hrs]

Unit III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates.

Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work-energy equation, conservation of energy, concept of impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact. [10Hrs]

Unit IV

Kinematics of Rigid Bodies: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of zero velocity, Velocity and acceleration.

Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.

Beam: Introduction, types of loading, methods for the reactions of a beam, space diagram, types of end supports, beams subjected to couple. [10Hrs]

Textbooks:

1.*Engineering Mechanics* by A.K.Tayal, Umesh Publications.

References:

1. *'Engineering Mechanics' by K. L. Kumar, Tata Mc-Graw Hill*
2. *'Engineering Mechanics' by S. Timoshenko, D. H. Young, J. V. Rao, Tata Mc-Graw Hill*
3. *'Engineering Mechanics-Statics and Dynamics' by Irwing H. Shames, PHI.*
4. *'Engineering Mechanics' by Basudev Bhattacharya, Oxford Higher Education.*

PaperCode: HS107	Paper: Communication Skills - I	L	T/P	C
PaperID: 99107		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

Course Objectives:

1:	To help them understand the structures of language, and build up the vocabulary.
2:	To enhance language proficiency and communication competence.
3:	To understand basic principles of written communication.
4:	To develop the efficiency of using language for Specific Purposes with clarity.
5:	To be able to critically appreciate the written texts and audio-visual inputs effectively.
6:	To develop the theoretical understanding of interpersonal communication effectively.

Course Outcomes (CO):

CO1:	Ability to understand the basic structure of language
CO2:	Ability to communicate effectively in writing.
CO3:	Ability to present their ideas effectively in professional and demanding situations.
CO4:	Ability to interpret texts and comprehend the extended discourse.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I

Basic Language Efficiency 1: Parts of Speech, Sentence Structure, Subject-Verb Agreement, Vocabulary, Common Errors, [8Hrs]

Unit II

Basic Language Efficiency 2: Writing Skills: Types of Writing, Paragraph writing,Paraphrasing, Summarizing, Précis Writing [8Hrs]

Unit III

Formal Written Communication: Meetings – Agenda and Minutes,Press release, Letter writing, Notice, Memorandum, E-mails [8Hrs]

Unit IV

Appreciating written Texts for comprehension ability:

1. Steven Spielberg's Speech at Harvard Commencement 2016(https://www.youtube.com/watch?v=TYtoDunfu00)
2. Lecture by Johan Rockstrom: Let the Environment Guide our Development http://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development

[8Hrs]

Textbooks:

1. *High English Grammar and Composition* by Wren, P.C. & Martin H., S.Chand & Company Ltd, New Delhi.
2. *Technical Communication: Principles & Practice* by Meenakshi Raman, New Delhi: Oxford University Press

References:

1. *Be Grammar Ready: The Ultimate Guide to English Grammar* by John Eastwood, New Delhi, Oxford University Press, 2020.
2. *Communication Skills: A Workbook* by Sanjay Kumar & Pushp Lata, New Delhi, Oxford University Press, 2018.
3. *Basic Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2012.
4. *Advanced Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2011.

PaperCode: BS109	Paper: Engineering Chemistry - I	L	T/P	C
PaperID: 99109		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge about understanding and modeling atomic structure and chemical bonding.
2:	To impart knowledge about understanding and modeling Thermochemistry and Reaction Kinetics.
3:	To impart knowledge about understanding and modeling organic compound structure and reactions.
4:	To impart knowledge about understanding and modeling Stereochemistry.

Course Outcomes (CO):

CO1:	Ability to understand and model atomic structure and chemical bonding.
CO2:	Ability to understand and model Thermochemistry and Reaction Kinetics.
CO3:	Ability to understand and model organic compound structure and reactions.
CO4:	Ability to understand and model Stereochemistry.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Atomic Structure: Introduction to wave mechanics, the Schrödinger equation as applied to hydrogen atom, origin of quantum numbers, Long form of periodic table on the basis of Electronic configuration s, p, d, f block elements periodic trends, Ionization potential, atomic and ionic radii electron affinity & electro-negativity.

Chemical Bonding: Ionic bond, energy changes, lattice energy Born Haber Cycle, Covalent bond-energy changes, Potential energy curve for H2 molecule, characteristics of covalent compound, co-ordinate bond-Werner's Theory, effective atomic numbers, A hybridization and resonance, Valence Shell Electron Repulsion theory (VSEPR), Discussion of structures of H2O, NH3, BrF3, SiF4, Molecular orbital theory, Linear combination of atomic orbitals (LCAO) method. Structure of simple homo nuclear diatomic molecule like H2, N2, O2, F2.

[12Hrs]

Unit II

Thermochemistry: Hess's Law, heat of reaction, effect of temperature on heat of reaction at constant pressure (Kirchhoff's Equation) heat to dilution, heat of hydration, heat of neutralization and heat of combustion, Flame temperature. Reaction Kinetics: Significance of rate law and rate equations, order and molecularity, Determinations of order of simple reactions-experimental method, Equilibrium constant and reaction rates -Lindermann, collision and activated complex theories, complex reactions of 1st order characteristics of consecutive, reversible and parallel reactions-Steady state and non-steady state approach. [10 Hrs]

Unit III

Basic concepts of Organics: Inductive, electromeric, mesomeric and hyperconjugative effects. Stability of reaction intermediates. Electrophiles and nucleophiles, concepts of acids and bases. Arrhenius, Lowry-Bronsted and Lewis theory of acids and bases (HSAB), Carbon acids (active methylene groups), super acids. Bonds weaker than covalent bond: Hydrogen bonding - nature, types, stability and effects. IUPAC Nomenclature. [8Hrs]

Unit IV

Stereochemistry: Classification of stereoisomers, diastereomers, Separation of enantiomers. Absolute configuration (R and S), Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elements of symmetry - center, plane and axis of symmetry, Conformations: Conformations around a C-C bond in acyclic and cyclic compounds.

[10Hrs]

Textbooks / References:

1. Engineering Chemistry (16th Edition) Jain, Jain, Dhanpat Rai Publishing Company, 2013.
2.Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017
3.Engineering Chemistry by E.R. Nagarajan and S. Ramalingam, Wiley, 2017.

Paper Code:	**Paper: Basic Engineering Chemistry- I**	**L**	**T/P**	**C**
PaperID:	w.e.f. Academic session 2022-23	**3**	**-**	**3**

TO BE OFFERED TO STUDENTS WHO HAVE NOT STUDIED CHEMISTRY AT 10+2 LEVEL IN LIEU OF BS109

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term and Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examination question paper.
2. The first question will be compulsory and cover the entire syllabus. This question will have five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This question will have a total weightage of 15 marks.
3. Apart from question 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators/ log-tables / data-tables may be specified if required.

Course Objectives:

1.	To impart knowledge about atomic structure, periodicity and chemical bonding.
2.	To impart understanding about thermodynamics and reaction kinetics.
3.	To understand the basic concepts of organic chemistry.
4.	To impart basic understanding about biomolecules.

Course Outcomes (CO):

CO1:	Students will be able to understand microscopic chemistry in terms of atomic orbitals and chemical bonding
CO2:	Ability to understand thermodynamics and reaction kinetics
CO3:	Ability to understand organic compound structure and reactions
CO4:	Students will be able to understand the basic structure and functions of biomolecules.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	P005	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Atomic Structure: Atomic models; Rutherford, Bohr's model (with drawbacks), Plank's quantum theory, quantum mechanical model of the atom: dual behaviour of atom, Heisenberg's uncertainty principle, basic idea of Schrödinger equation, orbitals and quantum numbers.

Periodic Table and properties: long form of periodic table on the basis of electronic configuration, s, p, d, f block elements, periodic trends: Ionisation potential, atomic and ionic radii, electron affinity and electronegativity.

Chemical Bonding: Lewis symbols, Octet rule, ionic bond (bond parameters), covalent bond, hybridisation and resonance, valence shell electron repulsion (VSEPR) theory, structures of H_2O, NH_3, BrF_3, SiF_4. Elementary idea of Valence bond theory, Molecular orbital theory.

Unit II

Thermodynamics: Basic thermodynamic terms, types of thermodynamic processes, concept of internal energy and enthalpy, Hess's law, heat of reaction, heat of dilution, heat of hydration, heat of neutralization, heat of combustion, concept of spontaneity and entropy, Gibb's energy change and equilibrium.

Kinetics: Rate of chemical reaction, factors influencing rate of reaction, order, molecularity of reaction, zero order, first order reactions, temperature dependence of reaction rate, effect of catalyst on rate of reaction.

Unit III:

Basic Concepts of Organic Chemistry: Inductive, electromeric, mesomeric and hyperconjugative effects. Stability of reaction intermediates. Electrophiles and nucleophiles, concept of acids and bases. Arrhenius, Lowry-Bronsted and Lewis theory of acids and bases (HSAB), Carbon acids (active methylene groups), super acids, Bonds weaker than covalent bond: Hydrogen bonding-nature, types, stability and effects. IUPAC Nomenclature.

Unit IV

Biomolecules:

Carbohydrates: Classification (aldoses and ketoses), monosaccharide (glucose and fructose), D-L configuration, oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen): importance. Proteins: Elementary idea of a - amino acids, peptide bond, polypeptides, proteins, primary structure, secondary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes. Vitamins: Classification and functions. Nucleic Acids: DNA and RNA.

PaperCode: BS111	**Paper: Engineering Mathematics – I**	**L**	**T/P**	**C**
PaperID: 99111		**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand use series, differential and integral methods to solve formulated engineering problems.
2:	To understand use Ordinary Differential Equations to solve formulated engineering problems.
3:	To understand use linear algebra to solve formulated engineering problems.
4:	To understand use vector calculus to solve formulated engineering problems.

Course Outcomes (CO):

CO1:	Ability to use series, differential and integral methods to solve formulated engineering problems.
CO2:	Ability to use Ordinary Differential Equations to solve formulated engineering problems.
CO3:	Ability to use linear algebra to solve formulated engineering problems.
CO4:	Ability to use vector calculus to solve formulated engineering problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Partial derivatives, Chain rule, Differentiation of Implicit functions, Exact differentials.Maxima, Minima and saddle points, Method of Lagrange multipliers. Differentiation underIntegral sign, Jacobians and transformations of coordinates. [8Hrs]

Unit II

Ordinary Differential Equations (ODEs): Basic Concepts. Geometric Meaning of y’= ƒ(x, y). Direction Fields, Euler’s Method, Separable ODEs. Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics, Orthogonal Trajectories. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling of Free Oscillations of a Mass–Spring System, Euler–Cauchy Equations. Wronskian, Nonhomogeneous ODEs, Solution by Variation of Parameters.
Power Series Method for solution of ODEs: Legendre’s Equation. Legendre Polynomials, Bessel’s Equation, Bessels’s functions Jn(x) and Yn(x). Gamma Function [12Hrs]

Unit III

Linear Algebra: Matrices and Determinants, Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space. Solutions of Linear Systems and concept of Existence, Uniqueness, Determinants. Cramer’s Rule, Gauss–Jordan Elimination. The Matrix Eigenvalue Problem.
Determining Eigenvalues and Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices.Eigenbases. Diagonalization. Quadratic Forms.Cayley – Hamilton Theorem (without proof) [10Hrs]

Unit IV

Vector Calculus: Vector and Scalar Functions and Their Fields. Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Path Independence of Line Integrals, Double Integrals, Green’s Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Stokes Theorem. Divergence Theorem of Gauss. [10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.
2. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013. (for Unit I)

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.

2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.

PaperCode: BS113	Paper: Engineering Physics – I	L	T/P	C
PaperID: 99113		3	-	3

Applicable w.e.f. Academic Session 2022-23

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1:	Ability to apply thermodynamic principles to solution of engineering problems.
CO2:	Ability to understand and model oscillations and waves.
CO3:	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4:	Ability to understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a "System'", "State", "Equilibrium", "Process'". Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy [8Hrs]

Unit II

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell's equations. work done by the electromagnetic field, Poynting's theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves [8Hrs]

Unit III

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half-wave plates, optical activity, specific rotation, Laurent half shade polarimeter. [12Hrs]

Unit IV

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence.

Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser [12Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw-Hill, 2017.
2. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017

References:

1. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.

PaperCode: BS113	Paper: Engineering Physics – I	L	T/P	C
PaperID: 99113		3	-	3

Applicable only to batch admitted in 2021-22

Marking Scheme:

3. Teachers Continuous Evaluation: 25 marks
4. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1:	Ability to apply thermodynamic principles to solution of engineering problems.
CO2:	Ability to understand and model oscillations and waves.
CO3:	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4:	Ability to understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a "System'", "State", "Equilibrium", "Process'". Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy [8Hrs]

Unit II

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell's equations. work done by the electromagnetic field, Poynting's theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves [8Hrs]

Unit III

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half-wave plates, optical activity, specific rotation, Laurent half shade polarimeter. [12Hrs]

Unit IV

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence. Invariance of Maxwell's equations under Lorentz Transformation.

Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser [12Hrs]

Textbooks:

3. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw-Hill, 2017.

4. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017

References:

4. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

5. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.

6. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.

PaperCode: LLB115	**Paper: Indian Constitution**	**L**	**T/P**	**C**
PaperID: 99115		**2**	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter (Maximum Marks for Term End Examinations: 75):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To create awareness among students about the Indian Constitution
2:	To create consciousness among students about democratic principles and enshrined in the Constitution of India

Course Outcomes (CO):

CO1:	To understand institutional mechanism and fundamental values enshrined in the Constitution of India
CO2:	To understand the inter-relation between Centre and State Government
CO3:	To understand Fundamental Rights and Duties
CO4:	To understand the structure and functions of judicial systems in the country.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	2	-	-	-	1
CO3	-	-	-	-	-	3	-	2	-	-	-	1
CO4	-	-	-	-	-	3	-	2	-	-	-	1

Unit I

Introduction to Constitution of India: Definition, Source and Framing of the Constitution of India.Salient Features of the Indian Constitution. Preamble of the Constitution. [6Hrs]

Unit II

Fundamental Rights and Duties: Rights To Equality (Article 14-18).Rights to Freedom (Article 19-22).Right against Exploitation (Article 23-24).Rights to Religion and Cultural and Educational Rights of Minorities(Article 25- 30). The Directive Principles of State Policy – Its significance and application. Fundamental Duties – Necessary obligations and its nature, legal status and significance [6Hrs]

Unit III

Executives and Judiciary: Office of President, Vice President and Governor: Power and Functions, Parliament, Emergency Provisions-, President Rule; Union Judiciary: Appointment of Judges, Jurisdiction of the Supreme Court, State Judiciary: Power and functions, Writ Jurisdiction [6Hrs]

Unit IV

Centre- States Relation: Is Indian Constitution Federal in Nature, Legislative relations between Union and States, Administrative Relations between Union and States, Financial Relations between Union and States [6Hrs]

Textbooks:

1. *Constitutional Law of India* by J.N Pandey, Central Law Publication, 2018.
2. *Introduction to the Indian Constitution of India*by D.D. Basu, PHI, New Delhi, 2021
3. *The Constitution of India* by P.M. Bakshi, Universal Law Publishing Co., 2020.

References:

1. *Indian Constitutional Law* by M.P. Jain, Lexis Nexis, 2013
2. *Constitution of India* byV.N. Shukla, Eastern Book Agency, 2014

PaperCode: ICT151	**Paper: Programming for Problem Solving Lab.**		**L**	**P**	**C**
PaperID: 164151			**-**	**2**	**1**
Teachers Continuous Evaluation:	**40 marks**	**Term End Examinations:**	**60 Marks**		
Instructions:					
1. The course objectives and course outcomes are identical to that of ICT101 (Programming for Problem Solving) as this is the practical component of the corresponding theory paper.					
2. The practical list shall be notified by the teacher in the first week of the class commencement.					

PaperCode: ICT153	Paper: Engineering Graphics-I	L	P	C
PaperID: 164153		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn the introduction of Engineering graphics, various equipment used, various scales, dimensions and BIS codes used while making drawings for various streams of engineering disciplines.
2:	The students will learn theory of projections and projection of points.
3:	The students will learn projection of lines and projection of planes.
4:	The students will learn the projection of solid and development of surfaces

Course Outcomes (CO):

CO1:	To understand the theory of projections and projection of points.
CO2:	Ability to do line projections.
CO3:	Ability to do plane projections.
CO4:	Ability to do solid projections and development of surfaces

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Introduction: Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales

Theory of Projections: Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.

Unit II

Projection of Lines: Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.

Unit III

Projection of Planes: Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.

Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Unit IV

Projection of Solids: Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principal plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.

Development of Surface: Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

<table>
<tr><td>PaperCode: ICT155</td><td colspan="3">Paper: Electrical Science Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td>PaperID: 164155</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teachers Continuous Evaluation:</td><td>40 marks</td><td colspan="2">Term End Examinations:</td><td colspan="3">60 Marks</td></tr>
<tr><td colspan="7">Instructions:
1. The course objectives and course outcomes are identical to that of ICT103 (Electrical Science) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

<table>
<tr><td>PaperCode: BS157</td><td colspan="3">Paper: Engineering Chemistry - I Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td>PaperID: 99157</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teachers Continuous Evaluation:</td><td>40 marks</td><td colspan="2">Term End Examinations:</td><td colspan="3">60 Marks</td></tr>
<tr><td colspan="7">Instructions:
1. The course objectives and course outcomes are identical to that of BA109 (Engineering Chemistry - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.</td></tr>
</table>

<table>
<tr><td>PaperCode: BS159</td><td colspan="3">Paper: Engineering Physics - I Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td>PaperID: 99159</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teachers Continuous Evaluation:</td><td>40 marks</td><td colspan="2">Term End Examinations:</td><td colspan="3">60 Marks</td></tr>
<tr><td colspan="7">Instructions:
1. The course objectives and course outcomes are identical to that of BA113 (Engineering Physics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.</td></tr>
</table>

PaperCode: HS102	Paper: Communication Skills - II	L	T/P	C
PaperID: 99102		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper.

Course Objectives:

1:	To develop the theoretical framework of communication to understand the professional interaction.
2:	To develop confidence in all aspects of communication whether verbal or non-verbal.
3:	To be able to create error-free and well-formatted formal documents for professional records.
4:	To be able to overcome the barriers to effective communication.
5:	To inculcate the capacity to organize ideas and systematically present them through various media.
6:	To be able to critically appreciate the written texts and audio-visual inputs effectively.

Course Outcomes (CO):

CO1:	Ability to understand basic concepts regarding communication and develop a clear understanding of the flow of thoughts.
CO2:	Ability to apply verbal and non-verbal communication skills in real-life situations.
CO3:	Ability to write and document the information in the appropriate formats.
CO4:	Ability to effectively communicate in interpersonal and intercultural situations without being misunderstood.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I
Communication as Process: Concept of Communication, Communication as a Process, Formal, Informal and Intercultural communication, Barriers to Effective Communication and remedies, Characteristics of Effective Communication [8Hrs]

Unit II
Communication Efficiency: Concept of Non-verbal Communication, Elements of Non-verbal Communication – Gestures, Postures, Facial-expressions, Gaze, Eye contact, and Space, Presentation skills – Interviews, Group Discussion, Making presentations with Audio-visual aids, Electronic Communication – Internet and Social media. [8Hrs]

Unit III
Technical Documents: Definition, Types, Structure, Significant Features of: Resume Writing, Report Writing, Proposal Writing, Dissertation, and Research Papers [8Hrs]

Unit IV
Communication in Society and Workplace:
Text 1 – Gender-inclusive Language
Background, Purpose, and Guidelines
United Nations Gender-inclusive Language
https://www.un.org/en/gender-inclusive-language/index.shtml

Text 2 – Cultural Diversity in India
India: Unity in Cultural Diversity Introduction (P. xii – xviii)
https://dsel.education.gov.in/sites/default/files/book_unity_in_diversity.pdf

Text 3 – The Matrix (1999)
Genre: Movie (Science Fiction)
Dir. The Wachowski Brothers

[8Hrs]

Textbooks:
1. *High English Grammar and Composition* by Wren, P.C. & Martin H., S. Chand & Company Ltd, New Delhi.
2. *Technical Communication: Principles & Practice* by Meenakshi Raman, New Delhi: Oxford University Press

References:

1. *Be Grammar Ready: The Ultimate Guide to English Grammar* by John Eastwood, New Delhi, Oxford University Press, 2020.
2. *Communication Skills: A Workbook* by Sanjay Kumar & Pushp Lata, New Delhi, Oxford University Press, 2018.
3. *Basic Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2012.
4. *Advanced Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2011.

PaperCode: BS104	**Paper: Engineering Chemistry - II**	**L**	**T/P**	**C**
PaperID: 99104		**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand methods to make pure water and use fuels.
2:	To understand the use of techniques used to characterize engineering materials.
3:	To understand the properties and industrial applications of polymers.
4:	To understand the basics of nano-technology and bio chemistry

Course Outcomes (CO):

CO1:	Ability to make pure water and use fuels and perform energy conversion calculations
CO2:	Ability to use techniques used to characterize engineering materials.
CO3:	Understand the properties and industrial applications of polymers.
CO4:	Understand the basics of nano-technology and bio chemistry

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Water treatment: Introduction, Hardness of water, Disadvantages of hard water, Water-softening-Lime-Soda process, Ion-exchanger polished water, Boiled-feed water, boiler problems-scale, sludge priming and foaming, caustic embrittlement and corrosion.

Fuels: Classification of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, Bomb calorimeter, Calorific value of gaseous fuel, Theoretical calculation of calorific value of a fuel, Wood, Coal, Analysis of coal, Natural Gas, Producer gas, water gas, Non-Conventional sources of energy. [10Hrs]

Unit II

Spectroscopic Techniques: Basic principles of spectroscopic methods. The use The use of various spectroscopic techniques for the determination of structure of simple compounds. XRD, SEM and TEM. [10Hrs]

Unit III

Polymers: Basic concepts & Terminology, such as monomers, Polymers, functionality, Thermoplastics, Thermosets, Linear, Branched, cross linked polymers etc. Different definitions of molecular weight's viz. Mw, Mn, Mv and then determinations, Industrial applications of polymers. General methods of synthesis of organics and their applications. [10Hrs]

Unit IV

Nano Technology: Introduction, Properties, Synthesis and characterization of Nanomaterials, Material self-assembly, Nanoscale materials and their applications.

Biochemistry: Molecular basis of life, study of macro molecules: Carbohydrates, Proteins, Lipids, Nucleic acid. Metabolism, basic concepts and design, Glycolysis citric acid cycle oxidative phosphorylation pentose phosphate pathway. [10Hrs]

Textbooks/References:

1. *Engineering Chemistry (16th Edition) by Jain, Jain, Dhanpat Rai Publishing Company, 2013.*
2. *Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017.*
3. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.
4. *Biochemistry* by Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto 9th Edition 2019. W H Freeman & Co.

Paper Code: BS 116	Paper: Basic Engineering Chemistry-II	L	T/P	C
PaperID:	w.e.f. Academic Session 2022-23	3	-	3

TO BE OFFERED TO STUDENTS WHO HAVE NOT STUDIED CHEMISTRY AT 10+2 LEVEL IN LIEU OF BS109

Marking Scheme:

1.Teachers Continuous Evaluation: 25 marks
2.Term and Theory Examinations: 75 marks

Instruction for paper setter:

6. There should be 9 questions in the term-end examination question paper.
7. The first question will be compulsory and cover the entire syllabus. This question will have five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This question will have a total weightage of 15 marks.
8. Apart from question 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each Unit shall have a marks weightage of 15.
9. The questions are to be framed keeping in view the learning outcomes of the course/paper. Thestandard/level of the questions to be asked should be at the level of the prescribed textbook.
10. The requirement of (scientific) calculators/ log-tables / data-tables may be specified if required.

Course Objectives:

1.	To understand methods to make pure water and use fuels.
2.	To understand corrosion and the methods used to prevent it.
3.	To understand the properties and industrial applications of some important engineering materials.
4.	To understand the basics and applications of nano- technology.

Course Outcomes (CO):

CO1:	Ability to make pure water and use fuels and perform energy conversion calculations.
CO2:	Understand the causes and remedies of Corrosion.
CO3:	Students will be able to understand the important applications of cement, glass and polymers.
CO4:	Understand the potential applications of nanomaterials.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	P005	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Water treatment: Introduction, Hardness of water, Disadvantages of hard water, Water softening techniques-Lime-Soda process, Ion Exchange Method, Boiler feed water, Boiler problems- scale and sludge formation, priming and foaming, caustic embrittlement and corrosion.

Fuels: Classification of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, Bomb calorimeter, calorific value of gaseous fuels, Theoretical calculation of calorific value of a fuel, Wood, Coal, Analysis of coal, Natural gas, Producer gas, Water gas, non-Conventional sources of energy.

Unit II

Corrosion and its Control: Definition, effects, theory (mechanisms): dry/chemical, wet/electrochemical corrosion, Pilling-Bedworth ratio; Types of corrosion: Galvanic corrosion, Soil corrosion, Pitting corrosion, Concentration cell or Differential Aeration corrosion, Stress corrosion; Mechanism of rusting of iron, Passivity. Factors influencing corrosion; protective measures: galvanization, tinning, cathodic protection, sacrificial anodic protection; electroplating and prevention of corrosion through material selection and design.

Unit III:

Engineering Materials: Portland Cement: manufacturing by Rotary Kiln, role of gypsum, chemistry of setting and hardening of cement. **Glass:** manufacturing by tank furnace, significance of annealing, types and properties of soft glass, hard glass, borosilicate glass. **Polymers:** Basic concepts & terminology, classification and functionality of polymers, Properties and applications of (excluding synthesis): polyethylene, polymethacrylate, nylon, bakelite, polycarbonate, conducting polymers, liquid crystalline polymers, biodegradable polymers.

Unit IV

Nano chemistry: Nanoscience & Nanotechnology; Top-down and bottom-up approaches for nanomaterial synthesis, properties of nanomaterials, synthesis: mechanical grinding, Sol-gel process, chemical vapour condensation; surface characterization techniques: BET and TEM; properties and applications of nanoscale materials: Carbon nanotubes, fullerenes, quantum dots, nanowires, nanocrystals, nanocones. Practical applications of nanomaterials in different areas.

Textbooks:

1. *Engineering Chemistry: Fundamentals and Applications (Second Edition) Shikha Agarwal, Cambridge University Press, 2019.*
2. *Engineering Chemistry (Seventeenth Edition) Jain& Jain, Dhanpat Rai Publication Company, 2021.*

PaperCode: BS106	Paper: Engineering Mathematics – II	L	T/P	C
PaperID: 99106		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand Complex series methods.
2:	To understand Complex analysis
3:	To understand Fourier and Laplace methods
4:	To understand how to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO):

CO1:	Ability to use Complex series methods.
CO2:	Ability to use Complex analysis to solve formulated engineering problems
CO3:	Ability to use Fourier and Laplace methods to solve formulated engineering problems
CO4:	Ability to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Complex Analysis – I : Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers and Roots, Derivative. Analytic Function, Cauchy–Riemann Equations. Laplace's Equation, Exponential Function, Trigonometric and Hyperbolic Functions. Euler's Formula, de'Moivre's theorem (without proof), Logarithm. General Power. Principal Value**.**Singularities and Zeros. Infinity,
Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of Analytic Functions, Taylor and Maclaurin Series. [10Hrs]

Unit II

Complex Analysis – II: Laurent Series, Residue Integration Method. Residue Integration of Real Integrals,
Geometry of Analytic Functions: Conformal Mapping, Linear Fractional Transformations (Möbius Transformations), Special Linear Fractional Transformations, Conformal Mapping by Other Functions, Applications: Electrostatic Fields, Use of Conformal Mapping. Modeling, Heat Problems, Fluid Flow. Poisson's Integral Formula for Potentials [10Hrs]

Unit III

Laplace Transforms: Definitions and existence (without proof), properties, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals and ODEs, Unit Step Function (Heaviside Function).Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration of Transforms. Solution of ODEs with Variable Coefficients, Solution of
Systems of ODEs. Inverse Laplace transform and its properties.
Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Sturm–Liouville Problems. Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform. Usage of fourier analysis for solution of ODEs. Inverse Fourier transform and its properties. [10Hrs]

Unit IV

Partial Differential Equations (PDEs): Basic Concepts of PDEs. Modeling: Vibrating String, Wave Equation. Solution by Separating Variables. Use of Fourier Series. D'Alembert's Solution of the Wave Equation. Characteristics. Modeling: Heat Flow from a Body in Space. Heat Equation:Solution by Fourier Series.Steady Two-Dimensional Heat Problems. Dirichlet Problem. Heat Equation: Modeling Very Long Bars.Solution by Fourier Integrals and Transforms. Modeling: Membrane, Two-Dimensional Wave Equation. Rectangular Membrane. Laplacian in Polar Coordinates. Circular Membrane. Laplace's Equation in Cylindrical and Spherical Coordinates. Potential. Solution of PDEs by Laplace Transforms. [10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.
6. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013.

PaperCode: BS108	Paper: Engineering Physics - II	L	T/P	C
PaperID: 99108	w.e.f. 2022-23	3	-	3

Applicable only to the batch admitted in academic session 2021-22

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To learn about the band theory of solids and properties and characteristics of diodes.
4:	To understand the basics of physical basis of biology.

Course Outcomes (CO):

CO1:	Understand and appreciate the quantum nature of reality.
CO2:	Understand quantum statistics and its significance.
CO3:	Understand the band theory of solids and properties and characteristics of diodes.
CO4:	To have an understanding of the physical basis of Biology.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems – solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy.

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations – Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars.

Unit III

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode its characteristics, LED

Unit IV

The DNA double helix - molecules to life (qualitative)X – ray diffraction and crystallography as a technique to determine structure: Basic principles and methodology.

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw – Hill, 2017.
2. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

1. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006
4. https://drive.google.com/file/d/169AQBvIzHzbRjZU6M8oe260ZUWp7iUm1/view [part of NPTEL Lectures https://nptel.ac.in/courses/115/101/115101121/#

PaperCode: BS108	**Paper: Engineering Physics - II**	**L**	**T/P**	**C**
PaperID: 99108		**3**	**-**	**3**

Applicable only to the batch admitted in academic session 2021-22

Marking Scheme:

3. Teachers Continuous Evaluation: 25 marks
4. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To learn about the band theory of solids and properties and characteristics of diodes.
4:	To understand the basics of physical basis of biology.

Course Outcomes (CO):

CO1:	Understand and appreciate the quantum nature of reality.
CO2:	Understand quantum statistics and its significance.
CO3:	Understand the band theory of solids and properties and characteristics of diodes.
CO4:	To have an understanding of the physical basis of Biology.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems – solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy. [12Hrs]

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations – Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars.
[12Hrs]

Unit III

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode its characteristics, LED [12Hrs]

Unit IV

Introduction to Physics in Biology: Overview : from molecules to life - the building blocks of biology, DNA Packing and Structure, The relationship between shape and function of biomolecules, Numbers and Sizes, System Variability and Spatial Scales, Timescales in Biological Systems [4Hrs]

Textbooks:

3. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw – Hill, 2017.
4. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

5. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
6. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
7. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006
8. https://drive.google.com/file/d/169AQBvIzHzbRjZU6M8oe260ZUWp7iUm1/view [part of NPTEL Lectures https://nptel.ac.in/courses/115/101/115101121/#

PaperCode: BS110	Paper: Probability and Statistics for Engineers	L	P	C
PaperID: 99110		**3**	**2**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 50 marks
3. Term end Practical Examinations: 25 marks

The marksheet shall reflect the teachers continuous evaluation as internal (out of 25) and the term end examination (out of 75, 25 for practical term end and 50 for theory term end examination) as external.

Instruction for paper setter (Term end Theory Examinations):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for design experiments and analysis.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to design experiments and analyse using ANOVA.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.

Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

[10Hrs]

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributionsand Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.

Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the Central Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

[10Hrs]

Unit III

Hypotheses Testing for a Single Sample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviation of a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference for Two Samples.

Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR. [10Hrs]

Unit IV

ANOVA and Design of experiments: Designing Engineering Experiments, Completely Randomized Single-Factor Experiment, The Random Effects Model, Randomized complete block design, Concept of Factorial Experiments, Two Factor Factorial Experiments, General Factorial Experiments, 2^k Factorial Designs, Response Surface Methods and Designs. SQC: Quality improvement and Statistics, Control Charts including $\overline{X}$ and R or S charts, P and U charts, time weighted charts. [10Hrs]

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher to the school where the students are admitted at the start of the teaching in the semester.

Textbooks:

1.*Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10^{th} Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.

PaperCode: ICT114	Paper: Human Values and Ethics	L	P	C
PaperID: 164114		1	-	1

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To help students regulate their behavior in a professional environment as employees
2:	To make students aware of the impact of taking non-ethical engineering decisions.
3:	To understand that mind and desire control is needed for being ethical.
4:	To understand organizational culture and to adapt to varying cultures withoutcompromising ethical values

Course Outcomes (CO):

CO1:	Realize the importance of human values.
CO2:	Understand that excessive desires of the mind make a person unethical and restless,while fewer desires lead to peace and professional progress
CO3:	Assess different types of risks involved in unethical practices. Know various means ofprotesting against unethical practices.
CO4:	Assess the benefits of restraining from unethical practices like bribery, extortion,nepotism, nexus between politicians and industrialists.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	3	1	1	-	1
CO2	-	-	-	-	-	3	-	3	1	1	-	1
CO3	-	-	-	-	-	3	-	3	1	1	-	1
CO4	-	-	-	-	-	3	-	3	1	1	-	1

Unit I

Human Values: Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality [3Hrs]

Unit II

Engineering Ethics: Senses of engineering ethics, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory

Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger [3Hrs]

UnitIII

Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis
Sefety lessons from 'the challenger', Case study: Power plants,Collegiality and loyalty, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights. [4Hrs]

UnitIV

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Engineering council of India, Codes of ethics in Business Organizations [3Hrs]

Textbooks:

1. *A Textbook on Professional Ethics and Human Values*, by R. S. Naagarazan, New Age Publishers, 2006.

References:

1. *Professional Ethics and Human Values* by D. R. Kiran, McGraw-Hill, 2014.

2. *Engineering Ethics, by Charles E Harris and Micheal J Rabins, Cengage Learning Pub., 2012.*
3. *Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017.*
4. *Unwritten laws of Ethics and Change in Engineeringby The America Society of Mechanical Engineers, 2015.*
5. *Engineering Ethics by Charles B. Fleddermann, Pearson, 2014.*
6. *Introduction to Engineering Ethics* by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010.
7. *Engineering Ethics: Concept and Cases* by Charles E. Harris, Michael S. Pritchard and Michael J.Rabins, Cengage, 2009.
8. *Ethics in Engineering Practiceand Research* by Caroline Whitbeck, Cambridge University Press, 2007.

PaperCode: EMES112	**Paper: Environmental Studies**	**L**	**P**	**C**
PaperID: 99112		**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The course is designed to impart basic knowledge of the environment and its components.
2:	The course deals in creating awareness about the energy resources and current environmental problems faced by the world.
3:	To understand and learn about environment pollution, related case studies and measures taken for control to pollution.
4:	To understand and explore different approaches of conserving and protecting environment for the benefit of society.

Course Outcomes (CO):

CO1:	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO2:	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts to humans.
CO3:	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO4:	Overall, course will help students to develop skills and ability of understanding environment- human relationship.

Course Outcomes (CO to Programme Outcomes (PO)) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	-	1	1	-	-	2	3	2	1	1	1	1
CO2	-	1	1	-	-	2	3	2	1	1	1	1
CO3	-	1	1	-	-	2	3	2	1	1	1	1
CO4	-	1	1	-	-	2	3	2	1	1	1	1

Unit I

Fundamentals:The Multidisciplinary nature of environmental studies: Definition, components, scope and importance, need for public awareness;

Ecosystems: Concept, Structure and function of an ecosystem, energy flow in ecosystems, food chain, food web, ecological pyramids, ecological succession; Introduction to types, characteristics features, structure and function of different ecosystems including forest, grassland, desert and aquatic ecosystem;

Biodiversity: Introduction to biodiversity-definition, genetics, species, ecosystem diversity, biogeographical classification of India, value of biodiversity-consumptive uses, productive, social, ethical, aesthetic and option values, biodiversity at global, national and local level, India as a mega diversity nation, endangered and endemic species of India, hot spots of biodiversity, threats to biodiversity – habitat loss, poaching of wild life, man wildlife conflicts and conservation of biodiversity- in-situ and ex-situ conservation. [16Hrs]

Unit II

Renewable and Non-renewable Resources:Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources-green fuel.

Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems

Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people, case studies

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of individual in conservation of natural resources, Resource Management-Sustainable development. [8Hrs]

Unit III

Environmental Pollution: (a) Air Pollution: Types of pollutants, source, effects, sink & control of primary pollutants– CO, NOX, HC, SOx and particulates, effect of pollutants on man & environment: photochemical smog, acid rain and global warming, CO2 Sequestration. (b) Water Pollution: Classification of Pollutants, their sources, waste water treatment (domestic and industrial). (c) Soil Pollution: Composition of soil, classification and effects of solid pollutants and their control. (d) Solid Waste Management: Classification, waste treatment and disposal methods; compositing, sanitary land filling, thermal processes, recycling and reuse methods. (e) Hazardous wastes - Classification, radioactive, biomedical & chemical, treatment and disposal- Physical, chemical and biological processes. (f) Marine Pollution: Causes, effects and control of marine pollution, coastal zone management (g) Thermal pollution: Causes, effects and control of marine pollution, coastal zone management.

Disaster Management: Floods, earth quake, cyclone and landslides [8Hrs]

Unit IV

Environmental Policies, Human Population and Environment

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, case studies; Some important Environmental laws, issues involved in enforcement of environment legislations, Green bench; carbon footprint, Montreal and Kyoto Protocol, conservation of Biological Diversity, The Chemical Weapons Convention, Environment Impact Assessment; population growth and variation among nations, Impacts on environment and human health, human right, Tribal people and rights, Human and wildlife conflicts in Indian context, Environmental ethics; Role of government and non government organizations in public awareness and environment improvement. [13Hrs]

Field work (equal to 5 hours) : visit to local areas to document environmental assets, study of simple ecosystems, study and identification of common plants, birds and insects.

Suggested Readings and References:

1. A textbook of environmental studies, R. Gadi, S. Rattan, S. Mohaptra, Kataria Publication, 2014.
2. Elements of environmental sciences & engineering, P. Meenakshi, PHI Learning Pvt Ltd, 2014.
3. Basics of Environment and Ecology, A. kaushik & C.P. Kaushik, New Age International Publishers, 2010.
4. Fundamental concepts in environmental studies, D.D. Mishra, S Chand & Co. Ltd., 2008.
5. Textbook of environmental studies, E. Barucha, UGC, 2005.
6. Environmental studies, B. Joseph, Tata McGraw-Hill Publishing Company Ltd., 2005.

PaperCode: ICT152	**Paper: Engineering Graphics-II**	**L**	**P**	**C**
PaperID: 164152		**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn sectioning of solid figures.
2:	The students will understand 3D projections. They will have understanding of isometric and oblique projections.
3:	The students will have understanding of perspective projections,
4:	The students will learn computer aided drafting.

Course Outcomes (CO):

CO1:	Ability to draw sectional diagrams of solids
CO2:	Ability to draw 3S projections (isometric and oblique).
CO3:	Ability to draw perspective projections.
CO4:	Understand and use a CAD tool (AutoCAD).

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Section of Solids: Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.

Unit II

Isometric Projection: Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.
Oblique Projection: Principle of oblique projection, difference between oblique projection and isometric projection, receding lines and receding angles, oblique drawing of circle, cylinder, prism and pyramid.

Unit III

Perspective Projection: Principle of perspective projection, definitions of perspective elements, visual ray method, vanishing point method.
Conversion of 3D to 2D figures.

Unit IV

Introduction to CADD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.
4. *AutoCAD 2017 for Engineers & Designers*by Sham Tickoo,, Dreamtech Press 2016.

PaperCode: BS156	**Paper: Engineering Chemistry - II Lab.**			**L**	**P**	**C**
PaperID: 99156				**-**	**2**	**1**
Teachers Continuous Evaluation:		**40 marks**	**Term End Examinations:**	**60 Marks**		

Instructions:

1. The course objectives and course outcomes are identical to that of BA104 (Engineering Chemistry - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: BS158	**Paper: Engineering Physics - II Lab.**			**L**	**P**	**C**
PaperID: 99158				**-**	**2**	**1**
Teachers Continuous Evaluation:		**40 marks**	**Term End Examinations:**	**60 Marks**		

Instructions:

1. The course objectives and course outcomes are identical to that of BA108 (Engineering physics - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: ICT154	**Paper: Workshop Technology**	**L**	**P**	**C**
PaperID: 164154		**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of various welding processes.
4:	The students will have understanding of sheet metals hop and fitting shop

Course Outcomes (CO):

CO1:	Ability to safely work in a Lab./workshop.
CO2:	Ability to use machines (lathe, mill, shaper, planer, grinder, drill).
CO3:	Ability to weld.
CO4:	Ability to use sheet metal tools and fitting shop tools.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I

Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II

Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and overview of operations performed on these machines by making some jobs.

Unit III

Introduction to welding shop: Welding, types of welding, tools and applications, gas welding and arc welding, edge preparation, various joints formation by gas welding and electric arc welding.

Unit IV

Introduction to sheet metal shop: Sheet metal tools and operations, formation of a box using sheet.
Introduction to fitting shop: Introduction to fitting, tools and applications, some jobs in fitting shop.

Textbooks:

1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.

References:

1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

PaperCode: ICT160	**Paper: Programming in Python**	**L**	**P**	**C**
PaperID: 164160			**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn the Programming in the Python Language
2:	The students will learn usage of language implemented data structures.
3:	The students shall learn the object oriented features of the Python Language.
4:	The students will learn usage of the Numpy, Panda and Matplotlib

Course Outcomes (CO):

CO1:	Ability to write procedural programmes in Python.
CO2:	Ability to write programs using standard data structures.
CO3:	Ability to use object oriented paradigm to write program in Python.
CO4:	Ability to use Numpy, Panda and Matplotlib modules to write programs.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	-	1	2	1	3	-	-	-	1	1	1	1
CO2	-	1	2	1	3	-	-	-	1	1	1	1
CO3	-	1	2	1	3	-	-	-	1	1	1	1
CO4	-	1	2	1	3	-	-	-	1	1	1	1

Unit I

Identifiers, keywords, statements & expressions, variables, operators, precedence & associativity, data types, indention, comments, console I/O, type conversion. Control flow statements (if family; while & for loops; continue & break statements), exception handling. Functions, command line arguments.

Unit II

String management & usage, Lists, Dictionaries, Tuples & Sets. The operations on these data structures. Filter, Map and Reduce Function,

Unit III

Object Oriented Programming: Properties / attributes, methods, inheritance, class variables & functions, static methods, delegation, abstract base classes, Generic function.
File Handling.

Unit IV

Numpy: Dtypes, Multidimensional Arrays, Slicing, Numpy Array & Memory, Array element-wise operations, Numpy Data I/O, floating point numbers, Advanced Numpy dtypes.
Pandas: Using series and Dataframes, Indexing &Reindexing, Deleting and merging items, Common operations, Memory usage and dtypes, Pipes, Displying dataframes, Rolling & Filling operations.
Matplotlib: Setting defaults, Legends, Subplots, Sharing Axes, 3D surfaces.

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher at the start of the teaching in the semester.

Textbooks:

1. *Introduction to Python Programming*, Gowrishankar S. and Veena A., CRC Press, 2019.
2. *Python Programming for Data Analysis*, Jose Unpingco, Springer Nature, 2021.

References:

1. *Python: An Introduction to Programming*, James R. Parker, 2nd Ed., Mercury Learning And Information, 2021.
2. *Introduction to Computation and Programming Using Python*, John V. Guttag, The MIT Press, 2021.
3. *Python Programming: A Practical Approach*, Vijay Kumar Sharma, Vimal Kumar, Swati Pathak, and Shashwat Pathak, CRC Press, 2021.

PaperCode: ICT162	Paper: Modern Workshop Practice	L	P	C
PaperID: 164162		-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of 3D printing with practical experience in its usage.
4:	The students will have understanding lathe machine and its usage

Course Outcomes (CO):

CO1:	Ability to safely work in a Lab./workshop.
CO2:	Ability to use machines (lathe, mill, shaper, planer, grinder, drill, CNCWood-Cutter).
CO3:	Ability to weld.
CO4:	Ability to use sheet metal tools and fitting shop tools.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I

Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II

Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and CNC woodcutter, and overview of operations performed on these machines.

Unit III

3D Printing and Digital Manufacturing

Definition, Types, Evolution, History. Product design and rapid product development. Feasibility of RPT, designing and prototyping, manufacturing and product release. Creation of STL or SLA file format of a 3D solid model. Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration.

Unit IV

Types of lathe drivers, merit and demerit. Description in details-head stock cone pulley type- all geared type-construction & function. Tumbler gear set. Reducing speed necessary & uses. Back Gear Unit -its construction use. Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools Drills-different parts, types, size etc., different cutting angles, cutting speed for different material. Boring tool. Lubricant and coolant-types, necessity, system of distribution, selection of coolant for different material: Handling and care. Knurling meaning, necessity, types, grade, cutting speed for knurling. Lathe mandrel different types and their uses.

Textbooks:

1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.
2. *An Introduction to 3D Printing*, Victoria E Zukas and Jonas A Zukas, Design Publishing, 2015

References:

1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

Note: This paper shall be offered by IDEA lab of the University.

PaperCode: ICT116	Paper: Introduction to Manufacturing Process	L	T/P	C
PaperID: 164116		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The students will have basic understanding of various manufacturing processes. The students will have knowledge about casting process.
2:	The students will have understanding of joining processes.
3:	The students will have understanding of forging and sheet metal works.
4:	The students will have basic idea of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO):

CO1:	Understand casting process.
CO2:	Understand joining process.
CO3:	Understand forging and sheet metal work.
CO4:	Basic understanding of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	1	1	2	-	-	-	-	-	1	1
CO2	2	1	1	1	2	-	-	-	-	-	1	1
CO3	2	1	1	1	2	-	-	-	-	-	1	1
CO4	2	1	1	1	2	-	-	-	-	-	1	1

Unit I

Definition of manufacturing, Importance of manufacturing towards technological and social economic development, Classification of manufacturing processes, Properties of materials.

Metal Casting Processes: Sand casting, Sand moulds, Type of patterns, Pattern materials, Pattern allowances, Types of Moulding sand and their Properties, Core making, Elements of gating system. Description and operation of cupola.

Working principle of Special casting processes - Shell casting, Pressure die casting, Centrifugal casting. Casting defects.

[10Hrs]

Unit II

Joining Processes: Welding principles, classification of welding processes, Fusion welding, Gas welding, Equipments used, Filler and Flux materials. Electric arc welding, Gas metal arc welding, Submerged arc welding, Electro slag welding, TIG and MIG welding process, resistance welding, welding defects. [10Hrs]

Unit III

Deformation Processes: Hot working and cold working of metals, Forging processes, Open and closed die forging process. Typical forging operations, Rolling of metals, Principle of rod and wire drawing, Tube drawing. Principle of Extrusion, Types of Extrusion, Hot and Cold extrusion.

Sheet metal characteristics -Typical shearing operations, bending and drawing operations, Stretch forming operations, Metal spinning. [10Hrs]

Unit IV

Powder Metallurgy: Introduction of powder metallurgy process, powder production, blending, compaction, sintering

Manufacturing Of Plastic Components: Types of plastics, Characteristics of the forming and shaping processes, Moulding of Thermoplastics, Injection moulding, Blow moulding, Rotational moulding, Film blowing, Extrusion, Thermoforming. Moulding of thermosets- Compression moulding, Transfer moulding, Bonding of Thermoplastics.

[10Hrs]

Textbooks:

1. *Manufacturing Technology: Foundry, Forming and WeldingVolume 1*, P. N Rao, , McGrawHill, 5e, 2018.
2.*Elements of Workshop TechnologyVol. 1 and 2*by Hajra Choudhury, Media Promoters Pvt Ltd.,2008.

References:

1. *Manufacturing Processes for Engineering Materials*, by Serope Kalpajian and Steven R.Schmid, Pearson Education, 5e, 2014.
2. *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems* by Mikell P. Groover, John Wiley and Sons, 4e, 2010 .
3. *Production Technology* byR.K.Jain and S.C. Gupta, Khanna Publishers. 16th Edition, 2001.

PaperCode: BS118	Paper: Industrial Chemistry	L	T/P	C
PaperID: 99118		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	Learn about the functioning of drugs and dyes.
2:	Learn about the most important ways of preventing corrosion.
3:	Learn about the properties of heterocycles
4:	Learn about techniques of synthesis.

Course Outcomes (CO):

CO1:	Understand the functioning of drugs and dyes.
CO2:	Understand the most important ways of preventing corrosion.
CO3:	Understand the properties of heterocycles
CO4:	Understand techniques of synthesis.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	3	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Polymerization technology, dyes and drugs: classification of polymers, plastics, fibres, elastomers. Dyes: Requirements of a dye, chemical nature, classification, chemistry of representative important dyes. Pharmaceuticals: sulfa drugs, antipyretics and analgesics, antibiotics, antimalarials. Caustic soda & Chlorine. Hydrochloric acid. Sulphur & sulphuric Acid. [10Hrs]

Unit II

Corrosion: Corrosion and its economic aspects, Thermodynamics of corrosion, Immunity, corrosivity and passivation. Mechanism and kinetics of Corrosion. Electrochemical methods for corrosion testing.

Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection. Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection. [10Hrs]

Unit III

Chemistry of Heterocyclic Compounds: Introduction, nomenclature, structures, and reactivities of heterocyclic compounds. Chemistry and reactivity of five and six membered heterocyclic compounds with one hetero atoms. Chemistry of selected industrially important heterocyclic compounds. [8Hrs]

Unit IV

Synthetic Methods: Introduction to synthesis, strategy of synthesis. Designing of green synthesis: choice of starting materials, reagents, catalysts and solvents. Basic principles of green chemistry and synthesis of organic compounds involving basic principles of green chemistry methodology of synthesis. New methods in organic synthesis: microwave technique, use of phase transfer catalyst in organic synthesis. [12Hrs]

Textbooks and References:

1. J.P. Mukhlyonov: Fundamentals of Chemical Technology.
2.M.G. Rao, M.Sittig: Dryden's out line of Chemicals Technology.
3.Emil Raymond Riegel: Industrial Chemistry.
4. Frank Hall Thorp: Outlines of Industrial Chemistry.
5.M.G. Fontana: Corrosion Engineering, McGraw Hill International Book Co. London.
6.L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, Edward Arnold Ltd, London.
7.J.C. Scully: Fundamental of Corrosion, Pargmon Press Inc. New York, USA
8.J.A. Joule, K. Mills and G.F. Smith: Heterocyclic chemistry, III Ed., East West Press vt Ltd, ND.

9.A.R. Katrizky and J.A. Boulton: Advances in Heterocyclic chemistry, Vol 1-27, Academic Press, NY.
10.R.M. Achesion: An Introduction to the Chemistry of Heterocyclic Compounds, II Ed, NY.

PaperCode: BT120	Paper: Introduction to Biotechnology	L	T/P	C
PaperID: 160120		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To introduce different areas in Biotechnology to students, laying a foundation for future courses within our biotechnology programme.
2:	To provide a historical perspective of the growth and development of biotechnology, as well as its scope and importance.
3:	To help students understand the interdisciplinary nature of biotechnology, involving integration of several disciplines to generate knowledge and technology impacting society and environment.
4:	To sensitize students towards IPR, safety and ethical concerns in biotechnology research and applications.

Course Outcomes (CO):

CO1:	Understand the history, scope, interdisciplinary nature and significance of biotechnology.
CO2:	Understand the basics of recombinant DNA technology, protein structure and engineering, bioinformatics and principle(s) underlying basic biotechnological techniques.
CO3:	Describe the basics of culturing microbes, animal cells and plant cells in laboratory, and their respective applications in Biotechnology.
CO4:	Have an awareness about the IPR, safety and ethical issues involved in use of biotechnology.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	3	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Introduction: Historical perspective, Definition of Biotechnology; Areas of biotechnology; Scope; Importance and Commercial potential; Interdisciplinary nature;

Solutions and Buffers: Introduction to Solutions and Buffers; Modes of expressing concentration of a solution, Making solutions, Concept of pH and buffers, Henderson-Hasselbach equation, Criteria for selection of buffers; [8Hrs]

Unit II

Recombinant DNA Technology: Tools of rDNA Technology; Making recombinant DNA; Introduction of recombinant DNA into host cells; Introduction to selection and screening techniques for identification of recombinants; Agarose Gel Electrophoresis; Principle, Steps and Applications of Polymerase Chain Reaction;

Protein Structure and Engineering: Introduction to the world of Proteins, Amino acids as building blocks, Non-covalent interactions, Structure of proteins, Structure Function relationship in Proteins, Recombinant proteins of high value, Introduction to Protein Engineering and Design, Introduction to Proteomics.

Introduction to basic techniques in Biotechnology: Beer-Lambert's Law, Spectrophotometer, Agarose Gel Electrophoresis, SDS-PAGE, Gel-Filtration Chromatography, Ion Exchange Chromatography, Affinity chromatography.

Introduction to Bioinformatics: Concept of Primary and Secondary databases, Nucleic acid and Protein databases, Introduction to sequence alignment, Applications of bioinformatics. [12Hrs]

Unit III

Microbial Biotechnology: Microbial Culture Techniques; Measurement and Kinetics of Microbial Growth; Scale up of microbial process; Isolation of microbial products; Strain Isolation; Improvement and Preservation;

Plant Biotechnology: History of plant tissue culture; Plant cell and tissue culture techniques; Transgenic plants with beneficial traits;

Animal Biotechnology: History of animal tissue culture; Animal Cell culture techniques; Finite and Continuous cell lines; Characterization of cell lines; Scale-up of animal cell culture; Applications of microbial, plant and animal biotechnology. [12Hrs]

Unit IV

Biotechnology and Society: Introduction to Patenting; Criterion for patents; Reading a patent; National and International Patent Laws; Safety and Ethical issues in Biotechnology; Biotechnology in India and global trends; Product safety and marketing. [8Hrs]

Text / Reference Books:

1. *Introduction to Biotechnology*, W.J. Thieman and M.A. Palladino, Pearson, 2019.
2. *Biotechnology Foundations*, J.O. Grady, 2019.
3. *Gene cloning and DNA Analysis. An introduction*. T. A Brown, Wiley-Blackwell Science, 2016.
4. *Concepts in Biotechnology: History, Science and Business*, K.Buchholz and J. Collins, Wiley-VCH, 2011.
5. *Biotechnology*, H.K. Das, 2010, Wiley Publishers.
6. *Biotechnology*, Smith, 2009, Cambridge Press.
7. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson & Walker, Cambridge Press, 2008.

BRIDGE COURSES FOR THE B.TECH LATERAL ENTRY STUDENTS

All the Lateral Entry students of B.Tech., who are directly admitted in the 2nd Year / 3rd Semester of the Progarmme of Study, have to pass the following bridge courses.

Paper Code	Paper Name	L/P
BC-121	Bridge Course in Mathematics	3
BC-123	Bridge Course in Programming in C	3

Implementation Rules for Bridge Courses:

1. The classes for the above bridge courses in the 3rd Semester shall be conducted alongwith the classes of the other courses.
2. These papers have to be qualified by the students.
3. For these papers examination shall be conducted by the concerned subject teacher as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.

Paper Code(s): BC-121	L / P
Paper: Bridge Course in Mathematics	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the limits, differentiation and integration.
2:	To understand differential equations.
3:	To understand the concepts of matrices.
4:	To understand the concept of vectors and to find out Eigen values.

Course Outcomes (CO):

CO1	Ability to understand the use of limits, differentiation and integration.
CO2	Ability to understand and apply the ordinary differential equations.
CO3	Ability to use matrices to solve linear equations.
CO4	Ability to understand linear independence and dependence of vectors.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I
Differentiation: Limits, Definition, Formulas, Differentiation Rules, Real life applications of Differentiation
Integration: Definition, Indefinite Integral, Integration formulas, Definite Integral and its properties, Real life applications of Integration

Unit II
Ordinary Differential Equations: Definition, Solution of ordinary differential equation, linear differential equation of first order, initial value problem, linear differential equation of higher order with constant coefficients

Unit III
Matrices-I: Definition of Matrix and Determinant, Type of Matrices, Properties of Determinants, Transpose of a matrix, Inverse of a matrix, Solution of system of linear equations using the inverse of a matrix, Rank of a matrix.

Unit IV
Matrices-II: Vectors, Linear independence and dependence of vectors; Eigen values and Eigen vectors or matrix.

Textbooks:
1. *Higher Engineering Mathematics* by B S Grewal, Khanna Publishing.

References:
1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

Paper Code(s): BC-123	**L / P**
Paper: Bridge Course in Programming in C	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in ‘C’.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in ‘C’.
3:	To impart knowledge about using arrays, pointers and structures to develop programs in ‘C’.
4:	To impart knowledge about using structures, unions and strings to develop programs in ‘C’.

Course Outcomes (CO):

CO1	Ability to write simple programs in in ‘C’.
CO2	Ability to implement conditional branching, iteration and arrays in ‘C’
CO3	Ability to implement functions and pointers in ‘C’
CO4	Ability to use structures, unions and strings in the programs in ‘C’.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme.

Introduction to C language: Basic structure of C programs, C tokens, variables, data types, I/O statements. Inter-conversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators operator precedence and associativity, evaluation of expressions, type conversions in expressions.

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.

Unit III

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.

Pointers: Pointer basics, pointer arithmetic, functions returning pointers, Dynamic memory allocation. Pointers and Strings.

Unit IV

Structures and unions: Structure definition, initialization, accessing structures, structures and functions, self-referential structures, unions, typedef.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library function.

Textbooks:

1. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
2. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
3. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).

THE SCHEME OF EXAMINATIONS OF 2nd to 4th YEAR

for

Dual degree Programs (B.Tech./M.Tech.)

a. **Computer Science and Engineering Major Discipline**
b. **Information Technology Major Discipline**
c. **Electronics and Communication Engineering Major Discipline**

Offered by

University School of Information, Communication & Technology at the GGSIPU University Campus, Dwarka

Primary Discipline:
COMPUTER SCIENCE AND ENGINEERING

Programme Education Objectives (PEO)

PEO 1: Our students will apply their knowledge and skills to succeed in their careers and/or obtain advanced degrees.

PEO 2: Our students will behave ethically and responsibly, and will remain informed and involved as full participants in their profession and society.

PEO 3: Our students will creatively solve problems, communicate effectively, and successfully function in diverse and inclusive multi-disciplinary teams.

PEO4 4: Our students will apply principles and practices of computing grounded in mathematics and science to successfully complete hardware and/or software-related engineering projects to meet customer business objectives and/or productively engage in research.

Programme Specific Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

PSO 2: Apply engineering analysis & design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

PSO 3: Communicate effectively with a range of audiences.

PSO 4: Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

PSO 5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

PSO 6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

PSO 7: Acquire and apply new knowledge as needed, using appropriate learning strategies.

PEO to PO Mapping

PEO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
PEO 1	3	1	1	1	1	1	1	1	1	1	1	3
PEO 2	1	-	-	-	-	3	3	3	-	-	-	3
PEO 3	3	3	3	3	3	2	2	1	1	3	3	-
PEO 4	3	3	3	3	3	-	-	-	1	1	3	-

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

PSO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
PSO 1	3	-	-	-	-	-	-	-	-	-	-	3
PSO 2	-	3	3	3	3	3	3	-	-	-	-	-
PSO 3	-	-	-	-	-	3	-	-	3	3		-
PSO 4	-	-	-	-	-	3	3	3	1	-	-	-
PSO 5	-	-	-	-	-	-	-	1	3	1	3	-
PSO 6	1	2	2	3	3	1	1	1	-	-	-	3
PSO 7	-	-	-	-	-	-	-	-	-	-	-	3

(scale 1: low, 2: Medium, 3: High)

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT201	Foundations of Computer Science	4	-	4
PC	ICT203	Operating Systems	3	-	4
PC	ICT205	Digital Logic & Computer Design	4	-	4
PC	ICT207	Database Management Systems	4	-	4
PC	ICT209	Object Oriented Programming using C++	4	-	4
PC	ICT211	Data Structures	4	-	4
HS/MS	ECO213	Engineering Economics**	2	-	2
Practical/Viva Voce					
PC	ICT251	Database Management Systems Lab.	-	2	1
PC	ICT253	Object Oriented Programming Using C++ Lab.	-	2	1
PC	ICT255	Data Structures Lab.	-	2	1
PC	ICT257	Operating Systems Lab.	-	2	1
Total			**25**	**8**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT202	Computer Graphics	3	-	4
PC	ICT204	Computational Methods	4	-	4
PC	ICT206	Design and Analysis of Algorithms	4	-	4
PC	ICT208	Theory of Computation	4	-	4
PC	ICT210	Software Engineering	3	-	4
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers**	2	-	2
Practical/Viva Voce					
PC	ICT252	Computer Networks Lab.	-	2	1
PC	ICT254	Design and Analysis of Algorithms Lab.	-	2	1
PC	ICT256	Computational Methods Lab.	-	2	1
PC	ICT258	Computer Graphics Lab.	-	2	1
PC	ICT260	Software Engineering Lab	-	2	1
Total			**24**	**10**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fifth Semester					
Code	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT303	Compiler Design	3	-	3
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 1.			4
HS	HS305***	Elements of Indian History for Engineers	2		2
MS	MS307**	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT395	Compiler Design Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total					**26**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,
**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.
***NUES: Comprehensive evaluation by the teacher of the paper, out of 100. The paper shall be taught by teachers of University School of Liberal Arts

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective – 2			4
PCE		Core area Elective – 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas – 3 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school – 2			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 3			4
HS/MS	ICT302	Technical Writing Using Latex	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					**28**

*NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PCE		Core area Elective – 4			4
PCE		Core area Elective – 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school – 4			4
OAE		Elective from other schools or emerging area / open elective offered by the school – 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6th semester) Report *			1
Total					**29**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

** The student shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the back-ground study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by the concerned supervisor while the term end examinations of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Dean of the school can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the school.

Eighth Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce/Internship%					
PC / Project	ICT452	Major Project – Dissertation**,#			15
	ICT454	Major Project Viva Voce#			4
	ICT456	Project Progress Evaluation*			2
PC / Internship	ICT458	Internship Report**,#			15
	ICT460	Internship Viva Voce#			4
	ICT462	Internship Progress Evaluation*			2
Total					**21**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8th semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School, shall proceed for internship.
** The student offered project work shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester.
# Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.
ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

PROGRAMME CORE ELECTIVE PAPERS (PCE)

Paper	Paper Code	Paper Name	T	P	Credits
		Semester 5: Choose any one paper			
311	ICT311T	Artificial Intelligence	3	-	3
	ICT311P	Artificial Intelligence Lab.	-	2	1
313	ICT313T	Microprocessors and Interfacing	3	-	3
	ICT313P	Microprocessors and Interfacing Lab	-	2	1
315	ICT315T	Engineering Optimization	3	-	3
	ICT315P	Engineering Optimization Lab.	-	2	1
317	ICT317T	Social Network Analysis and Sentiment Analysis	3	-	3
	ICT317P	Social Network Analysis and Sentiment Analysis Lab.	-	2	1
319	ICT319T	Software Requirements and Estimation	3	-	3
	ICT319P	Software Requirements and Estimation Lab.	-	2	1
321	ICT321	Graph Theory for Computer Science	4	-	4
331	ICT331T	PCB Fabrication and IoT	2	-	2
	ICT331P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 6: Choose any Two Paper			
312	ICT312T	Java Programming	3	-	3
	ICT312P	Java Programming Lab.	-	2	1
314	ICT314T	Systems Programming	3	-	3
	ICT314P	Systems Programming Lab.	-	2	1
316	ICT316T	Introduction to Robotics Engineering	3	-	3
	ICT316P	Introduction to Robotics Engineering Lab.	-	2	1
318	ICT318T	Network Security and Cryptography	3	-	3
	ICT318P	Network Security and Cryptography Lab.	-	2	1
320	ICT320T	Visual Basic.Net Programming	3	-	3
	ICT320P	Visual Basic.Net Programming Lab.	-	2	1
322	ICT322	Quantum Computing	4	-	4
324	ICT324T	Natural Language Processing	3	-	3
	ICT324P	Natural Language Processing Lab.	-	2	1
326	ICT326T	Object Technology and UML	3	-	3
	ICT326P	Object Technology and UML Lab.	-	2	1
328	ICT328T	Design Patterns	3	-	3
	ICT328P	Design Patterns Lab.	-	2	1
330	ICT330T	Data Warehousing and Data Mining	3	-	3
	ICT330P	Data Warehousing and Data Mining Lab.	-	2	1
332	ICT332	Computational Geometry	4	-	4
334	ICT334T	Introduction to Mobile Ad Hoc Networks	3	-	3
	ICT334P	Introduction to Mobile Ad Hoc Networks Lab.	-	2	1
358	ICT358T	PCB Fabrication and IoT	2	-	2
	ICT358P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 7: Choose any Two Papers			
401	ICT401T	Advanced Java Programming	3	-	3
	ICT401P	Advanced Java Programming Lab.	-	2	1
403	ICT403T	Blockchain Technology	3	-	3
	ICT403P	Blockchain Technology Lab.	-	2	1
405	ICT405T	Semantic Web	3	-	3
	ICT405P	Semantic Web Lab.	-	2	1
407	ICT407T	C#.net Programming	3	-	3
	ICT407P	C#.net Programming Lab.	-	2	1
409	ICT409	Cyber Security and Forensics	4	-	4
411	ICT411T	Software Verification, Validation and Testing	3	-	3
	ICT411P	Software Verification, Validation and Testing Lab.	-	2	1
413	ICT413	Cloud Computing	4	-	4
415	ICT415T	Introduction to IoT	3	-	3
	ICT415P	Introduction to IoT Lab.	-	2	1
417	ICT417	Complexity Theory	4	-	4
419	ICT419T	Human Computer Interface	3	-	3
	ICT419P	Human Computer Interface Lab.	-	2	1
421	ICT421T	Software Project Management	3	-	3

Paper	Paper Code	Paper Name	T	P	Credits
	ICT421P	Software Project Management Lab.	-	2	1
423	ICT423T	Next Generation Web	3	-	3
	ICT423P	Next Generation Web Lab.	-	2	1
425	ICT425T	Web Mining	3	-	3
	ICT425P	Web Mining Lab.	-	2	1
463	ICT463T	PCB Fabrication and IoT	2	-	2
	ICT463P	PCB Fabrication and IoT Lab.	-	4	2

Note:

1. Each paper to be studied as elective is of 4 credits. In most of the papers, there are two components, a 3 credit theory component to be evaluated as a (pure) theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination) and a (pure) laboratory / practical paper of 1 credit (40 marks teacher's continuous evaluation and 60 marks term end examination). If the paper is of 4 credits with only one component, then it is equivalent to a theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination).

2. An elective shall be offered to the student based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

3. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. Minimum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. Only after qualifying for the award of the degree of Bachelor of Technology, the student may be allowed to proceed for the Master in Technology part of the Bachelor / Master of Technology (Dual Degree). The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.

5. The scheme and syllabi of the Master of Technology part of the Bachelor / Master of Technology (Dual Degree) shall be notified separately. This document pertains to the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme only.

6. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (for students admitted in the 1st year / 1st semester).

Group	**Semester (Credits)**								**Total**	**Mandatory**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Credits**	**Credits**
BS	12	20							**32**	**16**
HS	5	4	2	2	4	4			**21**	**10**
ES	12	5							**17**	**17**
PC			27	27	10		5	21	**90**	**90**
PCE					4	8	8		**20**	**16**
EAE					4	8	8		**20**	**16**
OAE / EAE					4	8	8		**20**	**10**
Total	**29**	**29**	**29**	**29**	**26**	**28**	**29**	**21**	**220**	**175**

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)). This table is for students admitted in the 1st year and 1st semester of the degree programme.

(b) The students admitted as lateral entry student in the second year / 3rd semester of the degree programme shall have to undergo the following group of Courses / Papers as enumerated in the scheme (From the year 2022-23 lateral entry admissions):

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
HS	2	2	4	4			**12**	**6**
PC	27	27	10		5	21	**90**	**90**
PCE			4	8	8		**20**	**16**
EAE			4	8	8		**20**	**16**
OAE / EAE			4	8	8		**20**	**10**
Total	**29**	**29**	**26**	**28**	**29**	**21**	**162**	**138**

TABLE 2: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)). This table is for students admitted as lateral entry students in the 2nd year and 3rd semester of the degree programme.

7. Mandatory Credits value is 175, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 1), for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 138, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 12 and 13 also

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, The acquisition of the credits should be completed before the 15th of the July of the admission year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the School about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the School. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the school for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the school, then transferred to the Examinations division, shall be notified by the examinations division of the University, and a separate marksheet shall be issued by the Examinations divisions. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. See Clause 14 also.

11. Maximum Credits is at least 220 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 162 (Table 2). See clause 9 also.

The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

12. Minimum Credits required to be earned is atleast 200 (out of the 220 non Honours papers credits, see clause 11 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned is at least 148 (out of the 162 non Honours papers credits, see clause 11 also). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
   iv. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in clause 12.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in clause 12.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)***", if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned the student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in clause 12.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)***", if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in clause 12.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Major Discipline)";*** if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Major Discipline) (Honours)***", if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast the minimum credits specified in clause 12 (disregarding the mandatory credits clause of Table 1 or 2 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline).*** Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. Pass marks in every paper shall be 40.

16. Grading System shall be as per Ordinance 11 of the University.

17. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

18. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

19. Teachers of other Schools, as and when deputed by their school, for teaching the students enrolled in programmes offered by the University School of Information, Communication and Technology (USICT) shall be a part of the Academic Programme Committee of the school. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of USICT. Similarly, the guest faculty, the visiting faculty and the contract / Ad Hoc faculty as and when deputed to teach students of USICT shall form a part of APC of USICT.

20. The medium of instructions shall be English.

Primary Discipline:
INFORMATION TECHNOLOGY

Programme Education Objectives (PEO)

PEO 1: Our students will apply their knowledge and skills to succeed in their careers and/or obtain an advanced degree.

PEO 2: Our students will behave ethically and responsibly, and will remain informed and involved as full participants in their profession and society.

PEO 3: Our students will creatively solve problems, communicate effectively, and successfully function in diverse and inclusive multi-disciplinary teams.

PEO 4: Our students will apply principles and practices of information technology to identify, implement, and enable effective technologies and apply fundamental computing knowledge to solve information technology problems and be capable of doing research.

Programme Specifc Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

PSO 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

PSO 3: Communicate effectively in a variety of professional contexts.

PSO 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

PSO 5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

PSO 6: Identify and analyze user needs and to take them into account in the selection, creation, integration, evaluation, and administration of computing-based systems.

PEO to PO Mapping

PEO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
PEO 1	3	1	1	1	1	1	1	1	1	1	1	3
PEO 2	1	-	-	-	-	3	3	3	-	-	-	3
PEO 3	3	3	3	3	3	2	2	1	1	3	3	-
PEO 4	3	3	3	3	3	-	-	-	1	1	3	-

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

PSO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
PSO 1	3	3	-	3	-	-	-	-	-	-	-	3
PSO 2	-	3	3	3	3	1	1	-	-	-	-	3
PSO 3	-	-	-	-	-	3	-	-	3	3	3	-
PSO 4	-	-	-	-	-	3	3	3	1	-	-	-
PSO 5	-	-	-	-	-	-	-	1	3	1	3	-
PSO 6	1	3	3	3	3	1	1	1	-	-	-	3

(scale 1: low, 2: Medium, 3: High)

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT201	Foundations of Computer Science	4	-	4
PC	ICT203	Operating Systems	3	-	3
PC	ICT205	Digital Logic & Computer Design	4	-	4
PC	ICT207	Database Management Systems	4	-	4
PC	ICT209	Object Oriented Programming using C++	4	-	4
PC	ICT211	Data Structures	4	-	4
HS/MS	ECO213	Engineering Economics**	2	-	2
Practical/Viva Voce					
PC	ICT251	Database Management Systems Lab.	-	2	1
PC	ICT253	Object Oriented Programming using C++ Lab.	-	2	1
PC	ICT255	Data Structures Lab.	-	2	1
PC	ICT257	Operating System Lab.	-	2	1
Total			**25**	**8**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT202	Computer Graphics	3	-	3
PC	ICT204	Computational Methods	4	-	4
PC	ICT206	Design and Analysis of Algorithms	4	-	4
PC	ICT208	Theory of Computation	4	-	4
PC	ICT210	Software Engineering	3	-	3
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers**	2	-	2
Practical/Viva Voce					
PC	ICT252	Computer Networks Lab.	-	2	1
PC	ICT254	Design and Analysis of Algorithms Lab.	-	2	1
PC	ICT256	Computational Methods Lab.	-	2	1
PC	ICT258	Computer Graphics Lab.	-	2	1
PC	ICT260	Software Engineering Lab.	-	2	1
Total			**24**	**10**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fifth Semester					
Code	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT303	Compiler Design	3	-	3
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 1.			4
HS	HS305***	Elements of Indian History for Engineers	2		2
MS	MS307**	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT395	Compiler Design Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total				**2**	**26**

***NUES** : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

***NUES: Comprehensive evaluation by the teacher of the paper, out of 100. The paper shall be taught by teachers of University School of Liberal Arts

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective – 2			4
PCE		Core area Elective – 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas – 3 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 2			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 3			4
HS/MS	ICT302	Technical Writing Using Latex	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					**28**

*NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PCE		Core area Elective – 4			4
PCE		Core area Elective – 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school – 4			4
OAE		Elective from other schools or emerging area / open elective offered by the school – 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6^{th} semester) Report *			1
Total					**29**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

** The student shall be allocated a supervisor / guide for project work at the end of 6^{th} semester by the School, the project shall continue into the 8^{th} semester. In the 7^{th} semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the back-ground study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by the concerned supervisor while the term end examinations of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Dean of the school can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the school.

Eighth Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce/Internship%					
PC / Project	ICT452	Major Project – Dissertation**,#			15
	ICT454	Major Project Viva Voce#			4
	ICT456	Project Progress Evaluation*			2
PC / Internship	ICT458	Internship Report**,#			15
	ICT460	Internship Viva Voce#			4
	ICT462	Internship Progress Evaluation*			2
Total					**21**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8^{th} semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School shall proceed for internship.
** The student offered project work shall be allocated a supervisor / guide for project work at the end of 6^{th} semester by the School, the project shall continue into the 8^{th} semester.
# Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.
ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

PROGRAMME CORE ELECTIVE PAPERS

Paper	Paper Code	Paper Name	T	P	Credits
		Semester 5: Choose any one paper			
311	ICT311T	Artificial Intelligence	3	-	3
	ICT311P	Artificial Intelligence Lab.	-	2	1
313	ICT313T	Microprocessors and Interfacing	3	-	3
	ICT313P	Microprocessors and Interfacing Lab.	-	2	1
315	ICT315T	Engineering Optimization	3	-	3
	ICT315P	Engineering Optimization	-	2	1
317	ICT317T	Social Network Analysis and Sentiment Analysis	3	-	3
	ICT317P	Social Network Analysis and Sentiment Analysis	-	2	1
323	ICT323T	VHDL Programming	3	-	3
	ICT323P	VHDL Programming Lab	-	2	1
325	ICT325T	Multimedia Technologies	3	-	3
	ICT325P	Multimedia Technologies Lab.	-	2	1
331	ICT331T	PCB Fabrication and IoT	2	-	2
	ICT331P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 6: Choose any Two Paper			
312	ICT312T	Java Programming	3	-	3
	ICT312P	Java Programming	-	2	1
314	ICT314T	Systems Programming	3	-	3
	ICT314P	Systems Programming	-	2	1
316	ICT316T	Introduction to Robotics Engineering	3	-	3
	ICT316P	Introduction to Robotics Engineering	-	2	1
318	ICT318T	Network Security and Cryptography	3	-	3
	ICT318P	Network Security and Cryptography	-	2	1
320	ICT320T	Visual Basic.Net Programming	3	-	3
	ICT320P	Visual Basic.Net Programming	-	2	1
322	ICT322	Quantum Computing	3	-	3
324	ICT324T	Natural Language Processing	3	-	3
	ICT324P	Natural Language Processing Lab.	-	2	1
336	ICT336T	Introduction to Information and Communication Theory	3	-	3
	ICT336P	Introduction to Information and Communication Theory Lab.	-	2	1
338	ICT338T	Database Modelling and Design	3	-	3
	ICT338P	Database Modelling and Design Lab	-	2	1
340	ICT340T	Analog and Digital Communication	3	-	3
	ICT340P	Analog and Digital Communication Lab	-	2	1
326	ICT326T	Object Technology and UML	3	-	3
	ICT326P	Object Technology and UML Lab.	-	2	1
358	ICT358T	PCB Fabrication and IoT	2	-	2
	ICT358P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 7: Choose any Two Papers			
401	ICT401T	Advanced Java Programming	3	-	3
	ICT401P	Advanced Java Programming Lab.	-	2	1
403	ICT403T	Blockchain Technology	3	-	3
	ICT403P	Blockchain Technology Lab.	-	2	1
405	ICT405T	Semantic Web	3	-	3
	ICT405P	Semantic Web Lab.	-	2	1
407	ICT407T	C#.net Programming	3	-	3
	ICT407P	C#.net Programming Lab.	-	2	1
409	ICT409	Cyber Security and Forensic	4	-	4
411	ICT411T	Software Verification Validation and Testing	3	-	3
	ICT411P	Software Verification Validation and Testing Lab.	-	2	1
413	ICT413	Cloud Computing	4	-	4
415	ICT415T	Introduction to IoT	3	-	3
	ICT415P	Introduction to IoT Lab.	-	2	1
427	ICT427T	Middleware Technologies	3	-	3
	ICT427P	Middleware Technologies Lab.	-	2	1
429	ICT429T	Mobile Computing	3	-	3
	ICT429P	Mobile Computing Lab.	-	2	1

431	ICT431	E-Commerce	4	-	4
435	ICT435T	Network Programming	3	-	3
	ICT435P	Network Programming Lab.	-	2	1
433	ICT433T	Wireless Communication and Networks	3	-	3
	ICT433P	Wireless Communication and Networks Lab.	-	2	1
463	ICT463T	PCB Fabrication and IoT	2	-	2
	ICT463P	PCB Fabrication and IoT Lab.	-	4	2

Note:

1. Each paper to be studied as elective is of 4 credits. In most of the papers, there are two components, a 3 credit theory component to be evaluated as a (pure) theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination) and a (pure) laboratory / practical paper of 1 credit (40 marks teacher's continuous evaluation and 60 marks term end examination). If the paper is of 4 credits with only one component, then it is equivalent to a theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination).

2. An elective shall be offered to the student based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

3. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. Minimum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 4 years (N=4 years) (8 semesters).

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

4. Only after qualifying for the award of the degree of Bachelor of Technology, the student may be allowed to proceed for the Master in Technology part of the Bachelor / Master of Technology (Dual Degree).

5. The scheme and syllabi of the Master of Technology part of the Bachelor / Master of Technology (Dual Degree) shall be notified separately. This document pertains to the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme only.

6. The students shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)								Total Credits	Mandatory Credits
	I	II	III	IV	V	VI	VII	VIII		
BS	12	20							**32**	**16**
HS	5	4	2	2	4	4			**21**	**10**
ES	12	5							**17**	**17**
PC			27	27	10		5	21	**90**	**90**
PCE					4	8	8		**20**	**16**
EAE					4	8	8		**20**	**16**
OAE / EAE					4	8	8		**20**	**10**
Total	**29**	**29**	**27**	**29**	**26**	**28**	**29**	**21**	**220**	**175**

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)).

7. Mandatory Credits (175) specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree. See clause 12 and 13 also.

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, The acquisition of the credits should be completed before the 15th of the July of the admission year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the School about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the School. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the school for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the school, then transferred to the Examinations division, shall be notified by the examinations division of the University, and a separate marksheet shall be issued by the Examinations divisions. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. See Clause 14 also.

11. Maximum Credits: at least 220 (Table 1), these are the credits for which the student shall have to study for the non-Honours component of the curriculum. The student has to appear in the examinations for these credits.

12. Minimum Credits: atleast 200 (out of the 220 non Honours papers credits). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
   iv. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)***", if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)***", if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Major Discipline)";*** if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Major Discipline) (Honours)***", if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast 200 credits out of 216 credits as enumerated in Table 1 (disregarding the mandatory credits clause of Table 1 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline).*** Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. The scheme of examinations for the B.Tech. Programmes at the affiliated institutions shall be notified separately.

16. Pass marks in every paper shall be 40.

17. Grading System shall be as per Ordinance 11 of the University.

18. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a

part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

20. Teachers of other Schools, as and when deputed by their school, for teaching the students enrolled in programmes offered by the University School of Information, Communication and Technology (USICT) shall be a part of the Academic Programme Committee of the school. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of USICT. Similarly, the guest faculty, the visiting faculty and the contract / Ad Hoc faculty as and when deputed to teach students of USICT shall form a part of APC of USICT.

21. The medium of instructions shall be English.

Primary Discipline:

ELECTRONICS AND COMMUNICATIONS ENGINEERING

Programme Education Objectives (PEO)

PEO 1: To be well acquainted with fundamentals of Electronics & Communication Engineering for leading a successful career in industry or as an entrepreneur or pursuing higher education.

PEO 2: To inculcate rational approach towards constantly evolving technologies with ethical responsibilities.

PEO 3: To foster technical skills for innovative solutions in Electronics & Communication Engineering or related areas.

PEO 4: To participate in life-long learning in the relevant domain for addressing global societal needs.

Programme Specifc Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: To understand and analyse the principles and working of different electronic systems.

PSO 2: To utilize their knowledge, skills and resources to demonstrate and implement technology-based systems as per the requirement.

PSO 3: To offer real time and efficient solutions problems that are directly or indirectly related to Electronics and Communication Engineering areas and will contribute towards the development of society.

PSO 4: Ability to collaborate different fields of science and technology with right blend of attitude and aptitude for placements and higher education or to become a successful Entrepreneur and a worthy global citizen.

PEO to PO Mapping

PEO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
PEO 1	3	1	1	1	1	1	1	1	1	1	1	3
PEO 2	3	1	1	-	1	3	3	3	-	-	-	3
PEO 3	3	3	3	3	3	2	2	1	1	1	1	3
PEO 4	1	-	-	-	-	3	1	-	-	-	-	3

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

PSO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
PSO 1	3	3	-	-	3	-	-	-	-	-	-	1
PSO 2	2	3	3	3	3	1	1	-	-	-	-	1
PSO 3	2	3	3	3	3	3	3	3	1	3	3	3-
PSO 4	1	1	1	1	1	-	-	1	1	3	-	3

(scale 1: low, 2: Medium, 3: High)

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT215	Signal and Systems	3	-	3
PC	ICT217	Computational Methods	4	-	4
PC	ICT219	Digital Electronics	4	-	4
PC	ICT221	Analog Electronics – I	4	-	4
PC	ICT223	Analog Communications	3	-	3
PC	ICT225	Engineering Electromagnetics	4	-	4
HS/MS	ECO213	Engineering Economics**	2	-	2
Practical/Viva Voce					
PC	ICT263	Computational Methods Lab.	-	2	1
PC	ICT259	Digital Electronics Lab.	-	2	1
PC	ICT261	Analog Electronics – I Lab.	-	2	1
PC	ICT265	Signal and Systems Lab.	-	2	1
PC	ICT267	Analog Communications Lab.	-	2	1
Total			**24**	**10**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT216	Network Analysis and Synthesis	4	-	4
PC	ICT218	Control Systems	3	-	3
PC	ICT220	Analog Electronics – II	4	-	4
PC	ICT222	Digital Communications	3	-	3
PC	ICT224	Microprocessors	4	-	4
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers**	2	-	2
Practical/Viva Voce					
PC	ICT252	Computer Networks Lab.	-	2	1
PC	ICT262	Analog Electronics – II Lab.	-	2	1
PC	ICT264	Microprocessors Lab.	-	2	1
PC	ICT266	Digital Communications	-	2	1
PC	ICT268	Control Systems Lab	-	2	1
Total			**24**	**10**	**29**

**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.

Fifth Semester					
Code	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT309	Microelectronics and VLSI Design	3	-	3
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school - 1.			4
HS	HS305***	Elements of Indian History for Engineers*	2		2
MS	MS307**	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT397	Microelectronics and VLSI Design Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total				**2**	**26**

*****NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,
**NUES: Comprehensive evaluation by the teacher of the paper, out of 100.
***NUES: Comprehensive evaluation by the teacher of the paper, out of 100. The paper shall be taught by teachers of University School of Liberal Arts

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective – 2			4
PCE		Core area Elective – 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas – 3 (Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school - 2			4
OAE		Elective from other schools or open elective offered by the school - 3			4
HS/MS	ICT302	Technical Writing Using Latex	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					**28**

*NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PCE		Core area Elective – 4			4
PCE		Core area Elective – 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school – 4			4
OAE		Elective from other schools or open elective offered by the school – 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6th semester) Report *			1
Total					**29**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

** The student shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the back-ground study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by the concerned supervisor while the term end examinations of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Dean of the school can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the school.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce/Internship%					
PC / Project	ICT452	Major Project – Dissertation**,#			15
	ICT454	Major Project Viva Voce@			4
	ICT456	Project Progress Evaluation*			2
PC / Internship	ICT458	Internship Report#			15
	ICT460	Internship Viva Voce#			4
	ICT462	Internship Progress Evaluation*,#			2
Total					**21**

***NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100.**

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8th semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School, shall proceed for internship.
** The student offered project work shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester.
# Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.
ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.
ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

PROGRAMME CORE ELECTIVE PAPERS

Paper	Paper Code	Paper	T	P	Credits
		Semester 5: Choose any one paper			
311	ICT311T	Artificial Intelligence	3	-	3
	ICT311P	Artificial Intelligence Lab.	-	2	1
313	ICT313T	Microprocessors and Interfacing	3	-	3
	ICT313P	Microprocessors and Interfacing Lab.	-	2	1
323	ICT323T	VHDL Programming	3	-	3
	ICT323P	VHDL Programming Lab.	-	2	1
327	ICT327T	Telecommunication Switching and Networks	3	-	3
	ICT327P	Telecommunication Switching and Networks Lab.	-	2	1
329	ICT329T	Optoelectronic Devices	4	-	4
331	ICT331T	PCB Fabrication and IoT	2	-	2
	ICT331P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 6: Choose any Two Paper			
316	ICT316T	Introduction to Robotics Engineering	3	-	3
	ICT316P	Introduction to Robotics Engineering Lab.	-	2	1
318	ICT318T	Network Security and Cryptography	3	-	3
	ICT318P	Network Security and Cryptography Lab.	-	2	1
336	ICT336T	Introduction to Information and Communication Theory	3	-	3
	ICT336P	Introduction to Information and Communication Theory Lab	-	2	1
344	ICT344	Random Processes and Stochastic Systems	4	-	4
346	ICT346T	Antenna Design and Radiating Systems	3	-	3
	ICT346P	Antenna Design and Radiating Systems Lab.	-	2	1
348	ICT348T	Optical Communication Systems and Networks	3	-	3
	ICT348P	Optical Communication Systems and Networks Lab.	-	2	1
350	ICT350T	Embedded Systems	3	-	3
	ICT350P	Embedded Systems Lab.	-	2	1
352	ICT352T	RF Components and Circuit Design	3	-	3
	ICT352P	RF Components and Circuit Design Lab.	-	2	1
354	ICT354	Multimedia Communications	4	-	4
356	ICT356T	Wireless and Mobile Communication	3	-	3
	ICT356P	Wireless and Mobile Communication Lab.	-	2	1
358	ICT358T	PCB Fabrication and IoT	2	-	2
	ICT358P	PCB Fabrication and IoT Lab.	-	4	2
		Semester 7: Choose any Two Papers			
409	ICT409	Cyber Security and Forensic	4	-	4
415	ICT415T	Introduction to IoT	3	-	3
	ICT415P	Introduction to IoT Lab.	-	2	1
429	ICT429T	Mobile Computing	3	-	3
	ICT429P	Mobile Computing Lab.	-	2	1
441	ICT441	Advanced Computer Architecture	4	-	4
443	ICT443	Smart Antennas	4	-	4
445	ICT445	Fabrication Technology	4	-	4
447	ICT447	Power Electronics	4	-	4
449	ICT449	Electronic Measurements	4	-	4
451	ICT451	MEMS and Sensors	4	-	4
453	ICT453T	Radar and Satellite Communication	3	-	3
	ICT453P	Radar and Satellite Communication Lab.	-	2	1
457	ICT457T	Engineering Optimization	3	-	3
	ICT457P	Engineering Optimization Lab.	-	2	1
459	ICT459T	Radio and Television Engineering	3	-	3
	ICT459P	Radio and Television Engineering Lab.	-	2	1
461	ICT461T	RF and Microwave Engineering	3	-	3
	ICT461P	RF and Microwave Engineering Lab.	-	2	1
463	ICT463T	PCB Fabrication and IoT	2	-	2
	ICT463P	PCB Fabrication and IoT Lab.	-	4	2

Note:

1. Each paper to be studied as elective is of 4 credits. In most of the papers, there are two components, a 3 credit theory component to be evaluated as a (pure) theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination) and a (pure) laboratory / practical paper of 1 credit (40 marks teacher's continuous evaluation and 60 marks term end examination). If the paper is of 4 credits with only one component, then it is equivalent to a theory paper (25 marks teacher's continuous evaluation and 75 marks term end examination).

2. An elective shall be offered to the student based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

3. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. Minimum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 4 years (N=4 years) (8 semesters).

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

4. Only after qualifying for the award of the degree of Bachelor of Technology, the student may be allowed to proceed for the Master in Technology part of the Bachelor / Master of Technology (Dual Degree).

5. The scheme and syllabi of the Master of Technology part of the Bachelor / Master of Technology (Dual Degree) shall be notified separately. This document pertains to the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme only.

6. The students shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)								Total Credits	Mandatory Credits
	I	II	III	IV	V	VI	VII	VIII		
BS	12	20							**32**	**16**
HS	5	4	2	2	4	4			**21**	**10**
ES	12	5							**17**	**17**
PC			27	27	10		5	21	**90**	**90**
PCE					4	8	8		**20**	**16**
EAE					4	8	8		**20**	**16**
OAE / EAE					4	8	8		**20**	**10**
Total	**29**	**29**	**27**	**29**	**26**	**28**	**29**	**21**	**220**	**175**

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)).

7. Mandatory Credits (175) specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree. See clause 12 and 13 also.

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, The acquisition of the credits should be completed before the 15th of the July of the admission year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the School about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the School. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the school for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the school, then transferred to the Examinations division, shall be notified by the examinations division of the University, and a separate marksheet shall be issued by the Examinations divisions. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. See Clause 14 also.

11. Maximum Credits: at least 220 (Table 1), these are the credits for which the student shall have to study for the non-Honours component of the curriculum. The student has to appear in the examinations for these credits.

12. Minimum Credits: atleast 200 (out of the 220 non Honours papers credits). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
   iv. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)***", if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)***"; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)***", if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology (Major Discipline)";*** if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology (Major Discipline) (Honours)***", if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast 200 credits out of 216 credits as enumerated in Table 1 (disregarding the mandatory credits clause of Table 1 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline).*** Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. The scheme of examinations for the B.Tech. Programmes at the affiliated institutions shall be notified separately.

16. Pass marks in every paper shall be 40.

17. Grading System shall be as per Ordinance 11 of the University.

18. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a

part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

20. Teachers of other Schools, as and when deputed by their school, for teaching the students enrolled in programmes offered by the University School of Information, Communication and Technology (USICT) shall be a part of the Academic Programme Committee of the school. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of USICT. Similarly, the guest faculty, the visiting faculty and the contract / Ad Hoc faculty as and when deputed to teach students of USICT shall form a part of APC of USICT.

21. The medium of instructions shall be English.

MINOR SPECIALIZATION STREAMS
(EMERGING AREA ELECTIVE GROUPS)

These papers / streams shall be offered as per the prerequisite specified. The papers are to be offered to at the undergraduate level to the students of B.Tech. programmes. A course / paper is identified by the code allocated. A course may be split into a theory component which shall have the letter 'T' attached while its practical component shall have the letter 'P' suffixed. A student has to study both the theory and the practical component, if taken as an elective.

Emerging Area: Minor Specialization in Machine Learning & Data Analytics

Prerequisite: First Year Engineering Mathematics (3 papers), Programming in C at the level of the B.Tech. papers for these topics in the Curriculum of B.Tech. part of the USICT programmes of studies offered at the USICT campus). (Any Engineering Discipline).

Code	Paper Code	Paper	L	P	Credits	Semester
ITE301	ITE301T	Statistics, Statistical Modelling & Data Analytics	3	-	3	5th
	ITE301P	Statistics, Statistical Modelling & Data Analytics Lab.	-	2	1	
ITE302	ITE302T	Machine Learning	3	-	3	6th
	ITE302P	Machine Learning Lab	-	2	1	
ITE304	ITE304T	Supervised and Deep Learning	3	-	3	6th
	ITE304P	Supervised and Deep Learning Lab	-	2	1	
ITE401	ITE401T	Unsupervised Learning	3	-	3	7th
	ITE401P	Unsupervised Learning Lab	-	2	1	
ITE403	ITE403T	Big Data Analytics	3	-	3	7th
	ITE403P	Big Data Analytics Lab	-	2	1	

Emerging Area: Minor Specialization in Soft Computing

Prerequisite: First Year Engineering Mathematics (3 papers), Programming in C at the level of the B.Tech. papers for these topics in the Curriculum of B.Tech. part of the USICT programmes of studies offered at the USICT campus). (Any Engineering Discipline).

Code	Paper Code	Paper	L	P	Credits	Semester
ITE301	ITE301T	Statistics, Statistical Modelling & Data Analytics	3	-	3	5th
	ITE301P	Statistics, Statistical Modelling & Data Analytics Lab.	-	2	1	
ITE306	ITE306T	Artificial Neural Networks and Deep Learning	3	-	3	6th
	ITE306P	Artificial Neural Networks and Deep Learning Lab	-	2	1	
ITE308	ITE308T	Fuzzy logic and Systems	3	-	3	6th
	ITE308P	Fuzzy logic and Systems Lab	-	2	1	
ITE407	ITE407T	Global Optimization Methods	3	-	3	7th
	ITE407P	Global Optimization Methods Lab	-	2	1	
ITE409	ITE409T	Expert Systems and Knowledge Representation	3	-	3	7th
	ITE409P	Expert Systems and Knowledge Representation Lab.	-	2	1	

Emerging Area: Minor Specialization in Internet of Things

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE305	ITE305T	Introduction to Internet of Things	3	-	3	5th
	ITE305P	Introduction to Internet of Things Lab.	-	2	1	
ITE310	ITE310T	Wireless and Sensor Networks	3	-	3	6th
	ITE310P	Wireless and Sensor Networks Lab	-	2	1	
ITE312	ITE312T	IoT with Arduino, ESP, and Raspberry Pi	3	-	3	6th
	ITE312P	IoT with Arduino, ESP, and Raspberry Pi Lab	-	2	1	
ITE411	ITE411T	Design of smart systems	4	-	4	7th
ITE413	ITE413T	Privacy and Security issues in IoT	4	-	4	7th

Emerging Area: Minor Specialization in Embedded Systems
Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE307	ITE307T	Microprocessors and Interfacing *	3	-	3	5th
	ITE307P	Microprocessors and Interfacing Lab	-	2	1	
OR	OR	OR				
ITE309	ITE309	Real time operating systems*	4	-	4	
ITE314	ITE314T	Embedded System Architecture and Design	3	-	3	6th
	ITE314P	Embedded System Architecture and Design Lab	-	2	1	
ITE316	ITE316T	VHDL Programming*	3	-	3	6th
	ITE316P	VHDL Programming Lab.	-	2	1	
OR	OR	OR				
ITE318	ITE318T	Programming in C for Embedded Systems*	3	-	3	
	ITE318P	Programming in C for Embedded Systems Lab.	-	2	1	
ITE415	ITE415T	Real Time Embedded System Programming	3	-	3	7th
	ITE415P	Real Time Embedded System Programming Lab	-	2	1	
ITE417	ITE417T	Logic Design and Analysis Using Verilog*	3	-	3	7th
	ITE417P	Logic Design and Analysis Using Verilog Lab.	-	2	1	
OR	OR	OR				
IT421	ITE421	Sensors and Actuators*	4	-	4	

* Allocation on the basis of subjects studied earlier, by the School

Emerging Area: Minor Specialization in Software Engineering
Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE311	ITE311T	Software Measurements, Metrics, and Modelling	3	-	3	5th
	ITE311P	Software Measurements, Metrics, and Modelling Lab	-	2	1	
ITE320	ITE320T	Software Project Management*	3	-	3	6th
	ITE320P	Software Project Management Lab.	-	2	1	
OR	OR	OR				
ITE322	ITE322T	Service Oriented Architecture*	3	-	3	
	ITE322P	Service Oriented Architecture Lab.	-	2	1	
ITE324	ITE324T	Mining Software Repositories and Predictive Modelling	3	-	3	6th
	ITE324P	Mining Software Repositories and Predictive Modelling Lab.	-	2	1	
ITE423	ITE423T	Software Verification, Validation and Testing*	3	-	3	7th
	ITE423P	Software Verification, Validation and Testing Lab.	-	2	1	
OR	OR	OR				
ITE425	ITE425T	Software Security*	3	-	3	
	ITE425P	Software Security Lab.	-	2	1	
ITE427	ITE427	Software Engineering Standards	4	-	4	7th

* Allocation on the basis of subjects studied earlier, by the School

Emerging Area: Minor Specialization in VLSI Design
Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in ECE (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE313	ITE313T	Semiconductor Devices and Modelling	3	-	3	5th
	ITE313P	Semiconductor Devices and Modelling Lab.	-	2	1	
ITE326	ITE326T	VLSI Technology and Design	3	-	3	6th
	ITE326P	VLSI Technology and Design Lab	-	2	1	
ITE328	ITE328T	CMOS Analog Integrated Circuit Design	3	-	3	6th
	ITE328P	CMOS Analog Integrated Circuit Design Lab.	-	2	1	
ITE429	ITE429T	CMOS Digital Circuits Design	3	-	3	7th
	ITE429P	CMOS Digital Circuits Design Lab.	-	2	1	
ITE435	ITE435	VLSI Testing	4	-	4	7th

Emerging Area: Minor Specialization in Wireless and Mobile Communications

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE315	ITE315T	Wireless Communication Systems	3	-	3	5th
	ITE315P	Wireless Communication Systems Lab.	-	2	1	
ITE330	ITE330T	Cellular and Mobile communication	3	-	3	6th
	ITE330P	Cellular and Mobile communication Lab.	-	2	1	
ITE332	ITE332T	Ad hoc Sensor Networks	3	-	3	6th
	ITE332P	Ad hoc Sensor Networks Lab.	-	2	1	
ITE437	ITE437	Cognitive Radio & Networks	4	-	4	7th
ITE439	ITE439	Privacy and Security in Wireless Networks	4	-	4	7th

Emerging Area: Minor Specialization in Image Processing & Computer Vision

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper Code	Paper	L	P	Credits	Semester
ITE317	ITE317T	Fundamentals of Image Processing	3	-	3	5th
	ITE317P	Fundamentals of Image Processing Lab.	-	2	1	
ITE334	ITE334T	Image Filtering and Restoration	3	-	3	6th
	ITE334P	Image Filtering and Restoration Lab.	-	2	1	
ITE336	ITE336T	Computer Vision and Object Recognition	3	-	3	6th
	ITE336P	Computer Vision and Object Recognition Lab.	-	2	1	
ITE441	ITE441T	Deep Learning for Image Analysis	3	-	3	7th
	ITE441P	Deep Learning for Image Analysis Lab.	-	2	1	
ITE447	ITE447T	Medical Image Processing	3	-	3	7th
	ITE447P	Medical Image Processing Lab.	-	2	1	

MINOR SPECIALIZATION STREAMS

(OPEN ELECTIVE GROUPS)

OPEN ELECTIVE GROUPS

1. One open elective stream shall be offered from CSE/IT discipline to be called "minor specialization in Computer Engineering". This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in Electronics and Communication Engineering and other engineering branches of the University campus (other schools but classes shall be held only at Dwarka campus of the University) as (This shall not be offered to Students of B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in CSE / IT):

Minor Specialization in Computer Engineering

Code	Paper Code	Paper	L	P	Credits	Semester
ITE319 OR ITE321	ITE319 OR ITE321T ITE321P	Digital Logic and Computer Design* OR Introduction to Object Oriented Programming using C++* Introduction to Object Oriented Programming using C++ Lab.	4 3 -	- - 2	4 3 1	5th
ITE338	ITE338T ITE338P	Data Structures and Algorithms Data Structures and Algorithms Lab.	3 -	- 2	3 1	6th
ITE340	ITE340T ITE340P	Introduction to Database Management Systems Introduction to Database Management Systems Lab.	3 -	- 2	3 1	6th
ITE451	ITE451T ITE451P	Operating Systems Operating Systems Lab.	3 -	- 2	3 1	7th
ITE453 OR ITE455	ITE453T ITE453P OR ITE455T ITE455P	Introduction to Computer Networks* Introduction to Computer Networks Lab. OR Software Engineering Software Engineering Lab.	3 - 3 -	- 2 - 2	3 1 3 1	7th

* Allocation on the basis of subjects studied earlier, by the School

2. One open elective stream shall be offered from ECE discipline to be called "minor specialization in Electronics and Communications Engineering". This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in CSE / IT and other engineering branches of the University campus (other schools, but classes shall be held only at Dwarka campus of the University) as (This shall not be offered to Students of B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in ECE):

Minor Specialization in Electronics and Communications Engineering

Code	Paper Code	Paper	L	P	Credits	Semester
ITE323	ITE323	Circuits and Systems	4	-	4	5th
ITE342	ITE342T ITE342P	Electronic Devices and Circuits Electronic Devices and Circuits Lab.	3 -	- 2	3 1	6th
ITE344 OR ITE346	ITE344 OR ITE346T ITE346P	Digital Logic and Computer Design* OR Microprocessors & Interfacing* Microprocessors & Interfacing Lab.	4 3 -	- - 2	4 3 1	6th
ITE457 OR ITE459	ITE457T ITE457P OR ITE459T ITE459P	Analog and Digital Communication* Analog and Digital Communication Lab. OR Wireless and Sensor Networks* Wireless and Sensor Networks Lab.	3 - 3 -	- 2 - 2	3 1 3 1	7th
ITE453 OR ITE463	ITE453T ITE453P OR ITE463T ITE463P	Introduction to Computer Networks* Introduction to Computer Networks Lab. OR Introduction to Control Systems * Introduction to Control Systems Lab.	3 - 3 -	- 2 - 2	3 1 3 1	7th

* Allocation on the basis of subjects studied earlier, by the School

3. One open area elective stream from Computer Applications shall be offered to all engineering branches of the University and shall be called “minor specialization in Software Development”. This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) engineering branches of the University campus (classes shall be held only at Dwarka campus of the University):

Minor Specialization in Software Development

Code	Paper Code	Paper	L	P	Credits	Semester
ITE325	ITE325T	Introduction to Database Management Systems *	3	-	3	5th
	ITE325P	Introduction to Database Management Systems Lab.	-	2	1	
OR	OR	OR				
ITE455	ITE455T	Software Engineering*	3	-	3	
	ITE455P	Software Engineering Lab.	-	2	1	
OR	OR	OR				
ITE329	ITE329	System Analysis and Design*	4	-	4	
ITE348	ITE348T	Web Development – I*	3	-	3	6th
	ITE348P	Web Development – I Lab	-	2	1	
OR	OR	OR				
ITE350	ITE350T	Introduction to Object Oriented Programming using C++*	3	-	3	
	ITE350P	Introduction to Object Oriented Programming using C++ Lab.	-	2	1	
ITE352	ITE352T	Programming in the Windows Environment*	3	-	3	6th
	ITE352P	Programming in the Windows Environment Lab.	-	2	1	
OR	OR	OR				
ITE354	ITE354T	Software Project Management*	3	-	3	
	ITE354P	Software Project Management Lab.	-	2	1	
OR	OR	OR				
ITE356	ITE356T	Programming in Java*	3	-	3	
	ITE356P	Programming in Java Lab.	-	2	1	
ITE465	ITE465T	Web Development – II	3	-	3	7th
	ITE465P	Web Development – II Lab.	-	2	1	
OR	OR	OR				
ITE467	ITE467T	Programming in the Linux Environment	3	-	3	
	ITE467P	Programming in the Linux Environment Lab.	-	2	1	
ITE469	ITE469T	Android Development	3	-	3	7th
	ITE469P	Android Development Lab.	-	2	1	
OR	OR	OR				
ITE471	ITE471T	Advanced Java Programming	3	-	3	
	ITE471P	Advanced Java Programming Lab.	-	2	1	

* Allocation on the basis of subjects studied earlier, by the School

OPEN ELECTIVE PAPERS (LIST OF PAPERS THAT CAN BE OFFERED AS STAND ALONE PAPERS BY THE SCHOOL TO ANY ENGINEERING STUDENT OF THE UNIVERSITY CAMPUS.

1. Any paper that is a programme core paper (PC) (3rd Semester onwards offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
2. Any paper that is a programme core elective paper (5rd Semester onwards, offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
3. Any paper that is a emerging area elective paper (5rd Semester onwards offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.

4. Any paper that is a open elective group paper (5th Semester onwards) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
5. The Board of School of University School of Information, Communication and Technology may approve inclusion of papers with detailed syllabus for undergraduate programmes of studies in the university campus (other school students) as open electives. The same shall become a part of the scheme and syllabi of examinations for the concerned student once approved by the APC of the school.
6. The above shall apply in consonance with other rules specified in this document.

Assessment of Outcomes Achieved in a Course / Paper. That is, Learning Outcome Assessment Alignment Grid.

Learning Outcome	Course/Project	How Learning Will Be Assessed	Resources	Attainment Level

To complete the alignment grid, start by listing one learning outcome per row beneath the “Learning Outcome” column. Make sure that each learning outcome can be assessed by a single method.

Next, beneath the "Course/ Project" column, list the course(s) or project(s) or assignments or tests that students will complete in order to achieve the learning outcome.

In the "How Learning Will Be Assessed" column, list the assessment(s) tool that will be used for that particular learning outcome. It is fine for there to be more than one assessment used for a particular outcome, so long as each assessment captures the outcome in its entirety. Likewise, it is fine for a single assessment to be used for multiple outcomes.

In the column entitled "Resources", list any additional materials, technologies, or resources needed for students to meet the learning outcome.

In the column entitled "Attainment Level", list in a quantifiable manner the average attainment level.

Every teacher must make this sheet for every paper taught. Be that a paper with only theory component, only practical component or with both theory and practical component.

LIST OF COURSES / PAPERS WITH DETAILED SYLLABUS

(2nd Year)

Paper Code: ICT 201	Paper: Foundations of Computer Science	L	T/P	C
Paper ID:		4	0	4

Prerequisite Papers: None

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text books.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To introduce the concept of Mathematical Logic, concepts of sets, relation and functions
2.	To introduce the concept of Algorithm and number theory
3.	To understand Group theory and related examples
4.	To use Graph theory for solving problems

Course Outcomes (CO)

CO1:	Ability for constructing mathematical logic to solve problems
CO2:	Ability to Analyze/ quantify the efficiency of a developed solution (algorithm) of a computational problem
CO3:	Ability to Understand mathematical preliminaries to be used in the subsequent courses of the curriculum. This includes Boolean algebra, number theory, group theory, and combinatorics.
CO4:	Ability to Understand diverse relevant topics in discrete mathematics and computation theory with an emphasis on their applicability as mathematical tools in computer science.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	-	-	2	2	3	3
CO 2	3	3	3	2	2	-	-	-	2	2	3	3
CO 3	3	3	3	3	2	-	-	-	2	2	3	3
CO 4	3	3	3	3	2	-	-	-	2	2	3	3

UNIT – I

Sets, Logic, and Relation: Sets, Subsets, powerset, operations on sets, Propositional Logic, Rules of inferences in propositional logic, Quantifiers, Predicates and validity, Predicate Logic, normal forms. Proof Techniques-Direct Proof, Proof by Contraposition, and proof by contradiction. Principle of inclusion and exclusion, pigeonhole principle, permutation and combination. Principle of Well Ordering, principle of mathematical induction, principle of complete induction. Relation, properties of binary relation, equivalence relation and class, closures (symmetric, reflexive, and transitive).

UNIT - II

Functions, Order relations and Boolean Algebra: Functions, Growth of functions, Permutation functions, Partially ordered sets, lattices, Boolean algebra, Minimization of Boolean Expressions. GCD, LCM, prime numbers.

Recurrence relations, solution methods for linear, first-order recurrence relations with constant coefficients, generating functions, Analysis of Algorithms involving recurrence relations, solution method for a divide-and-conquer recurrence relation. Masters theorem (with proof).

UNIT - III

Group theory: Semi-group, Monoid, Groups, Group identity and uniqueness, inverse and its uniqueness, isomorphism and homomorphism, subgroups, Cosets and Lagrange's theorem, Permutation group and Cayley's theorem (without proof), Normal subgroup and quotient groups. Groups and Coding.

UNIT - IV

Graph theory: Graph Terminology, Planar graphs, Euler's formula (proof), Euler and Hamiltonian path/circuit. Chromatic number of a graph, five color theorem (proof), Shortest path and minimal spanning trees and algorithms, Depth-first and breadth first search, trees associated with DFS & BFS, Connected components. Complexity Analysis of the graph MST.

Textbook(s):

1. B. Kolman, R. C. Busby & S.C. Ross "Discrete Mathematical Structures", 6th edition, PHI/Pearson, 2009.
2. R. L. Graham, D. E. Knuth & O. Patashnik, "Concrete Mathematics", Pearson Education, 2000.

References:

1. Neal Koblitz, "A course in number theory and cryptography", Springer – Verlag, 1994.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science," TMH, New Delhi (2000).
3. Norman L. Biggs, "Discrete Mathematics", Second edition, Oxford University Press, New Delhi (2002).
4. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd edition, PHI/Pearson.
5. Anne Benoit, Yves Robert, Frédéric Vivien "A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis", CRC Press, 2013.

Paper Code: ICT203	**Paper: Operating Systems**	**L**	**T/P**	**C**
Paper ID:		**3**	**2**	**4**

PrerequisitePaper: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter :

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce fundamentals of services provided by and the design of an operating system
2.	To introduce Processor scheduling and synchronization techniques
3.	To introduce Primary and Secondary memory management techniques
4.	To introduce the structure and organization of the file system

Course Outcomes (CO) :

CO 1	Ability to understand OS types, and process management techniques.
CO 2	Ability to understand CPU scheduling and process synchronization techniques.
CO 3	Ability to understand memory management techniques like paging, segmentation and demand paging etc.
CO 4	Ability to understand techniques for file system management and system security and protection

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	3	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	2	3	2	-	-	-	2	2	2	3
CO 4	3	3	2	3	2	-	-	-	2	2	2	3

UNIT – I

Computer System Organization, Architecture, Operations, Resource Management, Kernel Data Structures, OS Services, OS Types, OS Booting.

Process Management: Concept Scheduling, Operations, IPC, Client – Server Architecture. Multicore Programming, Multithreading models, Thread Libraries, Implicit threading, Threading Issues

UNIT – II

CPU Scheduling: Concepts, Criteria, Algorithms, thread scheduling, multi-processor scheduling.

Process Synchronization: Critical Section, Petersen's solution, Mutex locks, semaphores, monitors, POSIX synchronization, Deadlocks and characterization; deadlock detection, prevention, avoidance,; recovery from deadlocks.

UNIT – III

Memory Management: Main Memory: contiguous allocation, paging, page table, swapping. Virtual Memory: Demand paging, copy on write, page replacement, frame allocation, thrashing, memory compression, kernel memory allocation.

Storage Management: HDD scheduling, NVM scheduling, error detection and correction, storage device management, swap space management, RAID. I/O hardware, application I/O interface, kernel I/O subsystem, STREAMS.

UNIT - IV

File System: Concept, access methods, directory structure, protection, memory mapped files. File system: structure, operations, directory implementation, space allocation and management, recovery; file system mounting, partitions, file sharing, virtual file systems, remote file systems.
Security and protection: program, system and network threats, cryptography as security tool, user authentication, system protection techniques: goals, principles, domain, access matrix, role based access control. (As a case study Linux and Windows OS to be used)

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):
1. A. Silberschatz, P. B. Galvin and G. Gagne, Operating system concepts, Wiley, 10 ed., 2018.

References:
1. W. Stallings, Operating systems – Internals and design principles,Pearson, 9th ed. 2018.
2. A. S. Tanenbaum and H. Bos, Modern Operating Systems, Pearson, 4th ed., 2015.
3. M. Milenkovic, Operating System : Concepts and Design, Tata Mcgraw-Hill, 2000.
4. N. Chauhan, Principles of Operating Systems, Oxford University Press, 2014.
5 F, Mchoes, Understanding Operating System, Thomson Press, Third Edition, 2003.

Paper Code: ICT 205 / ITE319 / ITE344	Paper: Digital Logic and Computer Design	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: None

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce basic concepts of Boolean Algebra and Combinational Logic
2.	To introduce various sequential circuits, designing with examples
3.	To relate combination circuit design and sequential circuit design with respect to the design of a computer system
4.	To introduce machine learning, computer arithmetic, modes of data transfer with respect to I/O and Memory organization of a computer

Course Outcomes (CO) :

CO 1	Ability to understand Boolean Algebra and Design Combinational Circuits .
CO 2	Ability to understand and Design Sequential Circuits.
CO 3	Ability to understand Design of a basic computer.
CO 4	Ability to understand Input-Output and Memory Organization of a Computer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Boolean Algebra and Combinational Logic: Review of number systems , signed, unsigned, fixed point, floating point numbers, Binary Codes, Boolean algebra – basic postulates, theorems , Simplification of Boolean function using Karnaugh map and Quine-McCluskey method – Implementations of combinational logic functions using gates, Adders, Subtractors, Magnitude comparator, encoder and decoders, multiplexers, code converters , parity generator/checker, implementation of combinational circuits using multiplexers.

UNIT – II

Sequential Circuits: General model of sequential circuits, Flip-flops, latches , level triggering, edge triggering, master slave configuration , concept of state diagram , state table, state reduction procedures , Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Memory Unit, Random Access Memory

UNIT – III

Basic Computer organization: Stored Program, Organization, Computer registers, bus system, instruction set completeness, instruction cycle, Register Transfer Language, Arithmetic, Logic and Shift Micro-operations, Instruction Codes, Design of a simple computer, Design of Arithmetic Logic unit, shifter, Design of a simple hardwired control unit, Programming the basic computer, Machine language instructions, assembly language, Microprogrammed control, Horizontal and Vertical Microprogramming, Central Processing Unit, instruction sets and formats, addressing modes, data paths, RISC and CISC characteristics.

UNIT - IV

Computer Arithmetic, addition, subtraction, multiplication and division algorithms, Input-Output Organization, Modes of data transfer, Interrupt cycle, direct memory access, Input-Output processor, Memory Organization, Memory Hierarchy, Associative Memory, Cache Memory, Internal and external Memory, Virtual Memory.

Text Book(s)

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016
2. M. Morris Mano, Rajib Mall "Computer System Architecture", 3rd Edition Pearson Education, 2017

References:

1. Leach, D. P., Albert P. Malvino, "Digital Principles and Applications", McGraw Hill Education, 8th Edition , 2014
2. Jain, R.P. ,"Modern Digital Electronics", McGraw Hill Education, 4th Edition , 2010
3. Floyd, Thomas L. , "Digital Fundamentals" Pearson Education, 11th Edition, 2017
4. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", Wiley, 5th Ed., 2005.

Paper Code: ICT 207	**Paper : Database Management System**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Papers: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce basic concepts, architecture and characteristics of database systems
2.	To introduce relational model concepts and PL/SQL programming
3.	To introduce relational database design and Normal forms based on functional dependencies
4.	To introduce concepts of object oriented & distributed databases

Course Outcomes (CO) :

CO 1	Ability to understand advantages of database systems
CO 2	Ability to use SQL as DDL, DCL and DML
CO 3	Ability to design database and manage transaction processing
CO 4	Understand object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Enhanced ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model. Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form

UNIT - II:

Relational model concepts, relational model constraints, relational algebra, relational calculus, SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point, stored procedures,Triggers (with emphasis on mySQL and postgreSQL).

UNIT - III

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.

UNIT - IV

File Structures and Indexing: Secondary Storage Devices, Operations on Files, Heap Files, Sorted Files, Hashing, Single level indexes, Multi-level indexes, B and B+ tree indexes.

Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Textbooks:

1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018
2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. Luca Ferrari and Enrico Pirozzi, Learn PostgreSQL: Build and manage high-performance database solutions using PostgreSQL 12 and 13"", Packt Publishing, 2020.

References:

1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
6. Joel Murach, Murach's Mysql"", 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
7. MySQL and PostgreSQL manuals.

Paper Code: ICT 209	Paper: Object Oriented Programming Using C++	L	T/P	C
Paper ID:		4	0	4

Prerequisite Papers: None

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter :
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce the basic Concepts of Object Oriented Programming (data types, operators and functions) using C++
2.	To introduce concepts of Classes and Objects with the examples of C++ programming
3.	To understand object oriented features such as Inheritance and Polymorphism
4.	To use various object oriented concepts (exceptional handling) to solve different problems

Course Outcomes (CO)

CO 1	Ability to have an in-depth knowledge of object oriented programming paradigm
CO 2	To be able to develop basic C++ programming skills
CO 3	To be able to apply various object oriented features using C++
CO 4	Ability to have an understanding of generic programming & standard templates

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT – I

Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, C++ Programming Language, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Type Conversions, Operator Precedence, The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend Functions, default parameter value.

UNIT - II

Specifying a class, Member Functions, Encapsulation, information hiding, abstract data types, objects & classes, Static Member Functions, Arrays of Objects, Constructors & Destructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, identity and behaviour of an object, C++ garbage collection, dynamic memory allocation, Explicit Type Conversions, Operator Overloading.

UNIT - III

Inheritance, inheritance methods, Class hierarchy, derivation – public, private & protected, aggregation, Inheritance Constructors, composition vs. classification hierarchies, Containership, Initialization List, Polymorphism, categorization of polymorphic techniques, polymorphism by parameter, parametric polymorphism, generic function – template function, function overriding, run time polymorphism, virtual functions.

UNIT - IV

Standard C++ classes, using multiple inheritance, persistant objects, streams and files, namespaces, exception handling, generic classes, standard template library: Library organization and containers, standard containers, algorithm and Function objects, iterators and allocators, strings, streams, manipulators, user defined manipulators, vectors.

Textbook(s):

1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, "C++ Primer", Addison-Wesley Professional, 2012.
2. Ivor Horton, "Using the C++ Standard Template Libraries", Apress, 2015.
3. R. Lafore, "Object Oriented Programming using C++", Galgotia.

References:

1. A.R.Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH
2. Bjarne Stroustrup, "Programming: principles and practice using C++", Addison-Wesley, 2015.
3. Bjarne Stroustrup, "A Tour of C++", Addison-Wesley Professional, 2018.
4. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley Professional, 2013.
5. Peter Van Weert and Marc Gregoire, "C++17 Standard Library Quick Reference: A Pocket Guide to Data Structures, Algorithms, and Functions", Apress (2019)
6. Rumbaugh et. al. " Object Oriented Modelling & Design", Prentice Hall
7. G . Booch "Object Oriented Design & Applications", Benjamin,Cummings.
8. E.Balaguruswamy, "Objected Oriented Programming with C++", TMH
9. Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication.
10. Slobodan Dmitrović, Modern C++ for Absolute Beginners":A Friendly Introduction to C++ Programming Language and C++11 to C++20 Standards", Apress, 2020.

Paper Code: ICT 211	**Paper: Data Structures**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: ICT101

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.)
2.	To understand the concepts of Stacks, Queues and Trees, related operations and their implementation
3.	To understand sets, heaps and graphs
4.	To introduce various Sorting and searching Algorithms

Course Outcomes (CO)

CO 1	To be able to understand difference between structured data and data structure
CO 2	To be able to create common basic data structures and trees
CO 3	To have a knowledge of sets, heaps and graphs
CO 4	To have basic knowledge of sorting and searching algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT – I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, List manipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT - II

Sparse Matrix Representation (Array and Link List representation) and arithmetic (addition, subtraction and multiplication), polynomials and polynomial arithmetic.
Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression trees and their usage, binary search trees, AVL Trees, Heaps and their implementation, Priority Queues, B-Trees, B* Tree, B+ Tree

UNIT - III

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort), Exchange Sort (Bubble, quicksort), Merge sort (External Sorting) (Natural merge, balanced merge and polyphase merge). Searching – List search, sequential search, binary search, hashing methods, collision resolution in hashing.

UNIT - IV

Disjoint sets representation, union find algorithm, Graphs, Graph representation, Graph Traversals and their implementations (BFS and DFS). Minimum Spanning Tree algorithms, Shortest Path Algorithms

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning, Oct 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Silicon Press (US), 2007.

References:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, September, 1996
2. Robert Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson, November, 1990
3. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", McGrawhill, 2017
4. A. M. Tenenbaum, "Data structures using C". Pearson Education, India, 1st Edition 2003.
5. Weiss M.A., "Data structures and algorithm analysis in C++", Pearson Education, 2014.

Paper Code: ECO 213	**Paper: Engineering Economics**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper: None

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard / level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	Introduce economic theory and value analysis.
2.	Understand cash flow.
3.	Learn about sampling and replacement maintenance.
4.	Learn about depreciation and inflation.

Course Outcomes (CO)

CO 1	Ability to do understand economic analysis.
CO 2	Ability to understand and use cash flow method.
CO 3	Ability to determine economic life of an asset and replacement method.
CO 4	Ability to do depreciation analysis and inflation adjustment.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	1	-	-	1	2	3	-	-	-	3	1
CO 2	-	1	-	-	1	2	3	-	-	-	3	1
CO 3	-	1	-	-	1	2	3	-	-	-	3	1
CO 4	-	1	-	-	1	2	3	-	-	-	3	1

UNIT I

Introduction, Flow in an economy, Law of Supply and Demand, Concept of Engineering Economics, Elements of Cost, Break-Even Analysis, P/V ratio, examples of simple economic analysis, Interest Formulas and Their Applications.

UNIT II

Present Worth Method of Comparison: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram
Future Worth Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram
Annual Equivalent Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram, Alternate approach.
Rate of Return Method.

UNIT III

Replacement and Maintenance Analysis: Introduction, Types, Determination of economic life of an asset, replacement method.
Depreciation: Introduction and methods of depreciation (Straight line, Declining Balance, Sum of the Years Digit method, Sinking fund method, Service output method). Evaluation of public alternative.

UNIT IV

Inflation Adjustment: Introduction, Procedure to adjust Inflation, Inflation Adjusted Economic Life of Machines. Inventory Control and Methods, Make or buy decision, Project Management: Introduction, Phases, CPM, Gantt/Time Chart, PERT. Value Analysis / Value Engineering

Textbook:

1. R. Paneerselvam, “Engineering Economics”, PHI Learning, New Delhi, 2012.

References:

1. David L. Whitman, Ronald E. Terry, Fundamentals of Engineering Economics and Decision Analysis, Morgan & Claypool Publishers (2012).
2. John A. White, Kellie Grasman, Fundamentals of Engineering Economic Analysis, Wiley (2013).
3. Leland Blank, Antony Tarquin, Engineering Economy, McGraw Hill, 2002.
4. K. L. Sharma, An Introduction to Engineering Economics, Momentum Press, 2015.
5. Chan S. Park, Fundamentals of Engineering Economics, Global Edition-Pearson, (2019).
6. Zahid A. Khan, Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, Principles of Engineering Economics with Applications, Cambridge University Press (2018).

Paper Code: ICT215	**Paper: Signal and Systems**	**L**	**T/P**	**C**
Paper ID:		**3**	**-**	**3**

Prerequisite Paper: None

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first(1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5. The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart understanding about various types of signals and systems, their classifications, analysis and operations.
2.	To impart knowledge of use of transforms in analysis of signals and system.
3.	To impart skill to carry out simulation on signals and systems for observing effects of applying various properties and operations.
4.	To impart strong foundation of communication and signal processing to be studied in the subsequent semester

Course Outcome (CO):

CO 1	Ability to understand about various types of signals and systems, classify them, analyze them, and perform various operations on them.
CO 2	Ability to understand use of transforms in analysis of signals and system.
CO 3	Ability to carry out simulation on signals and systems for observing effects of applying various properties and operations.
CO 4	Ability to create strong foundation of communication and signal processing to be studied in the subsequently.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO 2	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO 3	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO 4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Unit I

Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – properties of discrete time complex exponential unit impulse – unit step impulse functions – Transformation in independent variable of signals: time scaling, time shifting. Determination of Fourier series representation of continuous time and discrete time periodic signals – Explanation of properties of continuous time and discrete time Fourier series. Representation of continuous time signals by its sample - Sampling theorem – Reconstruction of a Signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals.

Unit II

Continuous time Fourier Transform and Laplace Transform analysis with examples – properties of the Continuous-time Fourier Transform and Laplace Transform basic properties, Parseval's relation, and convolution in time and frequency domains.

Basic properties of continuous time systems: Linearity, Causality, time invariance, stability, magnitude and Phase representations of frequency response of LTI systems -Analysis and characterization of LTI systems using Differential Equations and Continuous time LTI systems. Laplace transform: Computation of impulse response and transfer function using Laplace transform.

Unit III
Discrete time system analysis using Difference equations, Discrete Time Fourier Transform, Discrete Fourier Transform, FFT and their property and usage in the analysis of Discrete time systems.

Unit IV
Basic principles of z-transform - z-transform definition – region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform. Properties of convolution and the interconnection of LTI Systems – Causality and stability of LTI Systems. Computation of Impulse & response & Transfer function using Z Transform.

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):

1. Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab, “Signals & Systems”, 2nd ed., Pearson Education, 1997.
2. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley, 1999

References:

1. M. J. Roberts, “Signals and Systems Analysis using Transform method and MATLAB”, TMH 2003.
2. K. Lindner, “Signals and Systems”, McGraw Hill International, 1999.
3. Moman .H. Hays,” Digital Signal Processing “, Schaum’s outlines, Tata McGraw-Hill Co Ltd., 2004.
4. B. P. Lathi, “Signal Processing and Linear System”, Berkeley Cambridge Press, 1998.
5. H. P. Hsu, “Schaum’s Outlines of The Theory and Problems of Signals and Systems”, McGraw-Hill, 1995.
6. John G.Proakis and Dimitris G.Manolakis, “Digital Signal Processing, Principles, Algorithms and Applications, 3rd edn., PHI, 2000.

Paper Code: ICT 204 / ICT 217	Paper: Computational Methods	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: ICT

Marking Scheme :

1. Teacher’s Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle ’s Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic , Loss of significance in computation Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton’s method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton’s Forward Interpolation, Gregory-Newton’s backward Interpolation , Lagrange’s Interpolation, Newton’s divided difference interpolation

Numerical Integration: Definite Integral, Newton-Cote’s Quadrature formula, Trapezoidal Rule, Simpson’s one-third rule, simpson’s three-eight rule, Errors in quadrature formulae, Romberg’s Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular

Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method
Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV
Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):
1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:
1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. 2. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code: ICT219	Paper: Digital Electronics	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: None

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart understanding of principles of Boolean Algebra and minimization of logic functions.
2.	To impart skill of design and implementation of Combinational and Sequential logic circuits.
3.	To impart knowledge about Analog to Digital conversion and Digital to Analog conversion.
4.	To impart understanding of Digital logic families, PLDs, PLA, PAL and FPGA.

Course Outcome (CO):

CO 1	To understand principles of Boolean Algebra and minimization of logic functions.
CO 2	To design and implement Combinational and Sequential logic circuits.
CO 3	To understand Analog to Digital conversion and Digital to Analog conversion.
CO 4	To understand Digital logic families, PLDs, PLA, PAL and FPGA.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

Unit I

Fundamentals of Digital Systems: Analog and Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Examples of IC gates, Boolean Algebra.
Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, Don't care conditions, XOR and XNOR simplification of K-maps, minimization of logic functions using Quine-McCluskey's algorithm.

Unit II

Combinational Digital Circuits: Multiplexer, De-Multiplexer, Decoders, Encoder, Binary Adders and Subtractors, Binary multiplier, Digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices.
Sequential circuits and systems: S-R, J- K, T and D flip flops, race around condition, Level and Edge triggering mechanism, Master-slave flip flop, Excitation and characteristics tables of flip-flops, realization of flip-flops using other flip-flops, shift registers, applications of shift registers, Ripple (Asynchronous) counters, Synchronous counters, design of counters, special counter IC's: Ring counter and Johnson counter.

Unit III

Mealy and Moore machine, state diagram, state table, Design of sequence detector.
A/D and D/A Converters: D/A converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, Sample and hold circuit, Analog to Digital converters: quantization and encoding, A/D converter: Parallel A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, specifications of A/D converters, example of A/D converter ICs.

Unit IV

Logic families: Characteristics of Digital ICs, Digital logic families: TTL, ECL and CMOS logic.

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM). ROM as a PLD, Programmable logic array (PLA), Programmable array logic (PAL), Field Programmable Gate Array (FPGA).

Textbook(s):

1. Donald P. Leach, A. P. Malvino, and Gautam Saha, “Digital principles and applications”, TMH, 2011.
2. R. J. Tocci, “Digital Systems”, PHI, 2000.

References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. I. J. Nagrath, “Electronics, Analog & Digital”, PHI, 1999.
3. J. M. Yarbrough, “Digital Logic-Application and Design”, PWS Publishing.
4. B. S. Nai, “ Digital Electronics and Logic Design”, PHI.
5. Balabanian and Carlson, “Digital Logic Design Principles”, Wiley Pub.
6. Morris Mano, "Digital logic and Computer design", Pearson Education India, 2016.

Paper Code: ICT221	**Paper: Analog Electronics-I**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: None

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To develop understanding of operation, characteristics, parameters and applications of p-n junction diode
2.	To develop understanding about BJT and FET in terms of structure, operation, configurations and characteristics. Also analyse stability and amplifier circuit using small signal models
3.	To impart knowledge of cascade amplifiers, coupling schemes, power amplifiers and their analysis
4.	To impart knowledge of Feedback amplifiers and oscillators

Course Outcome (CO):

CO 1	Ability to understand of operation, characteristics, parameters and applications of p-n junction diode
CO 2	Ability to understand about BJT and FET in terms of structure, operation, configurations and characteristics and able to analyse stability and amplifier circuit using small signal models
CO 3	Ability to understand and analyse cascade amplifiers, coupling schemes in amplifiers and power amplifiers
CO 4	Ability to understand feedback amplifiers and oscillators

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT - I

Open circuit P-N junction diode, Forward and reverse biased diode, I-V characteristics of diode, Diode Equation, Temperature dependence of diode. Breakdown phenomena, diffusion and transition capacitance of diode. Diode equivalent circuit, Ideal diode. Solar cell.
Diode circuits: half-wave and full-wave rectifiers with capacitor filter, clamping and clipping circuits. Zener diodes as voltage regulator.

UNIT - II

Bipolar Junction transistor (BJT): Structure, modes of operation, Configurations, I-V characteristics, early effect, junction voltages; Transistor Biasing: Need of biasing, load line concept, fixed bias, self-bias, collector to base bias, stability factors, Current Mirrors; hybrid model of BJT amplifier, small signal analysis of CE BJT amplifier using h parameter
JFET: Physical structure, I-V characteristics; MOSFET: Depletion and enhancement types, Physical structure and I-V characteristics; FET small-signal model (low & high frequency); MOSFET as resistance and switch,

UNIT – III

Cascade amplifiers: Analysis of cascade amplifier (voltage gain, current gain, input and output impedances); Darlington pair, Cascode amplifier; Types of coupling: DC, RC and Transformer; RC coupled Amplifier and its frequency response; Differential Amplifier: differential and Common mode operation, CMRR.

Power Amplifiers: Classification of output stages (Class A, B, C & AB), Class A Amplifier, Transformer coupled class A amplifier, Push pull amplifiers: Class A and Class B, Harmonic distortion, efficiency, crossover distortion, class AB operation, Class C amplifier.

UNIT - IV

Feedback Amplifiers: classification, Feedback concept, basic feedback topologies, Characteristics of Negative Feedback, Feedback and stability, gain margin, Noise margin,
Sinusoidal Oscillator, Barkhausen criterion, RC phase shift, LC (Colpitt's, Hartley, Clapp), Crystal Oscillator.

Textbook(s):

1. J. Millman, C.C. Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill, 4th ed. , 1998
2. R. L. Boylestad and N. Nashlesky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Ed., 2014

References:

1. Adel S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits Theory and Applications," 5th Edition , OUP, 2004.
2. B. Kumar and S. B. Jain, "Electronic Devices and Circuits"", Prentice Hall of India, 2007
3. S Salivahanan, and N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India), 2018
4. B.P. Singh and Rekha Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2009.
5. J. J. Cathey, "Schaum's Outline of Theory and Problems in Electronic Devices and Circuits", McGraw Hill, 2002.

Paper Code: ICT223	Paper: Analog Communication	L	T/P	C
Paper ID:		3	2	4

Prerequisite Paper: None

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart understanding of the concepts of analog communication systems.
2.	To impart understanding of various modulation and demodulation techniques of analog communication.
3.	To impart understanding of transmitters and receivers in analog communication.
4.	To impart understanding of the causes of noise and noise performance of analog communication.

Course Outcome (CO):

CO 1	To understand the concepts of analog communication systems.
CO 2	To understand various modulation and demodulation techniques of analog communication.
CO 3	To understand transmitters and receivers in analog communication.
CO 4	To understand the causes of noise and noise performance of analog communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

The Communication Process, Review of Fourier Transforms and Dirac Delta Functions, Transmission through Linear Systems, Filters (low pass and band pass signals), Phase and Group Delay, Sources of Information.
Amplitude Modulation: Introduction, Double Sideband – Suppressed Carrier Modulation, Quadrature – Carrier Multiplexing, Single-Sideband and Vestigial-Sideband methods of modulation, Frequency Translation, Frequency-Division Multiplexing

UNIT II

Angle Modulation: Introduction, Basic Definitions, Frequency Modulation, Phase-Locked Loop, Nonlinear Effects in FM Systems, Superheterodyne receiver.

UNIT III

Probability and Random Processes: Introduction; Probability; Random Variables, Statistical Averages; Random Processes; Mean, Correlation, and Covariance functions; Transmission of a Random Process Through a Linear Filter, Power Spectral Density, Gaussian Process, Noise, Narrowband Noise

UNIT IV

Noise: Introduction, Receiver Model, Noise in DSB-SC Receivers, Noise in AM Receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM.

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):

1. Simon Haykins and Michael Moher, "Communication Systems" John Wiley &sons Inc, 5th edition, 2009.

References:

1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", OUP, 5th edition, 2019.
2. H. Taub, D. L. Schilling and Gaotam Saha, "Taub's Principles of Communication Systems", McGraw Hill Eduction, 4th edition, 2017.
3. J. G. Proakis, M. Salehi, "Fundamentals of Communications Systems", Pearson, 2nd Edition, 2014.
4. W. Tomasi, "Electronic communications systems (Fundamentals Through Advanced)", Pearson Education, 5th Edition, 2008.
5. G. Kennedy and B. Davis, "Electronic communication systems", TMH, 4th Edition, 2008 (reprint)

Paper Code: ICT225	Paper: Engineering Electromagnetics	L	T/P	C
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: None

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart knowledge to understand concept of EM wave and its propagation
2.	To impart knowledge to understand transmission lines concepts, parameters, application and graphical tool to analyse transmission line problems
3.	To impart knowledge to analyse rectangular and circular waveguides
4.	To impart knowledge to understand basic concepts of various types of antennas

Course Outcome (CO):

CO 1	To understand concept of EM wave and its propagation
CO 2	To understand transmission lines concepts, parameters, application and graphical tool to analyse transmission line problems
CO 3	To analyse rectangular and circular waveguides
CO 4	To understand basic concepts of various types of antennas

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

Vector algebra and vector calculus with significance of del operators- theorems and applications, Maxwell's equations (for static, time varying fields) in integral and differential forms, Continuity equation, boundary conditions for electric and magnetic fields, Programmatic solutions to Maxwell's equations using MATLAB, Poisson's and Laplace's equations

UNIT – II

Electromagnetic waves: wave generation and equations in free space, lossy and lossless dielectrics, conductors-skin depth – Plane wave reflection and refraction – Standing Wave – Applications. Wave propagation in lossless and conducting medium, phase and group velocity, Reflection by a perfect conductor, insulator, Brewster Angle, surface impedance. Guided waves and flow of power: Poynting vector and Poynting theorem, applications, power loss in a conductor.

UNIT – III

Transmission Lines: General solution of transmission lines - Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, meaning of reflection coefficient – wavelength and velocity of propagation, distortion less transmission line, Impedance matching - quarter wave line, single stub matching, double stub matching, Power transfer, Microstrip transmission line, Smith chart.

UNIT - IV

Waveguides: Rectangular waveguide, characteristic of TE and TM waves- cutoff wavelength and phase velocity impossibility of TEM waves in waveguides- dominant mode, Surface currents, Attenuation, impedances. Circular wave guides- solution of field equations in cylindrical coordinates- TE and TM waves in circular guides – wave impedance and characteristic impedance, Microwave cavities: rectangular cavity resonators, circular cavity resonators- Q-factor.
Introduction to antenna: monopole, dipole antenna and microstrip antenna

Textbook(s):

1. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
2. W.H. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, 2006

References:

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. G. S. Rao, "Electromagnetic Field Theory and Transmission lines" Wiley India.
3. G. S. N. Raju, "Electromagnetic Field Theory and Transmission lines" Pearson, 2006

Paper Code: ICT 202	**Paper: Computer Graphics**	**L**	**T/P**	**C**
Paper ID:		**3**	**-**	**3**

Prerequisite Paper: ICT209

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce fundamentals of computer graphics, types of graphics and Raster graphics algorithms
2.	To introduce geometric manipulation in 2D and 3D space, perspective projections, surface and solid modelling.
3.	To understand Color models and various illumination models
4.	To understand Rendering techniques and Advanced modelling techniques

Course Outcomes (CO)

CO 1	Ability to understand the usage of the computer graphics primitives and perform the operations on it like clipping etc.
CO 2	Ability to perform any editing of operations on geometry of the objects through 2D and 3D transformations as per the requirements and should be able to model curves and surfaces using different techniques.
CO 3	Ability to make the model appearance realistic in terms of desired color, material and final appearance calculations.
CO 4	Ability to understand the concepts of different rendering techniques and advanced modelling techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	1	3
CO 2	3	2	2	2	2	-	-	-	2	2	1	3
CO 3	3	2	2	3	2	-	-	-	2	2	1	3
CO 4	3	2	2	3	2	-	-	-	2	2	1	3

UNIT - I

Introduction to graphics and types of graphics, quality parameters of graphics display. Basic raster graphics algorithms for drawing 2 D primitives: DDA line, Bresenham's line, Bresenham's circle, midpoint circle, midpoint ellipse. Conic Sections, Clipping of line (Cohen Sutherland algorithm), clipping of polygon (Sutherland Hodgeman algorithm), polygon filling. Attributes of Output primitives, Antialiasing

UNIT - II

Geometric manipulation in 2D and 3D space, window to viewport transformations, homogeneous coordinates, projections: parallel and perspective projections.
Generating curves like Hermite, Bezier and B-spline. Surface generation, wireframe, surface and solid modelling. 3-D polygon surfaces, polygon tables, polygon meshes.

UNIT - III

Visible surface determination techniques for visible surface determination: Z-buffer, A- buffer algorithm, scanline algorithm, area subdivision algorithm for implementation of hidden surface removal. Achromatic and hardware color models and software color models. Local and global illumination models calculations, Lambert, Gouraud & Phong shading techniques.

UNIT - IV

Rendering: introduction to ray casting, ray-tracing, recursive ray tracing, and shadows. Advanced procedural modelling: fractals, concept of fractals generation, concept of grammar-based modelling.

Textbook(s):

1. D. D. Hearn, M.P. Baker, "Computer Graphics C version", Pearson Education India, 2nd Edition, 2002.
2. J.D. Foley et. al., "Computer Graphics Principles & Practice in C", Pearson Education India, 2nd Edition, 2006.

References:

1. R.H. Bartels, J.C. Beatty and B.A. Barsky, "An Introduction to Splines for use in Computer Graphics and Geometric Modeling", Morgan Kaufmann Publishers Inc., 1996.
2. W. M. Newman and R. F. Sproul, "Principles of Interactive Computer Graphics", McGraw-Hill Education, 2nd Edition, 2001.
3. Z. Xiang and R. Plastock, "Theory and Problems of Computer Graphics", Schaum's Series, McGraw Hill, 2nd Edition, 2017.
4. F.P. Preparata and M.I. Shamos, "Computational Geometry: An Introduction", Springer, Reprint of the original 1st ed. 1985 Edition, 2012.
5. D. Rogers and J. Adams, "Mathematical Elements for Computer Graphics", McGraw Hill Education, 2nd Edition , 2017.
6. David F. Rogers, "Procedural Elements for Computer Graphics", McGraw Hill Education, 2nd Edition , 2017.
7. Alan Watt and Mark Watt, "Advanced Animation and Rendering Techniques", Addison-Wesley, 2002.

Paper Code: ICT 206	Paper: Design and Analysis of Algorithms	L	T/P	C
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: ICT211

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To introduce the basic concept of Algorithm analysis, Growth of function and Disjoint sets
2.	To introduce the concept of dynamic programming and greedy programming techniques
3.	To understand graphs, graph traversal and applications of graphs.
4.	To understand String matching and NP complete problems

Course Outcomes (CO)

CO 1	To be able to understand time complexity and disjoint sets
CO 2	To be able to differentiate between dynamic programming and greedy programming methodologies
CO 3	To have a knowledge of graphs and applications of graphs.
CO 4	To have basic knowledge of string matching and NP complete problems using few examples of NP complete problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	3	2	3	3
CO 2	3	3	3	2	3	-	-	-	3	2	3	3
CO 3	3	3	3	3	3	-	-	-	3	3	3	3
CO 4	3	3	3	3	3	-	-	-	3	3	3	3

UNIT - I

Growth of Functions, Summations, Algorithm Design Paradigms, Divide and Conquer Strategy Strassen's algorithm for matrix multiplication, analysis of Merge sort, Quick Sort and Heap Sort, sorting in Linear Time: Counting sort, Radix Sort, Bucket Sort, Medians and Order Statistics, Disjoint Set operations, Rooted Tree Representations, Linked List representation of disjoint sets, disjoint set forests.

UNIT - II

Matrix Chain Multiplication, LCS, Optimal Binary Search Tree, General Greedy Approach Vs Dynamic Programming approach, Case studies: Knapsack problem, Huffman Coding Problem, Matroids
String Matching: The Naïve String Matching Algorithm, The Rabin Karp Algorithm, String Matching with Finite Automata, The Knuth Morris Pratt Algorithm.

UNIT - III

Representation of Graphs, Breadth First Search, Depth First Search, Topological Sort, Strongly Connected Components, Algorithms of Kruskal's and Prim's, Dijkstra's and Bellman ford algorithm, All pair shortest path, Flyod Warshall Algorithm

UNIT - IV

NP-Complete Problems: Polynomial Time Verification, NP-Completeness, Satisfiability and Reducibility, NP Completeness proof, NP-Complete Problems: The vertex-cover problem, the traveling-salesman problem, the set-covering problem, the vertex-cover problem, Hamilton Circuit Problem

Textbook(s):

1. T .H . Cormen, C . E . Leiserson, R .L . Rivest, Clifford Stein "Introduction to Algorithms", PHI Learning Pvt. Ltd. (Originally MIT Press); Third edition (2 February 2010)
2. A .V. Aho, J . E . Hopcroft, J . D . Ullman "The Design & Analysis of Computer Algorithms", Addison Wesley, 1998.

References:

1. E. Horwitz and S. Sahani "Fundamentals of Computer Algorithms", Galgotia, 1998.
2. Udi Manber "Introduction to Algorithms – A Creative Approach", Addison Wesley, 1998.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson; 3 edition,2011
4. David Harel, Yishai Feldman, "Algorithmics: The Spirit of Computing", 3rd Edition, 1987, Addison Wesley Publishers Limited and Pearson Education Limited

Paper Code: ICT 208	**Paper: Theory of Computation**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: ICT201

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required.

Course Objectives :

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completess NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design aspects of "abstract models" of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Ability to comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to decide what makes some problems computationally hard and others easy?
CO 4	A ability to deliberate the problems that can be solved by computers and the ones that cannot?

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	1	1	3
CO 2	3	2	2	2	2	-	-	-	2	1	1	3
CO 3	3	2	2	2	2	-	-	-	2	1	1	3
CO 4	3	2	2	2	2	-	-	-	2	1	1	3

UNIT – I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.

UNIT - II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.

UNIT - III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem., Recursion Theorem.

UNIT - IV

Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completess, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation, BPP class. Interactive proof systems and IP class. relativized computation and oracles.

Textbook(s):

1. Sipser, Michael. Introduction to the Theory of Computation, Cengage Learning, 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, Introduction to Automata Theory, Language and Computation, Pearson, 2nd Ed, 2006.

References:

1. Peter Linz, An Introduction to Formal Languages and Automata, 6th edition, Viva Books, 2017
1. Maxim Mozgovoy, Algorithms, Languages, Automata, and Compilers, Jones and Bartlett, 2010.
2. D. Cohen, Introduction to Computer Theory, Wiley, N. York, 2nd Ed, 1996.
3. J. C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2nd Ed. 2003.
4. K. L. Mishra and N. Chandrasekharan, Theory of Computer Science: Automata, Languages and Computation, PHI, 2006.
5. Anne Benoit, Yves Robert, Frédéric Vivien , A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis, CRC Press, 2013.

Paper Code: ICT 210 / ITE455T	**Paper: Software Engineering**	**L**	**T/P**	**C**
Paper ID:		**3**	**-**	**3**

Prerequisite Paper: ICT 101 or ICT209

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.

Course Objectives :

1.	To introduce the concepts of Software engineering, software processes and its models
2.	To understand Software requirements analysis, SRS document, software metrics and system modelling
3.	To understand fundamentals of Software Design, Software Quality and software maintenance
4.	To understand Software Testing and System Security

Course Outcomes (CO)

CO 1	Ability to demonstrate fundamentals of software engineering and techniques.
CO 2	Ability to develop, maintain and evaluate software systems.
CO 3	Ability to produce and execute test cases for software systems using different testing techniques.
CO 4	Ability to discover how to evaluate the software quality, evolutionary process and security.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT - I

Introduction: software processes and its models (waterfall, incremental development, spiral model, re-use oriented model, prototype), Process activities, Process improvement (CMM Levels).

Agile Development model, plan driven vs agile model of development, agile methods and development techniques (user stories, refactoring, test first development, pair programming, agile project management (SCRUM agile method).

UNIT - II

Requirement Engineering: Functional and non-functional requirements, requirement elicitation, use case development, requirement analysis and validation, requirement review or requirement change, SRS document.

Size Estimation: Software Size, LOC and function point, cost and effort estimation, COCOMO, ISO 9001:2015 Certification.

System modelling: Interaction models: Use case diagram, sequence diagrams, Structural models: class diagrams, generalization, aggregation, Behavioural models: ER diagrams, Data flow diagrams, data dictionaries.

UNIT - III

Software Design: Architectural views and patterns, Modularity (cohesion and coupling), information hiding, functional independence, function oriented design, object oriented design, SOA, SAAS.

Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Software Reliability.

Software Evolution: Evolution process, legacy system, software maintenance: Maintenance prediction, Re-Engineering, Refactoring.

UNIT –IV

Software Testing: verification, validation, Development testing (unit testing, component testing, system testing, Test Driven Development (TDD), Release Testing (Requirement based testing, scenario testing, performance testing), User testing (alpha, beta and acceptance testing), Regression Testing, Stress Testing.
System Security: Reliability engineering, reliability requirements (functional and non-functional) and its measurement, safety engineering: safety critical systems, its requirement, security engineering and its requirements, security guidelines

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):

1. Ian Sommerville, “Software Engineering”, 10th edition, Pearson, 2018.
2. K.K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, New Delhi, Third Edition, 2008.

References:

1. Pankaj Jalote,”A Concise Introduction to Software Engineering”, Springer, 2008.
2. Roger S. Pressman, “Software Engineering- A Practitioner’s Approach”, Eighth Edition, McGraw-Hill International Edition, 2010.
3. Cem Kaner, Jack Falk, Nguyen Quoc, “Testing Computer Software”, Second Edition, Van Nostrand Reinhold, New York, 1993.
4. Gojko Aszic, ”Specification by Example”, Manning Publications, 2011.
5. Kent Back, ”Test-Driven Development By Example”, Pearson Education.
6. Boris Beizer, “Software System Testing and Quality Assurance”, Van Nostrand Reinhold, New York, 1984.
7. Mike Cohn, ”Software Development Using Scrum Succeeding with Agile”, Pearson Education.

Paper Code: ICT 212	Paper: Computer Networks	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required.

Course Objectives :

1.	To introduce fundamentals of Data communication and Computer Networking
2.	To impart Physical layer concepts and data link layer functions
3.	To create awareness about data link control, channel access mechanisms and data link protocols
4.	To understand Networking, addressing, routing protocols and transmission control protocol

Course Outcomes (CO) :

CO 1	Ability to understand the concepts of computer networks, OSI model and TCP/IP model.
CO 2	Ability to understand the physical layer concepts and error control at Data link Layer
CO 3	Ability to understand the data link layer functions and protocols.
CO 4	Ability to understand network layer functions, Routing protocols and Transport layer functions

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	-	-	3	2	2	3
CO 2	3	3	3	2	2	-	-	-	3	2	2	3
CO 3	3	3	3	2	2	-	-	-	3	2	2	3
CO 4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT I

Overview; protocol suites: TCP/IP and OSI, History, Standard.

Application Layer: Application layer paradigm, Client-server paradigm, Standard Client Server Applications, P2P, Socket Interface programming.

Transport Layer: Protocols: simple, stop-and-wait, GBN, Selective repeat, Bidirectional protocols, Internet Transport Layer protocols, UDP, TCP

UNIT II

Network Layer: Introduction, IPv4, ICMPv4, Unicast Routing, Multicast routing, IPV6, ICMPv6.

Data-Link Layer (Wired Networks): Introduction, DLC, Multiple Access Protocols, Wired LANS (Ethernet, others)

UNIT III

Data-Link Layer (Wireless Networks): Introduction, IEEE 802.11, Bluetooth, WiMAX, Cellular telephony, Satellite Networks, Mobile IP.

Physical Layer and Transmission Media: Data and Signals, Digital Transmission, Analog Transmission, Bandwidth utilization, Transmission Media.

Multimedia and QoS: Data types, streaming of audio/video, real-time interactive protocols, Quality of Service.

UNIT IV

Network Management: Introduction, SNMP, ASN.1

Security: Introduction, Ciphers, Application layer security, transport layer security, network layer security, packet filter firewall, proxy firewall.

Programming: Socket programming.

Textbook(s):

1. B. A. Forouzan and F. Mosharraf, “Computer Networks: A Top-Down Approach”, TMH, 2012
2. James F. Kurose and Keith W.,"Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.

References:

1. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Edition, Tata McGraw Hill, 2013
2. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, 5th Edition, Pearson Education India 2013.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Elsevier, 2012
4. Natalia Olifer and Victor Olifer, “Computer Networks: Principles, Technologies and Protocols for Network Design”, Wiley, 2006
5. Jerry FitzGerald, Alan Dennis and Alexandra Durcikova, “Business Data Communications and Networking”, John Wiley & Sons, 2019
6. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, India, 2017
7. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 2005

Paper Code: MS 214	Paper: Accountancy For Engineers	L	T/P	C
Paper ID:		2	0	2

Prerequisite Paper: None

Marking Scheme :
1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Instructions for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To teach the principles of accountancy
2.	To teach preparation of trial balance.
3.	To teach preparation of final accounts.
4.	To teach depreciation handling

Course Outcomes (CO)

CO 1	Understand the principles of accountancy
CO 2	Ability to understand journal entry, preparation of balance sheet and trial balance
CO 3	Ability to understand final account statement
CO 4	Ability to model depreciation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	2	2	2	-	-	3	2
CO 2	-	-	-	-	-	2	2	2	-	-	3	2
CO 3	-	-	-	-	-	2	2	2	-	-	3	2
CO 4	-	-	-	-	-	2	2	2	-	-	3	2

UNIT – I

Objectives and Nature of Accounting, Definitions and Functions of Accounting, Book Keeping and Accounting, Interrelationship of Accounting with other Disciplines, Branches, Limitation.
Accounting Principles, Accounting Concepts and Conventions.

UNIT – II

Journal entries, Compound Journal Entries, Opening Entry, Ledger Posting and Trial Balance, Preparation of Ledger, Posting, Cash Book, Sales and Purchase Book and trial Balance.

UNIT – III

Preparation of Final Accounts with Adjustment, Trading Account, Profit and Loss Account, Balance Sheet. Green Accounting, Social Responsibility Accounting, Accounting ethics

UNIT – IV

Concept of Depreciation, Causes and Features of Depreciation, Depreciation Accounting, Fixation of Depreciation Amount, Methods of recording Depreciation, methods of providing Depreciation, Depreciation Policy.

Textbook:

1. S. N. Maheshwari, Suneel K. Maheshwari and Sharad K. Maheshwari, "Financial Accounting for BBA", Vikas Publishing House, 2018.

References:

1. S. N. Maheshwari, Suneel K. Maheshwari and Sharad K. Maheshwari, "Financial Accounting", Vikas Publishing House, 2018.

2. S. Chakraborty and N.S. Roy, “Accounting and Finance for Engineers”, Lawpoint Publications, 2016.
3. Y. P. Singh, “Accounting and Financial Management for I.T. Professional”, New Age International, 2007.
4. P.C. Tulsian, “Financial Accounting”, Pearson, 2002.

Paper Code: ICT216	**Paper: Network Analysis and Synthesis**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequiste Paper: ICT215

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart understanding of basic component of electrical network and transformations used for analysis.
2.	To impart understanding of basic theorems for DC and AC circuits.
3.	To impart understanding of the phase and frequency response and two port network analysis.
4.	To impart understanding of the synthesis of network and passive filter design.

Course Outcome (CO):

CO 1	To understand basic component of electrical network and transformations used for analysis.
CO 2	To understand basic theorems for DC and AC circuits.
CO 3	To understand the phase and frequency response and two port network analysis.
CO 4	To understand the synthesis of network and passive filter design.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT - I

Circuits: Voltage, Ideal Voltage Source, Current Ideal Current Sources, Classification of Circuits, Ohm's Law, Resistively, Temperature Effect, Resistors, Resistor Power Absorption, Nominal Values and Tolerances, Colour Codes, Open and Short Circuits, Internal Resistance. Capacitance, Inductance, Transformers, Fourier series, Fourier transform, Laplace transform and analysis of differential equations with constant coefficients.

UNIT - II

DC Circuits: Series and Parallel Circuits, Kirchhoff's Voltage and Current Law, Mesh Analysis, Loop Analysis, Nodal Analysis, Thevenin's and Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Millman's Theorem, Tellegens Theorem, Y - Δ and Δ- Y Transformation, Bridge Circuits.
AC Circuits: Circuits containing Capacitors and Inductors, Transient Response, Alternating Current and Voltages, Phasors, Impedences and Admittance, Mesh Analysis, Loop Analysis, Nodal Analysis, Thevenin's and Norton's Theorem, Y - Δ and Δ- Y Transformation, Bridge Circuits. Resonant Circuits, Complex Frequency and Network Function, Maximum Power Transfer Theorem, Superposition Theorem.

UNIT - III

Amplitude and phase response, Bode plots, single tuned circuits, double tuned circuits, on poles and zeros and time delay, network functions, Two port Networks. Relationship between two port parameters, transmission parameters, hybrid parameters, incidental dissipation, interconnections of two port, analysis of ladder networks, Passive Filters. Graph Techniques for Network Analysis, Causality and stability, Hurwitz polynomials, positive real functions, elementary synthesis procedures, Properties of LC immittance, RC driving point impedances, RL impedances and RC admittances, synthesis of LC driving point immittances, RC impedance or RL admittances, synthesis of certain RLC functions.

UNIT - IV

Properties of transfer functions and synthesis of constant resistant resistance networks. Analog filter design: filter design problem, approximation problem in network theory, maximally flat low pass filter approximation, other low pass filter approximations, Transient response of lowpass filters, method to reduce overshoot in filters, maximally flat delay and controllable magnitude approximation, synthesis of low pass filters, magnitude and frequency normalization, frequency transformations.

Textbook(s):

1. Franklin F. Kuo, “Network Analysis and synthesis”, 2nd Edition, Wiley India Pvt Ltd.
2. Behrouz Peikari, “Fundamentals of Network Analysis & synthesis”, Jaico Publishing House, 2006.

References:

1. M. E. van Valkenberg and T. S. Rathore, “Network Analysis”, 3rd Edition, Pearson, 2019.
2. S. P. Ghosh and A. K. Chakraborty, “Network Analysis and Synthesis”, Tata McGraw Hill Education, 2010
3. S. K. Bhattacharya and Manpreet Singh, “Network Analysis and Synthesis”, Pearson, 2015

aper Code: ICT218	Paper: Control System	L	T/P	C
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: ICT215

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart knowledge to design Lead-Lag compensators based on frequency data for an open-loop linear system.
2.	To impart knowledge to compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability.
3.	To impart knowledge to compute stability of linear systems using the Routh array test and use this to generate control design constraints.
4.	To impart knowledge to interpret and apply block diagram representations of control systems and design PID controllers based on empirical tuning rules.

Course Outcome (CO):

CO 1	To be able to design Lead-Lag compensators based on frequency data for an open-loop linear system.
CO 2	To be able to compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability.
CO 3	To be able to compute stability of linear systems using the Routh array test and use this to generate control design constraints.
CO 4	To be able to interpret and apply block diagram representations of control systems and design PID controllers based on empirical tuning rules.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

Introduction to Control Systems; Introduction, Control Systems, Closed-Loop Control versus Open-Loop Control. Mathematical Modeling of Control Systems; Transfer Function and impulse Response Function, Atomatic Control Systems, Modeling in state space, State-Space Representation of Scalar Differential Equation System, Transformation of Mathematical models, Linearization of Nonlinear Mathematical Models. Mathematical Modeling of Mechanical Systems and Electrical Systems, Introduction, Mathematical Modeling of Mechanical Systems, Mathematical Modeling of Electrical Systems, Example Problems and Solutions Problems. Mathematical Modeling of Fluid Systems and Thermal Systems; Liquid-Level Systems, Pneumatic Systems, Hydraulic Systems, Thermal Systems.

UNIT - II

Transient and Steady-State Response Analyses; First-Order Systems, Second-Order Systems, Higher Order Systems, Transient-Response Analysis, Routh's Stability Criterion, Effects of Integral and Derivative Control Actions on System, Steady-State Errors in Unity-Feedback Control Systems. Control Systems Analysis and design by the Root-Locus Method; Root-Locus Plots, plotting Root Loci, Root-Locus Plots of Positive Feedback Systems, Root-Locus Approach to control Systems Design, Lead Compensation, Lag Compensation, Lag-Lead Compensation.

UNIT - III

Control Systems Analysis and Design by the Frequency Response Method; Bode Digrams, Polar Plots, Log-Magnitude-versus-Phase plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability Analysis, Closed-Loop Frequency Response of Unity-feedback Systems, Determination of Transfer functions, Control Systems design by Frequency Response Approach, Lead Compensation, Lag Compensation, Lag-Lead Compensation.PID Controllers and Modified PID Controllers; Introduction,Ziegler- Nichols Rules for tuning PID controllers, Design of PID Controllers with Frequency Response Approach, Design of PID Controllers with Computational Optimization Approach, Modification of PID Control Schemes, Two-Degrees-of-freedom PID Control Schemes, Zero Placement Approach to Improve Response.

UNIT - IV

Control Systems Analysis in State Space; Introduction,State-space Representations of Transfer-Function Systems, Transformation of System Models, Solving the Time-Invariant State Equation, Some Useful Results in vector-Matrix Analysis, Controllability, Observability.Control Systems Design of in State Space; Introduction, Pole Placement,Solving Pole-Placement Problems, Design of Servo Systems, State Observers, Design of Regulator Systems with Observers, Design of Control Systems with Observers, Quadratic Optimal Regulator Systems, Robust Control Solutions.

Textbook(s):

1. K. Ogata, Modern Control Engineering, Prentice Hall India, 5th ed., 2010.

References:

1. William Boltons, Control Systems; Newnes, 2002.
2. Norman S. Nise, Control Systems Engineering, Wiley, 8th ed., 2019.
3. Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, Tata McGraw Hill, 10 ed., 2017.

Paper Code: ICT220	Paper: Analog Electronics -II	L	T/P	C
Paper ID:		3	2	4

Prerequisite Paper: ICT221

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To understand Basic building block and characteristic of Op-Amp
2.	To understand the frequency response and Configurations of Op-Amp
3.	To analyze and design linear, nonlinear and Oscillators circuits using Op-Amp
4.	To analyze and design active filters and to understand function of Op-Amp based special ICs

Course Outcome (CO):

CO 1	Ability to understand and use Op-Amps to design open-loop and closed loop configuration.
CO 2	Ability to analyse frequency response of and Op-Amp circuit.
CO 3	Ability to use Op-Amp in linear and non-linear applications.
CO 4	Ability to design Active Filters

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

The Operational Amplifiers: Block diagram representation of OP-AMP; Evolution of IC and types, Power supply for Op-Amp; The Ideal Op-Amp: schematic, characteristics, equivalent circuit, Ideal voltage transfer curve, typical IC 741 characteristics
Open Loop Op-Amp configurations: The differential amplifier, inverting amplifier, non-inverting amplifier
Closed loop Op-Amp configurations: inverting and non-inverting amplifiers, voltage followers, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, Inverting and Non-Inverting op-amp.

UNIT - II

The Practical Op-Amp: Input offset voltage, input bias current, input offset current, Total output offset voltage, thermal drift, error voltage, Supply voltage rejection ration (SVRR), CMRR
Frequency Response of An Op-Amp: Frequency response compensator networks, High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency, Slew rate, causes of slew rates and its effects in application.

UNIT - III

Linear applications of Op-Amps: Summing, scaling and averaging amplifier (inverting, non-inverting & differential configuration), voltage to current & current to voltage converters, Integrator, Differentiator,
Non-Linear applications of IC op-amps: Comparator, Zero crossing detector, Schmitt Trigger, Clipping & Clamping Circuits, Precision Rectifiers, sample and hold circuit
Oscillators: Principles & Types; Phase shift, Wein-bridge & quadrature. Square wave, triangular wave and saw tooth wave generators, voltage-controlled oscillator

UNIT - IV

Active Filters: Classification and frequency response of filters, response Advantages of active filters, characteristics of butter worth, chebyshev, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters.

Specialised IC- The 555 Timer: functional diagram, Monostable and Astable multivibrators; PLL: Basic PLL principle, monolithic 565 PLL; Voltage Regulators, Three terminal IC voltage regulators(LM 317

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2001.
2. D. Roy Choudhary & S. B Jain, “Linear Integrated Circuit”, 2nd ed. New age publication.2018.

References:

1. Adel S. Sedra and Kenneth C. Smith, “Micro Electronic Circuits Theory and Applications,” 5th Edition , OUP, 2004.
2. David A. Bell, “Op-amp & Linear ICs”, Oxford, 2013.
3. James M. Fiore, “Op Amps & Linear Integrated Circuits Concepts & Applications”, Cengage, 2010.
4. J. Michel Jacob, “Applications and Design with Analog Integrated Circuits”, PHI, 2004.
5. R. L. Boylestad and N. Nashlesky, “Electronic Devices and Circuit Theory”, Pearson Education, 11th Ed., 2014
6. J. Millman, C. Halkias, and C. D. Parikh, “Millman’s Integrated Electronics: Analog and Digital circuits and system”, McGraw Hill Education, 2018.

Paper Code: ICT222	**Paper: Digital Communication**	**L**	**T/P**	**C**
Paper ID:		**3**	**2**	**4**

Prerequisite Paper: ICT223

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To understand importance of information theory in digital communication and various PCM modulation.
2.	To understand the variance basic concepts of digital communication.
3.	To understand the various digital Modulation-demodulation techniques
4.	To understand various coding in digital communications.

Course Outcome (CO):

CO 1	Ability to understand the channel information carrying capacity and conversion of analog to digital signals.
CO 2	Ability to understand the effect of additive white Gaussian Noise on digital communication modulation techniques.
CO 3	Ability to analyse the effect of inter symbol interference as the source of channel impairment and the effect of multipath phenomenon.
CO 4	Ability to use and design communication systems for reliable communication

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Review of probability theory and Stochastic processes, Poisson and Gaussian Process, Noise, Narrowband Noise, Sinewave plus Narrowband Noise. Information Theory: Entropy, Source Coding Theorem, Lossless data compression, Discrete Memoryless channel, Mutual Information, Channel Capacity, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Random Ensembles, Information Capacity Law. Sampling Theory, PAM, Quantization characteristics, PCM, DPCM, Delta Modulation, Line Codes.

UNIT II

AWGN Channel Signalling: Geometric Representation of Signals, Conversion of Continuous AWGN Channel to a vector channel, : ASK, QASK, FSK, M-array FSK, BPSK, DPSK, DEPSK, QPSK, M-array PSK, QAM, MSK, GMSK, Coherent and non-coherent detection and other keying techniques.

UNIT III

Band Limited Channels: Error rate due to channel noise in a matched filer receiver, Intersymbol Interference, Signal Design for Zero ISI, Ideal Nyquist Pulse for Distortionless Baseband data transmission, Raised cosie and square root raised cosine spectrum, Eye pattern, Adaptive equalization, signalling over multiple baseband channel, Digital Subscriber Lines.

Fading Channels: Propagation effects, Jakes Model, Statistical Characteristics of wideband wireless channel, FIR modelling of doubly spread channel, Effects of flat fading, Diversity techniques, MIMO, MIMI Capacity for channel known at receiver, OFDM, Spread-spectrum signals, CDMA, Rake receiver and Multipath Diversity

UNIT IV

Error Control Coding: Introduction, Error Control using forward correction, Discrete Memory less channel, Linear Block Code, Cyclic Codes, Convolutional Codes, Optimum Decoding of Convolutional Codes

Note: The practical list shall be notified by the teacher in the first week of the class commencement.

Textbook(s):

1. Simon Haykins, “Digital Communication Systems” John Wiley, 2014

References:

1. Simon Haykins and Michael Moher, “Communication Systems” John Wiley &sons Inc, 5th edition, 2009.
2. B P Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, OUP, 5th edition, 2019
3. H P Hsu, Schaum Outline Series, Analog and Digital Communications, TMH 2006
4. J.G Proakis, Digital Communication, 4th Edition, Tata Mc Graw Hill Company, 2001.

Paper Code: ICT224	Paper: Microprocessors	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: ICT219

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To impart knowledge about computer organization concepts so that students can understand basic computer organization and design
2.	To impart knowledge about architecture and instruction set of 8085 microprocessor so that students can implement 8085 assembly language programs.
3.	To impart knowledge about interfacing of memory devices , data convertors and simple I/O devices with 8085 microprocessor.
4.	To impart knowledge about architecture and operation of Programmable Peripheral Devices and their interfacing with 8085 microprocessor.

Course Outcome (CO):

CO 1	Understand computer organization concepts and describe evolution of Microprocessor technology.
CO 2	Ability to understand and distinguish the use of different 8085 instructions and apply those instructions for implementing assembly language programs.
CO 3	Understand and realize the interfacing of memory devices, data convertors and simple I/O devices with 8085 microprocessor.
CO 4	Understand the architecture and operation of Programmable Peripheral Devices and ability to use them for interfacing I/O devices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	3	-	1	-	2	-	2	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-
CO 4	3	3	3	2	3	-	-	-	-	-	-	-

UNIT - I

Computer Organization concepts: Stored Program Organization, Computer Registers, Machine language instructions, addressing modes, Instruction formats, Arithmetic Logic Unit, Data path, Design of Control Unit, Instruction pipelining concepts.

Introduction to microprocessors – Single Chip CPU, Microprocessors Evolution, Trends in Microprocessor Technology.

UNIT – II

Study 8-bit microprocessor 8085-Architecture and Programming Model of 8085 Microprocessor, PIN Layout and description of Signals, Power supply requirements and system clock, Basic Interfacing Concepts, Memory mapped I/O, Instruction Set of 8085, Data transfer, Arithmetic, Logical and branch instructions, Format of 8085 machine instructions, Instruction Execution and Timing diagram, Example of an 8085 – based microcomputer board.

Assembly Language Programming of 8085- Counters and Time delays, Stacks and Subroutines, Code Conversion, BCD Arithmetic, implementing 16-bit operations on 8-bit microprocessor, implementing 8085 programs using a single board computer, writing programs using an assembler

UNIT – III

Methods of Data Transfer and Interrupt Structure of 8085- Data transfer mechanisms, Memory mapped and I/O mapped data transfer, Programmed data transfer, Parallel data transfer, Serial data transfer, RS-232 standard, RS-485 standard, GPIB/IEEE 488 standard, Interrupt driven data transfer, Interrupt Structure of 8085, RST instructions, Multiple interrupts and priorities, 8085 vectored interrupts, Direct Memory access concepts.

Interfacing of Memory devices with 8085-Generation of control signals for memory, Interfacing EPROM and RAM chips with 8085

Interfacing data converters with 8085-Interfacing 8-bit D/A and 8-bit A/D converters with 8085 using status check and interrupts.

UNIT – IV

Programmable peripheral devices and their Interfacing with 8085- 8255 programmable peripheral interface, operating modes, control words, Interfacing switches and LEDs, Interfacing A/D and D/A using 8255, Waveform generation, 8279 Keyboard and display controller, Interfacing seven segment displays and matrix keyboards, 8254 Programmable Interval Timer, 8259 Programmable Interrupt Controller, 8237 DMA Controller. Serial I/O and Data Communication, Asynchronous Serial I/O, Hardware Controlled Serial I/O using 8251

Textbook(s):

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and application with 8085, Sixth Edition, Penram International Publication, 2013.

References:

1. John Ufferbeck, Microcomputers and Microprocessors, Third Edition, PHI, 2000.
2. Barry B. Brey, Intel Microprocessors, 8th Edition, Pearson Education/Prentice Hall ,2009
3. J. L. Antonakos, “An Introduction to the Intel Family of Microprocessors”, Thomson, 1996.

Paper Code: ICT 251	Paper: Database Management lab		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 207 (Database Management Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 253	Paper: Object Oriented programming using C++ Lab		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 209 (Object Oriented programming using C++) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 255	Paper: Data Structure Lab		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 211 (Data Structure) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 257	Paper: Operating Systems Lab		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 203 (operating Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT256 / ICT 263	Paper: Computational Methods Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation:	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 204 / ICT 217 (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 259	Paper: Digital Electronics Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT 219 (Digital Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 261	**Paper: Analog Electronics – I Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 221 (Analog Electronics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 265	**Paper: Signals and Systems Lab**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 215 (Signals and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 267	**Paper: Analog Communications Lab**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 223 (Analog Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 252	**Paper: Computer Networks lab**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 212 (Computer Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 254	**Paper: Design and Analysis of Algorithms Lab**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 206 (Design and Analysis of Algorithms) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 258	**Paper: Computer Graphics Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 202 (Computer Graphics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

<table>
<tr><td colspan="2">Paper Code: ICT 260</td><td colspan="2">Paper: Software Engineering Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 210 (Software Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
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<table>
<tr><td colspan="2">Paper Code: ICT 262</td><td colspan="2">Paper: Analog Electronics - II Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 220 (Analog Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

<table>
<tr><td colspan="2">Paper Code: ICT 264</td><td colspan="2">Paper: Microprocessors Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 224 (Microprocessors) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
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<table>
<tr><td colspan="2">Paper Code: ICT 266</td><td colspan="2">Paper: Digital Communications Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 222 (Digital Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

<table>
<tr><td colspan="2">Paper Code: ICT 262</td><td colspan="2">Paper: Control Systems Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 218 (Control Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

LIST OF COURSES / PAPERS WITH DETAILED SYLLABUS

(3rd and 4th Year – Compulsory Papers)

Paper Code: ICT301	Paper: Digital Signal Processing	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper: ICT301

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.

2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.

4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.

5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	Understand Signal and systems
2.	To understand discrete time signal processing techniques
3.	To understand the design principles for DSP applications
4.	To understand efficient mechanisms for FFT calculation

Course Outcome (CO):

CO 1	Illustrate digital signals, systems and their significance.
CO 2	Analyse the digital signals using various digital transforms DFT, FFT etc.
CO 3	Design and develop the basic digital processing system.
CO 4	Ability to implement DFT and FFT

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	-	-	1	1	1	1
CO 2	3	3	3	3	2	1	-	-	1	1	1	1
CO 3	3	3	3	3	2	1	-	-	1	1	1	1
CO 4	3	3	3	3	2	1	-	-	1	1	1	1

UNIT - I

Introduction: Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples. Review of Fourier and Laplace Transform.

Discrete-Time Signals and Systems (Frequency Domain analysis): Z-transform & Inverse Z-transform, Linear convolution and its properties, Linear Constant Coefficient Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems.

UNIT – II

Analysis of Linear Time Invariant System: Analysis of LTI systems in time domain and stability considerations.

Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase.

UNIT – III

Structures for Discrete Time Systems: Block Diagram and signal flow diagram representations of Linear Constant-Coefficient Difference equations, Basic Structures of IIR Systems, lattice and lattice-ladder structures, Transposed forms, Direct and cascade form Structures for FIR Systems, Linear Phase FIR structure, Effects of Co efficient quantization.

Filter Design Techniques: Design of Discrete-Time IIR filters from Continuous-Time filters Approximation b derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques.

UNIT – IV

Discrete-Fourier Transform & Fast Fourier Transform: Representation of periodic sequences: The Discrete Fourier series and its properties Fourier transform of periodic signals, Sampling the fourier transform, The district Fourier transform, properties of DFT, Linear Convolution using DFT. FFT- Efficient Computation of DFT, Goertzel Algorithm, radix2 Decimation-in-time and Decimation in Frequenct FFT Algorithms

Textbook(s):

1. Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India Private Limited.
2. A.V. Oppenheim, R.W. Schafer, Digital Signal Processing, Pearson Education , 2010

References:

1. S.K. Mitra, Digital Signal Processing: A computer based approach, McGraw Hill Education , 4e,2013.
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing", Pearson, 2004

Paper Code: ICT303	**Paper:** Compiler Design	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper: ICT303

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To learn the various phases of compilation
2.	To understand intermediate code generation and run-time environment.
3.	To learn to implement the front-end of the compiler.
4.	To learn techniques of code generation and optimization .

Course Outcome (CO):

CO 1	Understand the techniques in different phases of a compiler.
CO 2	Design a lexical analyser for a sample language and learn to use the LEX/FLEX tool.
CO 3	Apply different parsing algorithms to develop a parser and learn to use YACC/BISON tool
CO 4	Understand semantics rules (SDT), intermediate code generation and run-time environment

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO 2	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**2**	**1**
CO 3	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

UNIT I

Compiler Structure: Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction. Lexical analysis: Interface with input parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, error reporting and implementation. Regular grammar & language definition, Transition diagrams, design of a typical scanner using LEX / FLEX.

UNIT II

Syntax Analysis: Context free grammars, ambiguity, associability, precedence, top down parsing, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing LL(1) grammar, Nor LL(1) grammar, Bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), Design of a typical parser using YACC or Bison.

Unit III

Syntax directed definitions: Inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. Type checking: type: type system, type expressions, structural and name equivalence of types, type conversion, overloaded function and operators, polymorphic function. Run time system: storage organization, activation tree, activation record, parameter passing symbol table, dynamic storage allocation. Intermediate code generation: intermediate representation, translation of declarations, assignments, Intermediate Code generation for control flow, Boolean expressions and procedure calls, implementation issues.

UNIT IV

Code generation and instruction selection: Issues, basic blocks and flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGS, peep hole optimisation, code generator generators, specification of machine. Code optimisation: source of optimisations, optimisation of basic blocks, loops, global dataflow analysis, solution to iterative dataflow equations, code improving transformations, dealing with aliases, data flow analysis of structured flow graphs.

Textbook(s):

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education.
2. Levine, Mason, and Brown, “Lex & Yacc”, O’ Reilly, 1998.
3. K. C. Louden, “Compiler Construction, Principle and Practice” Thomson Books, 2006

References:

1. K. C. Louden, “Compiler Construction, Principle and Practice” Thomson Books
2. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers,.
3. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers - Elsevier Science, India,
4. Alan Holub, “Compiler Design in C”, PHI,

Paper Code: HS305	Paper: Introduction to Indian Traditional Knowledge	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1.	Learn the significance of traditional knowledge
2.	Learn the role of modern organizations for science and technology in the country.

Course Outcome (CO):

CO 1	Understand the development and acheivements in science technology in ancient India.
CO 2	Understand the development and acheivements in science technology in medieval India.
CO 3	Understand the development and acheivements in science technology in modern India..
CO 4	Evaluate the concepts of intellectual property to protect the traditional knowledge and the traditional knowledge in different sectors.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	2	2	-	-	-	-	1
CO 2	-	-	-	-	-	3	3	-	-	-	-	1
CO 3	-	-	-	-	-	3	3	-	-	-	-	1
CO 4	-	-	1	1	-	3	3	-	-	-	-	1

UNIT I

Science and Technology in Ancient India: Astronomy (Surya-Siddhanta, Aryabhatta, Varahamihira), Mathematics, Agriculture, *Shilpa-shastra* and Architecture, Physics and Chemistry, Medicine (Ayurveda), Metallurgy, Textile Production, Shipbuilding and Armaments

UNIT II

Science and Technology in Medieval India: Geometry, Trigonometry and Algebra, Architecture, Agriculture (Canals and other irrigation systems), Graeco-Arabic Medicine (Unani-tibb)), Astronomy, medicine, textile, arms-making, shipbuilding and horticulture

Unit III

Modern Science in India: Surveys, Scientific Education, Scientific Societies, Growth of Scientific Institutions in colonial India, Indian Response

UNIT IV

Post-Independence India: Policies in Science and Technology in independent India (IITS, Council of Scientific and Industrial Research, Ministry of Science and Technology), Indian Council of Agricultural Research (1947), Indian Council of Medical Research (1949), DRDO and Defence Technology, TIFR and Department of Atomic Energy and Nuclear Energy, ISRO and Space Programme (Satellite and Communication Revolution), Digital India (IT Revolution and computerization of Indian Railways), C-DOT and Telecom Advancement.

References:

1. D.M. Bose, S.N. Sen & B.V. Subbarayappa (Eds.), A Concise History of Science in India, New Delhi: Indian National Science Academy, 1971
2. David Arnold, The New Cambridge History of India, III-5 (Science Technology and Medicine in Colonial India, Cambridge: Cambridge University Press, 2004
3. Suvobrata Sarkar (Ed.), History of Science, Technology, Environment and Medicine in India, London and New York: Routledge (Taylor & Francis), 2022
4. Deepak Kumar, Science and the Raj: A Study of British India, Oxford Scholarship Online, October 2012.

5. P. Rama Rao, 'Science and Technology in Independent India: Retrospect and Prospect', in Current Science, Vol. 74, No.5, 10 March 1998, pp.418-432
6. A.L. Basham, The Wonder That was India, Vol. I, New Delhi: Rupa & Co., 1981 (Only Chapter VIII: The Arts and the Appendices: Astronomy, The Calendar, Mathematics, Physics and Chemistry, Physiology and Medicine, Logic and Epistemology, Weights and Measures, Coinage)
7. S.A.A. Rizvi, The Wonder That was India, Vol. II, London: Sidgwick & Jackson, 1987 (Chapter VII; Fine Arts-only on Monuments, Architecture and Painting for Geometry, etc.)
8. M.S. Khan, 'Science and Technology in Early Medieval India', in https://dergipark.org.tr/tr/download/article-file/688183

Paper Code: MS307	Paper: Entrepreneurship Mindset	L	T/P	C
Paper ID:		2	0	2

Prerequisite Paper:

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1.	To provide a foundation for basic entrepreneurial skills and to acquaint them with the world of entrepreneurship and inspire them to set up and manage their businesses.
2.	To acquaint students with the process of creativity and innovation
3.	To expose students to various aspects of entrepreneurship and business
4.	To expose students to case studies on successful entrepreneurs

Course Outcome (CO):

CO 1	Students form a foundation for basic entrepreneurial skills
CO 2	Students understand creativity and innovation for opportunity recognition
CO 3	Students learn about opportunity analysis and writing a business plan
CO 4	Students are inspired by examples of successful entrepreneurs.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	2	2	-	1	2	1	2	-	3	-
CO 2	-	-	2	2	-	1	2	1	2	-	3	-
CO 3	-	-	2	2	-	1	2	1	2	-	3	-
CO 4	-	-	2	2	-	1	2	1	2	-	3	-

UNIT I

Introduction: The Entrepreneur; Theories of Entrepreneurship; Characteristics of successful entrepreneurs, myths of entrepreneurship; entrepreneurial mindset- creativity (steps to generate crea-tive ideas, developing creativity) and innovation (types of innovation)

UNIT II

Promotion of a Venture and Writing a business plan: Opportunity Analysis; External Environment Analysis Economic, Social and Technological Analysis. Business plan- What is busi-ness plan, parts of a business plan. Writing a Business Plan

UNIT III

Entrepreneurship Support: Entrepreneurial Development Programmes (EDP): EDP, Role of Government in Organizing EDPs. Institutions supporting small business enterprises: central level, state level, other agencies, industry associations.

UNIT IV:

- Presenting a business plan
- Project on Startup India or any other gov-ernment policy on entrepreneurship
- Discussion on why startup fails, role of MSME etc.
- Discussion on role of entrepreneur in eco-nomic growth.
- Discussion on technology park.
- Case study discussion on successful Indian entrepreneurs.

Suggested Readings:

1. Charantimath (8th Ed., 2014), Entrepreneurship Development and Small Business Enterprise, Pears Education.
2. Bamford C.E (1st Ed 2015), Entrepreneurship: A Small Business Approach, McGraw Hill Education.

3. Hisrich et al. (2013) Entrepreneurship, McGraw Hill Education
4. Balaraju, Theduri (2012), Entrepreneurship Development: An Analytical Study, Akansha Publishing House.
5. David, Otis, (2014), A Guide to Entrepreneurship, Jaico Books Publishing House, Delhi.
6. Kaulgud, Aruna, (2012), Entrepreneurship Management, Vikas Publishing House, Delhi.
7. Chhabra, T.N. (2014), Entrepreneurship Development, Sun India

Paper Code: ICT302	**Paper: Technical Writing Using Latex**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**
Prerequisite Paper:				
Marking Scheme: **1.** This is an NUES paper, hence evaluation out of 100 to be conducted by the concerned teacher.				

Course Objectives:	
1.	To provide a foundation for basic entrepreneurial skills and to acquaint them with the world of entrepreneurship and inspire them to set up and manage their businesses.
2.	To acquaint students with the process of creativity and innovation
3.	To expose students to various aspects of entrepreneurship and business
4.	To expose students to case studies on successful entrepreneurs
Course Outcome (CO):	
CO 1	Ability to use latex as a manuscript preparation tool.
CO 2	To understand the structure of a scientific paper or document
CO 3	
CO 4	To understand the ethical issues in scientific work reporting.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	-	-	-	-	-	-	-	-	2	1	-	1
CO 2	-	-	-	-	-	-	-	1	2	3	1	1
CO 3	-	-	-	-	-	-	-	1	2	3	2	1
CO 4	-	-	-	-	-	-	-	3	2	3	1	1

UNIT-I

Learning to use latex as a text formatting tool. Installation, Book, article, report and presentation classes. Standard symbols, equations, tables and figures in latex. Bibliography management using bibtex/natbib.

UNIT-II

Why write a scientific manuscript. Structure of a manuscript: Abstract, Introduction, Materials and Methods, Results, and Discussions and its variations. Language.

UNIT-III

Guidelines for writing: Memo’s and letters, Manuals, Resume etc.

UNIT-IV

Referencing styles. Bibliometric indexes. Research ethics: Citing another publication, Plagiarism and similarity (checking tools). Journal Impact and indices of journal quality. Writing a research proposal. Ethical Dilemmas and etiquettes of scientific publication.

Textbook(s)/Reference(s):

1.Margaret Cargill and Patrick O’Connor, “Writing Scientific Research Articles”, 2nd Edition, Wiley-Blackwell, 2013.
2.S.C. Parija and V. Kate (Editors), “Writing and Publishing a Scientific Research Paper”, Springer, 2017
3. M. Jay Katz, “From Research to Manuscript,” Springer, 2009
4. P. A. Laplante, “Technical Writing: A Practical Guide for Engineers and Scientists”, CRC Press, 2012
5. G. Gratzer, “Practical Latex”, Springer, 2014

Paper Code: ICT309	**Paper: Microelectronics and VLSI Design**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper: ICT303

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Objectives:

1.	To understand device structure and properties of NMOS, PMOS and CMOS
2.	To understand static and switching characteristics CMOS inverter
3.	To design the CMOS based combinational and sequential circuits
4.	To understand the concept of hierarchy, regularity, modularity and locality

Course Outcome (CO):

CO 1	Characterize IC Technology
CO 2	Characterize Switching characteristics & inter connection effects
CO 3	Design the CMOS based combinational and sequential circuits
CO 4	Understand the concept of hierarchy, regularity, modularity and locality

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	2	-	2	1	-	2
CO 2	3	3	3	3	2	1	2	-	2	1	-	2
CO 3	3	3	3	3	2	1	2	-	2	1	-	2
CO 4	3	3	3	3	2	1	2	-	2	1	-	2

UNIT I

Introduction: Introduction to IC Technology – MOS,PMOS,NMOS,CMOS & BiCMOS. Technologies: oxidation, lithography, diffusion, ion implantation, metallization, encapsulation, probe testing, integrated resistors and capacitors. VLSI design flow, MOS transistor theory- MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, CMOS inverter- DC characteristics, static load MOS inverter, pull up/ pull down ratio, static & dynamic power dissipation, CMOS & NMOS process technology – explanation of different stages in fabrication, latch up, biCMOS circuits and their characteristics.

UNIT II

Switching characteristics & inter connection effects: Rise time, fall time delays inverter design with delay constants, parasitic effect, super buffer. Clocked CMOS logic, pass transistor logic, domino, zipper CMOS, clocking strategies, clocked system, latches & registers, system timing set-up & hold timing, signal phase memory structure, 2 phase clocking, two phase memory structure.

UNIT III

Two phase logic structure, four phase memory & logic structure, design hierarchy, concept of regularity, modularity & locality, VLSI design style, design quality, computer aided design technology, design capture and verification tools. VLSI CIRCUIT DESIGN PROCESSES: MOS layers, stick diagrams, design rules and layout, CMOS design rules for wires, contacts, and transistors layout diagrams for NMOS and CMOS inverters and Gates, scaling of MOS circuits, limitations of scaling.

UNIT IV

GATE LEVEL DESIGN: basic circuit concepts, sheet resistance Rs and its concept to MOS, area capacitance units, delays, driving large capacitive loads, wiring capacitances, Fan in and fan out, choices of layers, fan in , fan out, typical NAND, NOR, delays transistor sizing XOR, and XNOR gates, CMOS logic structures, CMOS complimentary logic, Pseudo NMOS logic. CMOS testing: CMOS testing, need for testing, test principles, design strategies for test, chiplevel test techniques, system level test techniques, layout design for improved testability.

Textbook(s):

1. Essentials of VLSI circuits and systems- Kamran Eshraghian, Dougles A. Picknell, and Sholeh Eshraghian, PHI, 2005
2. Principles of CMOS VLSI Design: A Systems Perspective –Neil H.E. West and Kamran Eshraghian, Pearson education, 1999.

References:

1. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste and David Money Harris, Addison-Wesley (Pearson), 2011
2. VLSI Design, Debaprasad Das, Oxford University Press, 2015

Paper Code: ICT 391	**Digital Signal Processing Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 301 as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 393	**Summer Training (after 4^{th} semester) Report**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**-**	**Maximum Marks:**		**100 Marks**	

Instructions :

1. The paper is evaluated in the NUES mode.
2. Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of atleast 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school, teacher of any-other educational institution with the approval of the dean of the school / training and placement officer of the school or Industry with the approval of the dean of the school / training and placement officer

Paper Code: ICT 395	**Compiler Design Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 303 as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 397	**Microelectronics and VLSI Design Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 309 as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT 392	**NSS / NCC / Cultural clubs / Technical Society / Technical club**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**-**	**Maximum Marks:**		**100 Marks**	

Instructions :

1. The paper is evaluated in the NUES mode.
2. Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1^{st} semester and the evaluation shall be conducted at the end of the 6^{th} semester. How-ever for Lateral Entry Students, the duration of work / assessment shall be from the 3^{rd} semester to the 6^{th} semester.

LIST OF COURSES / PAPERS WITH DETAILED SYLLABUS

(3rd and 4th Year – Elective Papers)

Paper Code: ICT311T	Paper: Artificial Intelligence	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts of Artificial Intelligence, including problem-solving, knowledge representation, and reasoning.
CO 2	Apply various search algorithms and heuristics to solve complex problems.
CO 3	Develop an understanding of machine learning algorithms and their role in AI applications.
CO 4	Analyze and design basic intelligent systems for real-world problems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	-	-	-	-	-	1
CO 2	3	3	3	3	3	1	1	-	-	-	-	1
CO 3	3	3	3	3	3	2	1	-	-	-	-	1
CO 4	3	3	3	3	3	2	-	-	2	-	2	-

UNIT - I

Introduction to Artificial Intelligence: Definition and goals of Artificial Intelligence, History and evolution of AI, Intelligent agents and environments, Problem-solving using AI techniques, Turing test and its significance, Ethical and societal implications of AI

UNIT - II

Problem Solving and Search Algorithms: Problem formulation and state space representation; Uninformed search algorithms: Breadth-First Search, Depth-First Search, Uniform-Cost Search; Informed search algorithms: A* Search, Best-First Search; Heuristic functions and their properties; Constraint satisfaction problems and backtracking algorithms

UNIT - III

Machine Learning and Pattern Recognition: Introduction to machine learning and its types; Supervised learning: Decision trees, Naïve Bayes, k-Nearest Neighbors; Unsupervised learning: Clustering and dimensionality reduction; Introduction to neural networks and deep learning; Feature extraction and selection; Evaluation metrics for machine learning models

UNIT - IV

Knowledge Representation and Reasoning: Propositional and first-order logic; Knowledge representation using semantic networks, frames, and ontologies; Resolution and inference in propositional logic; Bayesian networks and probabilistic reasoning; Common-sense reasoning and expert systems

Textbook(s):

1. E. Rich, K. Knight and S.B Nair, Artificial Intelligence, McGraw Hill 3rd Edition 2009.
2. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education"3rd Edition 2015.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012.

References:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems" Pearson Education 2007.
2. Richard E. Neapolitan and Xia Jiang, "Foundations of Algorithms Using C++ Pseudocode," Jones & Bartlett Learning, 2014.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning," MIT Press, 2016.

4. Patrick Henry Winston, "Artificial Intelligence," Pearson, 1992.

Paper Code: ICT 311P	**Artificial Intelligence Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 311T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT313T / ITE307T /ITE346T	**Paper: Microprocessors and Interfacing**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand 8086 Architecture and hardware description
CO 2	Understand and perform 8086 programming and development of assembly language programs
CO 3	Understand x86 and x86_64 bit processors architecture
CO 4	Understand and perform 8086 interfacing.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**

UNIT - I

Introduction to Microprocessors: Microprocessor Evolution and types, 8-bit and 16-bit microprocessors. Internal Architecture of 8086 – Register Organization, Execution unit, Bus Interface Unit, Pin Diagram and Signal Description, Physical Memory Organization, General Bus Operation, I/O addressing capabilities, Minimum mode and maximum mode timing diagrams.

UNIT - II

8086 Assembly Language Programming: 8086 addressing modes, 8086 Instruction formats, Program development steps, Constructing Machine Codes for 8086, Implementing Program Structures in 8086 assembly language, String Procedures and Macros, 8086 Instruction set descriptions and Assembler directives. 8086 interrupts and interrupt applications.

UNIT - III

Advanced Architectures: 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro, Pentium II, III and IV and Core II duo microprocessors (architecture, Memory System and Management, I/O System, Special Modes, Protected Modes, Pi-Outs, New Instructions)

UNIT - IV

8086 interfacing: Interfacing 8086 with semiconductor memory, Software Programmable Timer 8254 and its applications, Digital Interfacing, Programmable Parallel Port 8255, Interfacing to Keyboards and Alpha-Numeric Displays, 8279 Programmable Keyboard Controller. D/A Converter, A/D Converter Interfacing.

Textbook(s):

1. D.V. Hall, "Microprocessors and Interfacing", McGraw Hill Education, 3rd Edition, 2017.
2. Barry B. Brey, "The Intel Microprocessors", Pearson, 2009.

References:

1. Hayes.J.P, "Computer Architecture and Organization", Mc Graw Hill Education, 3rd Edition 2017
2. Stallings W. "Computer Organization & Architecture", 10th edition, Pearson Education,2015.
3. Y.-C. Liu and G. A. Gibson, "Microprocessor Systems: The 8086/8088family Architecture, Programming & Design", 2nd Edition, Pearson Education, 2015.

4. A. K. Ray and K M Bhurchandi, "Advanced Microprocessors and Peripherals", 3rd Edition McGraw Hill Education, 2017.

<table>
<tr><td>Paper Code: ICT 313P / ITE307T/ IEC346P</td><td colspan="3">Microprocessors and Interfacing Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 313T / ITE307T / ITE346T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT315T / ICT457T	Paper: Engineering Optimization	L	T/P	C
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Ability to solve single variable optimization problems
CO 2	Ability to solve multiple variable optimization problems
CO 3	Ability to solve constrained optimization problems
CO 4	Ability to use GA and simulated annealing technique to solve single variable optimization problems

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	-	-	-	1
CO 2	3	3	3	2	3	-	-	-	-	-	-	1
CO 3	3	3	3	2	3	-	-	-	-	-	-	1
CO 4	3	3	3	2	3	-	-	-	-	-	-	1

UNIT - I

Introduction: Problem Formulation, Examples of Optimization problem (Design and Manufacturing, Modelling, Data fitting and Regression, Control Systems, Inverse Problems, Scheduling and Routing, Data Mining, Intelligent System Design).
Single variable Optimization: Optimality Criteria, Bracketing Methods, Range Elimination Methods, Fibonacci and Golden Search Methods, Point-Estimation Method, Gradient based methods (Newton Raphson, Bisection, Secant and Cubic Search methods), Root Finding.

UNIT - II

Multivariate Optimization Algorithms: Optimality Criteria, Unidirectional Search, Direct Search Methods (Box's Evolutionary Optimization Method, Simplex search method, Hooke-Jeeves search method, Powell's conjugate direction method), Gradient Based Methods (Cauchy's, Newton's, Marquardt, Conjugate gradient and Variable Metric Method).

UNIT - III

Constrained Optimization Algorithms: Kuhn Tucker Conditions, Lagrangian Duality Theory, Transformation Methods (Penalty Function and Method of multipliers), Sensitivity analysis, Direct Search for Constrained minimization. Linearized Search Techniques, Feasible Direction Method, Quadratic Programming,
Integer programming: Penalty function method, branch and Bound Method. Geometric programming

UNIT - IV

Genetic algorithms: Working principle, Difference with traditional methods, Similarity with traditional methods, GA for constrained optimization, GA operations,.
Simulated Annealing

Textbook(s):

1. Kalyanmoy Deb, "Optimization for Engineering Design", PHI pvt ltd,2012.

References:

1. Ramteen Sioshansi and Antonio J. Conejo, "Optimization in Engineering: Models and Algorithms", Springer, 2017.

2. R. Russel Rhinehart, "Engineering Optimization: Applications, Methods and Analysis", ASME Press and Wiley, 2018.
3. Ashok D. Belegundu and Tirupati R. Chandrupatla, "Optimization Concepts and Applications in Engineering", CUP, 2019.
4. MATLAB optimization Toolbox manual.

Paper Code: ICT315P / ICT457P	**Engineering Optimization Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 315T / ICT457T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT317T	Paper: Social Network Analysis and Sentiment Analysis	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand a broad range of network concepts and theories.
CO 2	Appreciate how network analysis can contribute to increasing knowledge about diverse aspects of society
CO 3	Understand techniques of sentiment analysis
CO 4	Ability to formulate and perform sentiment analysis

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	1
CO 2	3	3	3	3	-	-	-	-	-	-	-	1
CO 3	3	3	3	3	-	-	-	-	-	-	-	1
CO 4	3	3	3	3	3	3	-	-	2	-	1	-

UNIT - I

Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily. Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks.

Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Epidemics and information cascades. Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions, Ego networks, Weak ties, Structural holes

UNIT - II

Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity. The Erdos Renyi Model, Clustering Models, Preferential Attachment.

Navigation in Networks Revisited, Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory. Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

UNIT - III

Sentiment Analysis: Levels of analysis, Sentiment Lexicon, Natural Language Processing issues, Opinion Definition, Sentiment Analysis tasks, Summarization, Types of opinion, subjectivity and emotion, author and reader standing point, sentiment classification: supervised, unsupervised, rating prediction, cross domain and cross language sentiment classification. Sentence subjectivity and sentiment classification, dealing with conditional and sarcastic sentences. Aspect based sentiment classification

UNIT - IV

Sentiment Lexicon Generation: Dictionary based, Corpus based. Opinion Summarization: Aspect based, contrastive view, and traditional summarization. Analysis of Comparative opinions, Opinion search and retrieval: Web search, Opinion search. Opinion Spam detection.

Textbook(s):

1. S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications, Cambridge University Press, 1994.
2. Bing Liu, Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, CUP, 2020

References:

1. N. Aggrawal and A. Anand, Social Networks: Modeling and Analysis. CRC Press, 2022
2. Krishna Raj P.M, Ankhit Mohan and K G Srinivasa, Practical Social Network Analysis with Python, Springer, 2018.
3. Federico Pozzi, Elisabetta Fersini, Enza, Messina, Bing Liu: Sentiment Analysis in Social Networks, Morgan Kaufmann, Elsevier, 2017.
4. Antonio Moreno, Carlos A. Iglesias, Sentiment Analysis for Social Media, MDPI, 2020

<table>
<tr><td colspan="2">Paper Code: ICT317P</td><td colspan="2">Social Network Analysis and Sentiment Analysis Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 317T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT319T	**Paper: Software Requirements and Estimation**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Prepare well-organized, and maintainable software requirements documentation that can be reviewed, corrected, and (eventually) accepted by clients and stakeholders.
CO 2	Describe and participate in requirements verification, validation, and traceability activities.
CO 3	Describe COCOMO for effort estimation and other estimation techniques .
CO 4	Implementation of Project Tracking & study of various emerging trends.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT - I

Overview of software requirements engineering

Types of requirements: functional, non-functional, etc. Importance of requirements in software development, Techniques for eliciting requirements: interviews, surveys, workshops

Requirements Analysis and Documentation

Requirements modeling techniques: use cases, user stories, data flow diagrams, Attributes of requirements: priority, stability, traceability; Effective requirement documentation, Validation and review of requirements

UNIT - II

Requirements Management

Change management and version control of requirements, Requirement traceability and impact analysis
Requirements prioritization and negotiation, Tools for requirements management

Introduction to Software Estimation

Significance of software estimation; Types of estimates: rough, detailed, comparative; Factors influencing software project estimates; Estimation techniques: expert judgment, analogy-based, parametric

UNIT - III

Estimation Methods and Techniques

Function point analysis and lines of code estimation; COCOMO (COnstructive COst MOdel) for effort estimation; Agile estimation techniques: planning poker, wideband Delphi; Uncertainty estimation using Monte Carlo simulation

Agile Estimation and Planning

Estimation in Agile methodologies; Story points, velocity, and their role in Agile estimation; Release planning and iteration planning; Challenges of estimation in dynamic environments

UNIT - IV

Project Tracking and Control

Tracking actual progress vs. estimated progress; Earned value management for cost and schedule tracking; Re-estimation and adjustments during project execution; Risk management's influence on estimation

Emerging Trends and Case Studies

Current trends in requirements engineering and estimation; Case studies of successful and failed projects; Lessons learned and best practices

Textbook(s):

1. "Software Requirements" by Karl Wiegers and Joy Beatty. Microsoft Press, 2013.
2. "Requirements Engineering for Software and Systems", Phillip A. Laplante,. CRC Press, 2018
3. "Software Estimation: Demystifying the Black Art" by Steve McConnell. Microsoft Press, 2006.

References:

1. "Requirements Engineering: Fundamentals, Principles, and Techniques" by Klaus Pohl and Chris Rupp. Springer, 2009.
2. "Agile Estimating and Planning" by Mike Cohn. Prentice Hall, 2005.
3. "Effective Requirements Practices" by Ralph R. Young. Addison-Wesley Professional, 2001.
4. "Software Engineering", K.K. Aggarwal and Yogesh Singh, New Age, 2008.
5. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman. McGraw-Hill Education, 2014.
6. "Visual Model for Software Requirements", Joy Beatty and Anthony Chen, Microsoft Press, 2012.
7. SO/IEC/IEEE 29148:2018, Systems and software engineering — Life cycle processes — Requirements engineering standard

<table>
<tr><td>Paper Code: ICT319P</td><td colspan="2">Software Requirements and Estimation Requirements Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 319T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT321	Paper: Graph Theory for Computer Science	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understanding: Students will demonstrate a solid understanding of fundamental graph theory concepts, including graph representations, terminology, and graph algorithms such as BFS, DFS, spanning trees, MST, and shortest path algorithms.
CO 2	Problem Solving: Students will be able to apply graph algorithms to solve a variety of computational problems, ranging from network optimization and pathfinding to social network analysis and recommendation systems.
CO 3	Implementation Skills: Students will gain practical programming skills by implementing graph algorithms in various contexts, enhancing their ability to analyze, design, and optimize graph-related algorithms and data structures.
CO 4	Applications: Students will be able to recognize and analyze real-world applications of graph theory in computer science, such as social networks, web analysis, compiler optimization, and machine learning, contributing to their ability to make informed decisions in problem-solving scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	-	-	-	-	2	-	2	-
CO 3	3	3	3	2	2	-	-	-	2	-	2	-
CO 4	3	3	3	2	2	-	-	-	2	-	2	-

UNIT - I

Review of Concepts and Elementary Graph Algorithms

Introduction to graph theory: Definitions of graphs, vertices, edges, and basic terminology. Types of graphs: Directed and undirected graphs, weighted and unweighted graphs. Graph representation: Adjacency matrix, adjacency list, and their trade-offs. Basic graph algorithms: Breadth-First Search (BFS) and Depth-First Search (DFS) algorithms.

Spanning trees: Definition, properties, and algorithms to find spanning trees. Minimum Spanning Trees (MST): Kruskal's and Prim's algorithms.

Shortest path algorithms: Dijkstra's algorithm and Bellman-Ford algorithm.

UNIT - II

Advanced Graph Algorithms

Graph connectivity: Strongly connected components and their algorithms. Bipartite graphs: Properties and applications. Maximum Flow and Minimum Cut: Ford-Fulkerson algorithm and Edmonds-Karp algorithm.

UNIT - III

Matching theory: Bipartite matching, augmenting paths, and applications. Network flows: Applications in transportation, communication, and assignment problems.

UNIT - IV

Special Topics in Graph Theory

Graph coloring: Chromatic number, greedy coloring, and applications in scheduling.

Planar graphs: Kuratowski's theorem, Euler's formula, and applications.

Graph isomorphism: Definition, computational complexity, and applications.
Graph Theory Applications in Computer Science

Textbook/ References:

1. "Introduction to Graph Theory" by Douglas B. West (Year: 2001)
2. "Graph Theory and Its Applications" by Jonathan L. Gross and Jay Yellen (Year: 2005)
3. "Algorithms on Trees and Graphs" by Gabriel Valiente (Year: 2002)
4. "Network Flows: Theory, Algorithms, and Applications" by Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin (Year: 1993)
5. "Graph Algorithms" by Shimon Even and Guy Even(Year: 2012)
6. "Mining Massive Datasets" by Jure Leskovec, Anand Rajaraman, and Jeffrey D. Ullman (Year: 2014) - For applications in social networks and web graph analysis.

Paper Code: ICT323T / ITE316T	**Paper: VHDL Programming**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Develop a strong understanding of VHDL syntax, concepts, and its role in digital circuit design.
CO 2	Create and simulate digital designs using VHDL, and analyze their functionality and performance.
CO 3	Utilize VHDL to model and synthesize digital circuits for implementation on programmable logic devices.
CO 4	Collaborate on group projects to design, implement, and validate complex digital systems using VHDL

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	-	-	1	1	-	2
CO 2	3	3	3	2	2	1	-	-	1	1	-	2
CO 3	3	3	3	2	2	1	-	-	1	1	-	2
CO 4	3	3	3	2	2	1	-	-	1	1	-	2

UNIT - I

Introduction to VHDL Programming

Introduction to VHDL and its significance in digital design. Overview of VHDL syntax, data types, and entities. Design hierarchy and components in VHDL. Behavioral, dataflow, and structural modeling styles in VHDL. Simulation and testing methodologies using VHDL.

UNIT - II

VHDL Design and Simulation

Writing VHDL code for combinational and sequential circuits. State machines and their modeling using VHDL. Testbench design and simulation techniques. Timing and functional simulation of VHDL designs. Debugging techniques and waveform analysis.

UNIT - III

VHDL Synthesis and Implementation

Introduction to logic synthesis and its role in digital design. Synthesizable and non-synthesizable constructs in VHDL. Synthesis optimization and coding guidelines. Implementation of VHDL designs on FPGA and CPLD platforms. Timing analysis and constraints in VHDL-based designs.

UNIT - IV

Advanced VHDL Concepts

Parameterized and generic designs in VHDL. Using VHDL libraries and packages for design reusability. Introduction to VHDL for verification and testbenches. Introduction to System-on-Chip (SoC) design using VHDL.

Textbook(s):

1. J. Bhasker, "A VHDL Primer," 3rd ed., Prentice Hall, 2008.
2. P. Ashenden, "The Designer's Guide to VHDL," 3rd ed., Morgan Kaufmann, 2008.

References:

1. E. Perry, "VHDL Programming by Example," 4th ed., McGraw-Hill Education, 2019.
2. D. Pellerin, et al., "VHDL 101: Everything you need to know to get started," Newnes, 2018.

3. IEEE Standard VHDL Language Reference Manual, IEEE Std 1076-2008, 2009.

<table>
<tr><td>Paper Code: ICT323P / ITE316P</td><td colspan="3">VHDL Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 323T / ITE 316T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT325T	**Paper: Multimedia Technologies**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of multimedia technologies, including image, audio, and video processing techniques.
CO 2	Analyze and apply different compression methods used in multimedia systems to achieve efficient storage and transmission.
CO 3	Design and implement multimedia communication systems, considering protocols and standards for seamless data exchange.
CO 4	Develop interactive multimedia applications that integrate various media types to create engaging user experiences.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	-	-	-	-	-	-	-	1
CO 3	3	3	3	2	3	-	-	-	2	-	2	-
CO 4	3	3	3	2	3	-	-	-	2	-	2	-

UNIT - I

Introduction to Multimedia Technologies: Definition and characteristics of multimedia; Components of multimedia systems: text, image, audio, video, animation; Human perception and multimedia quality metrics; Multimedia data representations and formats.

UNIT - II

Image, Audio, and Video Processing: Image acquisition and representation; Image enhancement and manipulation techniques; Audio signal processing: sampling, quantization, compression; Video signal processing: frame interpolation, motion estimation, deinterlacing;

UNIT - III

Compression Techniques in Multimedia: Lossless and lossy compression algorithms; Image compression standards: JPEG, PNG; Audio compression standards: MP3, AAC; Video compression standards: MPEG-2, H.264, HEVC

UNIT - IV

Multimedia Communication and Applications: Multimedia communication principles and protocols; Streaming media technologies; Synchronization of multimedia elements; Interactive multimedia applications: virtual reality (VR), augmented reality (AR), gamification

Textbook(s):

1. ay Vaughan, "Multimedia: Making It Work," 9th Edition, McGraw-Hill Education, 2014.
2. Ze-Nian Li, Mark S. Drew, and Jiangchuan Liu, "Fundamentals of Multimedia," 2nd Edition, Springer, 2014..

References:

1. Ralf Steinmetz and Klara Nahrstedt, "Multimedia Systems," 2nd Edition, Springer, 2004.
2. Nalini K. Ratha and Raghavendra Ramachandra, "Multimedia Image and Video Processing," CRC Press, 2017.

Paper Code: ICT325P	Multimedia technologies Lab.			L	T/P	C
Paper ID:				-	2	1
Teacher's Continuous Evaluation :		**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 325T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT327T	Paper: Telecommunication Switching and Networks	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the fundamental concepts of telecommunication switching and network architectures.
CO 2	Evaluate various telecommunication switching technologies and their applications.
CO 3	Design and configure telecommunication networks using appropriate protocols and techniques.
CO 4	Identify and troubleshoot common issues in telecommunication networks.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

Switching Fundamentals:

Introduction to telecommunication switching systems; Circuit-switching vs. packet-switching; Types of switches: crossbar, space-division, time-division, and message-switching; Signaling techniques: in-band and out-of-band signaling; Public Switched Telephone Network (PSTN) architecture; Evolution of switching technologies: from electromechanical to digital switches;

UNIT - II

Digital Switching Systems: Principles of digital switching; Time-division switching: TST, TSI, TDM, and STS; Space-division switching: SSP, Tandem switch, and concentrators; Digital Switching Network: architecture and components; ISDN (Integrated Services Digital Network) and its basic rate and primary rate interfaces

UNIT - III

Telecommunication Network Architectures: Local Exchange (LE) and End Office (EO) functionalities; Trunking and access networks; Hierarchical network architecture: access, distribution, and core layers; Introduction to mobile switching centers and cellular networks; Voice over IP (VoIP) and its integration with traditional networks;

UNIT - IV

SS7 (Signaling System 7) protocol architecture: Call setup, call processing, and call teardown procedures; Introduction to intelligent networks and services; Telecommunication network management: fault, configuration, accounting, performance, and security (FCAPS); Network security considerations and challenges in telecommunication networks

Textbook(s):

1. J.E. Flood, "Telecommunication Switching, Traffic and Networks," Pearson Education, 2012

References:

1. L. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach," Morgan Kaufmann, 2011.
2. W. Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM," Prentice Hall, 1998.

Paper Code: ICT327P		**Telecommunication Switching and Networks Lab.**	**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 327T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT329	**Paper: Optoelectronic Devices**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the working principles and operational characteristics of various optoelectronic devices.
CO 2	Design and evaluate circuits incorporating optoelectronic devices for specific applications.
CO 3	Understand the integration of optoelectronic devices with existing electronic systems.
CO 4	Explore advanced trends and emerging technologies in the field of optoelectronics.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	1	1	1	-	1	1	-	1
CO 2	3	3	3	3	1	1	1	-	1	1	-	1
CO 3	3	3	3	3	1	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

Fundamentals of Optoelectronic Devices: Introduction to optoelectronic devices; Basics of optical radiation and semiconductor physics; Principles of light generation and emission in semiconductors; Light detection and photodetection mechanisms; Energy band diagrams and charge carriers in optoelectronic devices

UNIT - II

Light Sources and Emitters

Light-emitting diodes (LEDs): operation, types, characteristics
Laser diodes: principles, threshold conditions, types
Semiconductor lasers: structures, modulation, applications
LED and laser drivers: circuit design and control

UNIT - III

Photodetectors and Sensors

Photodiodes: working principles, responsivity, noise
Phototransistors and avalanche photodiodes (APDs)
Optoelectronic sensors: proximity sensors, ambient light sensors, etc.
Signal conditioning and amplification for photodetectors

UNIT - IV

Integration and Applications

Optical communication systems: fiber-optic communication, optical transmitters and receivers
Optoelectronic integrated circuits (OEICs)
Optoelectronics in imaging and displays: CCDs, CMOS image sensors, OLEDs
Emerging trends in optoelectronics: nanophotonics, quantum dots, etc

Textbook(s):

1. J. Wilson and J.F. B. Hawkes, "Optoelectronics: An Introduction," Prentice Hall, 1987.
2. S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices," Wiley-IEEE Press, 2006.

References:

1. G. Keiser, "Optical Fiber Communications," McGraw-Hill, 2010.

2. A. Yariv and P. Yeh, "Optical Waves in Crystals: Propagation and Control of Laser Radiation," Wiley-IEEE Press, 2003.
3. E. Rosencher and B. Vinter, "Optoelectronics," Cambridge University Press, 2002.
4. B. E. A. Saleh and M. C. Teich, "Fundamentals of Photonics," Wiley, 2007.
5. G. T. Reed and A. P. Knights, "Silicon Photonics: An Introduction," Wiley, 2004.

Paper Code: ICT331T / ITE358T / ICT463T	**Paper: PCB Fabrication and IoT**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	To understand and familiarisation of Electronic Components
CO 2	To familiarise with PCB fabrication process.
CO 3	To understand the architecture with Arduino and Raspberry board
CO 4	To develop the IoT based application

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	2	2	-	-	-	-	1	-	1	-
CO 2	-	1	2	-	2	-	2	-	2	-	-	-
CO 3	-	1	2	-	2	-	2	-	2	-	-	-
CO 4		1	2	-	2	-	2	-	3	-	-	3

UNIT I

Electronic component familiarization & PCB Designing

Identification of various components being used in any electronic circuit such as resistor, capacitor, various diodes (p-n junction, Zenner, LED), transistors (BJT, MOSFET, FET), breadboard, potentiometer. Learn graphical symbols used to represent the various components. Find the value of resistance, capacitance by its color code and value mentioned on the component.

Unit II

Introduction printed circuit board production techniques: Photo printing, film- master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques

Unit III

Introduction to IoT system, Brief about IoT development board, Basics of Arduino board, IoT Entities, IoT standards, IoT application development with embedded hardware. , IoT Development Boards: Arduino IDE and Board Types, Raspberry Pi Development Kit,

Unit IV

Development of application using IoT, Data handling Technologies, Flow of data, Data acquisition, Data Storage Applications of IoT: Home Automation

Textbook(s)/References:

1. Printed circuit board design, fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006
2. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press.
3. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education.
4. Internet of Things, Vasudevan, Nagrajan and and Sundaram, Wiley India.
5. Srinivasa K G —Internet of Things‖, Cengage Learning, India 2017

Paper Code: ICT331P / ITE358P / ICT463P	PCB Fabrication and IoT		L	T/P	C
Paper ID:			-	4	2
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT331T / ITE358T / ICT463T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT312T / ITE356T	**Paper: Java Programming**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:

3. Teacher's Continuous Evaluation: 25 Marks
4. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a comprehensive understanding of Java programming language, its syntax, and object-oriented principles.
CO 2	Develop Java applications using industry-standard practices, demonstrating proficiency in handling exceptions, input-output operations, and multi-threading.
CO 3	Design and implement object-oriented solutions to programming problems, applying concepts of inheritance, polymorphism, and encapsulation.
CO 4	Utilize Java libraries and frameworks to create efficient, scalable, and well-structured software applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT - I

Introduction to Java Programming

Introduction to Java, history and advantages, Java development environment setup, basic syntax and data types, control structures (if-else, loops), functions and methods, arrays, strings.

UNIT - II

Object-Oriented Programming in Java

Classes and objects, constructors, method overloading and overriding, encapsulation, inheritance, polymorphism, abstract classes and interfaces, packages and access modifiers.

UNIT - III

Advanced Java Concepts

Exception handling, file I/O operations, multithreading and synchronization, Java collections framework (lists, sets, maps), introduction to lambda expressions, stream API.

UNIT - IV

Java Application Development

GUI programming using Swing, event handling, introduction to JavaFX, database connectivity with JDBC, introduction to networking, web application basics using Servlets and JSP.

Textbook(s):

1. Cay S. Horstmann, "Java Concepts: Late Objects", 3rd edition, Wiley, 2018.
2. Herbert Schildt, "Java: The Complete Reference", 11th edition, McGraw-Hill Education, 2018.

References:

1. Joshua Bloch, "Effective Java", 3rd edition, Addison-Wesley Professional, 2017.
2. Kathy Sierra and Bert Bates, "Head First Java", 2nd edition, O'Reilly Media, 2005.

3. Bruce Eckel, "Thinking in Java", Prentice Hall, 2006.

<table>
<tr><td>Paper Code: ICT312P / ITE356P</td><td colspan="3">Java Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 312T / ITE 356T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT314T	Paper: Systems Programming	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand System-Level Programming Concepts
CO 2	Apply Low-Level Programming Techniques:
CO 3	Design and Develop System Utilities
CO 4	Analyze and Debug System Software

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT - I

Introduction to System Programming

Introduction to system programming, role of system software, interaction with hardware and operating system, system software layers, overview of system calls, user-level vs. kernel-level operations.

UNIT - II

Memory Management and Process Control

Memory hierarchy, virtual memory concepts, paging and segmentation, memory mapping, dynamic memory allocation, process creation and termination, process synchronization and communication, signals and signal handling.

UNIT - III

File Systems and I/O Operations

File system structure, file types, file manipulation operations, file I/O interfaces, directory operations, file system implementation strategies, file permissions and access control, I/O system calls.

UNIT - IV

Advanced System Programming Techniques

Introduction to assembly language programming, inline assembly, system call implementation, debugging techniques for system software, error handling in system programming, introduction to threads and concurrency.

Textbook(s):

1. Bryant, R. E., & O'Hallaron, D. R. (2016). Computer Systems: A Programmer's Perspective. Pearson.
2. Stevens, R., Rago, W., & Fenner, B. (2013). Advanced Programming in the UNIX Environment. Addison-Wesley Professional.

References:

1. Kerrisk, M. (2010). The Linux Programming Interface: A Linux and UNIX System Programming Handbook. No Starch Press.
2. Robbins, A., & Robbins, H. (2005). UNIX Systems Programming: Communication, Concurrency, and Threads. Pearson.
3. Love, R. (2010). Linux Kernel Development. Addison-Wesley Professional.

Paper Code: ICT314P	**Systems Programming Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :		**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 314T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT316T	Paper: Introduction to Robotics Engineering	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Robotic Components: Identify and explain the key components of robotic systems, including sensors, actuators, microcontrollers, and effectors.
CO 2	Analyze Robotic Kinematics: Apply principles of kinematics to analyze the motion and positioning of robots, considering both forward and inverse kinematics.
CO 3	Program Robots: Develop programs using appropriate programming languages and tools to control robotic systems for various tasks.
CO 4	Comprehend Robot Applications: Describe real-world applications of robotics in fields such as manufacturing, healthcare, and exploration.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	1	-	2	1	-	2
CO 2	3	3	3	3	2	2	1	-	2	1	-	2
CO 3	3	3	3	3	3	2	1	-	2	1	-	2
CO 4	3	3	3	3	3	2	1	-	2	1	1	2

UNIT - I

Introduction to Robotics: Historical evolution of robotics; Types of robots and their classifications; Robotic components: sensors, actuators, microcontrollers, effectors; Robot perception and cognition

UNIT - II

Robotic Kinematics: Degrees of freedom and robot motion; Forward kinematics: homogeneous transformations; Inverse kinematics: geometrical and numerical methods; Jacobian matrix and robot velocity

UNIT - III

Robot Programming: Programming languages for robotics: Python and ROS (Robot Operating System); Robot control architectures: reactive, deliberative, hybrid; Path planning and trajectory generation; Simulation tools for robotics;

UNIT - IV

Robot Applications: Industrial robotics: automation and assembly lines; Medical robotics: surgical and rehabilitation robots; Service robotics: domestic and entertainment robots; Robotic exploration: space and underwater robots

Textbook(s):

1. Craig, J. J. (2013). Introduction to Robotics: Mechanics and Control (3rd ed.). Pearson.

References:

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2005). Robot Modeling and Control. Wiley-IEEE Press.
2. Siciliano, B., & Khatib, O. (2008). Springer Handbook of Robotics. Springer.

<table>
<tr><td colspan="2">Paper Code: ICT316P</td><td colspan="2">Introduction to Robotics Engineering Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 316T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT318T	**Paper: Network Security and Cryptography**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze network security risks and design appropriate countermeasures to mitigate them.
CO 2	Apply cryptographic techniques to ensure confidentiality, integrity, and authenticity of data in network communications.
CO 3	Evaluate the security of networked systems through vulnerability assessment and penetration testing.
CO 4	Design and implement security solutions considering ethical and legal considerations in networked environments.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	2	2	3
CO 2	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**3**	2	2	3
CO 3	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**3**	2	2	3
CO 4	**3**	**3**	**3**	**2**	**3**	**3**	**-**	**3**	**3**	2	2	3

UNIT I

Network Security Fundamentals

Introduction to network security, types of security threats, security goals (confidentiality, integrity, availability, authenticity), security services (authentication, authorization, non-repudiation), security mechanisms (firewalls, intrusion detection/prevention systems), security policies and models.

UNIT II

Cryptographic Techniques

Classical cryptography (substitution, transposition), modern cryptography, symmetric encryption algorithms (DES, AES), asymmetric encryption algorithms (RSA, ECC), cryptographic hashes, digital signatures, key management, public key infrastructure (PKI), secure key exchange protocols.

UNIT III

Network Protocols and Security

Secure socket layer (SSL) and transport layer security (TLS), virtual private networks (VPNs), secure email protocols (PGP, S/MIME), secure file transfer protocols (SFTP, SCP), network security in wireless communication (WEP, WPA, WPA2, WPA3), network security in IoT devices.

UNIT IV

Network Security Implementation and Practices

Security assessment methodologies, penetration testing, vulnerability scanning, security best practices for operating systems and applications, security in cloud computing environments, legal and ethical considerations in network security, incident response and recovery.

Textbook(s):

1, William Stallings, "Cryptography and Network Security: Principles and Practice," Pearson, 2017.
2. Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing," Pearson, 2015.

References:

1. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C," Wiley, 1995.
2. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Cengage Learning, 2018.
3. Nist Special Publication 800-53, "Security and Privacy Controls for Federal Information Systems and Organizations," National Institute of Standards and Technology, 2020.

Paper Code: ICT318P	**Network Security and Cryptography Lab.**	**L**	**T/P**	**C**
Paper ID:		**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**	**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 318T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT320T	Paper: Visual Basic.Net Programming	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Design and develop Windows applications using Visual Basic .NET, incorporating graphical user interfaces and interactive controls.
CO 2	Implement data handling and manipulation techniques using Visual Basic .NET, including interactions with databases and data-driven application development.
CO 3	Apply object-oriented programming principles in Visual Basic .NET, fostering code modularity, reusability, and maintainability.
CO 4	Debug, test, and deploy Visual Basic .NET applications, demonstrating proficiency in troubleshooting and optimizing code for efficiency.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to Visual Basic .NET

Introduction to Visual Basic .NET, IDE overview, creating a new project, project structure, variables and data types, control structures (selection and iteration), procedures and functions, error handling.

UNIT II

Graphical User Interface Development

Windows Forms applications, designing forms using drag-and-drop tools, working with controls (buttons, labels, textboxes, etc.), event-driven programming, handling user input, creating menus and toolbars, dialog boxes.

UNIT III

Data Handling and Database Interaction

Working with data types and variables, arrays and collections, file I/O operations, ADO.NET architecture, connecting to databases, querying and manipulating data using SQL, integrating data into applications.

UNIT IV

Object-Oriented Programming in Visual Basic .NET

Introduction to object-oriented programming (OOP), classes and objects, encapsulation, inheritance, polymorphism, creating and using classes in Visual Basic .NET, designing reusable components.

Textbook(s):

1. Deitel, P., Deitel, H., & Liperi, T. (2019). Visual Basic 2017 for Programmers. Pearson.

References:

1. Albahari, J., & Albahari, B. (2017). C# 7.0 in a Nutshell: The Definitive Reference. O'Reilly Media.
2. Liberty, J., & MacDonald, B. (2015). Learning Visual Basic .NET. O'Reilly Media.
3. Microsoft Docs. (URL: https://docs.microsoft.com/en-us/dotnet/visual-basic/)

<table>
<tr><td>Paper Code: ICT320P</td><td colspan="2">Visual Basic.Net Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 320T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT322	**Paper: Quantum Computing**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the fundamental principles of quantum computing and contrast them with classical computing concepts.
CO 2	Develop and implement quantum algorithms for solving specific problems, demonstrating proficiency in quantum programming techniques.
CO 3	Evaluate the potential advantages and limitations of quantum computing applications in diverse domains.
CO 4	Synthesize insights from quantum computing and its implications into broader discussions on the future of computing technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO 2	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**
CO 3	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**
CO 4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**

UNIT I

Introduction to Quantum Computing:

Overview of quantum mechanics principles relevant to quantum computing. Classical vs. quantum bits (qubits) and their properties. Quantum gates and quantum circuits: similarities and differences with classical logic gates. Quantum entanglement and its significance in quantum information processing. Quantum parallelism and its implications for computational speedup.

UNIT II

Quantum Algorithms and Programming:

Deutsch-Jozsa algorithm: solving the Deutsch problem with quantum parallelism. Grover's algorithm: unstructured search problem and its quantum solution. Shor's algorithm: integer factorization using quantum period finding. Quantum programming languages: Qiskit, Cirq, and their syntax. Implementation of basic quantum algorithms on quantum simulators and actual quantum hardware.

UNIT III

Quantum Computing Applications:

Quantum simulation: simulating quantum systems efficiently using quantum computers. Optimization problems and the Quantum Approximate Optimization Algorithm (QAOA). Quantum cryptography: quantum key distribution and secure communication. Quantum machine learning: applications of quantum computing in enhancing machine learning algorithms. Case studies of real-world problems and their potential quantum computing solutions.

UNIT IV

Implications and Future of Quantum Computing:

Quantum supremacy and its significance in the advancement of quantum computing. Quantum error correction: challenges and strategies for maintaining quantum coherence. Ethical and societal implications of quantum computing: cryptography, privacy, and security concerns. Comparison of quantum computing with classical computing in terms of capabilities and limitations. Speculative discussion on the future of quantum computing and its potential impact on various industries.

Textbook:

1. Kaye, P., Laflamme, R., & Mosca, M. (2007). An Introduction to Quantum Computing. Oxford University Press.

References:

1. Nielsen, M. A., & Chuang, I. L. (2010). Quantum Computation and Quantum Information. Cambridge University Press.
2. Preskill, J. (2018). Quantum computing in the NISQ era and beyond. Quantum, 2, 79.

Paper Code: ICT324T	Paper: Natural Language Processing	L	T/P	C
Paper ID:		3	0	3
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
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4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts and techniques in Natural Language Processing.
CO 2	Implement and evaluate various NLP algorithms and models.
CO 3	Apply NLP techniques to solve real-world language processing problems.
CO 4	Critically analyze ethical and societal implications related to NLP technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	1
CO 2	3	3	3	3	3	-	-	-	2	-	2	1
CO 3	3	3	3	3	3	-	-	-	-	-	-	1
CO 4	3	3	3	3	3	-	-	-	-	-	-	1

UNIT I

Introduction to NLP: Overview of NLP and its applications; Challenges and complexities in language processing; Linguistic essentials for NLP; Text preprocessing: Tokenization, stemming, and lemmatization;

UNIT II

NLP Algorithms and Models: Language modeling: N-grams, probabilistic models; Part-of-speech tagging and syntactic parsing; Named Entity Recognition (NER) and Coreference resolution; Word embeddings: Word2Vec, GloVe; Sentiment analysis and text classification; Sequence-to-sequence models and machine translation;

UNIT III

Advanced NLP Techniques: Dependency parsing and constituency parsing; Advanced word embeddings: FastText, contextual embeddings (BERT, GPT); Information extraction and relation extraction ; Text summarization techniques; Speech recognition and synthesis basics;

UNIT IV

NLP Applications and Ethics: Question answering systems; Dialogue systems and chatbots; NLP for social media analysis; NLP in healthcare and biomedical text mining; Bias and fairness considerations in NLP; Ethical considerations and societal impact of NLP technologies

Textbooks:

1. Dan Jurafsky and James H. Martin, "Speech and Language Processing," Pearson Education, 2020.
2. Jacob Eisenstein, "Natural Language Processing," MIT Press, 2019.

References:

1. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, "Introduction to Information Retrieval," Cambridge University Press, 2008.
2. Yoav Goldberg, "Neural Network Methods in Natural Language Processing," Synthesis Lectures on Human Language Technologies, 2017.

3. Ian H. Witten, Eibe Frank, and Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques," Morgan Kaufmann, 2016.
4. Emily M. Bender, "Linguistic Fundamentals for Natural Language Processing: 100 Essentials from Morphology and Syntax," Morgan & Claypool, 2021.
5. Tim Rocktäschel and Sebastian Riedel, "Neural Approaches to Conversational AI: Question Answering, Task-Oriented Dialogue, and Chatbots," Morgan & Claypool, 2020.

Paper Code: ICT324P	**Natural Language Processing Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 324T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT326T	Paper: Object Technology and UML	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
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4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts and techniques in Natural Language Processing.
CO 2	Implement and evaluate various NLP algorithms and models.
CO 3	Apply NLP techniques to solve real-world language processing problems.
CO 4	Critically analyze ethical and societal implications related to NLP technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to Object-Oriented Principles and UML

Evolution of object-oriented concepts, Importance of modeling in software development, Introduction to UML and its history, Overview of UML diagrams and their categories.

UNIT II

Object-Oriented Analysis and Design

Requirements gathering and analysis using use case diagrams, Identifying and modeling classes, associations, and aggregations using class diagrams, Modeling object interactions and behavior with sequence diagrams.

UNIT III

Advanced UML Diagrams

Representing system structure through package diagrams and component diagrams, Modeling static relationships with deployment diagrams, Capturing state transitions and dynamic behavior using state machine diagrams, Visualizing collaborations and interactions using communication diagrams.

UNIT IV

Software Architecture and Design Patterns

Understanding architectural patterns (MVC, layered architecture), Applying design patterns (creational, structural, behavioral) in UML, Creating interaction overview diagrams to illustrate high-level interactions.

Textbooks:

1. Larman, C. (2004). Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development. Pearson Education.
2. Fowler, M., & Scott, K. (2003). UML Distilled: A Brief Guide to the Standard Object Modeling Language. Addison-Wesley Professional.

References:

Booch, G., Rumbaugh, J., & Jacobson, I. (2005). The Unified Modeling Language User Guide. Pearson.
Ambler, S. W. (2012). The Object Primer: Agile Model-Driven Development with UML 2.0. Cambridge University Press.
Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1994). Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley Professional.

Paper Code: ICT324P	**Object Technology and UML Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 326T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT328T	**Paper: Design Patterns**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Design Patterns: Demonstrate a clear understanding of various design patterns, their purpose, and how they address common software design problems.
CO 2	Apply Design Patterns: Apply different design patterns to design and implement robust software solutions that exhibit enhanced modularity, extensibility, and reusability.
CO 3	Evaluate Design Choices: Evaluate design alternatives and make informed decisions about which design pattern to use based on the specific requirements of a given software project.
CO 4	Analyze Real-world Scenarios: Analyze and adapt design patterns from real-world software systems, recognizing the applicability and limitations of each pattern.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	3	-	1	-	2	-	2	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-
CO 4	3	3	3	2	3	1	-	-	-	-	-	1

UNIT I
Creational Design Patterns: Singleton pattern, Factory method pattern, Abstract factory pattern, Builder pattern, Prototype pattern.
UNIT II
Structural Design Patterns: Adapter pattern, Bridge pattern, Composite pattern, Decorator pattern, Facade pattern, Flyweight pattern, Proxy pattern.
UNIT III
Behavioral Design Patterns: Chain of Responsibility pattern, Command pattern, Interpreter pattern, Iterator pattern, Mediator pattern, Memento pattern, Observer pattern, State pattern, Strategy pattern, Template Method pattern, Visitor pattern.
UNIT IV
Design Patterns in Practice: Applying design patterns to real-world case studies, Architectural patterns (MVC, MVVM), Anti-patterns and refactoring using design patterns, Design patterns for concurrent and parallel programming.

Textbooks:
1. E. Gamma, R. Helm, R. Johnson, and J. Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software," Addison-Wesley, 1994.
E. Freeman, E. Robson, B. Bates, and K. Sierra, "Head First Design Patterns," O'Reilly Media, 2004.
References:
1. S. Shalloway and J. R. Trott, "Design Patterns Explained: A New Perspective on Object-Oriented Design," Addison-Wesley, 2001.
2. A. Holzner, "Complete Reference to Design Patterns," McGraw-Hill Education, 2003.

<table>
<tr><td>Paper Code: ICT328P</td><td colspan="3">Design Patterns Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 328T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT330T	**Paper: Data Warehousing and Data Minimg**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of data warehousing and data mining.
CO 2	Design and implement data warehouses to efficiently store and manage large datasets.
CO 3	Apply various data mining techniques to extract meaningful patterns and insights from data.
CO 4	Evaluate the ethical and social implications of data warehousing and data mining practices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Data Warehousing and Data Mining

Introduction to data warehousing, Characteristics of data warehouses, Data warehouse architecture, Data warehouse vs. operational databases, Introduction to data mining, Data mining process, Data preprocessing techniques.

UNIT II

Data Warehouse Design and Implementation

Dimensional modeling, Fact and dimension tables, Star and snowflake schemas, ETL (Extract, Transform, Load) process, Data quality and cleansing, Metadata management, Tools for data warehousing.

UNIT III

Data Mining Techniques

Classification and prediction, Clustering analysis, Association rule mining, Outlier detection, Text mining, Time series analysis, Evaluation of data mining results.

UNIT IV

Ethical and Social Considerations

Privacy and security issues in data mining, Bias and fairness in data mining, Ethical guidelines for data mining, Social implications of data mining, Case studies.

Textbook:

1. Han, J., Kamber, M., & Pei, J. (2011). Data Mining: Concepts and Techniques. Morgan Kaufmann.

References:

1. Inmon, W. H., & Linstedt, D. (2015). Data Architecture: A Primer for the Data Scientist. Morgan Kaufmann.
2. Aggarwal, C. C. (2015). Data Mining: The Textbook. Springer.
3. Tan, P. N., Steinbach, M., & Kumar, V. (2013). Introduction to Data Mining. Pearson.

<table>
<tr><td colspan="2">Paper Code: ICT330P</td><td colspan="2">Datawarehousing and Data Mining Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td colspan="2">40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 330T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT332	Paper: Computational Geometry	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and model geometric problems using appropriate data structures and algorithms.
CO 2	Apply computational geometry techniques to solve problems in computer graphics, robotics, and other relevant domains.
CO 3	Implement and evaluate algorithms for geometric problems, demonstrating proficiency in coding and problem-solving.
CO 4	Critically assess and adapt existing geometric algorithms to solve novel problems, fostering creativity and innovation.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	-	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	2	-	-	-	-	3	2	2	3
CO 4	3	3	2	2	-	-	-	-	3	2	2	3

UNIT I

Geometric Primitives and Convex Hulls: Introduction to computational geometry and its applications. Basic geometric primitives: points, lines, segments, and polygons. Geometric transformations and operations. Convex hull: definition, properties, and algorithms (Graham scan, Jarvis march, Divide and Conquer). Applications of convex hulls in pattern recognition and optimization.

UNIT II

Line Segment Intersection and Voronoi Diagrams: Line segment intersection problem and its significance. Sweepline algorithm for line segment intersection. Voronoi diagrams: concepts, construction algorithms, and applications. Delaunay triangulations and their relationship with Voronoi diagrams. Applications of Voronoi diagrams in nearest neighbor search and mesh generation.

UNIT III

Range Searching and Geometric Data Structures: Range searching techniques: 1D range queries, 2D range queries. Quad trees and kd-trees: construction, query operations, and analysis. Binary space partitioning trees and their applications. Intersection searching using segment trees. Applications of range searching in GIS, collision detection, and image processing.

UNIT IV

Arrangements and Geometric Intersection Problems: Planar arrangements of curves: definitions and properties. Algorithmic techniques for constructing planar arrangements. Geometric intersection problems: line segment intersection, point location, ray shooting. Bentley-Ottmann algorithm for line segment intersection. Applications of arrangements in computer-aided design and visibility computations.

Textbooks:

1. Berg, M., Cheong, O., Kreveld, M., & Overmars, M. (2008). Computational Geometry: Algorithms and Applications (3rd ed.). Springer.
2. de Berg, M., van Kreveld, M., Overmars, M., & Schwarzkopf, O. (2000). Computational Geometry: Algorithms and Applications (2nd ed.). Springer.

References:

1. O'Rourke, J. (1998). Computational Geometry in C (2nd ed.). Cambridge University Press.
2. Shamos, M. I., & Preparata, F. P. (1985). Computational Geometry: An Introduction. Springer.
3. Moller, M., & Hoff, K. E. (1997). Robust Intersection Testing Using Interval Arithmetic and CORDIC. ACM Transactions on Graphics (TOG), 16(1), 17-28.

Paper Code: ICT334T	**Paper: Introduction to Mobile Ad Hoc Networks**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and characteristics of Mobile Ad Hoc Networks (MANETs) and differentiate them from traditional computer networks.
CO 2	Analyze various routing protocols and algorithms used in MANETs, and make informed decisions on their application based on network scenarios.
CO 3	Evaluate the security challenges and solutions in MANETs, and propose strategies to enhance the security of these networks.
CO 4	Design and simulate simple MANET scenarios, applying appropriate routing protocols and taking into account performance metrics for effective network management.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	2	-	-	-	3	2	2	3
CO 2	3	3	3	2	2	-	-	-	3	2	2	3
CO 3	3	3	3	2	2	-	-	-	3	2	2	3
CO 4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT I

Introduction to MANETs: Definition and characteristics of MANETs, advantages and challenges, classification based on network infrastructure, comparison with infrastructure-based networks.

UNIT II

Routing Protocols in MANETs: Proactive, reactive, and hybrid routing protocols, including DSDV, AODV, DSR, and OLSR; comparison of protocols, route discovery and maintenance, concept of multi-path routing.

UNIT III

Security in MANETs: Threats and vulnerabilities in MANETs, authentication and key management, secure routing, intrusion detection systems, securing communication in the presence of malicious nodes.

UNIT IV

Performance Evaluation and Simulation: Performance metrics in MANETs, packet delivery ratio, throughput, end-to-end delay; simulation tools (e.g., NS-2/NS-3), simulation of MANET scenarios, analyzing simulation results.

Textbooks:

1. C. E. Perkins and P. Bhagwat, "Ad Hoc Networking," Addison-Wesley, 2001.
2. S. Basagni, M. Conti, S. Giordano, and I. Stojmenovic, "Mobile Ad Hoc Networking," John Wiley & Sons, 2004.

References:

1. J. Macker and S. Corson, "Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations," RFC 2501, 1999.
2. I. Stojmenovic, "Handbook of Wireless Networks and Mobile Computing," John Wiley & Sons, 2002.
3. R. C. Shah, "Wireless Ad hoc and Sensor Networks: Protocols, Performance, and Control," CRC Press, 2007.
4. K. Ren and J. Zhou, "Security in Mobile Ad Hoc Networks: Challenges and Solutions," IEEE Wireless Communications, 2010, 17(2), 10-22.

<table>
<tr><td>Paper Code: ICT334P</td><td colspan="3">Introduction to Mobile Ad Hoc Networks Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 334T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT336T	Paper: Introduction to Information and Communication Theory	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts of information theory and its relevance to data compression and storage.
CO 2	Grasp the principles of communication theory, including modulation techniques and channel capacity.
CO 3	Analyze and design basic communication systems, considering noise, coding, and error correction.
CO 4	Apply their knowledge to evaluate and optimize information transmission in digital communication networks.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Information Theory: Introduction to information theory, entropy and information content, entropy of discrete and continuous random variables, entropy properties, data compression techniques (Huffman coding, arithmetic coding), source coding theorem, Shannon-Fano coding.

UNIT II

Communication Theory: Basics of communication systems, amplitude and frequency modulation, demodulation techniques, signal-to-noise ratio, channel capacity, Nyquist theorem, Shannon's theorem, error detection and correction codes, Hamming codes, convolutional codes.

UNIT III

Digital Communication Systems: Digital modulation techniques (ASK, PSK, FSK, QAM), bit and symbol error rates, spread spectrum modulation, multiple access techniques (TDMA, FDMA, CDMA), introduction to cellular networks, basics of information routing in networks.

UNIT IV

Information Theory in Networking: Introduction to network information theory, entropy rate, data compression for network data, network coding principles, information flow in networks, capacity of networks, introduction to information-centric networking.

Textbooks:

1. T. M. Cover and J. A. Thomas, "Elements of Information Theory," 2nd edition, Wiley, 2006.
2. S. Haykin, "Communication Systems," 5th edition, Wiley, 2013.
3. A. Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

References:
1. R. G. Gallager, "Information Theory and Reliable Communication," Wiley, 1968.
2. B. Sklar, "Digital Communications: Fundamentals and Applications," 2nd edition, Pearson Education, 2001.
3. S. Verdu, "Multiuser Detection," Cambridge University Press, 1998.
4. J. G. Proakis and M. Salehi, "Digital Communications," 5th edition, McGraw-Hill, 2007.
5. I. W. Sandberg, "Digital Communication Systems: Principles and Design," Prentice Hall, 1994.

<table>
<tr><td>Paper Code: ICT336P</td><td colspan="3">Introduction to Information and Communication Theory Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 336T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT338T	Paper: Database Modelling and Design	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze complex real-world scenarios and translate them into comprehensive data models.
CO 2	Apply advanced normalization techniques and understand their impact on database performance and design.
CO 3	Design and evaluate database schemas that adhere to industry best practices and optimize query performance.
CO 4	Incorporate practical considerations, such as security and scalability, into the database design process.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I

Fundamentals of Database Modelling

Entity-Relationship (ER) modeling, Enhanced Entity-Relationship (EER) modeling, attributes, relationships, keys, roles, constraints, weak entities, aggregation, review of normalization concepts.

UNI II

Advanced Data Modelling Techniques

Subtypes and supertypes, specialization and generalization hierarchies, modeling of time-dependent data, handling of large and complex datasets, data modeling for NoSQL databases, denormalization strategies.

UNIT III

Schema Design and Optimization

Topics: Functional dependencies, multi-valued dependencies, join dependencies, Boyce-Codd Normal Form (BCNF), Fourth Normal Form (4NF), Fifth Normal Form (5NF), schema refinement, schema integration, data redundancy reduction, trade-offs between normalization and query performance.

UNIT IV

Practical Considerations in Database Design

Security considerations in database design, access control and authorization, data privacy, scalability and performance optimization, indexing strategies, query optimization, physical database design, versioning and migration of database schemas, data archiving and purging.

Textbooks:

1. Hoffer, J. A., Topi, H., & Ramesh, V. (2020). Modern Database Management. Pearson.
2. Elmasri, R., & Navathe, S. B. (2019). Fundamentals of Database Systems. Pearson.

References:

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). Database System Concepts. McGraw-Hill Education.
2. Date, C. J. (2003). An Introduction to Database Systems. Addison-Wesley.

Paper Code: ICT338P	**Database Modelling and Design Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 384T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT340T / ITE457T	**Paper: Analog and Digital Communication**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of analog and digital communication systems.
CO 2	Analyze and design various modulation techniques for efficient information transmission.
CO 3	Differentiate between analog and digital communication systems, evaluating their respective advantages and limitations.
CO 4	Apply their knowledge to real-world communication system scenarios, demonstrating proficiency in troubleshooting and optimization.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**3**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**3**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**3**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**3**

UNIT I

Introduction to Communication Systems: Overview of communication systems, signal types, analog vs. digital communication, communication channel impairments, noise sources and types, measures of signal quality.

UNIT II

Analog Communication Systems: Amplitude modulation (AM), frequency modulation (FM), phase modulation (PM), demodulation techniques, AM and FM signal analysis, analog modulation schemes, analog-to-digital conversion.

UNIT III

Digital Communication Systems: Pulse modulation techniques (PAM, PWM, PPM), digital modulation techniques (ASK, FSK, PSK, QAM), line coding techniques, error detection and correction, digital modulation analysis, spread spectrum modulation.

UNIT IV

Communication System Performance and Emerging Technologies: Signal-to-noise ratio (SNR), bit error rate (BER), channel capacity, trade-off between bandwidth and power efficiency, multiple access techniques (TDMA, FDMA, CDMA), introduction to emerging communication technologies.

Textbooks:

1. Simon Haykin and Michael Moher, "An Introduction to Analog and Digital Communications," Wiley, 2nd edition, 2006.
2. John G. Proakis and Masoud Salehi, "Digital Communications," McGraw-Hill Education, 5th edition, 2007.

References:

1. Andreas F. Molisch, "Wireless Communications," Wiley, 2nd edition, 2011.
2. Bruce A. Carlson and Paul B. Crilly, "Communication Systems: An Introduction to Signals and Noise in Electrical Communication," McGraw-Hill, 4th edition, 2001.
3. John M. Wozencraft and Irwin Mark Jacobs, "Principles of Communication Engineering," Wiley, 1st edition, 1965.

4. Taub, H., & Schilling, D. L., "Principles of Communication Systems," McGraw-Hill, 3rd edition, 1986.

<table>
<tr><td>Paper Code: ICT340P / ITE457P</td><td colspan="3">Analog and Digital Communication Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="3">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 340T / ITE 357T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT344	**Paper: Random Processes and Stochastic Systems**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and characterize different types of random processes and their statistical properties.
CO 2	Apply random processes to model and analyze real-world stochastic systems in electronics engineering.
CO 3	Design and evaluate systems that involve randomness, making informed decisions based on probabilistic analysis.
CO 4	Interpret and communicate complex concepts related to random processes and stochastic systems to peers and professionals.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**-**	**2**	**1**	**-**	**1**
CO 2	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**-**	**2**	**1**	**-**	**1**
CO 3	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**-**	**2**	**1**	**-**	**1**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**1**

UNIT I

Introduction to Random Processes and Probability Concepts: Introduction to random processes, probability spaces, random variables, cumulative distribution function (CDF), probability density function (PDF), moments and moment-generating functions, conditional probability and independence.

UNIT II

Discrete and Continuous Random Processes: Definition and properties of discrete and continuous random processes, Bernoulli, Poisson, and Gaussian processes, stationarity, autocorrelation and cross-correlation functions, power spectral density, ergodicity.

UNIT III

Markov Processes and Applications: Markov chains, transition probability matrix, classification of states, steady-state analysis, first-order and second-order Markov processes, applications of Markov processes in communication systems and queuing theory.

UNIT IV

Stochastic Processes in Signal Processing and Communication: Random signals, autocorrelation and cross-correlation functions of random signals, white noise, matched filter, signal-to-noise ratio (SNR), applications of stochastic processes in modulation, demodulation, and error analysis.

Textbooks:

1. Papoulis, A., & Pillai, S. U. (2002). Probability, Random Variables and Stochastic Processes. McGraw-Hill Education. (ISBN: 978-0071226615)
2. Stark, H., & Woods, J. W. (1994). Probability and Random Processes with Applications to Signal Processing. Pearson.

References:

1. Ross, S. M. (2006). Stochastic Processes (2nd ed.). John Wiley & Sons.
2. Grimmett, G., & Stirzaker, D. (2001). Probability and Random Processes (3rd ed.). Oxford University Press.

3. Proakis, J. G., & Salehi, M. (2007). Fundamentals of Communication Systems (2nd ed.). Prentice Hall.
4. Gallager, R. G. (1996). Principles of Digital Communication. Cambridge University Press.

Paper Code: ICT 346T	**Paper: Antenna Design and Radiating Systems**	**L**	**T/P**	**C**
Paper ID:		**4**	**-**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

1.	Ability to understand fundamentals and working principle of the antennas.
2.	Ability to explore the different dipole antenna and array.
3.	Ability to Evaluate about wire and other antennas.
4.	Ability to design and implementation of microstrip antennas, and antenna measurement

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO01	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO02	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**3**
CO03	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**-**	**3**
CO04	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**-**	**3**

UNIT - I

Review of electromagnetic theory, Antenna and their different types, Radiation Mechanism and Current Distribution, Fundamental Parameters related to antenna (Radiation Pattern, Radiation Power Density, Directivity, Gain, Beam width, Antenna Efficiency, Bandwidth, Polarization, Radiation Efficiency, Antenna Factor) Radiation Integrals, Auxiliary Potential Functions and Construction of Solution, Solution of the inhomogeneous vector Potential Wave Equation, Far Field Radiation

UNIT - II

Infinitesimal dipole, Small Dipole, Finite length and Half-Wavelength Dipole – Analysis using assumed current Distribution Small Circular loop, Circular Loop with constant current, Two Element Array N-Element Linear Array with uniform amplitude and spacing, Broadside and End-Fire Array, N-Element Linear Array: Three Dimensional Characteristic

UNIT - III

Long Wire – Designing, V and Rhombic Antenna – Designing, Helical Antenna – Designing of normal and axial mode, Rectangular apertures with different configurations- --With analysis Circular Apertures, E-Plane Sectoral Horn – Analysis and Design, H-Plane Sectoral Horn – Analysis and Design Pyramidal Horn

UNIT-IV

Basic of Microstrip Antenna, Designing of Rectangular Microstrip Antenna, Antenna Ranges, Gain Measurement, Radiation Pattern Measurement, Anechoic Chamber

Textbook(s):
1. Antenna Theory Analysis and Design by C. A. Balanis , 3rd Edition Wiley Publication.
2. Antennas: For All Applications - Kraus, John D &, Ronald J Marhefka - Tata McGraw Hill, 3rd

Edition,

References:

1. Electromagnetic Waves and Radiating Systems by Jordan and Balmain, Prentice Hall, 2ndEdition.
2. Antenna Theory and Design by W. L. Stutzman and G. A. Thiele, Wiley Publication
3. Antenna Theory and Design by R. S. Elliot, Revised Edition, Wiley Publication (IEEE Press).

Paper Code: ICT346P	**Antenna Design and Radiating Systems Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 346T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.						

Paper Code: ICT348T	Paper: Optical Communication and Networks	L	T/P	C
Paper ID:		4	-	4

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

1.	Ability to understand basics of optical fiber communication
2.	Ability to explore the Signal distortion in optical fibers and Nonlinear Scattering losses.
3.	Ability to Evaluate about optical sources
4.	Ability to understand about Optical amplifiers

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO01	3	3	3	3	1	1	1	-	1	1	-	2
CO02	3	3	3	3	1	1	1	-	1	1	-	2
CO03	3	3	3	3	1	1	1	-	2	1	-	2
CO04	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

Overview of optical fiber communication: The general system, Advantages of optical fiber communication. Optical spectral band, Optical Fiber waveguides: Introduction, Ray theory transmission Total internal reflection, acceptance angle, numerical aperture, skew rays. Electromagnetic mode theory for optical propagation: Electromagnetic waves, modes in a planar guide, phase and group velocity, phase shift with total internal reflection and the evanescent field, goos hanchen shift. Cylindrical Fiber: modes, mode coupling, step index fibers Graded index fibers, Single mode Fiber: Cut-off wavelength, Mode field diameter and spot size, effective refractive index, Group delay and mode delay factor, The Gaussian approximation, equivalent step index methods.

UNIT - II

Signal distortion in optical fibers - Attenuation, Material Absorption, losses in silica glass fibers; Intrinsic absorption, Extrinsic absorption. Linear scattering losses; Ray light scattering, Mie scattering. Non linear Scattering losses: fiber bending losses; Dispersion, Chromatic dispersion: material dispersion, waveguide dispersion. Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber. Overall fiber dispersion Multimode fiber, Dispersion modified single mode fibers ,Dispersion–shifted fiber, dispersion flatted fibers, nonzero-dispersion- shifted fibers (MZ-DSF), Polarization: Fiber birefringence, polarization mode dispersion, polarization- maintaining fibers.

UNIT - III

Optical sources - Light Emitting Diodes (LEDs): Structures, light source materials, Quantum Efficiency on LED Power Modulation of a LED, Laser Diodes- models and threshold conditions, laser diode rate equations, External quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines. Source to fiber power launching, Source Output patterns, Power coupling calculation, Power launching versus wavelength, equilibrium numerical aperture. Photo detectors: Physical principles of photodiodes: The PIN photo detector, Avalanche photodiodes. Photo detector Noise: Noise sources, signal to noise ratio.

UNIT - IV

Optical amplifiers, EDFA, Raman Amplifier, Amplifier gain, WDM and DWDM systems. Principles of WDM networks., Optical TDM, Subscriber multiplexing, OCDMA Nonlinear effects in fiber optical fiber, soliton.

Textbook(s):

1. John M. Senior, "Optical Fiber Communications", PEARSON, 3rd Edition
2. Gerd Keiser, "Optical Fiber Communications", TMH

References:

1. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley
2. Joseph C. Plais, "Fiber Optic Communication", Pearson Education
3.Gowar J., optical communication systems, PHI.
4.Fiber Optic Communication Systems by Mynbev, Pearson

<table>
<tr><td>Paper Code: ICT348P</td><td colspan="3">Optical Communication Systems and Networks Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 348T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT 350T	Paper: Embedded Systems	L	T/P	C
Paper ID:164		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective,single line answers or short answer type questions of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub- parts/sub-questions. Each unit will have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/levelof questions to asked should be at the level of the prescribed textbook.
5. The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

1.	Ability to understand ARM Architecture and Programming
2.	Ability to use the understand Models of Embedded Systems
3.	Ability to use Process Management in Embedded Systems
4.	Ability to implement Embedded Real-Time Operating System

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO01	3	3	3	3	2	1	1	-	2	1	-	2
CO02	3	3	3	3	2	1	1	-	2	1	-	2
CO03	3	3	3	3	2	1	1	-	2	1	-	2
CO04	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

ARM Architecture and Programming : ARM Processor Modes , ARM CPU Registers , Instruction Pipeline . ARM Instructions , ARM System Emulators , ARM Programming, Interrupts and Exceptions Processing : ARM Exceptions , Interrupts and Interrupts Processing , Timer Driver , Keyboard Driver , UART Driver, Vectored Interrupts ,Nested Interrupts.

UNIT – II

Models of Embedded Systems : Program Structures of Embedded Systems , Super-Loop Model ,Event-Driven Model , Event Priorities , Process Models , Uniprocessor (UP) Kernel Model , Uniprocessor (UP) Operating System Model , Multiprocessor (MP) System Model , Real-Time (RT) System Model , Design Methodology of Embedded System Software.

UNIT – III

Process Management in Embedded Systems: Multitasking , The Process Concept , Multitasking and Context Switch , Dynamic Processes , Process Scheduling , Process Synchronization , Event-Driven Embedded Systems Using Sleep/Wakeup , Resource Management Using Sleep/Wakeup , Semaphores , Applications of Semaphores , Other Synchronization Mechanisms , Process Communication , Uniprocessor (UP) Embedded System Kernel,Memory Management in ARM .

UNIT – IV

General Purpose Operating Systems , Embedded General Purpose Operating Systems, Organization of EOS , Memory Management in EOS , Exception and Signal Processing, Signal Processing in EOS , Process Scheduling in EOS , Timer Service in EOS , File System , User Interface. Multiprocessing in Embedded Systems , Multiprocessing , ARM MPcore Processors, Embedded Real-Time Operating System, Concepts of RTOS , Task Scheduling in RTOS ,Survey of RTOS, Design Principles of RTOS.

Textbook(s):
1. K.C. Wang, Embedded and Real-Time Operating Systems, Springer International Publishing

References:
1. Dhananjay V. Gadre, Programming and Customizing the AVR Microcontroller, McGraw-Hill
2. A. Sloss, D. Symes and C. Wright, ARM System Developers Guide, Designing and Optimizing System Software, Morgan Kaufmann
3. K.V. Shibu, Introduction to Embedded Systems,Tata McGraw Hill

<table>
<tr><td>Paper Code: ICT350P</td><td colspan="3">Embedded System Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 350T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT352T	**Paper: RF Component and Circuit Design**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a solid understanding of RF circuit fundamentals, including passive and active components.
CO 2	Analyze, design, and simulate basic RF circuits using appropriate software tools.
CO 3	Apply theoretical knowledge to the design and optimization of RF amplifiers, oscillators, and filters.
CO 4	Evaluate the performance, limitations, and trade-offs in RF circuit design for various applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	3
CO 3	3	2	3	3	2	-	-	-	3	2	-	3
CO 4	3	3	3	3	3	-	-	-	3	2	-	3

UNIT I

RF Fundamentals and Passive Components

Introduction to RF circuits and their significance in modern electronics; Characteristics of RF signals: frequency, wavelength, modulation; Impedance matching and Smith chart analysis ;Design of RF passive components: resonators, transmission lines, impedance transformers

UNIT II

Active RF Components and Amplifier Design

Overview of active RF components: transistors (BJT, MOSFET), amplifiers, oscillators; Common transistor amplifier configurations: common emitter, common base, common collector Gain, stability, and noise considerations in RF amplifiers; Design and analysis of low noise amplifiers (LNA) and power amplifiers (PA)

UNIT III

RF Oscillators and Frequency Synthesis

Principles of RF oscillators: feedback, Barkhausen criteria, phase noise; Oscillator types: LC oscillators, crystal oscillators, voltage-controlled oscillators (VCO); Frequency synthesis techniques: PLL (Phase-Locked Loop), direct digital synthesis (DDS); Design and simulation of RF oscillators for stable frequency generation

UNIT IV

RF Filters and Matching Networks

Introduction to RF filters: types, specifications, applications; Passive RF filters: LC, RC, and crystal filters; Active RF filters: Sallen-Key, multiple feedback, and switched capacitor filters; Impedance matching networks: L-section, T-section, and pi-section networks

Textbooks:

1. Bowick, Christopher. "RF Circuit Design," Newnes, 2018.
2. Gonzalez, Guillermo. "Microwave Transistor Amplifiers: Analysis and Design," Prentice Hall, 1996.

References:

1. Razavi, Behzad. "RF Microelectronics," Pearson, 2011.
2. Lee, Thomas H. "Planar Microwave Engineering: A Practical Guide to Theory, Measurement, and Circuits," Cambridge University Press, 2004.

3. Pozar, David M. "Microwave Engineering," John Wiley & Sons, 2011.

Paper Code: ICT352P	**RF Component and Circuit Design Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 352T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ICT354	**Paper: Multimedia Communications**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of multimedia communication systems, including the various types of multimedia data and their characteristics.
CO 2	Analyze the principles of multimedia compression, coding, and decoding techniques for efficient data transmission.
CO 3	Evaluate the challenges and strategies related to multimedia synchronization, quality of service, and error resilience in communication systems.
CO 4	Apply their knowledge to design basic multimedia communication systems and make informed decisions regarding the selection of appropriate techniques and technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**3**
CO 3	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**3**
CO 4	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**3**

UNIT I

Introduction to Multimedia Communication Systems: Overview of multimedia communication systems and their significance; Types of multimedia data: text, images, audio, video; Characteristics and requirements of multimedia data; Human perception and multimedia quality metrics

UNIT II

Multimedia Data Compression and Coding: Principles of data compression: lossless vs. lossy compression; Image compression techniques: JPEG, JPEG2000; Audio compression techniques: MP3, AAC; Video compression techniques: MPEG-2, H.264, HEVC; Multimedia coding standards and formats

UNIT III

Multimedia Transmission and Synchronization: Digital modulation techniques for multimedia transmission; Channel coding and error correction methods; Multimedia synchronization issues: lip synchronization, audio-video synchronization; Quality of Service (QoS) considerations in multimedia communication

UNIT IV

Advanced Topics in Multimedia Communication: Multimedia streaming techniques and protocols; Error resilience and error concealment strategies; Multimedia communication over wireless networks; Emerging trends in multimedia communication: virtual reality, augmented reality

Textbooks:

1. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson Education, 2000.
2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia," Springer, 2014.

References:

1. J. G. Proakis and M. Salehi, "Communication Systems Engineering," Pearson Education, 2002.
2. A. C. Bovik, "The Essential Guide to Video Processing," Academic Press, 2009.

3. K. R. Rao and Z. S. Bojkovic, "Understanding MPEG Standards: Basics of audio and video compression," CRC Press, 2014.

Paper Code: ICT356T	**Paper: Wireless and Mobile Communication**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a solid understanding of RF circuit fundamentals, including passive and active components.
CO 2	Analyze, design, and simulate basic RF circuits using appropriate software tools.
CO 3	Apply theoretical knowledge to the design and optimization of RF amplifiers, oscillators, and filters.
CO 4	Evaluate the performance, limitations, and trade-offs in RF circuit design for various applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**2**
CO 2	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**
CO 3	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**
CO 4	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**2**

UNIT I

Introduction to Wireless Communication Systems

Evolution of wireless communication: From 1G to 5G and beyond.
Wireless communication system architecture: Base stations, mobile stations, and core network.
Frequency reuse and cellular concept: Hexagonal cell structure, cluster, and frequency planning.
Signal propagation: Free space path loss, shadowing, and multipath fading.
Small-scale and large-scale fading: Rayleigh and Rician fading models.
Modulation techniques for wireless communication: Analog and digital modulation schemes.

UNIT II

Wireless Transmission Techniques

Multiple Access Techniques: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM).
Wireless channel coding: Error detection and correction codes, convolutional codes, and Turbo codes.
Diversity techniques: Space, time, and frequency diversity.
MIMO (Multiple Input Multiple Output) systems: Spatial multiplexing and diversity gain.
Wireless medium access control: Carrier Sense Multiple Access (CSMA), CSMA/CA, and contention-based protocols.

UNIT III

Cellular Communication Systems

Cellular network generations: 1G, 2G, 3G, 4G, and 5G. 4G LTE architecture and air interface: Downlink and uplink channels, OFDMA, and MIMO. 5G architecture and key features: Network slicing, massive MIMO, millimeter-wave communication. Mobility management: Handover techniques, location management, and paging strategies. Radio resource management: Power control, admission control, and frequency reuse.

UNIT IV

Emerging Trends and Future of Wireless Communications

Internet of Things (IoT) and its impact on wireless networks. 6G and beyond: Vision, potential applications, and challenges. Wireless security and privacy concerns: Encryption, authentication, and secure key exchange. Cooperative and cognitive wireless communication: Spectrum sensing, dynamic spectrum access, and opportunistic communication.

Textbooks:

1. T.S. Rappaport, "Wireless Communications: Principles and Practice," Pearson Education, 2002.
2. A. Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

References:

1. A. Molisch, "Wireless Communications," Wiley-IEEE Press, 2011.
2. S. Haykin and M. Moher, "Modern Wireless Communications," Pearson, 2017.
3. A. S. Tanenbaum and D. J. Wetherall, "Computer Networks," Pearson, 2010.
4. J. G. Proakis and M. Salehi, "Digital Communications," McGraw-Hill Education, 2007.

Paper Code: ICT356P	**Wireless and Mobile Communication Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 356T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ITE301T	**Paper: Statistics, Statistical Modelling & Data Analytics**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a solid understanding of fundamental statistical concepts and techniques.
CO 2	Apply statistical modeling methods to analyze and interpret data in engineering applications.
CO 3	Utilize data analytics techniques to draw actionable insights from complex datasets.
CO 4	Communicate effectively about statistical analyses and findings to technical and non-technical audiences.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	3	2	2	3
CO 2	3	3	3	2	3	2	2	-	3	2	2	3
CO 3	3	3	3	2	3	2	-	-	3	2	2	3
CO 4	3	3	3	2	3	2	-	-	3	2	2	3

UNIT I

Descriptive Statistics and Data Visualization

Introduction to statistics and its importance in engineering. Types of data: categorical, numerical, discrete, continuous. Measures of central tendency: mean, median, mode. Measures of dispersion: range, variance, standard deviation. Exploratory data analysis (EDA) techniques. Data visualization techniques: histograms, box plots, scatter plots.

UNIT II

Probability and Statistical Distributions

Basic concepts of probability: events, sample space, probability rules. Probability distributions: discrete and continuous. Binomial, Poisson, and Normal distributions and their applications. Central Limit Theorem and its significance. Sampling techniques and sampling distributions.

UNIT III

Statistical Inference

Point estimation and interval estimation. Hypothesis testing: null and alternative hypotheses, p-values, significance levels. One-sample and two-sample t-tests. Chi-square tests for independence and goodness of fit. Introduction to ANOVA (Analysis of Variance).

UNIT IV

Statistical Modeling and Data Analytics

Linear regression: simple and multiple regression models. Model building, interpretation, and validation. Introduction to classification techniques: logistic regression, decision trees. Introduction to clustering techniques: k-means clustering, hierarchical clustering. Introduction to data analytics tools (e.g., Python libraries, R) for data manipulation and analysis.

Textbooks:

1. Montgomery, D. C., Runger, G. C., & Hubele, N. F. (2017). Engineering Statistics (5th ed.). Wiley.
2. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2011). Probability & Statistics for Engineers & Scientists **(9th ed.). Pearson.**

References:
1. Devore, J. L. (2015). Probability and Statistics for Engineering and the Sciences (9th ed.). Cengage Learning.
2. Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction (2nd ed.). Springer.

<table>
<tr><td>Paper Code: ITE301P</td><td colspan="3">Statistics, Statistical Modelling & Data Analytics Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 301T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE302T	**Paper: Machine Learning**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts of machine learning and its significance in real-world applications.
CO 2	Describe and apply various machine learning algorithms, including supervised, unsupervised, and reinforcement learning techniques.
CO 3	Implement and evaluate machine learning models using appropriate tools and techniques.
CO 4	Analyze and interpret the results of machine learning experiments to make informed decisions.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	3	2	2	3
CO 2	3	3	3	2	3	2	2	-	3	2	2	3
CO 3	3	3	3	2	3	2	-	-	3	2	2	3
CO 4	3	3	3	2	3	2	2	-	3	2	2	3

UNIT I

Introduction to Machine Learning: Introduction to machine learning, types of machine learning (supervised, unsupervised, reinforcement learning), components of a machine learning system, applications of machine learning in engineering, ethical considerations in machine learning.

UNIT II

Supervised Learning: Regression analysis, linear regression, polynomial regression, model training and evaluation, overfitting and underfitting, classification problems, logistic regression, decision trees, ensemble methods (random forests, gradient boosting), model selection and hyperparameter tuning.

UNIT III

Unsupervised Learning: Clustering techniques (k-means, hierarchical clustering), dimensionality reduction, principal component analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE), introduction to neural networks, autoencoders, applications of unsupervised learning in feature extraction and data compression.

UNIT IV

Reinforcement Learning and Practical Considerations: Introduction to reinforcement learning, Markov decision processes, exploration and exploitation, Q-learning, policy gradients, applications of reinforcement learning in engineering tasks (e.g., robotics, game playing), challenges and considerations in implementing machine learning solutions, bias and fairness in machine learning.

Textbooks:

1. T. Hastie, R. Tibshirani, and J. Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction," Springer, 2009.
2. I. Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," MIT Press, 2016.
3. C. M. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.

References:

1. K. P. Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012.
2. A. Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," O'Reilly Media, 2019.

3. R. S. Sutton and A. G. Barto, "Reinforcement Learning: An Introduction," MIT Press, 2018.

<table>
<tr><td>Paper Code: ITE302P</td><td colspan="3">Machine Learning Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 302T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE304T	Paper: Supervised and Deep Learning	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational concepts of supervised learning, including different types of supervised learning problems and their applications.
CO 2	Develop proficiency in designing, training, and evaluating traditional supervised learning algorithms.
CO 3	Comprehend the architecture and components of deep learning models, along with their strengths and limitations.
CO 4	Apply deep learning techniques to solve real-world problems, and critically assess the appropriateness of using deep learning in different scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	3	2	2	3
CO 2	3	3	3	2	3	-	-	-	3	2	2	3
CO 3	3	3	3	2	-	-	-	-	3	2	2	3
CO 4	3	3	3	2	3	3	3	-	3	2	2	3

UNIT I

Introduction to Supervised Learning: Overview of machine learning and its types. Introduction to supervised learning and its significance. Classification vs. regression: understanding the distinction. Model evaluation metrics: accuracy, precision, recall, F1-score, etc. Bias-variance trade-off in supervised learning. Overfitting and underfitting: causes and remedies.

UNIT II

Traditional Supervised Learning Algorithms: Linear regression: theory, interpretation, and applications. Logistic regression: binary and multiclass classification. k-Nearest Neighbors (k-NN) algorithm and its variants. Support Vector Machines (SVMs): principles and kernel methods. Decision trees and ensemble methods (Random Forests, Gradient Boosting). Feature engineering and preprocessing techniques.

UNIT III

Introduction to Deep Learning: Neural networks: architecture, layers, and activation functions. Backpropagation: understanding the training process. Optimization techniques: gradient descent, stochastic gradient descent. Feedforward neural networks for classification and regression. Introduction to deep learning frameworks (TensorFlow, PyTorch).

UNIT IV

Deep Learning Applications and Advanced Concepts: Convolutional Neural Networks (CNNs) for image classification. Recurrent Neural Networks (RNNs) for sequence data. Introduction to natural language processing with deep learning. Transfer learning and fine-tuning pretrained models. Ethical considerations and challenges in deep learning applications

Textbooks:

1. I. Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," MIT Press, 2016.
2. T. Hastie, R. Tibshirani, and J. Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction," Springer, 2009.

References:

1. C. M. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.
2. A. Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," O'Reilly Media, 2019.
3. I. Goodfellow et al., "Deep Learning for Computer Vision," Springer, 2017.
4. Y. LeCun, Y. Bengio, and G. Hinton, "Deep Learning," Nature, vol. 521, no. 7553, pp. 436-444, 2015.

Paper Code: ITE304P	**Supervised and Deep Learning Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 304T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE306T	Paper: Artificial Neural Networks and Deep Learning	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the theoretical foundations of artificial neural networks and explain their role in machine learning.
CO 2	Design and implement various types of neural network architectures for different tasks.
CO 3	Apply deep learning techniques to solve real-world problems, demonstrating an understanding of their strengths and limitations.
CO 4	Evaluate and critique the performance of neural network models, and make informed decisions on model selection and hyperparameter tuning.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	3	2	2	3
CO 2	3	3	3	2	3	-	-	-	3	2	2	3
CO 3	3	3	3	2	3	-	-	-	3	2	2	3
CO 4	3	3	3	2	-	-	-	-	3	2	2	3

UNIT I
Introduction to Neural Networks: Overview of neural networks and historical development. Biological inspiration: Neurons and synapses. Perceptrons and the McCulloch-Pitts model. Activation functions: Sigmoid, ReLU, and variants. Feedforward neural networks and their architecture.
UNIT II
Training and Optimization: Loss functions for neural networks: Mean Squared Error, Cross-Entropy, etc. Gradient descent and backpropagation algorithm. Stochastic gradient descent and mini-batch training. Regularization techniques: Dropout, L1 and L2 regularization. Optimization algorithms: Adam, RMSProp, SGD with momentum.
UNIT III
Advanced Neural Network Architectures: Convolutional Neural Networks (CNNs) for image processing. Recurrent Neural Networks (RNNs) and their applications in sequential data. Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRUs). Introduction to transformers and attention mechanisms. Transfer learning and pre-trained models.
UNIT IV
Deep Learning Applications and Trends: Image classification and object detection using CNNs. Natural language processing tasks: Sentiment analysis, named entity recognition. Generative models: Introduction to Generative Adversarial Networks (GANs). Ethical considerations and challenges in deep learning applications. Current trends and research directions in artificial neural networks and deep learning

Textbooks:
1. I. Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," MIT Press, 2016.
2. M. Nielsen, "Neural Networks and Deep Learning: A Textbook," Determination Press, 2015.
References:
1. F. Chollet, "Deep Learning with Python," Manning Publications, 2017.

2. A. Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," O'Reilly Media, 2019.
3. Y. LeCun, Y. Bengio, and G. Hinton, "Deep learning," Nature, vol. 521, no. 7553, pp. 436-444, 2015.

<table>
<tr><td>Paper Code: ITE306P</td><td colspan="3">Artificial Neural Networks and Deep Learning Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 306T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

<table>
<tr><td>Paper Code: ITE308T</td><td colspan="11">Paper: Fuzzy logic and Systems</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="11"></td><td>3</td><td>0</td><td>3</td></tr>
<tr><td colspan="15">Prerequisite Paper:</td></tr>
<tr><td colspan="15">Marking Scheme:
1. Teacher’s Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks</td></tr>
<tr><td colspan="15">Guidelines for Paper Setter(s):</td></tr>
<tr><td colspan="15">1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.</td></tr>
<tr><td colspan="15">Course Outcome (CO):</td></tr>
<tr><td>CO 1</td><td colspan="14">Understand the principles of fuzzy logic and its applications in various engineering domains.</td></tr>
<tr><td>CO 2</td><td colspan="14">Design and implement fuzzy logic systems for solving engineering problems involving uncertainty.</td></tr>
<tr><td>CO 3</td><td colspan="14">Analyze and evaluate the performance of fuzzy logic controllers in comparison to traditional control methods.</td></tr>
<tr><td>CO 4</td><td colspan="14">Apply fuzzy logic techniques to real-world engineering scenarios, demonstrating proficiency in problem-solving and decision-making under uncertainty.</td></tr>
<tr><td colspan="15">Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)</td></tr>
</table>

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	3	-	1	-	2	-	2	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-
CO 4	3	3	3	2	3	-	-	-	-	-	-	-

UNIT I

Introduction to Fuzzy Logic and Set Theory: Introduction to fuzzy sets: Crisp sets vs. fuzzy sets. Membership functions and their types. Fuzzification and defuzzification processes. Operations on fuzzy sets: Union, intersection, complement. Fuzzy relations and composition. Fuzzy set-based logic

UNIT II

Fuzzy Logic Systems and Inference: Fuzzy rules and linguistic variables. Fuzzy if-then rules and rule-based inference. Mamdani and Sugeno fuzzy inference systems. Defuzzification methods: Centroid, mean of maxima, weighted average. Rule aggregation and implication methods. Adaptive and evolving fuzzy systems

UNIT III

Fuzzy Control Systems: Basics of control systems and feedback control. Fuzzy controllers vs. traditional controllers. Design of fuzzy controllers: Rule base, inference engine, defuzzification. PID control using fuzzy logic. Applications of fuzzy control in robotics and industrial automation. Case studies: Fuzzy temperature control, speed control.

UNIT IV

Fuzzy Applications in Engineering: Fuzzy logic in decision-making and optimization. Fuzzy modeling for system identification. Fuzzy logic in pattern recognition and image processing. Fuzzy applications in engineering domains: Automotive, electronics, manufacturing. Case studies: Fuzzy traffic control, fuzzy washing machine control.

Textbooks:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," McGraw-Hill Education, 2010.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, and Eiji Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence," Prentice Hall, 1997.

References:

1. Lotfi A. Zadeh, "Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems: Selected Papers by Lotfi A. Zadeh," World Scientific Publishing Co., 1996.

2. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications," Prentice Hall, 1995.
3. Earl Cox, "Fuzzy Fundamentals: A Guide for Engineers and Scientists," CRC Press, 1994.
4. Didier Dubois and Henri Prade, "Fuzzy Sets and Systems: Theory and Applications," Academic Press, 1980.

<table>
<tr><td>Paper Code: ITE308P</td><td colspan="2">Fuzzy logic and Systems Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 308T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE305T	**Paper: Introduction to Internet of Things**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of the Internet of Things and its applications in engineering.
CO 2	Describe and analyze the key technologies and protocols used in IoT systems.
CO 3	Design and develop simple IoT systems, integrating hardware and software components.
CO 4	Evaluate the challenges and considerations related to security, privacy, and ethical aspects of IoT deployments.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT I

Introduction to Internet of Things (IoT): Definition and significance of IoT, Evolution of IoT, Components of IoT ecosystem, IoT applications in various engineering domains.

UNIT II

IoT Technologies and Protocols: Wireless communication technologies (Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT), IoT protocols (MQTT, CoAP, HTTP), Sensor technologies, Actuators and control mechanisms.

UNIT III

IoT System Design and Implementation: Sensor-node architecture, Data acquisition and preprocessing, Cloud computing and edge computing for IoT, Data storage and management, Introduction to IoT platforms.

UNIT IV

IoT Security, Privacy, and Ethical Considerations: Security challenges in IoT, Authentication and encryption, Privacy concerns and data protection, Legal and ethical considerations in IoT deployments.

Textbooks:

1. B. Ray, "Internet of Things: A Hands-On Approach," Springer, 2020.
2. A. Dunkels, "Interconnecting Smart Objects with IP: The Next Internet," Morgan Kaufmann, 2010.

References:

1. T. Ahmed, "Internet of Things (IoT): A Comprehensive Introduction," Springer, 2019.
2. R. Roman, et al., "Key Management for the Internet of Things," IEEE Access, 2017.
3. R. Sheltami, et al., "Towards an IoT Cloud for Smart Cities: Experiences and Lessons," IEEE Internet of Things Journal, 2016.
4. J. Whitmore, et al., "Internet of Things: A survey of topics and trends," Information Systems Frontiers, 2015.

<table>
<tr><td>Paper Code: ITE305P</td><td colspan="3">Introduction to Internet of Things Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 305T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE310T / ITE459T	Paper: Wireless and Sensor Networks	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the fundamental principles and components of wireless communication systems and sensor networks.
CO 2	Design and evaluate wireless network protocols and architectures to address various communication challenges.
CO 3	Apply knowledge of sensor networks to develop solutions for real-world applications, considering energy efficiency and data accuracy.
CO 4	Demonstrate the ability to assess emerging trends and advancements in wireless and sensor networks and their potential impact on engineering practices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	2
CO 2	3	3	3	2	2	1	1	-	-	-	-	2
CO 3	3	3	3	2	2	1	1	-	-	-	-	2
CO 4	3	3	3	2	2	1	1	-	1	-	-	2

UNIT I

Wireless Communication Principles: Introduction to wireless communication systems. Wireless channel characteristics and modelling. Modulation and demodulation techniques. Multiple access techniques: FDMA, TDMA, CDMA. Wireless network architectures: Cellular, ad hoc, and mesh networks. Wireless standards: IEEE 802.11 (Wi-Fi), Bluetooth, LTE.

UNIT II

Sensor Network Fundamentals: Introduction to sensor networks: characteristics and applications. Sensor node architecture and components. Energy-efficient communication protocols. Data aggregation and dissemination in sensor networks. Localization and synchronization techniques. Sensor network security and privacy considerations.

UNIT III

Wireless Network Protocols and Algorithms: Routing algorithms in wireless networks: AODV, DSR, OLSR. Medium Access Control (MAC) protocols: CSMA, TDMA, MACA. Error control and reliability in wireless communication. Quality of Service (QoS) provisioning in wireless networks. Network layer protocols and IP addressing in wireless networks. Mobility management and handoff in cellular networks.

UNIT IV

Applications and Emerging Trends: Internet of Things (IoT) and its integration with wireless networks. Wireless sensor network applications: environmental monitoring, healthcare, industrial automation. Energy harvesting techniques for sensor nodes. Cognitive radio and dynamic spectrum allocation. Case studies of real-world wireless and sensor network deployments.

Textbooks:

1. K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks: A Unified Approach," Prentice Hall, 2002.

2. I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless Sensor Networks: A Survey," Computer Networks, vol. 38, no. 4, pp. 393-422, 2002.

References:

1. T. S. Rappaport, "Wireless Communications: Principles and Practice," Prentice Hall, 2001.
2. S. S. Iyengar, "Wireless Sensor Networks," Springer, 2014.
3. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, "Wireless Sensor Networks," Springer, 2004.
4. J. N. Al-Karaki and A. E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey," IEEE Wireless Communications, vol. 11, no. 6, pp. 6-28, 2004.

Paper Code: ITE310P / ITE459P	**Wireless and Sensor Networks Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ITE310T / ITE459T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ITE312T	Paper: IoT with Arduino, ESP, and Raspberry Pi	L	T/P	C
Paper ID:164		3	0	3
Prerequisite Paper:				
Marking Scheme: 1. Teacher's Continuous Evaluation: 25 Marks 2. Term End Theory Examination: 75 Marks				
Instruction for paper setter:				
1. There should be 9 questions in the term end examinations question paper. 2. The first question should be compulsory and cover the entire syllabus. This question should be objective,single line answers or short answer type questions of total 15 marks. 3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit will have a marks weightage of 15. 4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/levelof questions to asked should be at the level of the prescribed textbook. 5. The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.				

Course Outcome (CO):

1.	Ability to understand the concepts of Internet of Things
2.	Ability to use the basic protocols in wireless sensor network
3.	Ability to use IoT applications in different domain and be able to analyze their performance
4.	Ability to implement basic IoT applications on embedded platform

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO01	3	2	3	2	2	-	-	-	3	2	2	3
CO02	3	2	3	2	2	-	-	-	3	2	2	3
CO03	3	2	3	3	2	-	-	-	3	2	2	3
CO04	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

UNIT – II

IoT & M2M- Machine to Machine, Difference between IoT and M2M, Software define Network, Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT – III

Developing IoTs, Programming on Arduino, ESP, and Raspberry Pi used for IoT. Introduction to different IoT tools. Developing applications through IoT tools such as CupCarbon Simulator and COOJA etc. Developing sensor-based application through embedded system platform. Implementing IoT concepts with python

UNIT – IV

Challenges in IoT Design, Development challenges, Security challenges, other challenges, Domain specific applications of IoT, Home automation, Industry applications, Surveillance applications, Other IoT applications.

Textbook(s):

1. Bahga, A., & Madisetti, V. , Internet of Things: A hands-on approach.
2.Dargie, W., & Poellabauer, C., Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons.

References:

1. Theoleyre, F., & Pang, A. C., Internet of Things and M2M Communications. River Publishers.
2. Dey, N., Hassanien, A. E., Bhatt, C., Ashour, A., & Satapathy, S. C., Internet of things and big data analytics toward next-generation intelligence, Berlin: Springer.

Paper Code: ITE312P	IoT with Arduino, ESP, and Raspberry Pi Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 312T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

<table>
<tr><td>Paper Code: ITE309T</td><td>Paper: Real Time Operating Systems</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td></td><td>4</td><td>0</td><td>4</td></tr>
<tr><td colspan="5">Prerequisite Paper:</td></tr>
<tr><td colspan="5">Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks</td></tr>
<tr><td colspan="5">Guidelines for Paper Setter(s):</td></tr>
<tr><td colspan="5">1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.</td></tr>
</table>

Course Outcome (CO):

CO 1	Understand the fundamental concepts of real-time operating systems and their differences from general-purpose operating systems.
CO 2	Analyze the design principles and scheduling algorithms used in real-time operating systems for efficient task management.
CO 3	Develop the skills to design and implement real-time systems considering timing constraints and synchronization requirements.
CO 4	Evaluate the challenges and methods for ensuring reliability, security, and performance in real-time operating system environments.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	3	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	2	3	2	-	-	-	2	2	2	3
CO 4	3	3	2	3	2	-	-	-	2	2	2	3

UNIT I

Introduction to Real-Time Operating Systems: Introduction to real-time systems, characteristics and requirements of real-time operating systems, classification of real-time tasks, challenges in real-time system design.

UNIT II

Task Scheduling and Synchronization: Preemptive and non-preemptive scheduling algorithms (Rate Monotonic, Earliest Deadline First, etc.), priority inversion and priority inheritance, mutual exclusion and synchronization techniques in real-time systems.

UNIT III

Memory Management and I/O in Real-Time Systems: Memory management strategies for real-time systems, memory protection mechanisms, device management and drivers in real-time environments, handling real-time I/O constraints.

UNIT IV

Real-Time System Design and Case Studies:

Design considerations for real-time systems, task modeling and specification, real-time kernel services, case studies of real-time operating systems in embedded systems, real-time Linux.

Textbooks:

1. C. K. Tan, "Real-Time Concepts for Embedded Systems," 2nd ed., CMP Books, 2003.
2. Jane W. S. Liu, "Real-Time Systems," Pearson Education, 2000.

References:

1. Stuart Bennett, "Real-Time Computer Control: An Introduction," Prentice Hall, 2003.
2. Giorgio C. Buttazzo, "Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications," Springer, 2011.
3. Sam Siewert and John Pratt, "Mastering the FreeRTOS Real Time Kernel: A Hands-On Tutorial Guide," 2016.

Paper Code: ITE314T	Paper: Embedded System Architecture and Design	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and evaluate the architecture of embedded systems, considering the interactions between hardware and software components.
CO 2	Design embedded systems using appropriate methodologies, taking into account performance, power efficiency, and real-time constraints.
CO 3	Implement and debug embedded software to control and manage hardware peripherals effectively.
CO 4	Apply their knowledge to solve real-world problems by designing and developing functional embedded systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to Embedded Systems: Overview of embedded systems and their applications, Characteristics and challenges of embedded system design, Microcontroller vs. microprocessor-based systems, Embedded system components: processors, memory, I/O devices, Introduction to real-time operating systems (RTOS)

UNIT II

Embedded System Architecture: Processor architectures(RISC, CISC, and hybrid architectures), Memory hierarchy in embedded systems(ROM, RAM, Flash), Interfacing techniques for external devices: GPIO, SPI, I2C, UART, Interrupts and exception handling in embedded systems, System-on-Chip (SoC) design considerations

UNIT III

Embedded Software Design: C and assembly language programming for embedded systems, Compilers, cross-compilers, and toolchains, Writing efficient code: optimization techniques, Real-time programming and task scheduling, Debugging and testing strategies for embedded software

UNIT IV

Embedded System Development: Hardware description languages: an overview, Sensor interfacing and data acquisition, Communication protocols for embedded systems: CAN, Ethernet, wireless Power management and optimization techniques, Case studies: Designing embedded systems for IoT, automotive, consumer electronics

Textbooks:

1. A. Singh and J. D. A. Lukkien, "Embedded Systems: Architecture, Programming and Design," 2nd ed., Springer, 2020.

References:

1. W. Wolf, "Computers as Components: Principles of Embedded Computing System Design," 3rd ed., Morgan Kaufmann, 2012.
2. K. Eshraghian, "Principles of CMOS VLSI Design: A Systems Perspective," Addison-Wesley, 2016.
3. P. Marwedel, "Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems," 3rd ed., Springer, 2018.

<table>
<tr><td>Paper Code: ITE314P</td><td colspan="3">Embedded System Architecture and Design Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 314T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE318T	**Paper: Programming in C for Embedded Systems**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Design and implement C programs that effectively utilize the features of microcontrollers and microprocessors in embedded systems.
CO 2	Analyze and optimize code for memory usage and execution speed in resource-constrained embedded environments.
CO 3	Integrate hardware and software components by utilizing appropriate programming interfaces and techniques for embedded systems.
CO 4	Develop robust and reliable embedded software applications by understanding and applying debugging and error-handling strategies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	-	-	1	1	-	1
CO 2	3	3	3	2	2	1	-	-	1	1	-	1
CO 3	3	3	3	2	2	1	-	-	1	1	-	1
CO 4	3	3	3	2	2	1	-	-	1	1	-	1

UNIT I

Advanced C Programming for Embedded Systems: Advanced data types and type manipulation, Bitwise operations, Pointers and memory management, Function pointers, Preprocessor directives for optimization, Inline assembly programming in C.

UNIT II

Memory and Performance Optimization: Memory hierarchy in embedded systems, Stack vs. Heap memory allocation, Dynamic memory management, Code and data optimization techniques, Profiling and benchmarking embedded code.

UNIT III

Hardware Interfaces and Peripherals: I/O programming concepts, Memory-mapped I/O vs. Port-mapped I/O, Interrupt-driven I/O, Timers and counters programming, Serial communication (UART) programming, Analog-to-digital and digital-to-analog conversion.

UNIT IV

Debugging and Testing in Embedded Systems
Topics: Debugging tools and techniques, Real-time debugging, Error handling and exception mechanisms, Testing methodologies for embedded software, Integration testing of hardware and software.

Textbooks:

1. Michael Barr, "Programming Embedded Systems in C and C++," First Edition, 2018.
2. E. Lee and S. Seshia, "Introduction to Embedded Systems - A Cyber-Physical Systems Approach," Second Edition, 2015.

References:

1. Jonathan W. Valvano, "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers," Fifth Edition, 2019.
2. Jean J. Labrosse, "MicroC/OS-II: The Real-Time Kernel," Second Edition, 2002.
3. David Simon, "An Embedded Software Primer," First Edition, 1999.
4. Daniel W. Lewis, "Fundamentals of Embedded Software with the ARM Cortex-M3," First Edition, 2013.

<table>
<tr><td colspan="2">Paper Code: ITE318P</td><td colspan="2">Programming in C for Embedded Systems Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 318T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE311T	Paper: Software Measurements, Metrics, and Modelling	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
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4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the importance of software measurements and metrics in evaluating and improving software development processes.
CO 2	Identify and apply appropriate metrics for measuring software quality, productivity, and process efficiency.
CO 3	Analyze measurement data and interpret the results to make informed decisions for process improvement.
CO 4	Utilize modeling techniques to predict software project outcomes, resource requirements, and potential risks.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT I

Fundamentals of Software Measurements and Metrics: Introduction to software measurements and metrics, measurement process, measurement scales, measurement theory, types of metrics, challenges in software measurement, establishing measurement objectives.

UNIT II

Software Measurement Techniques and Tools: Quantitative and qualitative measurement techniques, direct and indirect measurement, software measurement frameworks, automated measurement tools, data collection and analysis, interpreting measurement results.

UNIT III

Software Metrics for Quality and Performance Assessment: Software quality attributes and metrics, complexity metrics, size-based metrics, cohesion and coupling metrics, defect and error metrics, reliability and availability metrics, performance metrics, benchmarking.

UNIT IV

Software Modeling and Predictive Metrics: Software process modeling, predictive modeling techniques, regression analysis, parametric models, neural networks, estimation of software development effort, reliability prediction models.

Textbooks:

1. Fenton, N. E., & Pfleeger, S. L. (2014). Software Metrics: A Rigorous and Practical Approach (3rd ed.). PWS Publishing Company.
2. Kan, S. H. (2002). Metrics and Models in Software Quality Engineering. Addison-Wesley Professional.

References:

1. Basili, V. R., Caldiera, G., & Rombach, H. D. (1996). The Goal Question Metric Approach. Encyclopedia of Software Engineering.

2. Boehm, B. W. (1981). Software Engineering Economics. Prentice-Hall.
3. Pressman, R. S. (2014). Software Engineering: A Practitioner's Approach (8th ed.). McGraw-Hill Education.
4. Kitchenham, B. A., Pfleeger, S. L., Pickard, L. M., Jones, P. W., Hoaglin, D. C., El Emam, K., & Rosenberg, J. (2002). Preliminary Guidelines for Empirical Research in Software Engineering. IEEE Transactions on Software Engineering, 28(8), 721-734.

Paper Code: ITE311P	**Software Measurements, Metrics, and Modelling Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :
1. The course objectives and course outcomes are identical to that of ITE 311T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE320T / ITE354T /ICT421T	Paper: Software Project Management	L	T/P	C
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a comprehensive understanding of software project management principles, methodologies, and best practices.
CO 2	Develop project plans encompassing scope, time, cost, quality, and risk management strategies.
CO 3	Apply effective communication and collaboration techniques to lead project teams and engage with stakeholders.
CO 4	Analyze and adapt project management strategies based on real-world challenges and changing project requirements.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT I

Introduction to Software Project Management: Introduction to project management, software project characteristics, project life cycle models, project stakeholders, project constraints, role of project manager.

UNIT II

Project Planning and Estimation: Project initiation, scope definition, work breakdown structure (WBS), estimation techniques (e.g., COCOMO, Function Points), scheduling techniques (e.g., PERT, Gantt charts), resource allocation, project budgeting.

UNIT III

Project Execution and Control: Project execution methodologies (e.g., Agile, Waterfall), team organization and roles, project tracking and control, change management, configuration management, quality assurance, risk identification and mitigation.

UNIT IV

Project Communication and Stakeholder Management: Effective communication strategies, stakeholder identification and analysis, managing conflicts, negotiation skills, project reporting, status meetings, customer relationship management.

Textbooks:

1. Kathy Schwalbe, "Information Technology Project Management", 9th Edition, Cengage Learning, 2020.
2. Bob Hughes and Mike Cotterell, "Software Project Management", 6th Edition, McGraw-Hill Education, 2018.

References:

1. Roger S. Pressman and Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", 8th Edition, McGraw-Hill Education, 2014.
2. Norman F. Schneidewind, "Software Measurement and Estimation: A Practical Approach", Wiley-IEEE Computer Society Press, 2006.
3. Scott Berkun, "Making Things Happen: Mastering Project Management", O'Reilly Media, 2008.

<table>
<tr><td>Paper Code: ITE320P / ITE354P / ICT 421P</td><td colspan="3">Software Project Management Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 421P / ITE 320T / ITE354T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE322T	**Paper: Service Oriented Architecture**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of Service-Oriented Architecture and its benefits in designing distributed systems.
CO 2	Design and develop services using appropriate technologies and standards.
CO 3	Implement communication between services, ensuring interoperability and reusability.
CO 4	Analyze real-world scenarios and make informed decisions on the application of SOA in solving architectural challenges.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Service-Oriented Architecture: Introduction to SOA, Characteristics of SOA, Benefits and challenges of SOA, Service-orientation principles, Relationship between SOA and Software Engineering.

UNIT II

Designing Services: Service identification and modeling, Service contracts, Service granularity, Principles of service design, Design patterns for SOA, Service versioning and evolution.

UNIT III

Service Communication and Integration: Communication between services, RESTful architecture, SOAP-based services, Service orchestration and choreography, Middleware for service integration.

UNIT IV

Implementing and Managing SOA: Service development frameworks, Security in SOA, Quality of Service (QoS) in SOA, SOA governance and management, Case studies of successful SOA implementations.

Textbooks:

1. Thomas Erl, "SOA Principles of Service Design," Pearson, 2007.
2. Paul C. Brown, "Implementing SOA: Total Architecture in Practice," Addison-Wesley Professional, 2007.

References:

1. Roger Sessions, "SOA: Principles of Service Design," ACM Queue, vol. 4, no. 3, pp. 46-52, 2006.
2. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services," Addison-Wesley Professional, 2004.
3. Michael Bell, "Service-Oriented Modeling: Service Analysis, Design, and Architecture," Wiley, 2008.
4. Sandy Carter, "SOA Governance: Achieving and Sustaining Business and IT Agility," IBM Press, 2009.

Paper Code: ITE322P	Service Oriented Architecture Lab.			L	T/P	C
Paper ID:				-	2	1
Teacher's Continuous Evaluation :		40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 322T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE324T	Paper: Mining Software Repositories and Predictive Modelling	L	T/P	C
Paper ID:		3	0	3
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Apply mining techniques to extract meaningful information from software repositories.
CO 2	Design and implement predictive models for software engineering tasks.
CO 3	Analyze and interpret the results of mining software repositories and predictive models.
CO 4	Utilize insights gained to improve software development practices and decision-making.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Mining Software Repositories: Introduction to mining software repositories, data collection methods, data preprocessing techniques, version control analysis, bug tracking analysis, mailing list analysis.

UNIT II

Software Metrics and Feature Extraction: Software metrics overview, source code metrics, change metrics, code churn metrics, feature extraction techniques, feature engineering for predictive modeling.

UNIT III

Predictive Modeling in Software Engineering: Introduction to predictive modeling, classification and regression techniques, model evaluation metrics, cross-validation, feature selection, overfitting and underfitting, ensemble methods.

UNIT IV

Case Studies and Applications: Application of mining and predictive modeling in software maintenance, defect prediction, code review, software quality assessment, software evolution prediction.

Textbooks:

1. M. Gousios, "Software Analytics: Mining Software Engineering Data," Morgan Kaufmann, 2015.
2. T. Menzies, A. Marcus, L. C. Briand, "Data Science for Software Engineering," Springer, 2016.
3. Janice S. Huether, "Mining Software Repositories: Advances in Data Mining Techniques and Applications", IEEE Press, 2017.

References:

1. J. Madeyski, M. Ochodek, "Mining Software Repositories: Advances in Data Analysis," Springer, 2017.
2. A. Mockus, "Mining Software Engineering Data," Chapman & Hall/CRC, 2009.
3. T. Zimmermann, R. Premraj, "Mining Version Histories," Morgan & Claypool, 2007.
4. I. Steinmacher, T. Conte, M. A. Gerosa, "Mining Software Repositories: A Scientist's Perspective," Springer, 2018.
5. Tim Menzies, Laurie Williams, and Thomas Zimmermann, "Perspectives on Data Science for Software Engineering", IEEE Press, 2016.

6. Ahmed E. Hassan and Hesham H. Ali, "Software Analytics: Mining Software Engineering Data", Morgan Kaufmann, 2019.
7. Leandro Minku and Xin Yao, "Software Analytics for Predictive Maintenance", Springer, 2020.

<table>
<tr><td>Paper Code: ITE324P</td><td colspan="3">Mining Software Repositories and Predictive Modelling Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 324T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT411T / ITE423T	**Paper: Software Verification, Validation and Testing**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the principles and significance of software verification, validation, and testing in the software development lifecycle.
CO 2	Apply various testing techniques to assess software functionality, performance, and security.
CO 3	Analyze and design effective test cases, test suites, and testing strategies to ensure software quality.
CO 4	Utilize automated testing tools and methodologies to streamline the software testing process.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**2**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**2**	**3**
CO 3	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**2**	**3**
CO 4	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**2**	**3**

UNIT I

Introduction to Software Verification, Validation, and Testing: Software quality attributes, verification vs. validation, testing levels (unit, integration, system, acceptance), testing phases (planning, design, execution, closure), V-model of software development, challenges in testing, role of testing in software development.

UNIT II

Software Testing Techniques: White-box testing (statement coverage, branch coverage, path coverage), black-box testing, equivalence partitioning, boundary value analysis, decision table-based testing, state transition testing, use case-based testing, pairwise testing, exploratory testing, static vs. dynamic testing.

UNIT III

Test Case Design and Execution: Test case design process, test case specification, test oracle, test case prioritization, test case traceability, regression testing, test execution and reporting, capturing and managing defects, test data management.

UNIT IV

Automation in Software Testing: Need for automation, types of test automation tools, introduction to scripting languages for automation (e.g., Python), record and playback tools, test automation frameworks, continuous integration and continuous testing, challenges in test automation.

Textbooks:

1. Yogesh Singh, "Software Testing and Quality Assurance: Theory and Practice," Cambridge University Press, 2012.

References:

1. Cem Kaner, Jack Falk, and Hung Q. Nguyen, "Testing Computer Software," Wiley, 1993.
2. Glenford J. Myers, Corey Sandler, and Tom Badgett, "The Art of Software Testing," Wiley, 2011.
3. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach," CRC Press, 2018.
4. Elfriede Dustin, Thom Garrett, and Bernie Gauf, "Automated Software Testing: Introduction, Management, and Performance," Addison-Wesley Professional, 1999.
5. Roger S. Pressman and Bruce R. Maxim, "Software Engineering: A Practitioner's Approach," McGraw-Hill, 2015.

<table>
<tr><td>Paper Code: ICT411P/ ITE423P</td><td colspan="3">Software Verification, Validation and Testing Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 411T / ITE 423T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE425T	Paper: Software Security	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the principles of software security testing and its importance in the software development lifecycle.
CO 2	Apply various security testing techniques to identify common vulnerabilities and threats in software applications.
CO 3	Demonstrate proficiency in using security testing tools to assess the security posture of software systems.
CO 4	Develop and execute comprehensive security testing plans to ensure the robustness and resilience of software applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT I

Introduction to Software Security: Importance of software security, Security Development Lifecycle (SDL), Common types of software vulnerabilities (e.g., SQL injection, Cross-Site Scripting), Principles of secure software design, Secure coding guidelines.

UNIT II

Secure Coding Practices: Input validation and data sanitization, Authentication and authorization mechanisms, Session management security, Secure error handling, Proper usage of cryptography, Secure communication protocols.

UNIT III

Security Testing and Analysis: Threat modeling, Static code analysis for security, Dynamic security testing techniques (e.g., penetration testing, fuzz testing), Security assessment tools, Risk assessment and management.

UNIT IV

Secure Software Architecture: Security patterns and best practices, Secure software development frameworks, Role-based access control, Secure database design, Secure APIs and web services, Security considerations for mobile and cloud applications.

Textbooks:

1. McGraw, G. (2018). Software Security: Building Security In. Addison-Wesley Professional.

References:

1. Chess, B., & McGraw, G. (2004). Secure Programming with Static Analysis. Addison-Wesley Professional.
2. Viega, J., & McGraw, G. (2001). Building Secure Software: How to Avoid Security Problems the Right Way. Addison-Wesley Professional.
3. Howard, M., & LeBlanc, D. (2002). Writing Secure Code. Microsoft Press.

<table>
<tr><td>Paper Code: ITE425P</td><td colspan="3">Software Security Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 425T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE427	Paper: Software Engineering Standards	L	T/P	C
Paper ID:		4	0	4
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.

2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.

4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.

5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the importance of software engineering standards in ensuring quality and reliability in software development processes.
CO 2	Identify and apply relevant ISO/IEEE standards to different stages of software development.
CO 3	Analyze and evaluate software engineering processes in compliance with established standards.
CO 4	Communicate effectively about software engineering standards and their practical implications to both technical and non-technical stakeholders.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT I

Introduction to Software Engineering Standards: Overview of software engineering standards, ISO/IEEE standards for software engineering, relationship between standards and software development lifecycle, benefits of adhering to standards, impact on software quality and maintenance.

UNIT II

Software Process Standards: ISO/IEEE standards for software processes (e.g., ISO/IEC 12207), process lifecycle stages, process documentation and management, process tailoring, process assessment and improvement, case studies of successful process standard implementation.

UNIT III

Software Documentation and Quality Standards: Documentation standards (e.g., IEEE 830), software quality attributes, ISO/IEEE standards for software quality assurance (e.g., ISO/IEC 25010), quality planning, reviews and audits, metrics for quality evaluation.

UNIT IV

Verification, Validation, and Testing Standards: Verification, validation, and testing in software development, IEEE standards for software testing (e.g., IEEE 829, IEEE 1012), test planning and design, test case specification, test execution and reporting, automated testing, importance of testing in meeting standards.

Textbooks / References:

1. IEEE Computer Society. (2017). "Guide to the Software Engineering Body of Knowledge (SWEBOK)." IEEE Press.
2. ISO/IEC/IEEE International Standard. (2015). "Systems and Software Engineering - System Life Cycle Processes" (ISO/IEC/IEEE 15288).
3. ISO/IEC/IEEE International Standard. (2017). "Systems and Software Engineering - Requirements Engineering" (ISO/IEC/IEEE 29148).
4. IEEE Computer Society. (2013). "IEEE Standard for Software and System Test Documentation" (IEEE 829).

5. ISO/IEC/IEEE International Standard. (2011). "Systems and Software Engineering - Software Life Cycle Processes" (ISO/IEC/IEEE 12207).
6. Sommerville, I. (2011). "Software Engineering" (9th ed.). Addison-Wesley.
7. Pressman, R. S. (2014). "Software Engineering: A Practitioner's Approach" (8th ed.). McGraw-Hill Education.

Paper Code: ITE313T	Paper: Semiconductor Devices and Modelling	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the basic principles of semiconductor devices and their operating mechanisms.
CO 2	Model and analyze the behavior of various semiconductor devices using appropriate mathematical techniques.
CO 3	Apply the acquired knowledge to design and optimize semiconductor devices for specific applications.
CO 4	Critically evaluate emerging trends and advancements in semiconductor device technology.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Semiconductor Fundamentals and Diode Modeling: Introduction to semiconductor materials, Intrinsic and extrinsic semiconductors, Carrier statistics, PN junction diode operation and characteristics, Diode modeling using ideal and practical models, Temperature effects on diode behavior.

UNIT II

Bipolar Junction Transistors (BJTs) Modeling: BJT operation and modes (active, cutoff, saturation), Ebers-Moll model, Hybrid-π model, AC and DC analysis of BJTs, Temperature effects on BJT behavior, BJT amplifier configurations.

UNIT III

Field-Effect Transistors (FETs) Modeling: Introduction to FETs, Types of FETs (MOSFET, JFET), MOSFET operation in different modes, Basic MOSFET equations, Small-signal model of MOSFET, Biasing and analysis of FET amplifiers.

UNIT IV

Advanced Device Modeling and Simulation: High-frequency device modeling, Noise modeling in semiconductor devices, Semiconductor device simulation tools, Introduction to TCAD simulations, Reliability and thermal effects in devices, Emerging semiconductor technologies.

Textbooks:

1. J. R. Choma, "Semiconductor Devices: Physics and Technology," Wiley, 2002.
2. S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices," Wiley, 2006.

References:

1. S. M. Sze, "Semiconductor Devices: Physics and Technology," Wiley, 1985.

2. B. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices," Pearson, 2016.
3. Y. Tsividis, "Operation and Modeling of the MOS Transistor," Oxford University Press, 1999.
4. A. G. Milnes and G. L. Neudeck, "Electron Devices and Circuits," Prentice Hall, 1982.

Paper Code: ITE313P	**Semiconductor Devices and Modelling Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 313T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE326T	**Paper: VLSI Technology and Design**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and explain the fundamental principles of VLSI technology, including semiconductor physics, device characteristics, and fabrication processes.
CO 2	Design and model basic VLSI devices and circuits, demonstrating proficiency in using industry-standard software tools for simulation and analysis.
CO 3	Evaluate the performance and limitations of different VLSI devices and technologies, and make informed decisions in selecting appropriate components for specific applications.
CO 4	Apply their knowledge of VLSI technology to contribute effectively to the design and development of integrated circuits, taking into consideration the latest advancements and challenges in the field.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	2	-	2	1	-	2
CO 2	3	3	3	3	2	1	2	-	2	1	-	2
CO 3	3	3	3	3	2	1	2	-	2	1	-	2
CO 4	3	3	3	3	2	1	2	-	2	1	-	2

UNIT I

Review of Semiconductor Fundamentals and Device Physics: Introduction to semiconductor materials and crystal structures, Intrinsic and extrinsic semiconductors, doping, and carrier concentration, PN junctions and diode characteristics, Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs) principles, MOSFET operation modes and characteristics

UNIT II

VLSI Fabrication Processes: Overview of VLSI fabrication process flow; Photolithography and patterning techniques; Oxidation, diffusion, and ion implantation processes; Thin film deposition methods: CVD, PVD; Etching techniques: wet etching, dry etching, plasma etching; Interconnect technologies and back-end processing;

UNIT III

Device Modeling and Simulation: Introduction to device modeling and its significance, SPICE (Simulation Program with Integrated Circuit Emphasis) fundamentals, MOSFET modeling: Level 1, Level 2, and Level 3 models, Capacitance and delay modelling, Process variations and statistical modelling,

UNIT IV

Advanced VLSI Technologies and Trends: Introduction to advanced CMOS technologies (FinFET, FD-SOI, etc.), Low-power design techniques and considerations , Introduction to semiconductor memories: SRAM, DRAM, Flash, Emerging trends in VLSI: Quantum computing, Neuromorphic engineering; Overview of design automation and EDA (Electronic Design Automation) tools;

Textbooks:

1. N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective," Addison-Wesley, 2011.
2. J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective," Pearson, 2016.

3. E. J. Rymaszewski, "Advanced CMOS Process Technology," IEEE Press, 2005.

References:

1. S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices," Wiley, 2006.
2. Y. Leblebici and M. Tan, "Fundamentals of Microelectronics," McGraw-Hill, 2013.
3. J. D. Meindl and S. F. Gong, "Conduction and Breakdown in Solid Dielectrics," IEEE Press, 1993.
4. C. Liu and S. M. Kang, "Introduction to Solid State Physics," Wiley, 2015.

<table>
<tr><td>Paper Code: ITE326P</td><td colspan="3">VLSI Technology and Design Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="1">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="3">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 326T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE328T	**Paper: CMOS Analog Integrated Circuit Design**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the fundamental principles of CMOS technology and transistor behavior in analog integrated circuits.
CO 2	Design and simulate CMOS-based amplifiers, voltage references, and current sources with a focus on low-power and high-gain performance.
CO 3	Apply advanced techniques for noise analysis and mitigation in CMOS analog circuits.
CO 4	Integrate theoretical knowledge with practical skills to construct, test, and troubleshoot CMOS analog integrated circuits.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT I

CMOS Fundamentals and Transistor Models: Introduction to CMOS technology, CMOS fabrication process, MOS transistor operation, small-signal and large-signal transistor models, DC biasing and current mirrors, common-source and common-drain amplifiers.

UNIT II

CMOS Amplifier Design: Single-stage amplifiers (common-source, common-gate, common-drain), differential amplifiers, frequency response analysis, stability considerations, compensation techniques, cascode amplifiers.

UNIT III

CMOS Voltage References and Current Sources: Voltage reference circuits, bandgap reference, current reference sources, biasing techniques, temperature compensation, current mirrors, basic current sources, cascode current mirrors.

UNIT IV

Noise Analysis and High-Performance Design Techniques: Noise sources in CMOS circuits, noise analysis and calculations, noise optimization strategies, low-noise amplifier design, feedback in analog circuits, stability analysis, Miller compensation.

Textbooks:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill Education, 2000.
2. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2001.

References:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley, 2014.
2. Robert F. Pierret, "Semiconductor Device Fundamentals", Pearson, 1996.
3. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley-IEEE Press, 2019.
4. Franco Maloberti, "Analog Design for CMOS VLSI Systems", Springer, 2001.

Paper Code: ITE328P	CMOS Analog Integrated Circuit Design Lab.			L	T/P	C
Paper ID:				-	2	1
Teacher's Continuous Evaluation :		40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 328T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE429T	**Paper: CMOS Digital Circuits Design**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and design basic CMOS logic gates and combinational circuits.
CO 2	Understand the principles of sequential circuits and design flip-flops and counters.
CO 3	Design and optimize memory elements such as static and dynamic RAM cells.
CO 4	Apply practical techniques for CMOS circuit design and consider trade-offs between power, speed, and area.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**1**
CO 2	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**1**	**-**	**1**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**1**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT I

Introduction to CMOS Technology and Logic Gates: Introduction to CMOS technology, CMOS fabrication process, CMOS inverter operation and characteristics, CMOS logic gates (AND, OR, NAND, NOR), noise margin analysis, power dissipation considerations.

UNIT II

Combinational Circuit Design: Combinational logic design using CMOS gates, multiplexers, demultiplexers, adders, subtractors, code converters, comparison logic, introduction to layout design.

UNIT III

Sequential Circuit Design: Latches and flip-flops (NAND, NOR, SR, D, JK), analysis and design of sequential circuits, timing analysis, clocking strategies, state diagrams, introduction to finite state machines.

UNIT IV

Memory Elements and Practical Design Considerations: Static RAM (SRAM) cell design, dynamic RAM (DRAM) cell design, read and write operations in SRAM and DRAM, non-volatile memories, introduction to low-power design techniques, design challenges in nanometer-scale CMOS technologies.

Textbooks:

1. N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective," 4th ed., Pearson, 2010.
2. J. M. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective," 2nd ed., Pearson, 2003.

References:

1. J. R. Baker, H. W. Li, and D. E. Boyce, "CMOS: Circuit Design, Layout, and Simulation," IEEE Press, 2010.
2. B. Razavi, "Principles of CMOS VLSI Design: A Systems Perspective," IEEE Press, 2009.
3. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design," 4th ed., McGraw-Hill, 2014.
4. P. R. Gray, P. J. Hurst, S. H. Lewis, and R. G. Meyer, "Analysis and Design of Analog Integrated Circuits," 5th ed., Wiley, 2009.

<table>
<tr><td>Paper Code: ITE429P</td><td colspan="3">CMOS Digital Circuits Design Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher’s Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 329T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE435T	**Paper: VLSI Testing**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of VLSI circuit testing, including fault models, test generation, and test metrics.
CO 2	Apply various test generation algorithms and techniques to ensure the reliable operation of digital integrated circuits.
CO 3	Analyze and assess the effectiveness of different fault coverage measures and testing strategies.
CO 4	Design and implement test benches for VLSI circuits, utilizing simulation tools and industry-standard practices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	1	1	-	1
CO 2	3	3	3	3	2	1	1	-	1	1	-	1
CO 3	3	3	3	3	2	1	1	-	2	1	-	1
CO 4	3	3	3	3	2	1	1	-	2	1	-	1

UNIT I

Introduction to VLSI Circuit Testing: Overview of VLSI testing, challenges in VLSI testing, fault types and models, testing technology trends.

UNIT II

Test Generation Techniques: Automatic test pattern generation (ATPG) algorithms, pseudo-random and deterministic test pattern generation, fault simulation, test compaction techniques.

UNIT III

Test Coverage and Strategies: Coverage metrics (fault coverage, path coverage, transition fault coverage), fault diagnosis, design for testability (DFT) techniques, built-in self-test (BIST) methods.

UNIT IV

Advanced Topics in VLSI Testing: Scan chains and scan-based testing, memory testing, delay testing, analog and mixed-signal testing, boundary scan testing.

Textbooks:

1. J. Bhasker, "A VLSI Test Primer," Morgan Kaufmann, 1998.
2. N. K. Jha and S. Gupta, "Testing of Digital Systems," Cambridge University Press, 2003.

References:

1. M. L. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits," Springer, 2000.
2. L. W. Cooke and A. J. Wakerly, "Digital Design: Principles and Practices," Prentice Hall, 2003.
3. I. Pomeranz and S. M. Reddy, "Fault-Tolerant Test Compression," Springer, 2006.

Paper Code: ITE315T	Paper: Wireless Communication Systems	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the fundamental concepts and techniques used in wireless communication systems.
CO 2	Evaluate the design considerations and trade-offs in various wireless communication technologies.
CO 3	Design and simulate basic wireless communication systems for different applications.
CO 4	Critically assess the current trends and challenges in the field of wireless communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	2
CO 2	3	3	3	2	2	1	1	-	-	-	-	2
CO 3	3	3	3	2	2	1	1	-	-	-	-	2
CO 4	3	3	3	2	2	1	1	-	1	-	-	2

UNIT I

Introduction to Wireless Communication: Evolution of wireless communication, Types of wireless communication systems, Frequency reuse, Cellular architecture, Wireless channel characteristics, Signal propagation models.

UNIT II

Modulation and Coding Techniques: Analog and digital modulation techniques, Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Digital Modulation (ASK, FSK, PSK, QAM), Error detection and correction codes, Channel coding techniques.

UNIT III

Wireless Network Architectures: Multiple Access Techniques (FDMA, TDMA, CDMA), Wireless LANs and PANs, IEEE 802.11 standards, Cellular network generations (1G to 5G), Small cell networks, HetNets, Wireless sensor networks.

UNIT IV

Wireless Communication System Design:Link budget analysis, Wireless transceivers and antennas, Diversity techniques, Interference and co-channel interference management, Handover and mobility management, Introduction to wireless security.

Textbooks:
1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice," 2nd Edition, Prentice Hall, 2001.
2. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

References:
1. William C. Y. Lee, "Mobile Cellular Telecommunications: Analog and Digital Systems," 2nd Edition, McGraw-Hill, 1995.

2. Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications," 2nd Edition, Wiley, 2006.
3. Arogyaswami J. Paulraj, Rohit Nabar, Dhananjay Gore, "Introduction to Space-Time Wireless Communications," Cambridge University Press, 2003.
4. Martin Sauter, "From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband," Wiley, 2011.

Paper Code: ITE315P	**Wireless Communication Systems Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ITE 315T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.						

Paper Code: ITE330T	Paper: Cellular and Mobile Communication	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and compare various cellular network architectures and standards.
CO 2	Design and simulate cellular communication systems for different environments.
CO 3	Evaluate the performance of cellular networks and apply optimization techniques.
CO 4	Examine the latest developments and challenges in the field of mobile communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	1	1	1	-	1	-	-	2
CO 2	3	3	3	2	1	1	1	-	-	-	1	2
CO 3	3	3	3	2	1	1	1	-	-	-	1	2
CO 4	3	3	3	2	2	1	1	-	1	-	1	2

UNIT I

Fundamentals of Cellular Communication: Introduction to cellular networks, Frequency reuse and cell planning, Handoff and roaming, Cellular architecture and components, Propagation models for cellular networks.

UNIT II

Cellular Network Protocols and Technologies: GSM, CDMA, FDMA, TDMA, 3G, 4G LTE, 5G NR, Multiple access techniques, Mobile network protocols, Location management.

UNIT IV

Cellular Network Planning and Optimization: Coverage and capacity planning, Link budget analysis, Antenna systems and diversity, Interference management, Quality of Service (QoS) in cellular networks, Mobility management.

UNIT IV

Advanced Topics in Cellular Communication: HetNets and small cells, Massive MIMO technology, Carrier aggregation, Cloud RAN and virtualization, Internet of Things (IoT) connectivity in cellular networks, Security and privacy in mobile communication.

Textbooks:
1. A. Molisch, "Wireless Communications," Wiley, 2011.
2. T. S. Rappaport, "Wireless Communications: Principles and Practice," Pearson, 2019.

References:
1. A. Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
2. W. C. Y. Lee, "Mobile Communications Design Fundamentals," Wiley, 2013.
3. E. Dahlman et al., "5G NR: The Next Generation Wireless Access Technology," Academic Press, 2020.
4. M. Saquib et al., "Cellular Internet of Things: Technologies, Standards and Performance," Springer, 2017.

Paper Code: ITE330P	Cellular and Mobile Communication Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 330T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE332T	**Paper: Ad Hoc Sensor Networks**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the architectural components and characteristics of ad hoc sensor networks, and comprehend their role in various engineering applications.
CO 2	Evaluate and compare different routing algorithms and protocols used in ad hoc sensor networks, considering their performance metrics and trade-offs.
CO 3	Design and simulate ad hoc sensor network scenarios using appropriate tools, considering factors like energy efficiency, data aggregation, and network scalability.
CO 4	Investigate and propose solutions to the security and privacy challenges inherent in ad hoc sensor networks, demonstrating an understanding of cryptographic techniques and secure communication protocols.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	-	-	-	-	-	2
CO 2	3	3	3	2	2	1	1	-	2	-	2	2
CO 3	3	3	3	2	3	1	-	-	-	-	1	2
CO 4	3	3	3	2	3	1	-	-	1	-	1	2

UNIT I

Introduction to Ad Hoc Sensor Networks: Definition, characteristics, and applications of ad hoc sensor networks; Types of sensor nodes: static, mobile, and sink nodes; Communication models: direct communication, multihop communication; Network topologies: flat, hierarchical, and cluster-based architectures.

UNIT II

Routing Protocols for Ad Hoc Sensor Networks: Overview of routing challenges and solutions in sensor networks; Proactive, reactive, and hybrid routing protocols: DSDV, AODV, DSR, and OLSR; Energy-efficient routing: LEACH protocol and variations; Geographic routing algorithms: GPSR, Greedy Perimeter Stateless Routing

UNIT III

Network Simulation and Performance Evaluation: Introduction to network simulation tools (NS-2/NS-3, OMNeT++); Simulation of ad hoc sensor network scenarios: traffic patterns, node mobility; Performance metrics: throughput, latency, packet delivery ratio Data aggregation techniques for energy efficiency

UNIT IV

Security and Privacy in Ad Hoc Sensor Networks: Security challenges in sensor networks: node compromise, eavesdropping, data tampering; Cryptographic techniques: symmetric and asymmetric encryption, digital signatures; Key management and distribution: pairwise keys, group keys; Secure communication protocols: SPINS, TinySec

Textbooks:

1. S.S. Iyengar and R. Raghavendra, "Wireless Sensor Networks," Springer, 2010.

References:

1. C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols," Prentice Hall, 2004.
2. F. Akyildiz, M.C. Vuran, and S. Akan, "A Cross-Layer Protocol for Wireless Sensor Networks," IEEE Transactions on Networking, vol. 16, no. 2, pp. 425-438, 2008.
3. W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000.
4. I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless Sensor Networks: A Survey," Computer Networks, vol. 38, no. 4, pp. 393-422, 2002.

Paper Code: ITE332P	**Ad Hoc Sensor Networks Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 332T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE437	**Paper: Cognitive Radio & Networks**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of cognitive radio technology and its role in modern wireless communication systems.
CO 2	Analyze the challenges and benefits of dynamic spectrum access and management in cognitive radio networks.
CO 3	Design and evaluate cognitive radio networks, considering various parameters and constraints.
CO 4	Apply cognitive radio concepts to real-world engineering problems, demonstrating creativity and adaptability in wireless communication scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	2
CO 2	3	3	3	2	2	1	1	-	-	-	-	2
CO 3	3	3	3	2	2	1	1	-	-	-	-	2
CO 4	3	3	3	2	2	1	1	-	1	-	-	2

UNIT I

Introduction to Cognitive Radio: Introduction to cognitive radio technology, spectrum scarcity and opportunities, historical evolution of cognitive radio, spectrum sensing techniques, overview of cognitive radio architecture, cognitive cycle.

UNIT II

Spectrum Management and Dynamic Spectrum Access: Spectrum regulation and policy, spectrum sensing methods, spectrum sensing databases, spectrum mobility and handoff, cooperative spectrum sensing, spectrum sharing techniques, medium access control (MAC) protocols for cognitive radio networks.

UNIT III

Cognitive Radio Network Architecture: Cognitive radio network models, primary user detection and interference management, channel allocation strategies, routing in cognitive networks, energy efficiency in cognitive networks, quality of service (QoS) considerations.

UNIT IV

Applications and Future Trends: Cognitive radio for 5G and beyond, cognitive radio in IoT, security and privacy issues in cognitive networks, machine learning and AI techniques for cognitive radio, case studies of cognitive radio applications.

Textbooks:

1. T. Yucek and H. Arslan, "Cognitive Radio and Networking for Heterogeneous Wireless Networks," IEEE Press, 2015.
2. S. Haykin, "Cognitive Radio: Brain-Empowered Wireless Communications," Wiley, 2005.

References:

1. J. Mitola III and G. Q. Maguire Jr., "Cognitive Radio: Making Software Radios More Personal," IEEE Personal Communications, 1999.

2. A. G. Kouki, "Cognitive Radio and Its Applications for Next Generation Cellular and Wireless Networks," IEEE Communications Magazine, 2014.
3. S. C. Ergen, "Cognitive Radio: An Emerging Paradigm for Wireless Communications," Wiley, 2009.
4. I. F. Akyildiz, W. Y. Lee, M. C. Vuran, and S. Mohanty, "Next Generation/Dynamic Spectrum Access/Cognitive Radio Wireless Networks: A Survey," Computer Networks, 2006.

Paper Code: ITE439T	Paper: Privacy and Security in Wireless Networks	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the security risks and privacy concerns in wireless networks.
CO 2	Design and implement effective security mechanisms for wireless communication.
CO 3	Evaluate different encryption and authentication protocols used in wireless networks.
CO 4	Apply privacy-preserving techniques to safeguard user data in various wireless applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	2
CO 2	3	3	3	2	2	1	1	-	-	-	-	2
CO 3	3	3	3	2	2	1	1	-	-	-	-	2
CO 4	3	3	3	2	2	1	1	-	1	-	-	2

UNIT I

Fundamentals of Wireless Network Security: Introduction to wireless networks and their vulnerabilities, Threat models in wireless communication, Overview of cryptographic concepts, Security challenges in wireless networks.

UNIT II

Encryption and Authentication in Wireless Networks: Symmetric and asymmetric encryption techniques, Public key infrastructure (PKI), Wireless authentication protocols (WEP, WPA, WPA2), Identity and access management.

UNIT III

Privacy-Preserving Techniques in Wireless Applications: Location privacy in wireless networks, Anonymity and pseudonymity, Data aggregation techniques, Differential privacy, Privacy-enhancing technologies.

UNIT IV

Emerging Trends in Wireless Network Security: Security considerations in IoT devices and networks, 5G and beyond security challenges, Threats and countermeasures in mobile ad hoc networks, Wireless network intrusion detection and prevention.

Textbooks:

1. C. Clancy, D. Yuan, and B. A. LaMacchia, "Security and Privacy for Next-Generation Wireless Networks," IEEE Press, 2013.
2. A. Mishra and V. D. Gligor, "Wireless Communications and Mobile Devices Security," Springer, 2018.

References:

1. J. Wilander and J. Kamkar, "802.11 Security," IEEE Security & Privacy, vol. 2, no. 3, pp. 52-58, 2004.
2. I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A Survey on Sensor Networks," IEEE Communications Magazine, vol. 40, no. 8, pp. 102-114, 2002.
3. P. McDaniel and I. F. Akyildiz, "Security in Wireless Sensor Networks," IEEE Computer, vol. 38, no. 10, pp. 53-56, 2005.
4. D. Liu, P. Ning, and W. Du, "Group-Based Secure and Efficient Data Aggregation in Wireless Sensor Networks," IEEE Transactions on Information Forensics and Security, vol. 2, no. 4, pp. 828-836, 2007.

Paper Code: ITE317T	Paper: Fundamentals of Image Processing	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the basic principles of digital image processing and explain the core components of an image processing system.
CO 2	Apply various image enhancement techniques to improve image quality and interpret the effects of different enhancement methods.
CO 3	Implement image transformation and restoration techniques, and analyze their applications in noise reduction and image reconstruction.
CO 4	Describe the principles of image compression, apply different compression algorithms, and evaluate their trade-offs between compression ratio and image quality.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Image Processing: Introduction to digital image processing, image representation and models, human visual perception, image acquisition and sampling, color models and applications.

UNIT II

Image Enhancement: Histogram equalization, contrast stretching, spatial domain enhancement techniques (smoothing, sharpening), frequency domain enhancement (Fourier transform, filtering), adaptive and histogram specification.

UNIT III

Image Transformation and Restoration: Geometric transformations (scaling, rotation, translation), image interpolation methods, restoration models (degradation, noise), noise models (additive, multiplicative), image denoising techniques (spatial filters, median filters), image deblurring techniques.

UNIT IV

Image Compression: Lossless and lossy compression, entropy coding, Huffman coding, Run-Length Encoding (RLE), transform coding (Discrete Cosine Transform - DCT), JPEG image compression, evaluation metrics for compression.

Textbooks:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson, 2017.
2. Milan Sonka, Vaclav Hlavac, and Roger Boyle, "Image Processing, Analysis, and Machine Vision," Cengage Learning, 2013.

References:

1. William K. Pratt, "Digital Image Processing: PIKS Inside," Wiley, 2007.
2. Bernd Jahne, "Digital Image Processing," Springer, 2005.
3. Gonzalez, Rafael C., and Woods, Richard E., "Digital Image Processing Using MATLAB," Gatesmark Publishing, 2009.

Paper Code: ITE317P	**Fundamentals of Image Processing Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :		**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 317T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE334T	**Paper: Image Filtering and Restoration**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the basic concepts of image filtering and restoration techniques.
CO 2	Analyze different types of noise and artifacts present in images.
CO 3	Apply various image filtering techniques to enhance image quality.
CO 4	Implement image restoration algorithms to recover degraded images.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT I

Fundamentals of Image Filtering and Restoration: Introduction to image processing, image enhancement vs. image restoration, image degradation processes, noise models, point processing techniques, spatial domain vs. frequency domain methods.

UNIT II

Image Filtering Techniques: Convolution and correlation, linear and nonlinear filters, mean and order statistics filters, Gaussian and adaptive filters, edge enhancement filters, morphological filters, filter design and analysis.

UNIT III

Noise Reduction and Restoration: Noise reduction methods, types of noise (additive, multiplicative, impulse), spatial domain noise reduction filters (median, adaptive median, Wiener), frequency domain noise reduction (FFT-based filtering), restoration process overview, inverse filtering, least squares filtering, constrained least squares filtering.

UNIT IV

Advanced Restoration Techniques: Blind deconvolution, Wiener deconvolution, regularization methods (Tikhonov, total variation), image denoising algorithms (BM3D, wavelet denoising), image inpainting, super-resolution techniques, case studies in image restoration.

Textbooks:

1. Gonzalez, R.C., Woods, R.E., & Eddins, S.L. (2009). Digital Image Processing Using MATLAB. Pearson.
2. Pratt, W.K. (2007). Digital Image Processing: PIKS Inside. John Wiley & Sons.

References:

1. Burger, W., & Burge, M.J. (2008). Digital Image Processing: An Algorithmic Introduction Using Java. Springer.
2. Sonka, M., Hlavac, V., & Boyle, R. (2014). Image Processing, Analysis, and Machine Vision. Cengage Learning.
3. Milanfar, P. (2013). Super-Resolution Imaging. CRC Press.

4. Shapiro, L.G., & Stockman, G.C. (2001). Computer Vision. Prentice Hall.

Paper Code: ITE334P	**Image Filtering and Restoration Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 334T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE336T	**Paper: Computer Vision and Object Recognition**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

3. Teacher's Continuous Evaluation: 25 Marks
4. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational principles of computer vision and its applications in diverse fields.
CO 2	Analyze and implement image processing techniques for enhancing visual data.
CO 3	Apply different algorithms for object detection and recognition in images and videos.
CO 4	Design and develop computer vision applications to solve real-world problems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT I

Introduction to Computer Vision: Introduction to computer vision, history and applications of computer vision, human visual perception, image representation and acquisition, color spaces, image filtering and enhancement.

UNIT II

Image Processing and Feature Extraction: Image preprocessing, histogram equalization, noise reduction, image segmentation, edge detection, feature extraction techniques (HOG, SIFT, etc.), morphological operations.

UNIT III

Object Detection and Localization: Object detection methods (Haar cascades, YOLO, SSD), region-based methods, sliding window approach, object localization, non-maximum suppression, evaluation metrics for object detection.

UNIT IV

Object Recognition and Applications: Image classification, deep learning for computer vision, convolutional neural networks (CNNs), transfer learning, feature visualization, case studies in image recognition (face recognition, scene recognition), applications in autonomous vehicles and medical imaging.

Textbooks:

1. R. Szeliski, "Computer Vision: Algorithms and Applications," Springer, 2010.
2. S. Prince, "Computer Vision: Models, Learning, and Inference," Cambridge University Press, 2012.

References:

1. R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision," Cambridge University Press, 2004.
2. D. Forsyth and J. Ponce, "Computer Vision: A Modern Approach," Prentice Hall, 2002.
3. J. Redmon and A. Farhadi, "YOLOv3: An Incremental Improvement," arXiv:1804.02767, 2018.

4. A. Krizhevsky, I. Sutskever, and G. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," Advances in Neural Information Processing Systems, 2012.

Paper Code: ITE336P	**Computer Vision and Object Recognition Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 336T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE441T	**Paper: Deep Learning for Image Analysis**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational principles of deep learning and its applications in image analysis.
CO 2	Design and implement convolutional neural networks for image classification tasks.
CO 3	Apply deep learning techniques to solve real-world problems in object detection and image segmentation.
CO 4	Evaluate and critically analyze the performance of deep learning models for various image analysis tasks.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT I

Introduction to Deep Learning and Convolutional Neural Networks (CNNs): Introduction to deep learning, neural networks architecture, perceptrons, activation functions, training neural networks, convolutional layers, pooling layers, CNN architecture, backpropagation for CNNs.

UNIT II

Image Classification with CNNs: Image preprocessing, building CNN architectures for image classification, transfer learning, fine-tuning CNNs, regularization techniques, evaluation metrics for classification.

UNIT III

Object Detection and Localization: Object detection vs. classification, bounding boxes, anchor-based and anchor-free methods, region-based CNNs, one-stage vs. two-stage detectors, non-maximum suppression, evaluation metrics for object detection.

UNIT IV

Image Segmentation and Semantic Segmentation: Image segmentation overview, semantic segmentation vs. instance segmentation, fully convolutional networks (FCNs), U-Net architecture, dilated convolutions, evaluation metrics for segmentation.

Textbooks:

1. F. Chollet, "Deep Learning with Python," Manning Publications, 2017.
2. I. Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," MIT Press, 2016.

References:

1. R. Szeliski, "Computer Vision: Algorithms and Applications," Springer, 2010.
2. J. Redmon and A. Farhadi, "YOLO9000: Better, Faster, Stronger," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017.
3. O. Ronneberger, P. Fischer, and T. Brox, "U-Net: Convolutional Networks for Biomedical Image Segmentation," International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2015.

<table>
<tr><td>Paper Code: ITE441P</td><td colspan="3">Deep Learning for Image Analysis Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 441T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE447T	**Paper: Medical Image Processing**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.

2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.

4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.

5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Apply advanced image processing techniques to enhance and analyze medical images.
CO 2	Utilize segmentation algorithms to isolate and extract specific structures or regions of interest from medical images.
CO 3	Implement feature extraction methods to characterize and quantify relevant information from medical images.
CO 4	Evaluate and discuss the challenges and future trends in the field of medical image processing.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	-	-	-	-
CO 2	3	2	3	2	2	-	-	-	-	-	-	-
CO 3	3	2	3	3	2	-	-	-	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	-	-

UNIT I

Image Enhancement Techniques for Medical ImagesContrast enhancement, Histogram equalization, Adaptive histogram equalization, Spatial domain filtering for noise reduction, Frequency domain filtering for noise reduction, Unsharp masking for edge enhancement.

UNIT II

Medical Image Segmentation: Thresholding methods, Region-based segmentation, Edge-based segmentation, Clustering-based segmentation, Watershed transformation, Level set methods.

UNIT III

Feature Extraction from Medical Images: Texture analysis, Morphological feature extraction, Shape-based features, Intensity-based features, Principal Component Analysis (PCA) for dimensionality reduction, Feature selection techniques.

UNIT IV

Challenges and Future Trends in Medical Image Processing: Artifacts in medical images and correction techniques, 3D medical image processing, Deep learning for medical image analysis, Computer-aided diagnosis, Image registration in medical images, Emerging trends in medical imaging technologies.

Textbooks / References:

1. Gonzalez, R. C., & Woods, R. E. (2018). Digital Image Processing. Pearson.
2. Milan Sonka, Vaclav Hlavac, & Roger Boyle. (2014). Image Processing, Analysis, and Machine Vision. Cengage Learning.
3. Bankman, I. N. (Ed.). (2020). Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis. Academic Press.
4. Suri, J. S., & Reden, L. (Eds.). (2019). Handbook of Biomedical Image Analysis (Vol. 1-3). Springer.
5. Shen, D., & Yan, P. (Eds.). (2020). Deep Learning in Medical Image Analysis. Academic Press.

Paper Code: ITE447P	Medical Image Processing Lab.			L	T/P	C
Paper ID:				-	2	1
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 447T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE321T / ITE 350T	Paper: Introduction to Object Oriented Programming Using C++	L	T/P	C
Paper ID:		**3**	**-**	**3**

Prerequisite Papers: None

Marking Scheme :

3. Teacher's Continuous Evaluation : 25 marks
4. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

5. There should be 9 questions in the term end examinations question paper.
6. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
7. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
8. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Outcomes (CO)

CO 1	Ability to have an in-depth knowledge of object oriented programming paradigm
CO 2	To be able to develop basic C++ programming skills
CO 3	To be able to apply various object oriented features using C++
CO 4	Ability to have an understanding of generic programming & standard templates

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT – I

Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, C++ Programming Language, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Type Conversions, Operator Precedence, The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend Functions, default parameter value.

UNIT - II

Specifying a class, Member Functions, Encapsulation, information hiding, abstract data types, objects & classes, Static Member Functions, Arrays of Objects, Constructors & Destructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, identity and behaviour of an object, C++ garbage collection, dynamic memory allocation, Explicit Type Conversions, Operator Overloading.

UNIT - III

Inheritance, inheritance methods, Class hierarchy, derivation – public, private & protected, aggregation, Inheritance Constructors, composition vs. classification hierarchies, Containership, Initialization List, Polymorphism, categorization of polymorphic techniques, polymorphism by parameter, parametric polymorphism, generic function – template function, function overriding, run time polymorphism, virtual functions.

UNIT - IV

Standard C++ classes, using multiple inheritance, streams and files, namespaces, exception handling, generic classes, overview of standard template library, iterators and allocators, strings, streams, manipulators, user defined manipulators, vectors.

Textbook(s):

1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, "C++ Primer", Addison-Wesley Professional, 2012.
2. Ivor Horton, "Using the C++ Standard Template Libraries", Apress, 2015.

3. R. Lafore, “Object Oriented Programming using C++”, Galgotia.

References:

1. A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH
2. Bjarne Stroustrup, “Programming: principles and practice using C++”, Addison-Wesley, 2015.
3. Bjarne Stroustrup, “A Tour of C++”, Addison-Wesley Professional, 2018.
4. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition, Addison-Wesley Professional, 2013.
5. Peter Van Weert and Marc Gregoire, “C++17 Standard Library Quick Reference: A Pocket Guide to Data Structures, Algorithms, and Functions”, Apress (2019)
6. Rumbaugh et. al. “ Object Oriented Modelling & Design”, Prentice Hall
7. G . Booch “Object Oriented Design & Applications”, Benjamin,Cummings.
8. E.Balaguruswamy, “Objected Oriented Programming with C++”, TMH
9. Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication.
10. Slobodan Dmitrović, Modern C++ for Absolute Beginners”:A Friendly Introduction to C++ Programming Language and C++11 to C++20 Standards”, Apress, 2020.

Paper Code: ITE321P / ITE 350P	**Introduction to Object Oriented Programming using C++ Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher’s Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 321T / ITE 350T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE338T	Paper: Data Structures and Algorithms	L	T/P	C
Paper ID:		3	-	3

Prerequisite Papers: None

Marking Scheme :

5. Teacher's Continuous Evaluation : 25 marks
6. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

9. There should be 9 questions in the term end examinations question paper.
10. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
11. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
12. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Outcomes (CO)

CO 1	Ability to design programs using stacks and queues (array based). And, use them for expression representation and evaluation and sparse matrix representation. Also ability to write recursive programs.
CO 2	Ability to utilise linked list (single, doubly linked and circular) to write programs. And, to represent polynomials using lists with addition implementation.
CO 3	Ability to design operations on the tree structure for insertion, deletion and traversal. Ability to use the trees for searching applications.
CO 4	Ability to design operations on the graph structure for insertion, deletion and traversal. Ability to use the trees for searching applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO 2	**3**	**3**	**3**	**2**	**3**	**-**	**1**	**-**	**2**	**-**	**2**	**-**
CO 3	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO 4	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

UNIT – I

Basic Terminology, Elementary Data Organization, Structure operations, Algorithm Complexity and TimeSpace trade-off, Array Definition, Representation and Analysis, Single and Multidimensional Arrays, application of arrays, Character string operation, Array as Parameters, Ordered List, Sparse Matrices and Vectors, Array Representation and Implementation of stack, Operations on Stacks: Push & Pop,Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursive definition and processes, example of recursion, Tower of Hanoi Problem, Backtracking, recursive algorithms, principles of recursion

UNIT - II

Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, D-queues and Priority Queues. Representation and Implementation of Singly Linked Lists, Two-way Header List,Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list, Garbage Collection and Compaction

UNIT - III

Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees, Traversing, Threaded Binary trees, Huffman Algorithm, Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation

UNIT - IV

Insertion Sort, Bubble Sorting, Quick Sort, Two Way Merge Sort, Heap Sort, Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees, B-trees. Graphs & Multi-graphs, Directed Graphs, Sequential Representations of Graphs, Physical Storage Media File Organization, Organization of records into Blocks, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files,B Tree index Files, Indexing and Hashing Comparisons.

Textbook(s):

1. S. Sahni and E. Horowitz, "Data Structures, Algorithms and applications in C++", 2nd edition ,Universities Press.

References:

1. R.F.Gilberg,andB.A.Forouzan,"Data structures :A Pseudocode approach with C", Thomson Learning.
2. A.V.Aho, J.E.Hopcroft, J.D.Ulman, "Data Structures and Algorithm", Pearson Education.
3. A. Tanenbaum, "Data Structures using C", Pearson/PHI.
4. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", PHI/Pearson.

Paper Code: ITE338P	**Data Structures and Algorithms Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 338T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE 340T / ITE325T	Paper : Introduction to Database Management System	L	T/P	C
Paper ID:		**3**	**0**	**3**

Prerequisite Papers: None

Marking Scheme :

3. Teacher's Continuous Evaluation : 25 marks
4. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

5. There should be 9 questions in the term end examinations question paper.
6. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
7. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
8. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Outcomes (CO) :

CO 1	Ability to understand advantages of database systems
CO 2	Ability to use SQL as DDL, DCL and DML
CO 3	Ability to design database and manage transaction processing
CO 4	Understand object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Enhanced ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model. Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form

UNIT - II:

Relational model concepts, relational model constraints, relational algebra, relational calculus, SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types.

UNIT - III

Transaction control commands – Commit, Rollback, Save point, stored procedures,Triggers (with emphasis on mySQL and postgreSQL).

UNIT - IV

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.

Textbooks:

1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018

2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. Luca Ferrari and Enrico Pirozzi, Learn PostgreSQL: Build and manage high-performance database solutions using PostgreSQL 12 and 13"", Packt Publishing, 2020.

References:

1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
6. Joel Murach, Murach's Mysql"", 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
7. MySQL and PostgreSQL manuals.

Paper Code: ITE340P	**Introduction to Database Management System Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 340T / **ITE325T** as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE453T	Paper: Introduction to Computer Networks	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Outcomes (CO) :

CO 1	Ability to understand the concepts of computer networks, OSI model and TCP/IP model.
CO 2	Ability to understand the physical layer concepts and error control at Data link Layer
CO 3	Ability to understand the data link layer functions and protocols.
CO 4	Ability to understand network layer functions, Routing protocols and Transport layer functions

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO 2	**3**	**3**	**3**	**2**	**3**	**-**	**1**	**-**	**-**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**2**	**3**	**-**	**1**	**-**	**-**	**2**	**1**	**-**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**2**	**1**	**-**

UNIT I

Overview; protocol suites: TCP/IP and OSI, History, Standard.

Application Layer: Application layer paradigm, Client-server paradigm, Standard Client Server Applications, P2P, Socket Interface programming.

Transport Layer: Protocols: simple, stop-and-wait, GBN, Selective repeat, Bidirectional protocols, Internet Transport Layer protocols, UDP, TCP

UNIT II

Network Layer: Introduction, IPv4, ICMPv4, Unicast Routing, Multicast routing, IPV6, ICMPv6.

Data-Link Layer (Wired Networks): Introduction, DLC, Multiple Access Protocols, Wired LANS (Ethernet, others)

UNIT III

Data-Link Layer (Wireless Networks): Introduction, IEEE 802.11, Bluetooth, WiMAX, Cellular telephony, Satellite Networks, Mobile IP.

Physical Layer and Transmission Media: Data and Signals, Digital Transmission, Analog Transmission, Bandwidth utilization, Transmission Media.

UNIT IV

Network Management: Introduction, SNMP, ASN.1

Security: Introduction, Ciphers, Application layer security, transport layer security, network layer security, packet filter firewall, proxy firewall.

Textbook(s):

1. B. A. Forouzan and F. Mosharraf, “Computer Networks: A Top-Down Approach”, TMH, 2012

2. James F. Kurose and Keith W.,"Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.

References:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2013
2. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education India 2013.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Elsevier, 2012
4. Natalia Olifer and Victor Olifer, "Computer Networks: Principles, Technologies and Protocols for Network Design", Wiley, 2006
5. Jerry FitzGerald, Alan Dennis and Alexandra Durcikova, "Business Data Communications and Networking", John Wiley & Sons, 2019
6. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, India, 2017
7. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 2005

Paper Code: ITE353P		**Introduction to Computer Networks Lab.**		**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 353T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE323	**Paper: Circuits and Systems**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required.

Course Outcomes (CO) :

CO 1	Understand the classification and properties of signals and systems.
CO 2	Ability to use Fourier series, Fourier Transforms and Laplace transforms to analyse continuous systems while for discrete systems have ability to use Discrete Fourier Series, Discrete Time Fourier Transform and Z- Transform.
CO 3	Ability to analyse electrical networks with DC sources and the theorems and transformations (source and circuits) associated.
CO 4	Ability to analyse electrical networks with AC sources and the theorems and transformations (source and circuits) associated.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**3**	**2**	**2**	**3**
CO 2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**3**	**2**	**2**	**3**
CO 3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**3**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**3**	**2**	**2**	**3**

UNIT I

Review of complex variables: Complex Numbers, Algebra of Complex Numbers, Functions of Complex Variable, Taylor and Laurant Series, Differentiation, Integration, Cauchy Theorem, Residue Theorem. Signals, Classification of Signals, Systems, Classification of Systems. Linear Time Invariant (LTI) Systems.

UNIT II

Laplace Transform, z-Transform, Fourier Series and Transform (Continuous and Discrete) and their properties. Laplace Transform and Continuous Time LTI systems, z-Transform and Discrete Time LTI systems, Fourier analysis of signals and systems, State Space Analysis

UNIT III

Circuits: Voltage, Ideal Voltage Source, Current Ideal Current Sources, Classification of Circuits, Ohm's Law, Resistively, Temperature Effect, Resistors, Resistor Power Absorption, Nominal Values and Tolerances, Colour Codes, Open and Short Circuits, Internal Resistance.

UNIT IV

AC Circuits: Circuits containing Capacitors and Inductors, Transient Response, Alternating Current and Voltages, Phasors, Impedences and Admittance, Mesh Analysis, Loop Analysis, Nodal Analysis, Thevenin's and Norton's Theorem, Y - Δ and Δ- Y Transformation, Bridge Circuits. Resonant Circuits, Complex Frequency and Network Function, Two port Networks. Passive Filters

Textbook(s):

1. B. P. Lathi, "Signal Processing and Linear System", Berkeley Cambridge Press, 1998
2. A. H. Robbins and W. C. Miller, "Circuit Analysis: Theory and Practice", Thomson Learning/Delmar Pub., 2007.
3. A. B. Carlson, "Circuits", Thomson/Brooks-Cole, 2000.

References:

1. S. Haykin and B. V. Veen, “Signal and Systems”, John Wiley and Sons, 1999.
2. H. P. Hsu, “Schaum’s Outlines of The Theory and Problems of Signals and Systems”, McGraw-Hill, 1995.
3. S. Poornachandra, “Signal and Systems”, Thomson Learning, 2004.
4. M. Nahvi and J. A. Edminister, “Schaum’s Outline of Theory and Problems of Electric Circuits”, McGraw-Hill, 2003.

Paper Code: ITE342T	Paper: Electronic Devices and Circuits	L	T/P	C
Paper ID:		**3**	**0**	**3**
Prerequisite Paper: None				

Marking Scheme :

3. Teacher's Continuous Evaluation : 25 marks
4. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

6. There should be 9 questions in the term end examinations question paper.
7. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
8. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
9. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
10. The requirement of (scientific) calculators/log tables/data-tables may be specified if required.

Course Outcomes (CO) :

CO 1	Ability to analyse PN junctions in semiconductor devices under various conditions.
CO 2	Ability to design and analyse simple rectifiers and voltage regulators using diodes.
CO 3	Ability to describe the behavior of special purpose diodes.
CO 4	Ability to design and analyse simple BJT and MOSFET circuits.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT I

Construction, characteristics and working principles of semi conductor diodes: PN junction diode, zener diode, varactor diode, schottky diode, photo diodes, Light emitting diode, Laser diode.

UNIT II

Construction, operation of NPN & PNP transistor, characteristics, Types of configurations, methods of transistor biasing and stabilization.

UNIT III

Classification of FET's, construction & working principles of JFET, MOSFET, biasing methods, small signal model parameters.

UNIT IV

Linear Integrated Circuits: Differential amplifier circuits, operational amplifiers and its applications, Oscillators: Concept of Feedback, barkhausen criteria for sinusoidal oscillators, phase shift oscillators, wein bridge & crystal oscillator.

Textbook(s):

1. Millman & Halkias Electronic Devices & Circuits, TMH(ISE)
2. Boylestad, "Electronic Devices and Circuit Theory", 9th Ed.
3. B. G. Streetman, Theory & Technology & Semiconductor Devices.

References:

1. B. P. Singh and R. Singh, Electronic Devices & Integrated Circuits, Pearson, 2006.
2. B. Kumar and S. J. Jain, Electronic Devices and Circuits, "Prntice Hall of India, 2007.
3. S.G. Burns, P.R. Bond, "Principles of Electronic Circuits, 2nd Ed., Galgotia
4. M.S. Roden, G.L. Carpenter & W.R.Wieseraman, "Electronic Design", Shroff Publisher & Distributors.
5. S. Salivahanan & other, Electronic Devices & Circuits, TMH.
6. Malvino, Electronic Principles, TMH.7. Jacob Millman, Micro Electronics, TMH.
7. Jacob Millman, Micro Electronics, TMH.

<table>
<tr><td>Paper Code: ITE342P</td><td colspan="2">Electronic Devices and Circuits Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 342T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE463T	Paper: Introduction to Control Systems	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper: None

Marking Scheme :

1. Teacher's Continuous Evaluation : 25 marks
2. Term and Theory Examinations : 75 marks

Guidelines for Paper Setter(s)

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3. Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
5. The requirement of (scientific) calculators/log tables/data-tables may be specified if required.

Course Outcomes (CO) :

CO 1	Ability to analyse PN junctions in semiconductor devices under various conditions.
CO 2	Ability to design and analyse simple rectifiers and voltage regulators using diodes.
CO 3	Ability to describe the behavior of special purpose diodes.
CO 4	Ability to design and analyse simple BJT and MOSFET circuits.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT I

Basics of Control Systems: Introduction to control systems and their significance in engineering; Open-loop and closed-loop systems: distinctions and applications; Block diagrams, signal flow, and system components; Time-domain analysis: transient and steady-state response; Basics of mathematical modeling for control systems

UNIT II

Modeling and Analysis: Differential equations and transfer function representation; Laplace transform and its application to control systems; Modeling engineering systems: mechanical, electrical, and more; Stability analysis using poles, zeros, and frequency response; Introduction to discrete-time systems and z-transform

UNIT III

Control System Design Techniques: Control system specifications and objectives; Proportional-Integral-Derivative (PID) control and tuning Root-locus analysis and design techniques Frequency domain analysis and Bode plots Brief overview of state-space representation

UNIT IV

Digital control systems: discretization and implementation; Nonlinear systems and control challenges; Robust control concepts and applications; Introduction to optimal control: LQR and LQG; Multivariable control considerations

Textbook(s):

1. "Modern Control Engineering" by Katsuhiko Ogata. Published by Pearson. Year: 2010.
2. "Control Systems Engineering" by Norman S. Nise. Published by Wiley. Year: 2019..

References:

1. Dorf, R. C., & Bishop, R. H. (2016). "Modern Control Systems." Pearson.
2. Franklin, G. F., Powell, J. D., & Emami-Naeini, A. (2014). "Feedback Control of Dynamic Systems." Pearson.
3. Åström, K. J., & Murray, R. M. (2010). "Feedback Systems: An Introduction for Scientists and Engineers." Princeton University Press.

Paper Code: ITE463P	Introduction to Control Systems Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 463T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE329	Paper: System Analysis and Design	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Apply System Analysis Techniques: Utilize various techniques to analyze engineering systems, identify requirements, and formulate solutions.
CO 2	Design Effective Systems: Design and model engineering systems considering both software and hardware components to meet specified requirements.
CO 3	Integrate Software and Hardware: Integrate software and hardware components seamlessly within engineering systems while ensuring compatibility and optimal performance.
CO 4	Collaborate in System Development: Work effectively as part of a team to develop and refine engineering systems, incorporating feedback and iterative design processes.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	2	3	-	-	-	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	3	2	3
CO 4	3	3	3	2	3	-	-	-	2	3	2	3

UNIT I
Introduction to System Analysis and Design: Introduction to system analysis and design, Role of system analyst, System development life cycle, Feasibility analysis, Requirement gathering techniques, Modeling tools and techniques.
UNIT II
Requirements Analysis and Specification: Requirements determination, Types of requirements, Elicitation methods (interviews, surveys, observations), Data and process modeling, Use case diagrams, Requirements documentation, Validation and verification of requirements.
UNIT III
System Design: System architecture, Software design principles, Interface design, Data design, User interface design, Design patterns, Security and privacy considerations in design.
UNIT IV
System Implementation and Integration: Software development methodologies (Waterfall, Agile, etc.), Coding and testing, System integration, Deployment strategies, System maintenance, Change management.

Textbooks:
1. Dennis, A., Wixom, B. H., & Roth, R. M. (2012). Systems Analysis and Design. John Wiley & Sons. (ISBN: 978-1118057629)
2. Satzinger, J. W., Jackson, R. B., & Burd, S. D. (2015). Systems Analysis and Design in a Changing World. Cengage Learning. (ISBN: 978-1305117204)

References:

1. Pressman, R. S. (2014). Software Engineering: A Practitioner's Approach. McGraw-Hill Education. (ISBN: 978-0078022128)
2. Hawryszkiewycz, I. T. (2013). Systems Analysis and Design. Pearson. (ISBN: 978-0273774308)
3. Whitten, J. L., Bentley, L. D., & Dittman, K. C. (2017). Systems Analysis and Design Methods. McGraw-Hill Education. (ISBN: 978-1259662887)
4. Sommerville, I. (2016). Software Engineering. Pearson. (ISBN: 978-0133943030)

<table>
<tr><td>Paper Code: ITE348T</td><td>Paper: Web Development - I</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td></td><td>3</td><td>0</td><td>3</td></tr>
<tr><td colspan="5">Prerequisite Paper:</td></tr>
<tr><td colspan="5">Marking Scheme:
1. Teacher’s Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks</td></tr>
<tr><td colspan="5">Guidelines for Paper Setter(s):</td></tr>
<tr><td colspan="5">1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
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4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.</td></tr>
</table>

Course Outcome (CO):

CO 1	Fundamental Understanding: Demonstrate a solid understanding of web development concepts, including the structure of web pages, the role of client-side scripting, and the basics of server-client interactions.
CO 2	HTML and CSS Proficiency: Develop proficiency in creating well-structured HTML documents and applying CSS styles for effective presentation and layout of web content.
CO 3	Interactive Web Elements: Utilize JavaScript to create interactive web elements, validate user input, and dynamically modify web page content.
CO 4	Version Control and Collaboration: Gain familiarity with version control systems and collaborative workflows for managing web development projects in a team environment.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to Web Development: Introduction to the internet and the World Wide Web, client-server architecture, HTTP basics, introduction to web browsers and web servers.

UNIT II

Front-end Development: HTML fundamentals, semantic HTML5 elements, CSS basics, styling techniques, responsive design principles, introduction to Flexbox and CSS Grid.

UNIT III

Introduction to JavaScript: JavaScript fundamentals, variables, data types, control structures, functions, DOM manipulation, event handling, form validation.

UNIT IV

Version Control and Collaboration: Introduction to version control using Git, creating and managing repositories, branching and merging, collaborative workflows using GitHub, project hosting.

Textbook:

1. Deitel, P. J., & Deitel, H. M. (2021). "Web Development and Design Foundations with HTML5." Pearson.

References:

1. Duckett, J. (2014). "HTML and CSS: Design and Build Websites." Wiley.
2. Flanagan, D. (2016). "JavaScript: The Definitive Guide." O'Reilly Media.
3. W3Schools. (https://www.w3schools.com/)
4. MDN Web Docs. (https://developer.mozilla.org/)

<table>
<tr><td>Paper Code: ITE348P</td><td colspan="3">Web Development - I Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 348T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE352T	Paper: Programming in the Windows Environment	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Develop an understanding of the Windows programming environment and its key components.
CO 2	Design and implement Windows applications with graphical user interfaces using event-driven programming.
CO 3	Integrate various Windows features, such as file I/O, networking, and multimedia, into their applications.
CO 4	Apply debugging and testing techniques specific to Windows-based applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to Windows Programming: Introduction to Windows operating system architecture, Windows API, Integrated Development Environments (IDEs) for Windows programming, setting up a development environment, overview of GUI design principles.

UNIT II

GUI Design and Event-Driven Programming: Fundamentals of GUI design, creating windows and dialogs, working with controls (buttons, text boxes, etc.), event-driven programming paradigm, handling user input events, managing UI responsiveness.

UNIT III

Windows Application Development: Using graphics and multimedia in Windows applications, incorporating file I/O operations, introduction to networking concepts in Windows applications, error handling and debugging techniques specific to Windows programming.

UNIT IV

Advanced Windows Programming Concepts: Multithreading and parallelism in Windows applications, integrating advanced UI components (menus, toolbars), accessing system resources and services, overview of security considerations in Windows programming.

Textbooks:

1. J. Richter, "Programming Applications for Microsoft Windows," Microsoft Press, 2016.
2. C. Petzold, "Programming Windows," Microsoft Press, 2019.

References:

1. A. Troelsen and P. Japikse, "Pro C# 7: With .NET and .NET Core," Apress, 2017.
2. J. Prosise, "Programming Windows with MFC," Microsoft Press, 2018.
3. M. Young, "The Windows 10 Book: The Independent Guide to Mastering Your PC," Imagine Publishing, 2020.

<table>
<tr><td>Paper Code: ITE352P</td><td colspan="2">Programming in the Windows Environment Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 352T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE365T	Paper: Web Development - II	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Server-Side Programming: Acquire proficiency in server-side programming languages and frameworks to build dynamic web applications.
CO 2	Database Integration: Integrate databases into web applications, design efficient database schemas, and perform CRUD operations.
CO 3	Authentication and Security: Implement user authentication, authorization mechanisms, and apply best practices for web security to mitigate common vulnerabilities.
CO 4	Full-Stack Development: Develop the ability to design and build complete, end-to-end web applications, incorporating both front-end and back-end components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	1	-	-	3	2	2	3

UNIT I

Introduction to Back-end Development: Server-side scripting languages (e.g., Node.js, Python), introduction to Express.js framework, handling HTTP requests, routing, middleware.

UNIT II

Database Integration: Relational databases (e.g., MySQL, PostgreSQL), database design, SQL queries, ORM (Object-Relational Mapping), database interactions in web applications.

UNIT III

Web Security: Common web vulnerabilities, authentication and authorization, secure communication (HTTPS), input validation, sanitization, and output encoding.

UNIT IV

Full-Stack Web Application Development: Integrating front-end and back-end, RESTful APIs, AJAX and asynchronous programming, deploying web applications, performance optimization.

Textbook:

1. Evert, A., & Lange, V. (2019). "Full-Stack Web Development with Vue.js and Node: Build scalable and powerful web apps with modern web stack: MongoDB, Vue, Node.js, and Express." Packt Publishing.

References:

1. Freeman, A., & Robson, E. (2018). "Head First JavaScript Programming: A Brain-Friendly Guide." O'Reilly Media.

2. Holzner, S. (2016). "Python Complete Reference." McGraw-Hill Education.
3. Flanagan, D. (2011). JavaScript: The Definitive Guide. O'Reilly Media.
4. Scholten, J., & Harbison, P. (2018). Node.js Web Development: Server-side Development with Node 10 made easy (3rd ed.). Packt Publishing.
5. W3Schools. (https://www.w3schools.com/)
6. MDN Web Docs. (https://developer.mozilla.org/)
7. Spine, B., & Fain, Y. (2018). ng-book: The Complete Book on Angular. Fullstack.io.
8. Cheary, J., & Kapor, A. (2019). Learning Vue.js 2: Learn how to build amazing and complex reactive web applications easily with Vue.js. Packt Publishing.
9. Flanagan, D., & Matsumoto, Y. (2019). The Ruby Programming Language. O'Reilly Media.
10. Newman, M. (2015). Building Microservices: Designing Fine-Grained Systems. O'Reilly Media.
110 Chou, T. (2017). Cloud Native DevOps with Kubernetes: Building, Deploying, and Scaling Modern Applications in the Cloud. O'Reilly Media.

<table>
<tr><td>Paper Code: ITE465P</td><td colspan="3">Web Development - II Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 365T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE367T	Paper: Programming in the Linux Environment	L	T/P	C
Paper ID:		3	0	3
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Linux Fundamentals: Develop a strong foundational knowledge of the Linux operating system, its architecture, file system structure, and basic command-line operations.
CO 2	Apply Programming Concepts: Demonstrate the ability to write, compile, and execute programs using programming languages such as C and Python in a Linux environment.
CO 3	Utilize Linux Tools: Effectively employ essential Linux programming tools, version control systems, and debugging utilities to create efficient and reliable programs.
CO 4	Implement System-Level Programming: Gain practical experience in system-level programming tasks, including process management, file I/O, memory management, and networking within the Linux environment.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	3	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	2	3	2	-	-	-	2	2	2	3
CO 4	3	3	2	3	2	-	-	-	2	2	2	3

UNIT I

Introduction to Linux Programming: Linux operating system overview, Linux architecture, file system hierarchy, shell basics and scripting, introduction to programming languages in Linux.

UNIT II

Programming Fundamentals in Linux: Basics of C programming, data types and operators, control structures, functions and modular programming, arrays and pointers in C, introduction to Python programming in Linux.

UNIT III

Linux Programming Tools and Utilities: Text editors (e.g., Vim, Emacs), compilation process, Makefiles, version control with Git, debugging techniques using GDB, scripting with Bash.

UNIT IV

Advanced Linux Programming Concepts: Process management and multitasking, file I/O operations, memory management, dynamic memory allocation, network programming basics, inter-process communication (IPC) mechanisms.

Textbook:

1. R. Love, "Linux System Programming: Talking Directly to the Kernel and C Library," O'Reilly Media, 2013.

References:

1. E. Garfinkel, D. B. House, and S. D. Adams, "Linux: The Complete Reference," McGraw-Hill Education, 2017.
2. M. Kerrisk, "The Linux Programming Interface: A Linux and UNIX System Programming Handbook," No Starch Press, 2010.
3. W. Richard Stevens, S. A. Rago, "Advanced Programming in the UNIX Environment," Addison-Wesley Professional, 2013.

Paper Code: ITE467P	**Programming in the Linux Environment Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 367T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE469T	Paper: Android Development	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
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4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Design and develop Android applications using Java and Android Studio.
CO 2	Understand the components and architecture of the Android operating system.
CO 3	Implement user interfaces and interactive features for mobile applications.
CO 4	Utilize various tools and techniques for debugging, testing, and deploying Android applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to Android Development: Introduction to mobile app development, Android history and evolution, Android architecture overview, Android Studio installation and setup, Creating the first Android project, Understanding the project structure, Emulator and device configuration, Introduction to Java for Android.

UNIT II

User Interface Design: Layouts and Views, XML layout design, UI components (Buttons, TextFields, ImageViews, etc.), Event handling, Fragments and their lifecycle, Supporting multiple screen sizes, Styles and themes, Material Design principles.

UNIT III

Data Management and Application Components: Activities and Intents, Building and navigating between activities, SharedPreferences for data persistence, SQLite database implementation, Content Providers and sharing data, Handling background tasks with AsyncTask, Services and Broadcast Receivers.

UNIT IV

Advanced Topics in Android Development: Networking and web services integration, RESTful APIs and JSON parsing, Location-based services and Google Maps integration, Sensors and device hardware interaction, Debugging and error handling techniques, Introduction to Kotlin for Android development.

Textbooks:

1. Paul Deitel and Harvey Deitel, "Android How to Program," Pearson, 2017.
2. Reto Meier, "Professional Android 4 Application Development," Wiley, 2012.

References:

1. Mark L. Murphy, "The Busy Coder's Guide to Android Development," CommonsWare, 2020.
2. Big Nerd Ranch Guides, "Android Programming: The Big Nerd Ranch Guide," Big Nerd Ranch, 2021.
3. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide," Big Nerd Ranch, 2020.

Paper Code: ITE469P	Android Development Lab.			L	T/P	C
Paper ID:				-	2	1
Teacher's Continuous Evaluation :		**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 469T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT401T/ ITE471T	Paper: Advanced Java Programming	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and implement advanced object-oriented programming concepts in Java.
CO 2	Design and develop Java applications using advanced data structures and algorithms.
CO 3	Apply multithreading and concurrency techniques to enhance program performance.
CO 4	Create networked and distributed Java applications using relevant technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Advanced Object-Oriented Programming: Inheritance and polymorphism, abstract classes and interfaces, nested classes, generics and type erasure, reflection and annotations.

UNIT II

Data Structures and Algorithms in Java: Advanced data structures (trees, graphs, hash maps), algorithm analysis and optimization, searching and sorting algorithms (binary search, merge sort, quicksort), dynamic programming.

UNIT III

Multithreading and Concurrency: Threads and synchronization, thread communication and coordination, concurrent collections, parallelism and performance optimization, thread safety and deadlock prevention.

UNIT IV

Networked and Distributed Java Applications: Socket programming, networking fundamentals, client-server architecture, remote method invocation (RMI), web services and APIs, introduction to distributed computing.

Textbooks:

1. Cay S. Horstmann, "Core Java Volume I--Fundamentals," 11th edition, Pearson, 2018.
2. Joshua Bloch, "Effective Java," 3rd edition, Addison-Wesley, 2018.

References:

1. Herbert Schildt, "Java: The Complete Reference," 11th edition, McGraw-Hill Education, 2018.
2. Brian Goetz et al., "Java Concurrency in Practice," Addison-Wesley Professional, 2006.
3. Elliotte Rusty Harold, "Java Network Programming," 4th edition, O'Reilly Media, 2013.

Paper Code: ICT401P / ITE471P	**Advanced Java Programming Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 471T / ICT401T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT403T	Paper: Blockchain Technology	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational principles of blockchain technology, including its decentralized nature, cryptographic components, and data structure.
CO 2	Analyze different consensus mechanisms used in blockchain systems and their implications for security, scalability, and energy efficiency.
CO 3	Develop and assess smart contracts, demonstrating knowledge of their automated execution and applications in various domains.
CO 4	Evaluate real-world use cases of blockchain technology across industries, considering the benefits, challenges, and potential impact on existing systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT I

Introduction to Blockchain Technology: Definition and characteristics of blockchain. Cryptographic building blocks: Hash functions, digital signatures, and public-key cryptography. Structure of a blockchain: Blocks, transactions, and Merkle trees. Types of blockchains: Public, private, and consortium. Applications of blockchain beyond cryptocurrency.

UNIT II

Consensus Mechanisms: Byzantine fault tolerance and consensus requirements. Proof of Work (PoW) and its limitations. Proof of Stake (PoS) and variations. Practical Byzantine Fault Tolerance (PBFT). Delegated Proof of Stake (DPoS) and other consensus algorithms.

UNIT III

Smart Contracts and Decentralized Applications (DApps)

Introduction to smart contracts: Definition, properties, and benefits .
Ethereum platform and Solidity programming language. Designing and deploying smart contracts.
Decentralized Autonomous Organizations (DAOs). Interactions between smart contracts and blockchain transactions

UNIT IV

Blockchain Applications and Future Trends: Real-world use cases: Supply chain management, finance, healthcare, and more. Challenges in blockchain adoption: Scalability, interoperability, and regulatory aspects. Integration of Internet of Things (IoT) with blockchain. Privacy and security considerations in blockchain systems

Textbooks:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction." Princeton University Press.

References:
1. Antonopoulos, A. M. (2018). "Mastering Bitcoin: Unlocking Digital Cryptocurrencies." O'Reilly Media.
2. Tapscott, D., & Tapscott, A. (2016). "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World." Penguin.

Paper Code: ICT403P	**Blockchain Technology Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :
1. The course objectives and course outcomes are identical to that of ICT403T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT405T	**Paper: Semantic Web**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the principles and fundamental concepts of the Semantic Web.
CO 2	Describe the technologies and standards used in the development of the Semantic Web.
CO 3	Apply Semantic Web techniques to organize, integrate, and retrieve information effectively.
CO 4	Analyze real-world scenarios and design solutions using Semantic Web technologies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	1	-	-	3	2	2	3

UNIT I

Introduction to Semantic Web: Introduction to Semantic Web, Evolution of the Web, Semantic Web Architecture, RDF (Resource Description Framework), RDF Triples, Ontologies, Knowledge Representation.

UNIT II

Semantic Web Technologies: OWL (Web Ontology Language), RDFS (RDF Schema), SPARQL (SPARQL Protocol and RDF Query Language), Linked Data Principles, Ontology Languages, Reasoning in the Semantic Web.

UNIT III

Semantic Web Applications: Semantic Annotation, Semantic Search and Querying, Semantic Interoperability, Ontology Matching and Alignment, Semantic Web Services, Use Cases of Semantic Web in Industry.

UNIT IV

Advanced Semantic Web Topics: Knowledge Graphs, Reasoning with Uncertainty in the Semantic Web, Semantic Web and Machine Learning Integration, Current Trends and Future Directions in the Semantic Web.

Textbooks:

1. A. Gomez-Perez and O. Corcho, "Ontological Engineering: With Examples from the Areas of Knowledge Management, e-Commerce and the Semantic Web," Springer, 2004.

J. Davies, D. Fensel, and F. van Harmelen, "Towards the Semantic Web: Ontology-Driven Knowledge Management," Wiley, 2003.

References:

1. T. Berners-Lee, J. Hendler, and O. Lassila, "The Semantic Web," Scientific American, vol. 284, no. 5, pp. 34-43, 2001.
2. I. Horrocks, P. F. Patel-Schneider, H. Boley, S. Tabet, B. Grosof, and M. Dean, "SWRL: A Semantic Web Rule Language Combining OWL and RuleML," W3C Member submission, 2004.
3. E. Simperl and W. B. Li, "The Next Wave of Semantic Technologies: Linked Data and the Semantic Web," IEEE Intelligent Systems, vol. 27, no. 4, pp. 81-85, 2012..

<table>
<tr><td>Paper Code: ICT405P</td><td colspan="2">Semantic Web Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 405T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT407T	**Paper: C#.Net Programming**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Demonstrate a solid understanding of C#.Net programming concepts, syntax, and language features.
CO 2	Design and implement software applications using C#.Net for solving real-world engineering problems.
CO 3	Apply object-oriented programming principles to create efficient and maintainable code.
CO 4	Debug, test, and optimize C#.Net applications to ensure their functionality, reliability, and performance.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT I

Introduction to C#.Net Programming: Overview of C#.Net and the .Net Framework. Setting up the development environment: Visual Studio, Basic syntax and data types in C#.Net. Variables, constants, and data manipulation. Control structures: decision-making and loops.

UNIT II

Object-Oriented Programming with C#.Net: Introduction to object-oriented programming (OOP) concepts. Classes, objects, and constructors. Inheritance, polymorphism, and encapsulation. Abstract classes and interfaces. Exception handling and error management

UNIT III

Advanced C#.Net Programming: Delegates and events. Collections and generics. File I/O and serialization. LINQ (Language Integrated Query). Multithreading and asynchronous programming

UNIT IV

Graphical User Interface (GUI) Development:Windows Forms applications. GUI controls and layout management. Event-driven programming. User input validation and error handling. Deployment and distribution of C#.Net applications

Textbooks:

1. Troelsen, A., & Japikse, P. (2020). C# 8.0 and .NET Core 3.1 - Modern Cross-Platform Development: Build applications with C#, .NET Core, Entity Framework Core, ASP.NET Core, and ML.NET. Apress.
2. Albahari, J., Albahari, B., & Albahari, B. (2017). C# 7.0 in a Nutshell: The Definitive Reference. O'Reilly Media.

References:

1. Richter, J. (2018). CLR via C# (4th Edition). Microsoft Press.
2. Deitel, P. J., & Deitel, H. M. (2021). C# How to Program (10th Edition). Pearson.
3. Freeman, A., & Fraser, A. (2013). Pro C# 5.0 and the .NET 4.5 Framework. Apress.

<table>
<tr><td>Paper Code: ICT407P</td><td colspan="2">C#.Net Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="6">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 407T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT409	Paper: Cyber Security and Forensic	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of cybersecurity and digital forensics, and identify their significance in protecting digital assets.
CO 2	Analyze different types of cyber threats, vulnerabilities, and attacks, and design strategies to mitigate risks.
CO 3	Apply various cybersecurity techniques, such as cryptography and network security mechanisms, to safeguard information in digital systems.
CO 4	Utilize digital forensics principles, tools, and methodologies to investigate and analyze cyber incidents, and present findings effectively.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	-	3	2	2	1	2
CO 2	3	3	3	3	3	3	-	3	2	2	1	2
CO 3	3	3	3	3	3	3	-	3	2	2	1	2
CO 4	3	3	3	3	3	3	-	3	2	2	1	2

UNIT I

Introduction to Cybersecurity and Digital Forensics: Overview of cybersecurity and digital forensics, types of cyber attacks, threat landscape, importance of cybersecurity in modern technology, digital forensics process, legal and ethical considerations in digital investigations.

UNIT II

Cybersecurity Principles and Techniques: Network security and protocols, access control mechanisms, threat detection and prevention, cryptography fundamentals, public and private key cryptography, cryptographic algorithms, security best practices for software development.

UNIT III

Malware Analysis and Incident Response: Types of malware, malware analysis methodologies, dynamic and static malware analysis, intrusion detection and prevention systems, incident response process, handling and containing cyber incidents, disaster recovery planning.

UNIT IV

Digital Forensics Procedures and Tools: Digital evidence collection and preservation, data acquisition techniques, file system analysis, recovering deleted files, email and social media forensics, memory and mobile device forensics, introduction to digital forensic tools.

Textbooks:

1. N. K. Rountree and M. H. Rountree, "Cybersecurity and Cyberwar: What Everyone Needs to Know," Oxford University Press, 2014.
2. J. Sammons, "The Basics of Digital Forensics," Syngress, 2012.

References:

1. W. Stallings and L. Brown, "Computer Security: Principles and Practice," Pearson, 2017.

2. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet," Academic Press, 2018.
3. R. Rogers, "Network Security Essentials: Applications and Standards," Pearson, 2019.
4. G. F. Master and G. M. Shieh, "Malware Forensics: Investigating and Analyzing Malicious Code," Syngress, 2012.

Paper Code: ICT413	**Paper: Cloud Computing**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and models of cloud computing.
CO 2	Evaluate different cloud service models and deployment strategies.
CO 3	Design and implement applications for cloud environments.
CO 4	Manage and monitor cloud resources effectively.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Cloud Computing: Evolution of computing paradigms, Characteristics of cloud computing, Cloud service models (IaaS, PaaS, SaaS), Cloud deployment models (Public, Private, Hybrid, Multi-cloud), Benefits and challenges of cloud computing.

UNIT II

Cloud Infrastructure and Services: Virtualization technology, Server and storage virtualization, Network virtualization, Containerization, Cloud infrastructure components, Identity and Access Management (IAM), Cloud service catalog.

UNIT III

Cloud Application Development: Principles of cloud application design, Microservices architecture, API development and management, DevOps practices in the cloud, Scalability and load balancing, Serverless computing, Case studies of cloud-based applications.

UNIT IV

Cloud Management and Security: Cloud resource provisioning and orchestration, Monitoring and performance optimization, Data backup and disaster recovery in the cloud, Cloud security challenges and solutions, Encryption and data protection, Compliance and legal considerations.

Textbooks:

1. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture," Pearson Education, 2013.
2. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, "Cloud Computing: Principles and Paradigms," Wiley, 2011.

References:

1. Michael Armbrust et al., "Above the Clouds: A Berkeley View of Cloud Computing," University of California, Berkeley, 2009.
2. Armando Fox and Rean Griffith, "Engineering Long-Lasting Software: An Agile Approach Using SaaS and Cloud Computing," Morgan Kaufmann, 2018.
3. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things," Morgan Kaufmann, 2012.

Paper Code: ICT415T	Paper: Introduction to IoT	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand IoT Fundamentals: Grasp the foundational concepts of the Internet of Things, including its architecture, components, communication protocols, and data management principles.
CO 2	Design and Develop IoT Systems: Demonstrate the ability to design and develop basic IoT systems, integrating sensors, actuators, and communication modules to gather and transmit data effectively.
CO 3	Analyze IoT Data: Apply data analytics techniques to IoT-generated data, extract meaningful insights, and make informed decisions based on data-driven trends.
CO 4	Address IoT Challenges: Identify and address key challenges related to security, privacy, interoperability, and scalability within IoT ecosystems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to IoT Fundamentals: Overview of IoT and its significance, IoT architecture layers (perception, network, and application), IoT communication protocols (MQTT, CoAP, HTTP), Introduction to sensor technologies and actuators, IoT data management and storage principles.

UNIT II

Building IoT Systems: Selection and integration of sensors and actuators, Microcontroller platforms for IoT (Arduino, Raspberry Pi), Communication interfaces (Bluetooth, Wi-Fi), Data transmission and aggregation, Hands-on IoT system development.

UNIT III

Data Analytics for IoT: Introduction to IoT data analytics, Data preprocessing and cleaning, Exploratory data analysis for IoT data, Basic statistical analysis, Introduction to machine learning for IoT data, Visualization of IoT data insights.

UNIT IV

Addressing IoT Challenges: Security and privacy challenges in IoT, Authentication and authorization mechanisms, Ensuring data integrity and confidentiality, Interoperability and standardization in IoT, Scalability and managing large-scale IoT deployments.

Textbooks:

1. S. Y. Suh, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things," Wiley, 2017.
2. R. Rajkumar, "Real-Time Systems: Design Principles for Distributed Embedded Applications," Springer, 2011.

References:

1. A. Dunkels et al., "Interconnecting Smart Objects with IP: The Next Internet," Morgan Kaufmann, 2010.
2. M. D. McDaniel and S. McLaughlin, "Security and Privacy in the Internet of Things," IEEE Computer Society, 2016.
3. V. C. Gungor and G. P. Hancke, "Industrial Internet of Things (IIoT): Challenges, Opportunities, and Directions," IEEE Transactions on Industrial Informatics, 2016, 12(3), 1747-1756.

Paper Code: ICT415P	**Introduction to IoT Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 415T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ICT417	**Paper: Complexity Theory**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand and apply foundational concepts of complexity theory to classify problems into different complexity classes.
CO 2	Analyze and design algorithms with considerations for their computational complexity.
CO 3	Evaluate the significance of computational reductions and their role in problem-solving.
CO 4	Critically examine the implications and challenges of the P vs. NP problem on computational science.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**3**
CO 2	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**3**
CO 3	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**3**

UNIT I

Introduction to Complexity Theory: Basics of computational complexity, time and space complexity, Big-O notation, problem classification (P, NP, NP-hard, NP-complete), polynomial-time reductions.

UNIT II

Models of Computation: Turing machines and variants, non-deterministic computation, circuit complexity, random access machines, complexity of specific algorithms (sorting, searching, graph algorithms).

UNIT III

Computational Reductibility: Cook-Levin theorem, polynomial-time reductions, NP-completeness, examples of NP-complete problems (SAT, 3-SAT, CLIQUE), techniques for proving NP-completeness.

UNIT IV

P vs. NP Problem and Beyond: P vs. NP problem statement, consequences of P = NP, PSPACE and other complexity classes, introduction to complexity theory beyond polynomial time, selected advanced topics (approximation algorithms, interactive proofs).

Textbooks:

1. M. Sipser, "Introduction to the Theory of Computation," 3rd ed., Cengage Learning, 2013.
2. C. Papadimitriou, "Computational Complexity," Addison-Wesley, 1994.

References:

1. S. Arora and B. Barak, "Computational Complexity: A Modern Approach," Cambridge University Press, 2009.
2. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, "Algorithms," McGraw-Hill Education, 2006.
3. M. Garey and D. Johnson, "Computers and Intractability: A Guide to the Theory of NP-Completeness," W. H. Freeman, 1979.

Paper Code: ICT419T	**Paper: Human Computer Interface**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational theories and principles of Human-Computer Interaction.
CO 2	Design and develop user-centered interfaces following established design guidelines and usability principles.
CO 3	Evaluate user interfaces using various evaluation methods and techniques.
CO 4	Apply advanced concepts and current trends in HCI to real-world software design challenges.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to HCI: Introduction to Human-Computer Interaction, Importance of HCI in Software Design, Historical Evolution of HCI, Models of HCI (GOMS, Norman's Model), Human-Centered Design Principles.

UNIT II

User Interface Design: User-Centered Design Process, User Research Techniques, Task Analysis, Interaction Design, Information Architecture, Wireframing and Prototyping, Design Patterns, Accessibility and Inclusive Design.

UNIT III

Usability Evaluation: Usability Goals and Metrics, Heuristic Evaluation, Cognitive Walkthrough, Usability Testing, A/B Testing, User Feedback and Surveys, Data Analysis for Usability Evaluation.

UNIT IV

Advanced HCI Concepts and Trends: User Experience (UX) Design, Mobile and Responsive Design, Gesture and Touch Interfaces, Virtual and Augmented Reality Interfaces, Voice User Interfaces, Ethical and Social Implications in HCI, Future Trends in HCI.

Textbooks:

1. Shneiderman, B., & Plaisant, C. (2010). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Pearson.
2. Preece, J., Rogers, Y., & Sharp, H. (2019). Interaction Design: Beyond Human-Computer Interaction. Wiley.

References:

1. Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). Human-Computer Interaction. Pearson Education.
2. Norman, D. A. (2013). The Design of Everyday Things: Revised and Expanded Edition. Basic Books.

3. Nielsen, J., & Molich, R. (1990). Heuristic Evaluation of User Interfaces. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 249-256).

Paper Code: ICT419P	**Paper: Human Computer Interface Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 419T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT423T	**Paper: Next Generation Web**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Modern Web Architectures: Analyze and explain the key components of modern web architectures, including client-server interaction, API integration, and microservices.
CO 2	Develop Responsive Web Applications: Design and implement responsive web applications using HTML5, CSS3, and advanced front-end frameworks to ensure compatibility across various devices and screen sizes.
CO 3	Utilize Advanced Front-end Technologies: Apply advanced techniques in front-end development, including Single Page Applications (SPA), asynchronous programming with JavaScript, and front-end build tools.
CO 4	Implement Secure and Scalable Web Services: Develop secure and scalable web services by integrating server-side technologies such as Node.js, Express.js, and incorporating best practices for data security and authentication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	1	-	-	3	2	2	3

UNIT I

Introduction to Next Generation Web Development: Evolution of web technologies. Client-server architecture. RESTful API principles. Microservices and their benefits. Introduction to front-end and back-end technologies.

UNIT II

Front-end Development and Responsive Design: HTML5 and semantic markup. CSS3 and modern layout techniques. Introduction to front-end frameworks (e.g., React, Angular, Vue). Building responsive web interfaces. Cross-browser compatibility and testing

UNIT III

Advanced Front-end Techniques: Single Page Applications (SPA) and their advantages. Asynchronous programming with JavaScript (Promises, async/await). Front-end build tools (Webpack, Babel). State management in front-end frameworks. Introduction to Progressive Web Apps (PWA)

UNIT IV

Server-side Development and Security: Introduction to server-side programming (Node.js). Creating RESTful APIs with Express.js. Data security and authentication best practices. Handling user authentication and authorization. Basics of database integration and management.

Textbooks:
1. D. Flanagan, "JavaScript: The Definitive Guide," O'Reilly Media, 2019.
2. E. Freeman et al., "Head First Design Patterns," O'Reilly Media, 2020.

References:
1. M. Crawford, "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics," O'Reilly Media, 2021.
2. A. Mead, "The Complete Node.js Developer Course," Udemy, 2022.
3. E. Raj et al., "Web Development with Angular and Bootstrap," Springer, 2018.

Paper Code: ICT423P	**Next Generation Web Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**			**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 423T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.						

Paper Code: ICT425T	**Paper: Web Mining**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and principles of web mining.
CO 2	Apply various web mining techniques to extract information from web data.
CO 3	Analyze web content, structure, and usage patterns to derive meaningful insights.
CO 4	Design and implement web mining strategies for practical applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	1	-	-	3	2	2	3

UNIT I
Introduction to Web Mining
Introduction to web mining, types and categories of web mining, web data sources, challenges in web mining, ethical considerations in web data usage.

UNIT II
Web Content Mining
Text mining techniques for web content, information retrieval, natural language processing for web data, sentiment analysis, content categorization and clustering.

UNIT III
Web Structure Mining
Analysis of web page structure, page ranking algorithms, link analysis, web graph mining, detecting communities in web graphs.

UNIT IV
Web Usage Mining
Web log data analysis, clickstream mining, user behavior tracking, recommendation systems, personalization, case studies in web usage mining.

Textbooks:
1. J. Han and M. Kamber, "Data Mining: Concepts and Techniques," 3rd ed., Morgan Kaufmann, 2011.
2. B. Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data," 2nd ed., Springer, 2011.
References:
1. R. Kosala and H. Blockeel, "Web Mining Research: A Survey," ACM SIGKDD Explorations Newsletter, vol. 2, no. 1, pp. 1-15, 2000.

2. O. Etzioni, "Web Mining: Machine Learning for Web Applications," Machine Learning, vol. 50, no. 1-2, pp. 127-156, 2003.
3. B. Berendt, A. Hotho, and G. Stumme, "Towards Semantic Web Mining," Web Semantics: Science, Services and Agents on the World Wide Web, vol. 1, no. 1, pp. 7-28, 2003.
4. X. Wu, V. Kumar, J. R. Quinlan, J. Ghosh, Q. Yang, H. Motoda, G. J. McLachlan, A. Ng, B. Liu, P. S. Yu, Z. Zhou,
5. M. Steinbach, D. J. Hand, and D. Steinberg, "Top 10 Algorithms in Data Mining," Knowledge and Information Systems, vol. 14, no. 1, pp. 1-37, 2008.

Paper Code: ICT425P	**Web Mining Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 425T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT427T	**Paper: Middleware Technology**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of middleware technology, including its role in distributed systems and its significance in modern software architecture.
CO 2	Analyze and compare various communication models and middleware components to determine the most suitable choices for specific application requirements.
CO 3	Design and develop middleware-based solutions that facilitate seamless communication and cooperation among heterogeneous software components.
CO 4	Evaluate the performance, security, and reliability aspects of middleware technologies in real-world scenarios and make informed decisions for system integration.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	1
CO 2	3	2	3	2	2	-	-	-	3	2	2	1
CO 3	3	2	3	3	2	-	-	-	3	2	2	1
CO 4	3	3	3	3	3	-	-	-	3	2	2	1

UNIT I

Introduction to Middleware Technology: Introduction to middleware, characteristics and importance of middleware in distributed systems, middleware services, middleware architecture models, middleware standards and protocols.

UNIT II

Communication Models and Middleware Components: Remote Procedure Call (RPC), Message-Oriented Middleware (MOM), Object-Oriented Middleware (OOM), Publish-Subscribe Middleware, Service-Oriented Architecture (SOA), Web services, RESTful architecture.

UNIT III

Designing Middleware Solutions: Middleware design principles, interoperability challenges and solutions, middleware for data integration, transaction management, security services in middleware, error handling and fault tolerance.

UNIT IV

Performance, Testing, and Future Trends: Performance evaluation of middleware, benchmarking and testing of middleware-based systems, scalability and load balancing, emerging trends in middleware technology, edge computing and IoT middleware.

Textbooks:

1. Gregersen, H. B., Hansen, M. R., & Schougaard, K. R. (2012). Middleware Technologies: Object-Oriented Middleware, CORBA, DCOM, and RMI. IEEE Computer Society Press.

2. Puschner, P., & Reindl, L. (2007). Middleware for Communication. Springer.

References:

1. Magee, J., & Kramer, J. (2006). Concurrent and Real-Time Systems: The CSP Approach. Wiley-IEEE Press.
2. Papazoglou, M. P., & Georgakopoulos, D. (2003). Service-oriented computing. Communications of the ACM, 46(10), 24-28.
3. Emmerich, W. (2010). Software Engineering and Middleware: Third International Workshop, SEM 2002 Orlando, FL, USA, May 20-21, 2002 Revised Papers. Springer.
4. Coulouris, G. F., Dollimore, J., Kindberg, T., & Blair, G. (2011). Distributed Systems: Concepts and Design. Pearson.

Paper Code: ICT427P	**Middleware Technology Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 427T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT429T	Paper: Mobile Computing	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and architectural components of mobile computing systems.
CO 2	Analyze and evaluate various wireless communication technologies and their applicability in mobile systems.
CO 3	Develop mobile applications using appropriate platforms and programming languages.
CO 4	Recognize the security issues and solutions related to mobile computing systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	-	-	1	1	-	3
CO 2	3	3	3	3	3	1		-	1	1	-	3
CO 3	3	3	3	3	3	1	-	-	1	1	-	3
CO 4	3	3	3	3	3	1	-	-	1	1	-	3

UNIT I

Introduction to Mobile Computing

Mobile Computing Architectures, Mobile Communication Models, Mobile Operating Systems, and Mobile Middleware.

UNIT II

Wireless Communication Technologies

Cellular Networks (3G, 4G, 5G), Wi-Fi Technology, Bluetooth and Bluetooth Low Energy (BLE), Near Field Communication (NFC), and Satellite Communication.

UNIT III

Mobile Application Development

Mobile App Development Frameworks, User Interface (UI) Design for Mobile Apps, Cross-Platform Development, Mobile App Testing, and App Deployment.

UNIT IV

Mobile Security and Privacy

Mobile Device Security (Authentication, Authorization, Encryption), Secure Mobile Application Development, Mobile Data Protection, and Emerging Trends in Mobile Security.

Textbooks:

1. Jochen Schiller, "Mobile Communications," Pearson Education, 2nd edition, 2003.
2. Raj Kamal, "Mobile Computing: Principles and Practice," Oxford University Press, 2007.

References:

1. William Stallings, "Wireless Communications and Networks," Pearson Education, 2nd edition, 2004.
2. Chris Ward, "Beginning Android Programming with Android Studio," Wrox, 4th edition, 2017.

3. N. Asokan, Lucas Davi, Alexandra Dmitrienko, Ahmad-Reza Sadeghi, "Mobile Security: Attacks and Defenses," Synthesis Lectures on Information Security, Privacy, and Trust, 2016.
4. IEEE Xplore Digital Library (Various research papers and articles on mobile computing and related topics).

Paper Code: ICT429P	**Mobile Computing Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 429T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT431	**Paper: E-Commerce**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the foundational principles of e-commerce and differentiate between various e-commerce models and platforms.
CO 2	Analyze the technical and security aspects of online transactions, demonstrating an awareness of potential risks and safeguards.
CO 3	Evaluate the impact of e-commerce on businesses, customers, and society, and identify emerging trends shaping the future of digital commerce.
CO 4	Apply e-commerce strategies and tools to solve real-world business challenges and create effective online business solutions.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	-
CO 2	3	3	3	3	3	-	-	-	-	-	-	-
CO 3	3	3	3	3	3	1	-	-	-	2	2	-
CO 4	3	3	3	3	3	3	3	3	-	2	2	1

UNIT I
Introduction to E-Commerce
Evolution of e-commerce, types of e-commerce models (B2B, B2C, C2C, C2B), e-commerce framework, online marketplaces, e-commerce payment systems, online consumer behavior.

UNIT II
E-Commerce Infrastructure and Security
E-commerce infrastructure components, internet technologies for e-commerce, security challenges in e-commerce, encryption and digital signatures, secure payment processing, authentication and authorization.

UNIT III
E-Commerce Business Strategies
Online business models, digital marketing and advertising, customer relationship management (CRM), supply chain management in e-commerce, e-commerce legal and ethical issues, intellectual property rights.

UNIT IV
Emerging Trends and Practical Applications
Mobile commerce (m-commerce), social commerce, internet of things (IoT) and e-commerce, data analytics in e-commerce, personalized shopping experiences, virtual and augmented reality in e-commerce.

Textbooks:
1. Kalakota, R., & Whinston, A. B. (1997). "Frontiers of Electronic Commerce". Addison-Wesley Professional.
2. Laudon, K. C., & Traver, C. G. (2016). "E-commerce 2016: Business, Technology, Society". Pearson.

References:

1. Turban, E., King, D., Lee, J. K., Liang, T. P., & Turban, D. C. (2015). "Electronic Commerce 2016: A Managerial and Social Networks Perspective". Springer.
2. Chaffey, D., & Ellis-Chadwick, F. (2019). "Digital Marketing: Strategy, Implementation and Practice". Pearson.
3. Rayport, J. F., & Jaworski, B. J. (2001). "Introduction to e-commerce". McGraw-Hill/Irwin.
4. Strauss, J., & Frost, R. (2016). "E-Marketing". Routledge.

Paper Code: ICT435T	**Paper: Network Programming**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.

2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.

4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.

5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Network Communication Fundamentals: Comprehend the fundamental concepts of network communication, including the OSI model, TCP/IP stack, network protocols, and data transmission.
CO 2	Implement Socket Programming: Develop socket-based network applications using both the Berkeley sockets API on Linux and the Winsock API on Windows.
CO 3	Design and Develop Networked Applications: Design, implement, and troubleshoot networked applications that involve client-server interactions, data exchange, and network security considerations.
CO 4	Cross-Platform Network Development: Adapt and modify network applications to function seamlessly across both Linux and Windows operating systems, demonstrating proficiency in platform-independent network programming.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	-	-	-	2	-	1
CO 2	3	3	3	2	3	-	1	-	-	2	1	1
CO 3	3	3	3	2	3	-	1	-	-	2	1	1
CO 4	3	3	3	3	3	2	1	-	-	2	1	1

UNIT I

Review of Network Communication

Overview of network communication concepts; OSI model and its layers; TCP/IP protocol suite; Data encapsulation and decapsulation; Network addressing and port numbers

UNIT II

Socket Programming and Basic Network Operations

Introduction to sockets and their types; Socket programming workflow; Socket addressing: IP addresses and ports; Error handling and debugging in socket programming; Implementing basic client-server communication

UNIT III

Advanced Socket Programming and Network Protocols

Socket options and configurations; Non-blocking and asynchronous socket operations; Introduction to common network protocols (HTTP, FTP, SMTP); Introduction to network security protocols (SSL/TLS); Hands-on: Developing a multi-client chat application

UNIT IV

Platform-Specific Network Programming

Linux network programming: socket APIs and tools; Windows network programming: Winsock API; Handling platform-specific nuances in network development; Case study: Porting a network application between Linux and Windows

Textbook:

1. W. Richard Stevens, Bill Fenner, and Andrew M. Rudoff, "UNIX Network Programming, Volume 1: The Sockets Networking API," 3rd Edition, Addison-Wesley Professional, 2003.

References:

1. Douglas E. Comer, "Internetworking with TCP/IP, Volume 1: Principles, Protocols, and Architecture," 6th Edition, Pearson, 2014.
2. Forouzan, B. A., & Fegan, S. C., "Data Communications and Networking," 5th Edition, McGraw-Hill Education, 2019.
3. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks," 5th Edition, Pearson, 2010.
4. Microsoft Documentation for Winsock API and Networking on Windows.
5. Linux man pages and online resources for socket programming on Linux.

<table>
<tr><td>Paper Code: ICT435P</td><td colspan="3">Network Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ICT 435T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ICT433T	**Paper: Wireless Communication and Networks**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.

2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.

4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.

5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Wireless Communication Principles: Gain a strong foundation in the fundamentals of wireless communication, including modulation techniques, signal propagation, and channel impairments.
CO 2	Design and Analyze Network Architectures: Comprehend various wireless network architectures, such as ad hoc networks, cellular networks, and wireless sensor networks, and analyze their design considerations and challenges
CO 3	Evaluate Wireless Protocols and Security: Evaluate different wireless communication protocols, their advantages, and limitations. Understand wireless network security threats and the methods to mitigate them
CO 4	Explore Emerging Wireless Technologies: Explore emerging trends in wireless communication, including 5G and beyond, Internet of Things (IoT), and wireless multimedia systems, and their impact on modern networking.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	2
CO 2	3	3	3	2	2	1	1	-	-	-	-	2
CO 3	3	3	3	2	2	1	1	-	-	-	-	2
CO 4	3	3	3	2	2	1	1	-	1	-	-	2

UNIT I

Fundamentals of Wireless Communication

Introduction to wireless communication, electromagnetic spectrum, wireless channel characteristics, modulation techniques (AM, FM, PM), multiple access techniques (FDMA, TDMA, CDMA), wireless propagation models, path loss and shadowing, fading and diversity techniques.

UNIT II

Wireless Network Architectures

Wireless ad hoc networks, cellular networks architecture, wireless sensor networks, wireless LANs and PANs, mobility management, handover techniques, network protocols (TCP/IP, UDP), Quality of Service (QoS) in wireless networks.

UNIT III

Wireless Communication Protocols and Security

IEEE 802.11 family (Wi-Fi) protocols, Bluetooth technology, Zigbee protocol, network layer protocols (IPv4, IPv6), transport layer protocols (TCP, UDP), wireless network security threats, encryption and authentication techniques, security protocols (WPA, WPA2, WPA3).

UNIT IV

Emerging Trends in Wireless Communication
Introduction to 5G and beyond, IoT communication protocols (MQTT, CoAP), wireless multimedia systems, cognitive radio and spectrum sensing, overview of satellite communication, energy-efficient wireless communication techniques.

Textbooks:
1. T. S. Rappaport, "Wireless Communications: Principles and Practice," 2nd ed., Prentice Hall, 2001.
3. A. Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

References:
1. A. Molisch, "Wireless Communications," Wiley, 2011.
2. I. F. Akyildiz et al., "Wireless Sensor Networks: A Survey," Computer Networks, vol. 38, no. 4, pp. 393-422, 2002.
3. S. M. Alamouti, "A Simple Transmit Diversity Technique for Wireless Communications," IEEE Journal on Selected Areas in Communications, vol. 16, no. 8, pp. 1451-1458, 1998.

Paper Code: ICT433P	**Wireless Communication and Networks Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 433T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ICT441	Paper: Advanced Computer Architecture	L	T/P	C
Paper ID:		**4**	**0**	**4**
Prerequisite Paper:				
Marking Scheme: 1. Teacher's Continuous Evaluation: 25 Marks **2.** Term End Theory Examination: 75 Marks				
Guidelines for Paper Setter(s):				
1.There should be 9 questions in the term end examinations question paper. 2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks. 3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15. 4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook. 5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.				

Course Outcome (CO):	
CO 1	Analyze and evaluate complex computer architectures, identifying their strengths and weaknesses in terms of performance, power efficiency, and scalability.
CO 2	Design advanced memory hierarchies and storage systems that optimize data access patterns and enhance overall system performance.
CO 3	Develop strategies for exploiting parallelism at various levels, including instruction-level parallelism, thread-level parallelism, and data-level parallelism.
CO 4	Apply performance measurement and analysis techniques to identify bottlenecks, propose optimizations, and make informed design decisions for computer systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT I

Advanced Microarchitecture and Pipelining

Superscalar and VLIW architectures, out-of-order execution, branch prediction techniques, advanced pipelining techniques, speculative execution, dynamic scheduling.

UNIT II

Memory Hierarchy and Caching

Cache coherence protocols, multi-level caching, memory organizations (NUMA, UMA), virtual memory management, TLBs, memory optimization techniques.

UNIT III

Parallelism and Thread-Level Architectures

Simultaneous multithreading, multi-core architectures, shared vs. distributed memory systems, thread-level parallelism exploitation, synchronization mechanisms.

UNIT IV

Performance Optimization and Emerging Trends

Performance metrics, profiling and benchmarking, vector processing, GPU architectures, power-efficient computing, cloud and edge computing trends.

Textbooks:

1. Hennessy, J. L., & Patterson, D. A. (2017). Computer Architecture: A Quantitative Approach. Morgan Kaufmann. (ISBN: 978-0123838728)

2. Patterson, D. A., & Hennessy, J. L. (2017). Computer Organization and Design: The Hardware/Software Interface. Morgan Kaufmann. (ISBN: 978-0124077263)

References:

1. Tanenbaum, A. S., & Bos, H. (2018). Modern Operating Systems. Pearson. (ISBN: 978-0133591620)
2. Flynn, M. J. (1995). Computer Architecture: Pipelined and Parallel Processor Design. Jones & Bartlett Learning. (ISBN: 978-0867202098)
3. Hill, M. D., & Marty, M. R. (2018). Computer Organization and Design RISC-V Edition: The Hardware/Software Interface. Morgan Kaufmann. (ISBN: 978-0128122754)

Paper Code: ICT443	Paper: Smart Antenna	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and principles of smart antenna systems, including beamforming, spatial processing, and diversity techniques in wireless communications.
CO 2	Analyze and compare various smart antenna algorithms and techniques, evaluating their advantages, limitations, and performance metrics.
CO 3	Design and simulate smart antenna systems using relevant software tools, considering real-world constraints and optimizing their performance for different wireless communication scenarios.
CO 4	Critically assess the current trends and emerging technologies in the field of smart antennas, enabling students to adapt to the dynamic landscape of wireless communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	3
CO 3	3	2	3	3	2	1	-	-	3	2	-	3
CO 4	3	3	3	3	3	1	-	-	3	2	-	3

UNIT I
Introduction to Smart Antennas
Introduction to smart antennas, basic antenna parameters, types of smart antennas, advantages and applications of smart antennas, overview of wireless communication systems.

UNIT II
Beamforming and Spatial Processing
Principles of beamforming, adaptive beamforming algorithms (LMS, NLMS, RLS), conventional beamforming, pattern synthesis, spatial filtering, direction of arrival (DOA) estimation.

UNIT III
Diversity Techniques and MIMO Systems
Diversity techniques in wireless communication, space diversity, polarization diversity, frequency diversity, MIMO systems and spatial multiplexing, MIMO architectures, capacity and throughput enhancement.

UNIT IV
Advanced Topics in Smart Antennas
Interference suppression techniques, adaptive nulling, eigenbeamforming, hybrid beamforming, mmWave smart antennas, massive MIMO, 5G and beyond, practical considerations and challenges.

Textbooks:
1. T. A. Roach, "Smart Antennas," IEEE Press, 2004.

2. A. A. Zohdy and D. H. Schaubert, "Adaptive Antennas and Phased Arrays for Radar and Communications," IEEE Press, 2008.

References:

1. R. W. Heath Jr., "Introduction to Wireless Digital Communication: A Signal Processing Perspective," IEEE Press, 2017.
2. S. Haykin, "Adaptive Filter Theory," Prentice Hall, 2001.
3. T. S. Rappaport, "Wireless Communications: Principles and Practice," Pearson Education, 2002.
4. A. Sayeed, "Introduction to Smart Antennas," Morgan & Claypool Publishers, 2005.

Paper Code: ICT445	**Paper: Fabrication Technology**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the principles of various fabrication processes used in electrical engineering.
CO 2	Analyze the impact of fabrication technology on the performance of electronic components.
CO 3	Apply theoretical knowledge to practical fabrication techniques.
CO 4	Evaluate and select appropriate fabrication methods for specific electronic devices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	1	-	2	1	-	1
CO 2	3	3	3	2	2	1	1	-	2	1	-	2
CO 3	3	2	3	2	2	1	-	-	2	1	-	3
CO 4	3	3	3	2	2	1	-	-	2	1	-	3

UNIT I

Semiconductor Basics and Photolithography

Introduction to semiconductor materials, Crystal growth techniques, Dopant diffusion, Ion implantation, Photolithography process, Photoresists, Mask alignment and exposure, Etching techniques, Introduction to cleanroom protocols.

UNIT II

Thin Film Deposition and Oxidation

Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), Atomic Layer Deposition (ALD), Epitaxial growth, Thermal oxidation of silicon, Dry and wet oxidation processes, Oxide growth mechanisms, Oxide thickness measurement techniques.

UNIT III

Etching and Patterning

Plasma etching, Wet etching, Reactive ion etching (RIE), Etch mask design and optimization, Etch rate control, Etch selectivity, Introduction to lift-off techniques, Patterning of microstructures.

UNIT IV

Packaging and Assembly

Packaging hierarchy, Wire bonding, Flip-chip bonding, Die attachment techniques, Encapsulation methods, Introduction to MEMS packaging, Reliability testing of packages, Packaging challenges for high-frequency and high-power devices.

Textbooks:

1. S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices," 3rd ed., Wiley-IEEE Press, 2006.
2. S. K. Ghandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide," 2nd ed., Wiley, 1994.

References:

1. J. D. Plummer, M. D. Deal, and P. B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice, and Modeling," Prentice Hall, 2000.
2. C. A. Harper, "Electronic Packaging and Interconnection Handbook," 4th ed., McGraw-Hill Education, 2005.
3. R. F. Pierret, "Semiconductor Device Fundamentals," 2nd ed., Addison-Wesley Publishing Company, 1996.

Paper Code: ICT447	Paper: Power Electronics	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and Design: Analyze the operation of various power semiconductor devices and design basic power electronic circuits employing different converter topologies.
CO 2	Control Techniques: Understand and apply control techniques for regulating the output of power electronic converters and maintaining desired performance characteristics.
CO 3	Applications: Recognize and assess the applications of power electronics in diverse industries, such as motor drives, renewable energy systems, and power supplies.
CO 4	Problem Solving: Apply acquired knowledge to troubleshoot and solve common issues in power electronic circuits and systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	1	-	1	-	1	1	-	1
CO 2	3	3	3	2	1	-	1	-	1	1	-	1
CO 3	3	2	3	2	1	1	-	-	1	1	-	1
CO 4	3	3	3	2	1	1	-	-	1	1	-	1

UNIT I

Power Semiconductor Devices and Basic Concepts: Introduction to power electronics, Power semiconductor devices (diodes, thyristors, MOSFETs, IGBTs), Device characteristics and ratings, Switching loss mechanisms, Diode and thyristor rectifiers, Power diode and thyristor models, Turn-on and turn-off processes.

UNIT II

AC-DC Converters and DC-DC Converters: Single-phase and three-phase diode rectifiers, Controlled rectifiers, Phase-controlled converters, DC-DC converter fundamentals, Buck, Boost, Buck-Boost converters, PWM techniques for DC-DC converters, Voltage and current sources, Non-isolated and isolated converters.

UNIT III

Inverters and AC Voltage Controllers: Introduction to inverters, Half-bridge and full-bridge inverters, Pulse-width modulation (PWM) techniques for inverters, Sinusoidal pulse-width modulation (SPWM), Voltage source inverters (VSI), Current source inverters (CSI), AC voltage controllers, Single-phase and three-phase control strategies.

UNIT IV

Applications, Control, and Advanced Topics: Applications of power electronics in motor drives, Renewable energy systems (solar and wind), Uninterruptible power supplies (UPS), Power quality improvement, Basics of electric vehicle charging, Introduction to resonant converters, High-frequency transformers, Thermal management in power electronics.

Textbook:

1.Ned Mohan, Tore M. Undeland, and William P. Robbins, "Power Electronics: Converters, Applications, and Design," 3rd Edition, John Wiley & Sons, 2003.

References:

1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices, and Applications," 4th Edition, Pearson, 2013.
2. Daniel W. Hart, "Introduction to Power Electronics," Prentice Hall, 2017.
3. B.W. Williams and S. N. Vukosavic, "Introduction to Power Electronics," Pearson, 2020.
4. M. H. Rashid, "Power Electronics Handbook," Academic Press, 2010.

Paper Code: ICT449	**Paper: Electronic Measurements**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of electronic measurements and the characteristics of measurement instruments.
CO 2	Apply various measurement techniques to quantify electronic parameters accurately.
CO 3	Analyze measurement uncertainties and make informed decisions based on measurement results.
CO 4	Design and conduct experiments to measure and analyze electronic circuits and systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**-**	**1**
CO 2	**3**	**3**	**3**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**2**	**3**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**2**

UNIT I
Introduction to Electronic Measurements
Overview of electronic measurements, importance of measurements in engineering, units and standards for measurements, types of errors in measurements, statistical analysis of measurement data.

UNIT II
Measurement Instruments
Classification of measurement instruments, analog and digital instruments, measurement sensitivity and accuracy, voltage and current measurements, impedance measurement techniques, oscilloscopes and signal generators.

UNIT III
Measurement Techniques
Bridge measurements, measurement of resistance, inductance, and capacitance, time and frequency measurements, digital measurements, data acquisition systems, sensors and transducers, measurement of temperature and pressure.

UNIT IV
Measurement Uncertainty and Data Analysis
Sources of measurement uncertainty, propagation of errors, calibration methods, uncertainty estimation, data presentation and analysis, regression analysis, significance of measurement results.

Textbooks:
1. A. D. Helfrick and W. D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques," Pearson, 2013.
2. E. C. Titchmarsh and A. J. Amos, "Introduction to the Theory of Fourier Integrals," Clarendon Press, 2016.

References:

1. J. C. Mallinson, "Instrumentation for Scientists and Engineers," CRC Press, 2018.
2. D. A. Bell, "Electronic Instrumentation and Measurements," Oxford University Press, 2019.
3. R. S. Figliola and D. E. Beasley, "Theory and Design for Mechanical Measurements," Wiley, 2014.
4. J. G. Webster, "Electrical Measurement, Signal Processing, and Displays," CRC Press, 2018.

Paper Code: ICT451	**Paper: MEMS and Sensors**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the Principles: Comprehend the underlying principles of MEMS technology and various types of sensors, and explain their working mechanisms.
CO 2	Design and Analysis: Design simple MEMS devices and sensors, and analyze their performance characteristics using relevant modeling and simulation tools.
CO 3	Fabrication Techniques: Describe the different fabrication techniques involved in creating MEMS devices and sensors, and understand the impact of fabrication processes on device performance.
CO 4	Applications: Recognize the wide-ranging applications of MEMS devices and sensors in areas such as consumer electronics, healthcare, automotive systems, and industrial automation.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	1	-	1	-	1	1	-	1
CO 2	3	3	3	2	1	-	1	-	1	1	-	1
CO 3	3	2	3	2	1	1	-	-	1	1	-	1
CO 4	3	3	3	2	1	1	-	-	1	1	-	1

UNIT I

Introduction to MEMS and Sensors

Overview of MEMS and sensor technologies; Historical development and key milestones; Classification of sensors based on physical principles; Importance of sensors in modern technology

UNIT II

MEMS Fundamentals and Design

Microfabrication processes: lithography, etching, deposition; Mechanical properties at the microscale; Transduction principles: piezoelectric, capacitive, resistive, and optical; Design considerations and constraints for MEMS devices

UNIT III

Sensor Technologies and Applications:

Pressure sensors: piezoresistive, capacitive, resonant; Accelerometers and gyroscopes: MEMS-based inertial sensors; Temperature sensors: thermoelectric, resistive, capacitive; Optical sensors: photodetectors, image sensors; Biosensors: principles and applications in healthcare; MEMS sensors in automotive and aerospace industries

UNIT IV

Fabrication Processes and Case Studies

Bulk and surface micromachining techniques; Packaging and encapsulation of MEMS devices; Case studies of MEMS devices: micro-mirror arrays, microfluidic devices; Reliability and testing of MEMS devices; Introduction to sensor interface circuits and signal processing

Textbook:

1. N. Maluf and A. P. Maluf, "An Introduction to Microelectromechanical Systems Engineering," Artech House, 2000.

References:

1. S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices," John Wiley & Sons, 2006.
2. R. T. Howe and R. S. Muller, "Piezoresistive Sensors," Springer Science & Business Media, 2008.
3. J. H. Smith, "Principles of Inertial Navigation," American Institute of Aeronautics and Astronautics, 2000.
4. G. K. Fedder and R. W. Dutton, "Modeling of Microelectromechanical Systems," IEEE Press, 2003.

Paper Code: ICT453T	Paper: Radar and Satellite Communication	L	T/P	C
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts and functioning of radar systems, including waveform generation, signal processing, and target detection.
CO 2	Analyze the architecture and components of satellite communication systems, including link budget calculations and modulation techniques.
CO 3	Design and evaluate radar and satellite communication links based on given requirements, considering factors like propagation, noise, and system parameters.
CO 4	Demonstrate the ability to integrate radar and satellite communication systems into broader technological applications, considering practical constraints and real-world scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	1	-	-	1
CO 2	3	3	3	2	2	1	1	-	-	-	-	1
CO 3	3	3	3	2	2	1	1	-	-	-	-	1
CO 4	3	3	3	2	2	1	1	-	1	-	-	1

UNIT I
Radar Systems
Introduction to Radar Systems, Radar Waveforms and Signal Processing, Radar Antennas and Propagation, Radar Targets and Detection, Clutter and Noise in Radar.

UNIT II
Satellite Communication
Basics of Satellite Communication, Satellite Orbits and Coverage, Link Budget Analysis, Modulation and Multiplexing Techniques, Satellite Communication Subsystems.

UNIT III
Radar and Satellite System Design
Radar System Design Considerations, Radar Transmitters and Receivers, Pulse Doppler Radar and Moving Target Detection, Satellite Communication System Design, Error Control Coding in Satellite Communication.

UNIT IV
Integration and Applications
Radar and Satellite Integration Challenges, Remote Sensing Applications of Radar, Satellite Communication Networks, Emerging Trends in Radar and Satellite Communication.

Textbooks:
1. Skolnik, M. I., "Introduction to Radar Systems," 3rd Edition, McGraw-Hill, 2001.

2. Maral, G., & Bousquet, M., "Satellite Communications Systems: Systems, Techniques and Technology," 5th Edition, Wiley, 2009.

References:

1. Richards, M. A., Scheer, J. A., & Holm, W. A., "Principles of Modern Radar: Basic Principles," SciTech Publishing, 2010.
2. Elbert, B. R., "Introduction to Satellite Communication," 3rd Edition, Artech House, 2008.
3. Stimson, G. W., "Introduction to Airborne Radar," 2nd Edition, SciTech Publishing, 2013.
4. Pratt, T., & Bostian, C. W., "Satellite Communications," 2nd Edition, Wiley, 2002..

Paper Code: ICT453P	Radar and Satellite Communication Lab.		L	T/P	C
Paper ID:			-	2	1
Teacher's Continuous Evaluation :	40 Marks	Term End Examinations :		60 Marks	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 453T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT459T	**Paper: Radio and Television Engineering**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and explain the fundamental concepts of radio and television engineering, including signal modulation, transmission, and propagation.
CO 2	Design and evaluate various types of antennas used in radio and television broadcasting systems.
CO 3	Apply modulation techniques to efficiently transmit audio and video signals, taking into consideration bandwidth and signal quality.
CO 4	Critically assess the latest trends and advancements in radio and television technologies, demonstrating an understanding of their impact on the field.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**2**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**2**	**-**	**2**

UNIT I
Fundamentals of Radio and Television Engineering
Introduction to radio and television systems, electromagnetic spectrum, frequency bands for broadcasting, signal types and their characteristics, amplitude modulation (AM), frequency modulation (FM), digital modulation techniques.

UNIT II
Transmission and Propagation
Transmission lines and waveguides, transmission loss and attenuation, propagation of radio waves, ground wave, sky wave, space wave propagation, ionospheric effects, fading and multipath propagation, link budget analysis.

UNIT III
Antenna Design and Broadcasting Systems
Antenna fundamentals, types of antennas, radiation pattern characteristics, antenna gain and directivity, antenna arrays, television broadcasting systems, radio broadcasting systems, satellite television broadcasting.

UNIT IV
Modulation Techniques and Advanced Technologies
Amplitude modulation (AM) and its parameters, frequency modulation (FM) and its parameters, digital modulation (ASK, FSK, PSK), stereo FM broadcasting, digital audio and video broadcasting, High Definition (HD) television, Internet streaming and its challenges.

Textbooks:

1. C. A. Balanis, "Antenna Theory: Analysis and Design," John Wiley & Sons, 2016.
2. B. E. Saha and S. Bandyopadhyay, "Introduction to Radio and Television Engineering," McGraw-Hill Education, 2007.
3. F. E. Terman and J. R. Whinnery, "Radio Engineers' Handbook," McGraw-Hill Professional, 2018.

References:

1. G. L. Krauss, "Electromagnetics," McGraw-Hill Education, 2015.
2. E. A. Marino, "Modern Digital and Analog Communication Systems," Oxford University Press, 2019.
3. W. L. Stutzman and G. A. Thiele, "Antenna Theory and Design," John Wiley & Sons, 2012.
4. R. E. Collin, "Antennas and Radiowave Propagation," McGraw-Hill Education, 2019.

Paper Code: ICT459P	**Radio and Television Engineering Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ICT 459T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ICT461T	Paper: RF and Microwave Engineering	L	T/P	C
Paper ID:		3	0	3
Prerequisite Paper:				

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and design RF and microwave circuits, including passive and active components.
CO 2	Understand the behavior of electromagnetic waves in the RF and microwave frequency range.
CO 3	Design and analyze RF amplifiers and oscillators for different applications.
CO 4	Apply theoretical knowledge to practical RF and microwave systems, demonstrating problem-solving skills in real-world scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	3
CO 3	3	2	3	3	2	-	-	-	3	2	-	3
CO 4	3	3	3	3	3	-	-	-	3	2	-	3

UNIT I

Fundamentals of RF and Microwave Engineering: Introduction to RF and Microwave frequencies, Transmission line theory and Smith chart, S-parameters and their applications, Microwave network analysis, Microwave resonators and cavities.

UNIT II

RF Passive Components and Antennas: Design and analysis of RF filters, RF couplers and dividers, Antenna fundamentals and types, Antenna parameters and radiation patterns, Matching networks and impedance transformation.

UNIT III

RF Active Components and Amplifiers: Review of semiconductor physics for RF applications, RF diodes and their applications, Design of RF power amplifiers, Low noise amplifiers (LNAs) for RF receivers, Stability and gain considerations in RF amplifiers.

UNIT IV

RF Oscillators and Microwave Systems: Principles of RF oscillators, Design and analysis of RF voltage-controlled oscillators (VCOs), Introduction to microwave systems (radar, satellite communication, wireless networks), Microwave system components and design considerations, Introduction to RF measurement techniques and instruments.

Textbooks:

1. Thomas H. Lee, "Planar Microwave Engineering: A Practical Guide to Theory, Measurement, and Circuits," Cambridge University Press, 2004.
2. David M. Pozar, "Microwave Engineering," John Wiley & Sons, 2011.

References:

1. Robert E. Collin, "Foundations for Microwave Engineering," IEEE Press, 2001.
2. Leo L. Tsai, "Microwave Circuit Design Using Linear and Nonlinear Techniques," John Wiley & Sons, 2020.
3. Samuel Y. Liao, "RF and Microwave Circuit Design for Wireless Communications," Artech House, 2016.
4. David M. Pozar, "Microwave and RF Design: A Systems Approach," John Wiley & Sons, 2020.

5. G. R. McGrath and T. H. Lee, "The Design of Radio-Frequency CMOS Power Amplifiers," IEEE Journal of Solid-State Circuits, vol. 38, no. 9, pp. 1440-1451, Sep. 2003.

Paper Code: ICT461P	**RF and Microwave Engineering Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	
Instructions : 1. The course objectives and course outcomes are identical to that of ICT 461T as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement.					

Paper Code: ITE401T	**Paper: Unsupervised and Reinforcement Learning**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of unsupervised learning and apply clustering and dimensionality reduction techniques to analyze and interpret complex datasets.
CO 2	Grasp the principles of reinforcement learning and implement basic algorithms to solve sequential decision-making problems.
CO 3	Compare and contrast different unsupervised and reinforcement learning approaches, evaluating their strengths and limitations for various engineering applications.
CO 4	Design and develop solutions for engineering challenges using unsupervised and reinforcement learning techniques, demonstrating proficiency in model selection, training, and evaluation.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT I

Introduction to Unsupervised Learning

Overview of Unsupervised Learning, Clustering Techniques: K-Means, Hierarchical Clustering, DBSCAN, Dimensionality Reduction: Principal Component Analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE), Applications of Unsupervised Learning in Engineering.

UNIT II

Advanced Unsupervised Learning Methods

Gaussian Mixture Models (GMM), Cluster Evaluation and Validation, Anomaly Detection, Recommender Systems, Case Studies and Practical Implementation.

UNIT III

Introduction to Reinforcement Learning

Basics of Reinforcement Learning, Markov Decision Processes (MDPs), Exploration and Exploitation Trade-off, Dynamic Programming: Policy Iteration, Value Iteration.

UNIT IV

Advanced Reinforcement Learning Techniques

Q-Learning and Deep Q-Networks (DQN), Policy Gradient Methods, Actor-Critic Architectures, Applications of Reinforcement Learning in Engineering.

Textbooks:

1. Sutton, R. S., & Barto, A. G. (2018). "Reinforcement Learning: An Introduction." MIT Press.

2. Bishop, C. M. (2006). "Pattern Recognition and Machine Learning." Springer.

References:

1. Hastie, T., Tibshirani, R., & Friedman, J. (2009). "The Elements of Statistical Learning: Data Mining, Inference, and Prediction." Springer.
2. Murphy, K. P. (2012). "Machine Learning: A Probabilistic Perspective." MIT Press.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2016). "Deep Learning." MIT Press.
4. Shalev-Shwartz, S., & Shammah, S. (2014). "Online Learning: Theory, Algorithms, and Applications." Cambridge University Press.

Paper Code: ITE401P	**Unsupervised and Reinforcement Learning Lab.**			**L**	**T/P**	**C**
Paper ID:				**-**	**2**	**1**
Teacher's Continuous Evaluation :		**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 401T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE403T	**Paper: Big Data Analytics**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental concepts of Big Data Analytics, including the challenges and opportunities posed by large-scale datasets.
CO 2	Apply various techniques and tools for data preprocessing, cleaning, and transformation on big datasets.
CO 3	Utilize different methods for analyzing and visualizing large-scale data to extract meaningful patterns and insights.
CO 4	Gain hands-on experience in using relevant software tools and technologies for Big Data Analytics.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT I
Introduction to Big Data Analytics
Introduction to big data, Characteristics of big data, Importance of big data analytics in engineering applications, Overview of the data analytics process, Ethical considerations in big data analytics.

UNIT II
Data Preprocessing for Big Data
Data cleaning and preprocessing techniques, Handling missing data, Data transformation and normalization, Dimensionality reduction methods.

UNIT III
Big Data Analysis Techniques
Exploratory data analysis (EDA) on big data, Clustering methods for large datasets, Classification techniques for big data, Regression analysis on big data, Association rule mining in big data.

UNIT IV
Big Data Visualization and Tools
Principles of data visualization for big data, Visualization tools and libraries for big data, Introduction to Hadoop and MapReduce, Introduction to Apache Spark for big data processing.

Textbooks:
1. J. Manyika et al., "Big Data: A Revolution That Will Transform How We Live, Work, and Think," Houghton Mifflin Harcourt, 2012.
2. A. G. Daskalakis, "Big Data Analytics: Methods and Applications," Springer, 2016.

References:

1. T. H. Davenport, "Big Data at Work: Dispelling the Myths, Uncovering the Opportunities," Harvard Business Review Press, 2014.
2. I. Witten et al., "Data Mining: Practical Machine Learning Tools and Techniques," Morgan Kaufmann, 2016.
3. T. White, "Hadoop: The Definitive Guide," O'Reilly Media, 2015.
4. M. Zaharia et al., "Learning Spark: Lightning-Fast Big Data Analysis," O'Reilly Media, 2015.

Paper Code: ITE403P	**Big Data Analytics Lab.**		**L**	**T/P**	**C**
Paper ID:			**-**	**2**	**1**
Teacher's Continuous Evaluation :	**40 Marks**	**Term End Examinations :**		**60 Marks**	

Instructions :

1. The course objectives and course outcomes are identical to that of ITE 403T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: ITE407T	**Paper: Global Optimization Methods**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand optimization and corelate to real world applications
CO 2	Analyze the characteristics different types of functions in optimization.
CO 3	Understand Deterministic Global Optimization Algorithms.
CO 4	Understand various Metaheuristic Global Optimization Algorithms.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	-	-	-	3
CO 2	3	2	2	2	3	-	-	-	-	-	-	3
CO 3	3	2	2	2	3	-	-	-	-	-	-	3
CO 4	3	2	2	2	3	-	-	-	-	-	-	3

UNIT I
Introduction to Global Optimization
Overview of optimization, classification of optimization problems, challenges in global optimization, real-world applications of global optimization methods.

UNIT II
Mathematical Foundations
Convex and non-convex functions, properties of objective functions, constraints in optimization, duality in optimization.

UNIT III
Deterministic Global Optimization Algorithms
Brute-force methods, branch and bound, branch and cut, interval arithmetic, Lipschitz optimization, DIRECT algorithm.

UNIT IV
Metaheuristic Global Optimization Algorithms
Genetic algorithms, simulated annealing, particle swarm optimization, ant colony optimization, differential evolution.

Textbooks:
1. A. R. Conn, K. Scheinberg, and L. N. Vicente, "Introduction to Derivative-Free Optimization," Society for Industrial and Applied Mathematics, 2009.
3. C. A. Floudas and P. M. Pardalos, "Encyclopedia of Optimization," Springer, 2001.

References:
1. J. C. Spall, "Introduction to Stochastic Search and Optimization: Estimation, Simulation, and Control," John Wiley & Sons, 2003.

2. M. D. McKay, R. J. Beckman, and W. J. Conover, "A Comparison of Three Methods for Selecting Values of Input Variables in the Analysis of Output from a Computer Code," Technometrics, vol. 21, no. 2, pp. 239-245, 1979.
3. K. Deb, "Multi-Objective Optimization Using Evolutionary Algorithms," John Wiley & Sons, 2001.
4. S. Kirkpatrick, C. D. Gelatt, and M. P. Vecchi, "Optimization by Simulated Annealing," Science, vol. 220, no. 4598, pp. 671-680, 1983.
5. J. Kennedy and R. C. Eberhart, "Particle Swarm Optimization," Proceedings of IEEE International Conference on Neural Networks, pp. 1942-1948, 1995.

<table>
<tr><td colspan="2">Paper Code: ITE407P</td><td colspan="2">Global Optimization Methods Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td colspan="2">Paper ID:</td><td colspan="2"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 407T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE409T	Paper: Expert Systems and Knowledge Representation	L	T/P	C
Paper ID:		3	0	3
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the core concepts of expert systems, knowledge representation, and their real-world applications.
CO 2	Develop and implement rule-based systems using appropriate knowledge representation techniques.
CO 3	Create and assess fundamental expert systems tailored to solve specific domain problems.
CO 4	Analyze the challenges and limitations related to knowledge representation and expert system development.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT II
Introduction to Expert Systems
Introduction to expert systems, components of expert systems, knowledge engineering processes, expert system life cycle, comparison with conventional programming.

UNIT II
Knowledge Representation Techniques
Propositional logic, first-order logic, semantic networks, frames, ontologies for effective domain knowledge representation.

UNIT III
Rule-Based Systems and Inference Engines
Modeling domain knowledge using production rules, rule representation, forward and backward chaining, conflict resolution strategies, explanation mechanisms within inference engines.

UNIT IV
Expert System Development and Applications
Knowledge acquisition, knowledge verification, validation techniques, practical aspects of expert system development, user interface design, integration with external data sources.

Textbooks:
1. Jackson, P. (1999). "Introduction to Expert Systems" (3rd ed.). Addison-Wesley.
2. Hayes-Roth, B., Waterman, D. A., & Lenat, D. B. (1983). "Building Expert Systems." Addison-Wesley.

References:
1. Brachman, R. J., & Levesque, H. J. (2004). "Knowledge Representation and Reasoning." Elsevier.
2. Giarratano, J. C., & Riley, G. (2004). "Expert Systems: Principles and Programming" (4th ed.). Course Technology.
3. Davis, R., Shrobe, H. E., & Szolovits, P. (1993). "What is a Knowledge Representation?" AI Magazine, 14(1), 17-33.

<table>
<tr><td>Paper Code: ITE409P</td><td colspan="3">Expert Systems and Knowledge Representation Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 409T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE411T	**Paper: Design of Smart Systems**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze and explain the fundamental concepts and components of smart systems.
CO 2	Design and implement smart systems using appropriate sensors, actuators, and communication interfaces.
CO 3	Develop algorithms for data processing, decision-making, and control in smart systems.
CO 4	Evaluate the ethical, security, and societal implications of deploying smart systems in various applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**-**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**1**	**2**	**-**	**3**

UNIT I

Introduction to Smart Systems and Components

Introduction to smart systems and their significance; Overview of sensors and transducers in smart systems; Actuators and their role in smart systems; Microcontrollers and embedded platforms for smart systems; Communication protocols: UART, SPI, I2C, and wireless options

UNIT II

Sensor Integration and Data Processing

Types of sensors: temperature, humidity, light, motion, etc.; Sensor interfacing techniques with microcontrollers; Analog and digital signal conditioning; Noise reduction and data filtering methods; Introduction to data processing algorithms.

UNIT III

Actuator Control and Decision-Making

Actuator control methods and circuits; Feedback control systems in smart systems; Introduction to decision-making algorithms; Real-time control vs. batch processing; Case study: Smart system control for energy efficiency

UNIT IV

Communication and Ethical Considerations

Wireless communication protocols: Wi-Fi, Bluetooth, Zigbee, LoRa; Security challenges in smart systems: data privacy, authentication; Ethical considerations in designing and deploying smart systems; Case study: Smart healthcare devices and privacy concerns; Future trends in smart systems design

Textbooks:

1. N. P. Mahalik, "Embedded Systems: Architecture, Programming, and Design," CRC Press, 2018.
2. M. Lee, "IoT and Edge Computing for Architects," Packt Publishing, 2019.

References:

1. R. Rajkumar, "Real-Time Systems," MIT Press, 2019.

2. K. Townsend, "Designing Connected Products: UX for the Consumer Internet of Things," O'Reilly Media, 2015.
3. S. McBurney, "Ethics and the Internet of Things," Cambridge University Press, 2020.

Paper Code: ICT413T	Paper: Privacy and Security Issues in IoT	L	T/P	C
Paper ID:		4	0	4
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Analyze the privacy implications of different IoT architectures and applications.
CO 2	Evaluate security vulnerabilities in IoT devices, networks, and protocols.
CO 3	Design and propose solutions to enhance privacy in IoT data collection and usage.
CO 4	Apply cryptographic techniques and protocols to secure IoT communication and data storage.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	-	3	2	2	1	2
CO 2	3	3	3	3	3	3	-	3	2	2	1	2
CO 3	3	3	3	3	3	3	-	3	2	2	1	2
CO 4	3	3	3	3	3	3	-	3	2	2	1	2

UNIT I
Privacy Challenges in IoT
Introduction to IoT and its significance, Types of IoT data and their sensitivity, Privacy risks in IoT data collection and sharing, Legal and ethical considerations in IoT privacy.

UNIT II
Security Vulnerabilities in IoT Systems
Common security threats in IoT, Unauthorized access and authentication issues, IoT device and firmware vulnerabilities, Network-level attacks on IoT, Case studies of security breaches in IoT.

UNIT III
Enhancing Privacy in IoT
Privacy-preserving data aggregation and anonymization, User consent and control mechanisms, Role of encryption in IoT data privacy, Privacy-enhancing technologies for IoT, Privacy impact assessments.

UNIT IV
Securing IoT: Cryptographic Protocols and Best Practices
Fundamentals of cryptography for IoT, Secure key management in IoT, Cryptographic protocols for secure IoT communication, Securing IoT storage and data integrity, Industry standards and best practices for IoT security.

Textbooks:
1. B. Roman, P. Najera, and J. Lopez, "The Internet of Things: Contiki-Based Privacy Mechanisms and Data Security," Springer, 2015.
2. R. Roman, J. Zhou, and J. Lopez, "Introduction to Privacy and Security in the Internet of Things," Springer, 2017.

References:

1. D. Gubbi et al., "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems, vol. 29, no. 7, 2013, pp. 1645-1660.
2. K. Renaud and R. K. Baillie, "A survey of risk assessment in the Internet of Things," Journal of Reliable Intelligent Environments, vol. 1, no. 1, 2015, pp. 1-14.
3. T. Zohar and S. Levy, "Privacy-preserving data collection in IoT networks," IEEE Internet of Things Journal, vol. 4, no. 5, 2017, pp. 1411-1420.
4. C. Karlof and D. Wagner, "Secure routing in wireless sensor networks: Attacks and countermeasures," Ad Hoc Networks, vol. 1, no. 2-3, 2003, pp. 293-315.

Paper Code: ITE415T	**Paper: Real Time Embedded System Programming**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**
Prerequisite Paper:				

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand Real-Time Embedded Systems: Demonstrate a clear understanding of real-time embedded systems, including their characteristics, challenges, and significance in modern engineering applications.
CO 2	Program Real-Time Systems: Develop the skills necessary to program real-time embedded systems, including proficiency in selecting appropriate programming languages, tools, and methodologies for real-time applications.
CO 3	Design and Implement Real-Time Tasks: Design and implement real-time tasks, including task scheduling, synchronization, and communication mechanisms, considering the timing constraints and resource limitations.
CO 4	Analyze and Optimize Performance: Analyze the performance of real-time embedded systems, identify bottlenecks, and apply optimization techniques to meet timing requirements and enhance system efficiency.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	-	-	1	1	-	1
CO 2	3	3	3	2	2	1	-	-	1	1	-	1
CO 3	3	3	3	2	2	1	-	-	1	1	-	1
CO 4	3	3	3	2	2	1	-	-	1	1	-	1

UNIT I
Introduction to Real-Time Embedded Systems
Concepts of real-time systems, hard vs. soft real-time, timing constraints, importance of predictability.

UNIT II
Real-Time Programming Basics
C/C++ programming for real-time, real-time operating systems (RTOS), debugging and testing real-time code.

UNIT III
Real-Time Task Scheduling and Synchronization
Topics covered: Task scheduling algorithms (Rate Monotonic, Earliest Deadline First), priority inversion, inter-task communication (semaphores, message queues), avoiding deadlocks.
UNIT IV
Performance Analysis and Optimization
Profiling and benchmarking, latency analysis, optimization strategies (caching, memory management), real-time debugging tools.

Textbooks:

1. S. S. Saj and G. M. Hughes, Real-Time Embedded Systems Programming: 32-Bit Microcontrollers in C. Wiley-IEEE Press, 2012.
2. M. Barr, Programming Embedded Systems: With C and GNU Development Tools. O'Reilly Media, 2006.

References:

1. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach. MIT Press, 2017.
2. F. Vahid and T. Givargis, Embedded System Design: A Unified Hardware/Software Introduction. Wiley, 2001.

<table>
<tr><td>Paper Code: ICT415P</td><td colspan="3">Real Time Embedded System Programming Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 415T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE417T	Paper: Logic Design and Analysis Using Verilog	L	T/P	C
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand fundamental concepts of digital logic design and apply them to real-world engineering problems.
CO 2	Demonstrate proficiency in writing and interpreting Verilog code for designing digital circuits.
CO 3	Analyze and optimize digital circuits for performance, area, and power consumption.
CO 4	Design and simulate complex digital systems using Verilog, considering factors such as modularity, scalability, and reusability.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	-	-	1	1	-	2
CO 2	3	3	3	2	2	1	-	-	1	1	-	2
CO 3	3	3	3	2	2	1	-	-	1	1	-	2
CO 4	3	3	3	2	2	1	-	-	1	1	-	2

UNIT I

Introduction to Logic Design and Verilog Basics: Number systems and codes; Boolean algebra; Logic gates and their applications; Introduction to Verilog HDL; Data types and operators in Verilog; Verilog modules and hierarchical design

UNIT II

Combinational Logic Design and Verilog Implementation: Combinational logic circuits; Design procedure for combinational circuits; Verilog implementation of combinational circuits; Case studies: Multiplexers, Decoders, Encoders;

UNIT III

Sequential Logic Design and Verilog Modeling: Sequential logic circuits; Flip-flops and latches; Analysis and synthesis of sequential circuits; Finite State Machines (FSMs); Verilog modeling of sequential circuits;

UNIT IV

Advanced Topics in Logic Design and System Integration: Timing and hazards in digital circuits; Synchronous and asynchronous counters; Introduction to system-level design; Designing with memory elements; Integration of modules into larger systems;

Textbooks:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", Pearson, 2019.
2. Donald Thomas and Philip R. Moorby, "The Verilog Hardware Description Language", Springer, 2012.

References:

1. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw-Hill, 2007.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson, 2003.
3. John F. Wakerly, "Digital Design Principles and Practices", Pearson, 2019.
4. Thomas L. Floyd and David M. Buchla, "Fundamentals of Digital Logic and Microcomputer Design", Cengage Learning, 2018.

<table>
<tr><td>Paper Code: ITE417P</td><td colspan="3">Logic Design and Analysis Using Verilog Lab.</td><td>L</td><td>T/P</td><td>C</td></tr>
<tr><td>Paper ID:</td><td colspan="3"></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Teacher's Continuous Evaluation :</td><td>40 Marks</td><td colspan="2">Term End Examinations :</td><td colspan="2">60 Marks</td></tr>
<tr><td colspan="7">Instructions :
1. The course objectives and course outcomes are identical to that of ITE 417T as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.</td></tr>
</table>

Paper Code: ITE421	Paper: Sensors and Actuators	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 25 Marks
2. Term End Theory Examination: 75 Marks

Guidelines for Paper Setter(s):

1.There should be 9 questions in the term end examinations question paper.
2.The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
3.Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto five sub-parts/sub-questions. Each unit will have a marks weightage of 15.
4.The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard/level of questions to asked should be at the level of the prescribed textbook.
5.The requirements of (scientific) calculators/ log-tables/ data- tables may be specified if required.

Course Outcome (CO):

CO 1	Understand the fundamental principles of sensors and actuators, and how they are used in engineering systems.
CO 2	Analyze the characteristics and operational principles of different types of sensors and actuators.
CO 3	Design and select appropriate sensors and actuators for specific engineering applications.
CO 4	Integrate sensors and actuators into systems while considering practical constraints and optimization strategies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I
Introduction to Sensors and Actuators
Sensor and actuator classification; Sensing mechanisms; Transduction principles; Calibration techniques Actuation methods
UNIT II
Sensor Technologies and Applications
Resistive sensors; Capacitive sensors; Inductive sensors; Piezoelectric sensors; Optical sensors; Magnetic sensors; Applications in temperature sensing; Applications in pressure sensing; Applications in proximity sensing
UNIT III
Actuator Technologies and Control
Electrostatic actuators; Electromagnetic actuators; Piezoelectric actuators; Pneumatic actuators; Open-loop control; Closed-loop control; Practical considerations in actuator design and control
UNIT IV
Sensor-Actuator Interfaces and System Integration
Signal conditioning; Amplification techniques; Analog-to-digital conversion; Digital communication protocols; System-level integration of sensors and actuators; Sensor fusion techniques; Case studies of integrated sensor-actuator systems

Textbooks:
1. R. S. Khandpur, "Handbook of Sensors and Actuators," McGraw-Hill Education, 1989.
2. A. J. Rogers and S. R. P. Silva, "Fundamentals of Sensors for Engineering and Science," 2nd ed., Elsevier, 2018.

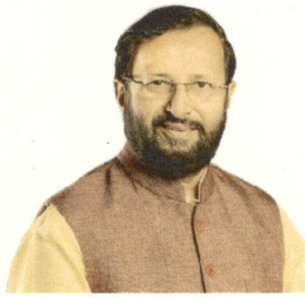
References:
1. C. A. Grimes, E. C. Dickey, and M. V. Pishko, "Encyclopedia of Sensors," American Scientific Publishers, 2006.
2. A. B. Lostetter and R. M. White, "Introduction to Sensors and Actuators," Pearson, 2003.

3. N. S. Grewal and A. M. Shur, "Introduction to Sensors for Ranging and Imaging," CRC Press, 2017.
4. B. E. Jones, "Instrumentation and Sensors for the Food Industry," 2nd ed., Woodhead Publishing, 2018.

प्रकाश जावडेकर
Prakash Javadekar

सत्यमेव जयते

मंत्री
मानव संसाधन विकास
भारत सरकार
MINISTER
HUMAN RESOURCE DEVELOPMENT
GOVERNMENT OF INDIA



MESSAGE

I am extremely pleased to note that AICTE has taken strong measures to improve quality of technical education in the country. AICTE prepared the model curriculum of various disciplines of Undergraduate & Postgraduate degree courses in Engineering & Technology which was released on 24th January, 2018. I am happy to note that this is being adopted by the Institutions / Universities in the country from the academic year 2018-19 onwards. As a step forward, it is commendable that AICTE has done an impressive task of compiling 'List of suggested books of Indian Authors' for Undergraduate & Postgraduate degree courses in Engineering & Technology for helping students and teachers.

I congratulate the Chairman and his team at AICTE for such a thoughtful initiative of promoting Indian books by our own Indian Authors. It is a much deserved recognition for our Indian Authors which will definitely accelerate and encourage Indian Authors to write quality books. Our students should take advantage of wealth of information about books.

Looking forward towards more such quality initiatives by AICTE and best wishes for future endeavours.

(PRAKASH JAVADEKAR)

Room No. 3, 'C' Wing, 3rd Floor, Shastri Bhavan, New Delhi-110 115
Phone : 91-11-23782387, 23782698, Fax : 91-11-23382365,
E-mail : minister.hrd@gov.in

AICTE RECOMMENDED

LIST OF SUGGESTED BOOKS OF INDIAN AUTHORS & PUBLISHERS

FOR

UNDERGRADUATE DEGREE COURSES IN

ENGINEERING & TECHNOLOGY

[FEBRUARY 2018]

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
Nelson Mandela Marg, Vasant Kunj, New Delhi 110 070
www.aicte-india.org

FIRST YEAR UNDERGRADUATE DEGREE COURSES

BASIC SCIENCE COURSES

List of Recommended Books:

BSC101 – Physics

1. Engineering Physics, Malik and Singh, Tata Mc Graw Hill
2. Engineering Physics, Naidu, Pearson
3. Mechanics, Mathur, S.Chand Publishing
4. Classical Mechanics, Upadhyaya, Himalaya Publishing House
5. Classical Mechanics, G. Aruldhas, PHI
6. Engineering Physics, Gupta & Gaur, Dhanpat Rai
7. Quantum Mechanics, Ajay Ghatak S. Lokanathan, Trinity
8. Quantum Mechanics: A Text Book for undergraduates, Mahesh C Jain, TMH
9. Text Book of Ruantum Mechanics, M. Mathews &Venkatesan, TMH
10. Electromagnetic Theory, Prabir K. Basu & Hrishikesh Dhasmana, AneBooks
11. Fundamentals of Electromagnetic Theory, Khunita, PHI
12. A Text Book of Optics, Avadhanulu, S. Chand
13. Optics, Ajoy Ghatak, TMH
14. Modern Physics for Engineers, S.P. Taneja, R. Chand
15. The Physics of waves and Oscillations, N.K. Bajaj, TMH

BSC102 – Chemistry-I

1. Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
2. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
3. Essentials of Physical Chemistry, Bahl&Tuli, S.Chand Publishing
4. Applied Chemistry, Sunita Rattan, Kataria
5. Engineering Chemistry, Baskar, Wiley
6. Engineering Chemistry – I, D. GrourKrishana, Vikas Publishing
7. Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.

BSC103 – Mathematics – I

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 9789386173522)
2. Engineering Mathematics for first year, Veerarajan T., Tata McGraw-Hill
3. Higher Engineering Mathematics, Ramana B.V., Tata McGraw
4. Differential Calculus Shanti Narayan & Dr. P.K. Mittal, S.Chand Publishing
5. A Course & Mathematical Analysis (ISBN: 9788121904728), Narayan &Mittal, S.Chand
6. Elements of Mathematical Analysis, R.Agor, (ISBN: 9789382609599)
7. Integral Calculus Shanti Narayan & Dr. P.K. Mittal, (ISBN: 9788121906814), S.Chand
8. A Textbook of Matrices, Narayan &Mittal, (ISBN: 9788121925969), S.Chand
9. Advanced Engineering Mathematics (ISBN: 9788120336094), Sashtry, PHI
10. Engineering Mathematics – I, Reena Garg, Khanna Book Publishing

BSC103 – Mathematics – II

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
3. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI

ENGINEERING SCIENCE COURSES

List of Recommended Books:

ESC101 – Basic Electrical Engineering

1. Basic Electrical Engineering, Ritu Sahdev, (ISBN: 9789386173492), Khanna Book Publishing
2. Basic Electric Engineering, DP Kothari & Nagrath, Tata McGraw Hill
3. Basic Electrical Engineering, Mittle & Mittal, Tata McGraw Hill
4. Basic Electric Engineering, DC Kulshrehtra, Tata McGraw Hill

ESC102 – Engineering Graphics and Design

1. Engineering Graphics & Design, Jain, Maheshwary, Gautam, Khanna Publishing House
2. Engineering Drawing, ND Bhat, Charotar Publishing House
3. Engineering Drawing and Computer Graphics, Shah, Pearson
4. Textbook on Engineering Drawing, Narayana, Scitech Publishers
5. Engineering Graphics, Agarwal & Agarwal, TMH

ESC103 – Programming for Problem Solving

1. Programming in ANSI in C, E Balaguruswamy, Tata McGraw Hill
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing
3. Let us C, Yashavant P. Kanetkar, BBP Publications, Delhi

HUMANITIES & SOCIAL SCIENCES

List of Recommended Books:

ESC104- Workshop Manufacturing Practices

1. Basic Manufacturing Process, Mehta & Gaira, Viva Books
2. Elements of Workshop Technology, Hajra & Choudhary, Media Promotors
3. Workshop Practices, HS Bawa, Tata Mc Graw Hill
4. Manufacturing Technology, Vol.1,2 and 3, PN Rao, TMH

HSMC101 – English

1. Technical Communication, Meenakshi Raman & Sangeeta Sharma, Oxford University Press
2. Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi
3. Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press

CIVIL ENGINEERING

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

ESC202 – Basic Electronics

1. Basic Electronics, Santiram Kal, Prentice Hall
2. Basic Electronics, BL Thareja, S.Chand Publishing
3. All-in-One Electronics Simplified, A.K. Maini, Khanna Book Publishing

ESC109 – Biology for Engineers

1. Biology for Engineers (ISBN: 9781121439931), TMH

ESC203 – Computer Aided Civil Engineering Drawing

1. Civil Engineering Drawing, Sharma & Gurucharan Singh, Standard Publishers
2. A Course in Civil Engineering Drawing, Sikka, S.K. Kataria & Sons
3. Engineering Drawing, Dhanarajay A Jolhe, Tata McGraw Hill

ESC205 – Engineering Mechanics

1. Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Engineering Mechanics, R. S. Khurmi, S.Chand Publishing
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications
4. Engineering Mechanics, Sharma, Pearson

ESC212 – Energy Science & Engineering

1. Energy Technology, OP Gupta, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Energy Engineering & Management, Chakrabarti A, PHI

BSC225 – Life Science

1. Life Sciences, Vol-I, II, Pranav Kumar, Pathfinder Publication

BSC201 – Mathematics – III

1. Advanced Engineering Mathematics, Chandrika Prasasd & Reena Garg, Khanna Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
3. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI
4. Discrete Mathematics and Its Applications, S. Chakraborty & B.K. Sarkar, Oxford

HSMC251 – Introduction to Civil Engineering

1. Basic Civil Engineering, Palanichamy, McGraw Hill
2. Basic Civil Engineering, Satheesh Gopi, Pearson Publishers

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

ESC209 – Mechanical Engineering

1. Basic Mechanical Engineering, M.P. Poonia, S.C. Sharma & T.R. Banga, Khanna Publishing House
2. Basic Mechanical Engineering, G. Shanmugam &S Ravindran, Mc Graw Hill
3. Basic Mechanical Engineering, Pravin Kumar, Pearson

PCC-CE201 – Instrumentation & Sensor Technologies for Civil Engineering Applications

1. Electronics Measurements & Instrumentation, J.G. Joshi, Khanna Publishing House
2. A Course in Electronics Measurements and Instrumentation, A.K. Sahwney, Dhanpat Rai

PCC-CE202 – Engineering Geology

1. Text Book of Engineering Geology, N. Chenna Kesavulu, Macmillan Publishers
2. Engineering Geology for Civil Engineers, Varghese P.C, PHI
3. Engineering and General Geology, Parbin Singh, SK Kataria & Sons
4. Engineering Geology, Subinoy Gangopadhyay, Oxford University

PCC-CE203 – Disaster Preparedness & Planning

1. Disaster Management, S.C. Sharma, Khanna Publishing House
2. Disaster Management, Ghosh G.K., APH Publishing Corporation
3. Handbook of Disaster Management, Singh B.K., Rajat Publication
4. Disaster Management in India, A.K. Singh, New Royal Book Company

PCC-CE204 – Introduction to Fluid Mechanics

1. Fluid Mechanics, Sadhu Singh, Khanna Books, Delhi
2. Fluid Mechanics, RK Bansal, Laxmi Publications
3. Fluid Mechanics, Modi & Seth, Standard Publishers
4. Fluid Mechanics, Hydraulics and Hydraulic Machines, KR Arora, Standard Publishers Distributors

PCC-CE205 – Introduction to Solid Mechanics

1. Strength of Materials, D.S. Bedi, Khanna Publishing House
2. Strength of Materials, R Subramanian, Oxford University Press
3. Strength of Materials, RK Bansal, Laxmi Publications

PCC-CE206 – Surveying & Geomatics

1. Advanced Surveying, Madhu & Gobi, Pearson India
2. Geomatics Engineering, Arora & Badjatia, Nem Chand & Co.
3. Surveying Vol.-I, II, III, BC Punamia, Laxmi Publications
4. Surveying, Vol.-I, II, III, K.R. Arora, Standard Book House

PCC-CE206 – Materials, Testing & Evaluation

1. Highway Materials and Pavement, Khanna & Justo, Nemchand & Bros.

MC-CE207– Management – I (Organizational Behaviour)
1. A Textbook of Organizational Behaviour, CB Gupta, S.Chand Publications
2. Organizational Behaviour, LM Prasad, Sutan Chand and Sons

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

PCC-CE301 – Mechanics of Materials
1. Structural Analysis, R. Agor, Khanna Publishing House
2. Mechanics of Materials, BC Punmia & A.K. Jain, Laxmi Publications

PCC-CE302 – Hydraulic Engineering
1. Fluid Mechanics & Hydraulic Machines, SS Rattan, Khanna Publishing House
2. Hydraulic and Fluid Mechanics, PN Modi & SM Seth, Standard Book House
3. Fluid Mechanics, Dr K Subramanya, TMH
4. Fluid Mechanics and Machinery, CSP Ojha, R Berndtsson & P.N. Chandramouli, Oxford University
5. Fluid Machinery, Sadhu Singh, Khanna Publishing House, Delhi

PCC-CE303 – Structural Engineering
1. Advanced Structural Analysis, A.K. Jain, Nem Chand Bros.
2. Prestressed Concerte, Srikant B. Vanakudre, Khanna Publishing House
3. Design of Prestressed Concrete, Krishnan Raju, Tata McGraw Hill
4. Design of Steel Structures, N. Subramanian, Oxford University Press
5. Reinforced Concrete Vol. II, H.J. Shah, Charotar Publications
6. Structural Analysis, R. Agor, Khanna Publishing House

PCC-CE304 – Geotechnical Engineering
1. Principles of Geotechnical Engineering, Braja Das, Cengage
2. Basic and applied Soil Mechanics, Rajan & Rao, New Age International Publishers
3. Soil Mechanics & Foundation Engineering, Arora KR, Standard Publishers

PCC-CE305 – Hydrology & Water Resources Engineering
1. Engineering Hydrology, Subramanayan, McGraw Hill
2. Applied Hydrology, KN Muthreja, McGraw Hill

PCC-CE306 – Environmental Engineering
1. Environmental Engineering, S.C. Sharma, Khanna Publishing House
2. Basic Environmental Engineering, R.C. Gaur, Newage Publications
3. Water Resources Engineering, PN Modi, Standard Publishers
4. Environmental Engineering, Dr. AK Jain (ISBN: 978-93-86173560), Khanna Publishers
5. Irrigation Water Power & Water Resource Engineering, Arora, Standard Publishers

PCC-CE307 – Transportation Engineering
1. Transportation Engineering, L.R. Kadiyali, (ISBN: 978-93-82609-85-8), Khanna Publishing
2. Principles of Transportation Engineering, Chakrobarty, PHI Learning
3. Highway Engineering, Khanna & Justo, Nemchand & Bros.
4. Principles of Transportation Engineering, Partha Chakraborty, PHI Learning

HSMC255 – Professional Practice, Law & Ethics

1. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Sangal, G.P. Bagaria, Excel Books, Delhi
2. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing

MC-1 – Constitution of India

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

PCC-CE308 – Construction Engineering & Management

1. Construction Engineering & Management, S.C. Sharma & S.V. Deodhar, Khanna Book Publishing
2. Construction Project Management, Jha, Pearson
3. Building Construction, Varghese PC, Prentice Hall India

PCC-CE309 – Engineering Economics, Estimation & Costing

1. Estimating and Costing in Civil Engineering, BN Dutta, UBS Publishers
2. Estimating, Costing Specifications & Valuation, M Chakraborty
3. Handbook of Construction Management, Joy PK, , Macmillan

List of Some Other Useful Books:

1. Concrete: Microstructure, Properties & Materials, PK Mehta, Tata McGraw
2. Air Pollution Control Engineering, Keshav Kant, Khanna Publishing House
3. Design of Bridge Structures, T.R. Jagadeesh & M.A. Jayaram, Phi
4. Project Management with CPM /PERT, Punmia, Laxmi Publications
5. Introductory Methods of Numerical Analysis, Sashtry, PHI
6. Basics of Remote Sensing & GIS, S. Kumar, University Sc. Press
7. Theory of Structures, Punmia, Laxmi Publications
8. Civil Engineering Construction Materials, S.K. Sharma, KBP House
9. Ground Improvement Techniques, Purushottam Raj, Tata McGraw Hill
10. Elements of Land/Soil Pollution, O.P. Gupta, Khanna Publishing House
11. Water Supply and Sanitary Engineering, Rangwala, Charotar Publications
12. Harbour, Dock and Tunnel Engineering, Srinivasan, Charotar Publications
13. Airport Engineering, Rangwala, Charotar Publications

ELECTRICAL ENGINEERING

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

PCC-EE01 – Electrical Circuit Analysis

1. Networks and Systems, Asfaq Hussain, Khanna Publishing House, Delhi
2. Networks and systems, D. Roy Choudhary, New Age International Publishers
3. Problems and Solutions of Electrical Circuit Analysis, R.K. Mehta & A.K. Mal, CBS Publishers

PCC-EE02 – Analog Electronics

1. Analog Electronics, L.K.Maheshwari, Laxmi Publications
2. Analog Electronics, A.K. Maini, Khanna Publishing House
3. Analog Electronics, I.G.Nagrath, PHI

PCC-EE04 – Electrical Machines - I

1. Electrical Machines-I, GC Garg, (ISBN: 978-93-86173-447), Khanna Book Publishing, Delhi
2. Electrical Machines, Kothari & Nagrath, TMH
3. Electrical Machines, Mehta & Mehta, S.Chand Publications

ESC201 – Engineering Mechanics

1. Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
2. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications
4. Engineering Mechanics, Sharma, Pearson

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

PCC-EE07 – Digital Electronics

1. Digital Electronics, A. Anand Kumar, PHI
2. Modern Digital Electronics, R.P. Jain, TMH
3. Digital Electronics, R.Anand Khanna Publishing House

PCC-EE09 – Electrical Machines - II

1. Electrical Machines - II, GC Garg, (ISBN: 978-93-86173-60-7), Khanna Book Publishing, Delhi
2. The Performance & Design of Alternating Current Machines, Say, CBS Publishers
3. Principle of Electrical Machine Design with Computer Programs, S.K. Sen, Oxford & IBH

PCC-EE11 – Power Electronics

1. Modern Power Electronics, P.C. Sen., Chand & Co.
2. Power Electronics, V.R.Moorthi, Oxford University Press
3. Power Electronics, Muhammad H. Rashid, Pearson

PCC-EE13 – Signals and Systems

1. Signals and Systems, A. Anand Kumar, Phi
2. Signals and Systems, Rishabh Anand, Khanna Book Publishing Co., Delhi
3. Signals and Systems, Tarun Rawat, Oxford University Press
4. Signal Processing and Linear Systems, B.P. Lathi, Oxford University Press
5. Signals and Systems, J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, TMH

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BSC201 – Mathematics - III

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
3. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI
4. Discrete Mathematics and Its Applications, S. Chakraborty & B.K. Sarkar, Oxford

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

PCC-EE14 – Power Systems – I

1. Modern Power System Analysis, Kothari Nagrath, McGraw Hill Education
2. Power System Operation and Control, S. Sivanagaraju & G. Sreenivasan, Pearson
3. Electrical Power Systems, C.L. Wadhwa, Newage Publishers

PCC-EE16 – Control Systems

1. Control System Engineering, Nagrath & Gopal, Newage Publishers
2. Control Systems, Ambikapathy, Khanna Book Publishing Co. (P) Ltd., Delhi

PCC-EE17 – Microprocessors

1. Microprocessors, Ramesh Gaonkar, Penram Publications
2. Advanced Microprocessors and Peripherals, Burchandi, TMH
3. Advanced Microprocessors, AK Gautam, Khanna Publishing House

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

PCC-EE20 – Power Systems – II

1. Modern Power System Analysis, Kothari & Nagrath, McGraw Hill Education
2. Power System Operation and Control, Sivanagaraju & Sreenivasan, Pearson
3. Electrical Power Systems, C.L. Wadhwa, Newage Publishers

List of Recommended Books for Elective Courses:

1. Electromagnetic Waves, Shevgaonkar, R, McGraw Hill
2. Electrical Power Generation, Transmission and distribution, Singh, PHI
3. Electrical Power Generation, Tanmoy Deb, Khanna Publishers
4. HVDC Power Transmission System, K. R. Padiyar, Wiley
5. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumati & S. N. Deepa, Springer
6. High Voltage Engineering, C.L. Wadhwa, Newage Publishers
7. Introduction to Neural Networks using MATLAB, Sivanandam, TMH
8. Electric Drives, N.K. De & P.K. Sen, PHI
9. Fundamentals of Electrical Drives, Dubey, Narosa Publishing House

MECHANICAL ENGINEERING

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

BSC201 – Physics -II

1. Engineering Physics, Garg & Singh
2. Mechanics, Mathur, S.Chand Publishing
3. Classical Mechanics, Upadhyaya, Himalaya Publishing House
4. Classical Mechanics, G. Aruldhas, PHI
5. Engineering Physics, Gupta & Gaur, Dhanpat Rai
6. Quantum Mechanics, Ajay Ghatak S. Lokanathan, Trinity
7. Quantum Mechanics: A Text Book for undergraduates, Mahesh C Jain, TMH
8. A text Book of Ruantum Mechanics, M. Mathews & K. Venkatesan, TMH
9. Electromagnetic Theory, Prabir K. Basu & Hrishikesh Dhasmana, Ane Books
10. Fundamentals of Electromagnetic Theory, Khunita, PHI
11. A Text Book of Optics, Avadhanulu, S. Chand
12. Optics, Ajoy Ghatak, TMH
13. Modern Physics for Engineers, S.P. Taneja, R. Chand
14. The Physics of waves and Oscillations, N.K. Bajaj, TMH

BSC202 – Mathematics - III

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
3. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI
4. Discrete Mathematics and Its Applications, S. Chakraborty & B.K. Sarkar, Oxford

ESC201 – Basic Electronics Engineering

1. Basic Electronics, Santiram Kal, Printice Hall
2. Basic Electronics, B.L. Thareja, S.Chand Publishing
3. Basic Electronics, S. Biswas, Khanna Publications

ESC202 – Engineering Mechanics

1. Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
2. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications
4. Engineering Mechanics, DP Sharma, Pearson

PCC-ME201– Thermodynamics

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill
2. Basic and Applied Thermodynamics, P.K. Nag, Tata McGraw Hill

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

PCC-ME202– Applied Thermodynamics

1. Engineering Thermodynamics, Nag P.K, Tata McGraw Hill
2. Basic and Applied Thermodynamics, PK Nag, Tata McGraw Hill

PCC-ME203– Fluid Mechanics and Fluid Machines

1. Fluid Mechanics, Sadhu Singh, Khanna Publishing House, Delhi
2. Fluid Mechanics, Modi & Seth, Standard Publishers

PCC-ME204– Strength of Materials

1. Strength of Materials, D.S. Bedi, Khanna Publishing, Delhi
2. Strength of Materials, R.K. Rajput, Laxmi Publications
3. Strength of Materials, R. Subramanian, Oxford Publications

PCC-ME205– Materials Engineering

1. Engineering Materials Properties and Selection, Budinski and Budinski, PHI
2. Material Science & Engineering, R. Balasubhramanium, Wiley India

MC - II– Environmental Science

1. Textbook of Environmental Studies, Erach Bharucha, University Press
2. Environmental Studies, MP Poonia & SC Sharma, Khanna Publishing House
3. Environmental Studies, Rajagopalan, Oxford University Press

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

PCC-ME301– Heat Transfer

1. Fundamental of Heat and Mass Transfer, M.Thirumaleshwar, Pearson
2. Computational Heat Transfer and Fluid Flow, Murlidhar & Sunder Rajan, Narosa
3. Thermal Engineering, M.L. Mathur & F.S. Mehta, Jain Publications
4. A Course in Heat & Mass Transfer, V.M. Domkundwar, Dhanpat Rai & Co.

PCC-ME302– Solid Mechanics

1. Strength of Materials, D.S. Bedi, Khanna Publishing House
2. Strength of Materials, R Subramanian, Oxford University Press
3. Strength of Materials, RK Bansal, Laxmi Publications
4. Mechanics of Materials, Punmia, Jain and Jain, Laxmi Publications

PCC-ME304– Kinematics & Theory of Machines

1. Theory of Machines, SS Rattan, Tata McGraw Hill
2. Kinematics & Theory of Machines, Sadhu Singh, Pearson

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

PCC-ME307– Manufacturing Technology

1. Manufacturing Technology, Vol. 1, 2, 3, PN Rao, TMH
2. Manufacturing Technology, RK Rajput, Laxmi Publications
3. Production and Operations Management, S.N.Chary, TMH

PCC-ME308– Design of Machine Elements

1. Machine Design (ISBN: 9789382609575), Sadhu Singh, Khanna Publishing House, Delhi
2. Machine Design Data Book, Sadhu Singh, Khanna Publishing House
3. Design Data Book, Mahadevan, CBS Publishers & Distributors
4. Introduction to Machine Design, V.B. Bhandhari, McGraw Hill
5. A Textbook of Machine Design, RS Khurmi, S.Chand Publications

SEMESTER – VII (FOURTH YEAR)

List of Recommended Books:

PCC-ME401– Automation in Manufacturing

1. Modern Machining Process, Pandey and Shan, TMH
2. Manufacturing Automation Metal Cutting Mechanics, Machine Tool Vibrations, CNC Design, Yusuf, Cambridge University Press

List of Recommended Books for Other Courses:

Mechatronics

1. A Textbook of Mechatronics, RK Raput, S.Chand Publishing
2. Mechatronics: Principles, Concepts and applications, Mahalik N.P, Tata McGraw Hill
3. Introduction to Mechnotronics, Kuttan, Oxford University

Finite Element Analysis

1. A Text Book of Finite Element Analysis, Seshu, Phi
2. The Finite Element Methods in Engineering, SS Rao, Butterworth
3. An Introduction to Finite Element Methods, J Reddy, Tata McGraw Hill

Power Plant Engineering

1. Power Plant Engineering, P.K. Nag, TMH
2. Power Plant Engineering, S.C. Sharma, Khanna Publications

Refrigeration and Air Conditioning

1. Refrigeration and Air Conditioning, C.P. Arora, TMH
2. Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House
3. A Course in Refrigeration & Air Conditioning, Domkundwar, Dhanpat Rai

Machine Drawing

1. Machine Drawing, PS Gill, Katsons
2. Machine Drawing, O.P Jahkar, Amit Mathur, Khanna Publishing House

Gas Turbines
1. Gas Turbines, Ganeshan, Tata McGraw Hill
2. Internal Combustion Engines, Mathur & Sharma, Dhanpat Rai
3. Steam, Gas Turbine and Power Plant Engineering, Yadav, CPH, Allahabad

Total Quality Management
1. Total Quality Management, Poonia & Sharma, Khanna Publishing House
2. Total Quality Management, Gopal, PHI

Engineering Management
1. Engineering Management: Industrial Engineering & Management, SC Sharma, Khanna Publishing House, Delhi
2. Industrial Engineering & Operations Management, SK Sharma

Automobile Engineering
1. Automotive Engineering, Kirpal Singh, Standard Publishers
2. Automobile Mechanics, A.K. Babu & S.C. Sharma, T.R. Banga, Khanna Book Publishing
3. Automotive Electricals and Electronics, A.K. Babu, Khanna Publishing House
4. A Textbook of Automobile Engineering, R.K. Rajput, Laxmi Publications

Reliability Engineering
1. Reliability Engineering, E. Balaguruswamy, Tata McGaw Hill
2. Reliability Engineering, L.S. Srinath, Affliated East-West Press
3. Industrial Maintenance Management, S.K. Srivastava, S.Chand & Co.

List of Some Other Useful Books:

1. Robotics and Control, Mittal & Nagrath, Tata McGraw Hill
2. Robotics Technology, Satyarajan Deb, TMH
3. Practical Non-Destructive Testing, Baldev Raj, T. Jay Kumar, M. Thavasimuthu, Narosa
4. Mechanical Vibrations, S.S. Rao, Addison Wesley Longman
5. Principles and Practice of Management, Prasad, L.M, Sultan Chand
6. Mechanical Vibrations, SS Rao, Pearson
7. Mechanical Vibrations, GK Grover, Nem Chand Bros.
8. Transducers and Instrumentation, V.S. Murthy, PHI
9. Transducers and Instrumentation, Nakra & C.Houdhary, TMH
10. Fundamentals of Industrial Drives, Sarkar, PHI
11. Automotive Engines, A.K. Babu, Khanna Publications
12. Modern Machining Process, Pandey & Shan, Tata McGraw Hill

COMPUTER SCIENCE ENGINEERING

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

ESC201 – Analog Electronic Circuits

1. Analog Electronics, L.K. Maheshwari, Laxmi Publications
2. Analog Electronics, A.K. Maini, Khanna Publishing House
3. Analog Electronics, I.G. Nagrath, PHI

PCC-CS301 – Data Structures & Algorithms

1. Fundamentals of Data Structures, Sartaj Sahni, University Press
2. Data Structures, RS Salaria, Khanna Publishing House
3. Data Structures through C, Yashwant Kanetkar, BPB Publications
4. Expert Data Structures with C++, RB Patel, Khanna Publications

ESC302– Digital Electronics

1. Digital Electronics, A. Anand Kumar, PHI
2. Modern Digital Electronics, R.P. Jain, TMH
3. Digital Electronics, Rishabh Anand, Khanna Publishing House

BSC301 – Mathematics – III

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw
3. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
4. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

PCC-CS401 – Discrete Mathematics

1. Discrete Mathematics and Its Applications, Chakraborty & Sarkar, Oxford
2. Discrete Structures, S.B. Singh, Khanna Book Publishing, Delhi
3. Discrete Mathematics, T. Veerarajan, Tata McGraw-Hill

PCC-CS402– Computer Organization & Architecture

1. Computer Fundamentals Architecture and Organization, B. Ram, New Age International
2. Computer Organization & Architecture, Rajaraman, PHI Learning

PCC-CS403 – Operating Systems

1. Operating Systems, Ekta Walia, Khanna Publishing House, Delhi
2. Operating Systems A Concept-Based Approach, Dhananjay M. Dhamdhere, McGraw Hill

PCC-CS404– Design & Analysis of Algorithms

1. Design & Analysis of Algorithms, S. Sridhar, Oxford
2. Design & Analysis of Algorithms, Sharma, Khanna Publishing House, N.Delhi

HSMC401 – Management – I

1. A Textbook of Organizational Behaviour, CB Gupta, S.Chand Publications
2. Organizational Behaviour, LM Prasad, Sultan Chand and Sons

MC – Environmental Sciences

1. Textbook of Environmental Studies, Erach Bharucha, University Press
2. Environmental Studies, MP Poonia & SC Sharma, Khanna Publishing House
3. Environmental Studies, Rajagopalan, Oxford University Press

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

ESC501 – Signals and Systems

1. Signals and Systems, A. Anand Kumar, Phi
2. Signals and Systems, Tarun Rawat, Oxford University Press
3. Signals and Systems, Rishabh Anand, Khanna Book Publishing Co., Delhi
4. Signal Processing and Linear Systems, B.P. Lathi, Oxford University Press
5. Signals and Systems, J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, TMH

PCC-CS501- Database Management Systems

1. Fundamental of Database Systems, E. Ramez and Navathe, Pearson
2. Database Management Systems, R.P. Mahapatra & Govind Verma, Khanna Publishing House
3. Database Management Systems, Raghurama Krishan, McGraw Hill

PCC-CS502 - Formal Language & Automata Theory

1. Theory of Computer Science: Automata, Languages and Computation, Mishra, Phi
2. Theory of Computation, RB Patel & Prem Nath, Khanna Publications

PCC-CS503 - Object Oriented Programming

1. Object Oriented Programming with C++, Balaguruswamy, TMH
2. Mastering Object-Oriented Programming with C++, R.S. Salaria, Khanna Book Publishing, N.Delhi
3. Programming with Java, Balaguruswamy, TMH
4. Object Oriented Programming in C++ and Java, D.Samantha, PHI
5. Internet and Java Programming, Tanweer Alam, Khanna Publishing House

MC- Constitution of India

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

PCC-CS602 - Computer Networks

1. Computer Networks, M. Dave, Cengage
2. An Engineering Approach to Computer Networking, Keshav, Pearson
3. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publications
4. Telecommunication Switching System and Networks, Viswanathan, PHI

List of Recommended books for Additional Courses:

Graph Theory

1. Graph Theory, Deo and Narsingh, PHI Publications
2. Combinatorics & Graph Theory, Singh, Khanna Publishing House

Software Engineering

1. A concise introduction to software Engineering, Pankaj Jalote, Springer
2. Software Engineering, Nasib Singh Gill, Khanna Publishing House
3. Software Engineering, K.K. Aggarwal & Yogesh Singh, New Age International

Python Programming

1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Introduction to Computing and Problem Solving with Python, J. Jose, Khanna Publications
3. Python Programming, Seema Thareja, Pearson

Artificial Intelligence

1. A classical approach to Artificial Intelligence, Munesh Chandra Trivedi, Khanna Publications
2. Artificial Intelligence and Machine Learning, Chandra S.S. & H.S. Anand, PHI Publications
3. Machine Learning, Rajiv Chopra, Khanna Publishing House

Cryptography & Network Security

1. Cryptography & Network Security, Atul Kahate, McGraw Hill
2. Cryptography & Network Security, V.K. Jain, Khanna Publishing House

Internet of Things

1. Internet of Things, Jeeva Jose, (ISBN: 978-93-86173-591), Khanna Publishing House
2. Internet of Things, Arsheep Bahga and Vijay Madisetti

Software Testing

1. Software Testing, Yogesh Singh, University Press
2. Fundamentals of Software Testing, AB Mathur, Pearson
3. Software Testing Principles and Practices, Chauhan, Oxford University Press

Data Analytics

1. Big Data & Hadoop, V.K. Jain, Khanna Publishing House
2. Big Data Black Book, DT Editorial Services, Wiley India
3. Data Science & Analytics, V.K. Jain, Khanna Publishing House
4. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, ISBN: 978-93-86173454

Numerical Methods

1. Numerical Methods, E.Balaguruswamy, TMH
2. Introductory Methods of Numerical Analysis, S.S.Sastry, PHI
3. Computer Oriented Numerical Methods, R.S. Salaria, Khanna Publishing House

List of Some Other Useful Books:

1. Information Systems Security, Nina Godbole, Wiley
2. Introduction to Embedded Systems, K.V. Shibu, McGraw Hill
3. Introduction to Embedded Systems, Raj Kamal, Tata McGraw Hill
4. Fundamentals of Computers, Ravichandran, Tata McGraw Hill
5. Fundamentals of Computers, Rajaraman, PHI
6. Computer Fundamentals and Programming in C, Nasib Singh Gill, KBP
7. Hacking, Harsh Bothra, Khanna Publishing House
8. Cryptography and Information Security, V. K. Pachghare, PHI Learning
9. Information Security & Cyber Laws, Gupta, Khanna Publishing House
10. Ad hoc Wireless Networks Architectures, C.Siva Ram Murthy, Pearson
11. Multimedia Systems Concepts Standards and Practices, Ramesh, PHI
12. Multimedia and Animation, V.K. Jain
13. Information Theory, R Ash, Dover Science Publications
14. Essentials of Cloud Computing, K. Chandrasekaran
15. Cloud Computing, Pandey & Choudhary

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

EC01 – Electronic Devices
1. Solid State Electronic Devices, G. Streetman, and S. K. Banerjee, Pearson
2. Semiconductor Physics and Devices, D. Neamen, D. Biswas, McGraw Hill
3. All-in-One Electronic Simplified, A.K. Maini, Khanna Publishing House

EC03 – Digital System Design
1. Modern Digital Electronics, RP Jain, TMH
2. Digital System Design using VHDL, R. Anand, Khanna Publishing House
3. A VHDL Primer, Bhaskar, Pearson
4. A VHDL Synthesis, Bhaskar, Pearson

EC05 – Signals and Systems
1. Signals and Systems, A. Anand Kumar, Phi
2. Signals and Systems, Tarun Rawat, Oxford University Press
3. Signals and Systems, Rishabh Anand, Khanna Book Publishing Co., Delhi
4. Signal Processing and Linear Systems, B.P. Lathi, Oxford University Press
5. Signals and Systems, J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, TMH

EC05 – Network Theory
1. Networks and Systems, Asfaq Hussain, Khanna Publishing House, Delhi
2. Circuits and Network, Sudhakar & Shyammohan, Tata McGraw-Hill
3. Networks and systems, D. Roy Choudhary, New Age International Publishers

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

EC07 – Analog & Digital Communication
1. Analog & Digital Communication, B.P. Lathi, Gupta, Oxford University Press
2. Analog & Digital Communications, Debajani Mitra, TMH
3. Digital Design, Natrajan Ananda, PHI Publications

EC09 – Analog Circuits
1. Analog Electronics, L.K. Maheshwari, Laxmi Publications
2. Analog Electronics, A.K. Maini, Khanna Publishing House
3. Analog Electronics, I.G. Nagrath, PHI

EC11 – Microcontrollers
1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing
2. Microprossers and Microcontrollers, Krishna Kant, PHI
3. 8051 Microcontrollers, Rajakamal, TMH

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

EC13 – Electromagnetic Waves
1. Electromagnetic Fields & Waves, R.L. Yadava, Khanna Publishing House
2. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India
3. Engineering Electromagnetics, Narayana Rao, PHI

EC15 – Computer Architecture
1. Computer Fundamentals Architecture and Organization, B. Ram, New Age
2. Computer Organization & Architecture, Rajaraman, PHI Learning

EC17 – Digital Signal Processing
1. Digital Signal Processing, S. Salivahanan, McGraw Hill
2. Digital Signal Processing, S.K. Mitra, TMH
3. Digital Signal Processing, Ashok Ambardar, Cengage
4. Digital Signal Processing, A. Anand Kumar, PHI

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

EC19 – Control Systems
1. Control Systems, Gopal, Tata McGraw-Hill
2. Modern Control Engineering, Nagrath & Gopal, New Age International
3. Control Systems, A. Ambikapathy, Khanna Publishing House

EC20 - Computer Networks
1. Computer Networks, M. Dave, Cengage
2. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publications
3. Telecommunication Switching System and Networks, Viswanathan, PHI
4. An Engineering Approach to Computer Networking, Keshav, Pearson

List of Recommended books for Additional Courses:

ECEL02 – Fiber Optic Communication
1. Integrated Optics, T. Tamir, Springer-Verlag,
2. Nonlinear Fiber Optics, G. Agrawal, Academic Press
3. Fiber optic Communication Systems, G. Agrawal, Wiley India

ECEL05 – Introduction to MEMS
1. Micro and Smart Systems, Ananthasuresh & Gopalkrishnan, Wiley India
2. Microsystem Design, S. D. Senturia, Kluwer Academic Publishers

ECEL07 – Antennas and Propagation
1. Micro Strip Antennas, J. Bahl and P. Bhartia, Artech House
2. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill
3. Electromagnetic Waves, R.L. Yadav, Khanna Publishing House

ECEL14 – Power Electronics

1. Modern Power Electronics, P.C. Sen, Chand & Co.
2. Power Electronics, V.R.Moorthi, Oxford University Press.
3. Power Electronics, Muhammad H. Rashid, Pearson
4. Power Electronics, Joseph Vithyalthil, TMH

List of Some Other Useful Books:

1. Microwave Circuits, K.C. Gupta, Newage Publishers
2. Fundamentals of Digital Image Processing, Anil Kumar Jain, PHI
3. Fundamentals of Digital Processing, Tamal Bose, Wiley
4. Electronic Product Design, G. Kaduskar and V.B. Baru, Wiley India
5. Information Theory, R.B. Ash, PHI
6. Telecommunication Switching Systems and Networks, T. Viswanathan, PHI
7. Elements of Electronic Navigation Systems, N.S. Nagaraja, Tata McGraw Hill
8. Control in Robotics and Automation, Ghosh, Allied Publishers
9. Robotics Technology, Deb, Wiley India
10. Switchgear & Protection, Haroon Asfaq, Khanna Book Publishing

CHEMICAL ENGINEERING

SEMESTER – II (FIRST YEAR)

List of Recommended Books:

BS105 – Mathematics – II

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw
3. Advanced Engineering Mathematics (978-81-203-3609-4), Sashtry, PHI
4. Advanced Engineering Mathematics, Jain & Iyer, Narosa Publications

ESC-GES102 – Thermodynamics - I

1. An Introduction to Thermodynamics, Rao, John Wiley
2. Chemical Technology Volume – I, Pandey, Lion Press

PCC-GES103 – Electrical & Electronics Engineering

1. Basic Electrical and Electronics Engineering, Sukhija and Nagsarkar, Oxford
2. Basic Electrical and Electronics Engineering, Kothari & Nagrath, TMH
3. All-in-One Electronics Simplified, A.K. Maini, Khanna Book Publishing Co., Delhi

PCC-CS101 – Material & Energy Balance Computation

1. Basic Principles and Calculations in Chemical Engineering, Himmelblau, Phi
2. Stoichiometry, Bhatt & Vora, TMH
3. Stoichiometry and Process Calculations, Narayanan & Lakshmikutty, PHI

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

ESC-GES105 – Engineering and Solid Mechanics

1. Mechanics of Materials, Punmia & Jain, Laxmi Publications
2. Strength of Materials, D.S. Bedi, Khanna Publishing House
3. Strength of Materials (Mechanics of Solid), R.S. Khurmi, S.Chand Publications

BS107 - Chemistry – II

1. Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
2. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
3. Essentials of Physical Chemistry, Bahl & Tuli, S.Chand Publishing
4. Applied Chemistry, Sunita Rattan, Kataria
5. Engineering Chemistry, Baskar, Wiley
6. Engineering Chemistry – I, D. Grour Krishana, Vikas Publishing
7. Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.

PC-CS103 - Thermodynamics - II

1. Chemical Engineering Thermodynamics, YVC Rao, University Press

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

PCC-CS104 – Heat Transfer

1. Process Heat Transfer and Chemical Equipment Design, D.C.Sikdar, Khanna Publishing House
2. Heat Transfer: Principles and Applications, B.K. Dutta, PHI

PCC-CS105 - Mass Transfer – I

1. Principles of Mass Transfer and Separation Processes, B.K. Dutta, PHI

PCC-CS106 - Fluid Mechanics

2. Fluid Mechanics, Sadhu Singh, Khanna Book Publishing
3. Introduction to Fluid Mechanics and Fluid Machines, Som & Biswas, TMH

ESC-GES107 - Material Science

1. Materials Science and Engineering, Raghavan, V, PHI
2. Material Science & Engineering, Upadhyaya, Anshan Publications
3. Testing of Metallic Materials, Suryanarayanan, A.V.K., Tata McGraw

PCC-CS107 - Numerical Methods in Chemical Engineering

1. Numerical Methods for Engineers, Gupta, Newage Publishers
2. Numerical Methods for Engineers with Personal Computer Applications, S.C. Chapra, McGraw

MC - Environmental Sciences

1. Textbook of Environmental Studies, Erach Bharucha, University Press
2. Environmental Studies, MP Poonia & SC Sharma, Khanna Publishing House
3. Environmental Studies, Rajagopalan, Oxford University Press

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

PCC-CS108 - Chemical Reaction Engineering – I

1. Principles of Chemical Reaction Engineering, Dawande S.D, Central Techno Publications, Nagpur
2. Chemical Reaction Engineering - I, K A Gavhane, Nirali Prakahan

PCC-CS109 - Mass Transfer – II

1. Principles of Mass Transfer and Separation Processes, B.K. Dutta, PHI

PC-CS1111- Particle & Fluid Particle Processing

1. Unit Operations-I, Fluid Flow & Mechanical Operation, Gavhane, Nirali Prakashan
2. Unit Operations Vol.-I, K. A. Gavhane, Nirali Prakashan
3. Chemical Process Simulation, Husain, Wiley Eastern India

SEMESTER – VI (THIRD YEAR)

List of Recommended Books:

PCC-CS112 - Chemical Reaction Engineering – II

1. Principles of Chemical Reaction Engineering, Dawande S.D, Central Techno Publications, Nagpur
2. Chemical Reaction Engineering Vol. - II, K. A. Gavhane, Nirali Prakashan

PCC-CS113 – Process Technology & Economics

1. Dryden's Outlines of Chemical Technology, Rao, Affliated Press
2. Chemical Process Technology, O.P. Gupta, Khanna Publishing House
3. Chemical Project Economics, Mahajani, McMillan

PCC-CS114–Process Control

1. Instrumentation and Process Control, D.C. Sikdar, Khanna Publishing House
2. Instrumentation, Measurement and Analysis, Nakra, TMH

SEMESTER – VII (FOURTH YEAR)

List of Recommended books for Additional Courses:

Water Conservation & Management

1. Elements of Water Pollution Control Engineering, OP Gupta, Khanna Publishing House, Delhi
2. Water Supply and Sanitary Engineering, Rangwala, Charotar Publications

Advanced Separation Process

1. Process Design of Equipments, Dawande, S.D., Central Techno, Nagpur

Environmental Pollution and Control

1. Elements of Environmental Pollution Control, OP Gupta, Khanna Publishing House
2. Environmental Pollution Control Engineering, C.S. Rao, Newage Publications

Energy Resources (Conventional & Non-Conventional)

1. Elements of Fuels & Combustion Technology, Gupta, Khanna Publishing House
2. Energy Audit and Management, Teri Press
3. Energy Conservation, Diwan & Dwivedi, Pentagon Press
4. Non-Conventional Energy Resources, Chandra, Khanna Publishing House

Optimization Methods

1. Optimization Techniques, SS Rao, Wiley Eastern India

Petroleum Engineering

1. Elements of Petroleum Refinery Engineering, Gupta, (ISBN: 9789382609728)
2. Outlines of Chemical and Petroleum Engineering, Suryanaryana & Mahto, Khanna Publishing

METALLURICAL ENGINEERING & MATERIAL SCIENCE

SEMESTER – III (SECOND YEAR)

List of Recommended Books:

BS201 – Biology

1. Biology for Engineers (ISBN: 9781121439931), TMH

BS203 – Mathematics - III

1. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Book Publishing
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill
3. Advanced Engineering Mathematics (ISBN:9788120336094), Sashtry, PHI

PCC-MM201 – Introduction to Materials Engineering

1. Materials Science and Engineering, Raghavan, V, PHI
2. Material Science & Engineering, Upadhyaya, Anshan Publications
3. Testing of Metallic Materials, Suryanarayanan, A.V.K., Tata McGraw

PCC-MM203 – Phase Transformation

1. Solid State Phase Transformations, V. Raghavan, PHI

ESC201 – Materials Thermodynamics

1. Metallurgical Thermodynamics, S.K. Dutta, S.Chand Publications
2. Essentials of Metallurgical Thermodynamics, R.H. Tupkary, Khanna Publishing House

ESC201 – Engineering Mechanics

1. Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
2. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications
4. Engineering Mechanics, Sharma, Pearson
5. Applied Mechanics and Strength of Materials, Jindal, Galgotias

MC – Environmental Sciences

1. Textbook of Environmental Studies, Erach Bharucha, University Press
2. Environmental Studies, MP Poonia & SC Sharma, Khanna Publishing House
3. Environmental Studies, Rajagopalan, Oxford University Press

SEMESTER – IV (SECOND YEAR)

List of Recommended Books:

PCC-MM202 - Mechanical Properties for Materials

1. Engineering Materials, Budinski & Narasimhulu, Pearson

PCC-MM206 - Physical Metallurgy

1. Physical Metallurgy: Principles and Practice, V. Raghavan, PHI Learning

PC-MM208 - Physics of Materials

1. Physics of Materials, Essential concepts of Solid State Physics, Prathap Haridoss, Wiley India

HSMC202 - Economics for Engineers

1. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House, Delhi

SEMESTER – V (THIRD YEAR)

List of Recommended Books:

PCC-MM301 - Materials Characterization

1. Materials Characterization, P.K. Maitra, PHI

PCC-MM303 - Environmental Degradation of Materials

1. Elements of Environmental Pollution Control, OP Gupta, Khanna Publishing House
2. Environmental Pollution Control Engineering, C.S. Rao, Newage Publications

SEMESTER – VII (FOURTH YEAR)

List of Recommended Books:

ESC401 - Introduction to Instrumentation

1. Instrumentation and Process Control, DC Sikdar, Khanna Publishing House

List of Recommended books for Additional Courses:

Energy Materials

Energy Technology, O.P. Gupta, Khanna Book Publishing House, Delhi

Biomaterials

Introduction to Biomaterials, Agrawal & Gopinath, Cambridge University Press

Electronic Materials

Semiconductor Materials, Devices and Fabrication, Swaminathan, Wiley India

Fatigue and Fracture Mechanics

Fatigue of Materials, Suresh, Cambridge India

Failure Analysis

Failure Analysis of Engineering Materials, Ashok Choudhury, McGraw-Hill

Powder Metallurgy

Powder Metallurgy, Upadhyaya & Upadhyaya, Universities Press
Power Metallurgy, Subramanian, PHI

LIST OF SUGGESTED BOOKS OF INDIAN AUTHORS

FOR

POSTGRADUATE DEGREE COURSES IN

ENGINEERING & TECHNOLOGY [May 2018]

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
Nelson Mandela Marg, Vasant Kunj, New Delhi 110 070
www.aicte-india.org

COMPUTER SCIENCE & ENGINEERING

SEMESTER -I

S.No.	COURSES	S.No.	LIST OF SUGGESTED BOOKS/ PUBLICATIONS
1	Mathematical Foundations for Computer Science	1.	K.Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley
		2.	V. Balakrishnan, Schaum's Outlines of Combinatorics, TMH
		3.	Mansih Sharma & Amit Gupta, The Practice of Business Statistics, KPH, New Delhi
2	Advanced Data Structures	1.	E. Balaguruswamy, Data Structures Using C, TMH
		2.	R.B. Patel, Expert Data Structures with C++, Khanna Book Publishing
		3.	Yashwant Kanetkar, Data Structures Through C, BPB
3	Data Science	1.	V.K. Jain, Data Science & Analytics, Khanna Book Publishing, New Delhi
		2.	Dinesh Kumar, Business Analytics, Wiley India
4	Machine Learning	1.	V.K. Jain, Machine Learning, Khanna Publishing House
		2.	Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI
		3.	Rajiv Chopra, Deep Learning
5	Research Methodology and IPR	1.	Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, Sage Publishing
		2.	T. Ramappa, Intellectual Property Rights Under WTO, S. Chand
		3.	Gupta, Business Research Methods, McGraw Hill Education
6	Ethical Hacking	1.	Harsh Bothra, Hacking, Khanna Book Publishing, New Delhi
		2.	Prateek Shukla & Navneet Mehra, The Unrevealed Secrets of Hacking and Cracking, Unicorn
		3.	Ankit Fadia, The Unofficial Guide to Ethical Hacking, Laxmi Publications
8	Introduction to Intelligent Systems	1.	M.C.Trivedi, Artificial Intelligence, Khanna Publishing House
		2.	Rich, Knight, Shivshankar, Artificial Intelligence, TMH
		3.	Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill
9	Distributed Systems	1.	Pradeep K. Sinha, Distributed Operating Systems, PHI
		2.	Ikvinderpal Singh, Distributed Systems, Khanna Book Publishing
10	Advanced Wireless and Mobile Networks	1.	Pandya Raj, Mobile, Personal Communications Systems and Services, PHI
		2.	Talukdar, Mobile Computing, TMH
		3.	Brijesh K. Gupta, Mobile Computing, Khanna Publications
11	Operating System Design	1.	M. Singhal, N.G. Shivratri, Advanced Concept in Operating System, McGraw Hill Education
		2.	Ekta Walia, Operating Systems, Khanna Book Publishing Co. (P) Ltd., Delhi
		3.	Godbole, Operating Systems, TMH
12	Cluster and Grid Computing	1.	Janakiram, Grid Computing Models, TMH
		2.	Buyya, High Performance Cluster Computing, Pearson
13	Wireless Access	1.	Singal, Wiresless Communications, TMH

	Technologies	2.	Jaganatham, Principles of Modern Wireless Communications Systems, TMH
14	Smart Sensors and Internet of Things	1.	Jeeva Jose, Internet of Things, Khanna Publishing House
		2.	Raj Kamal, Internet of Things, TMH
		3.	Bahga, Internet of Things, University Press
15	Logic and Functional programming	1.	Saroj Kaushik, Logic and Prolog Programming, New Age International Ltd
16	Recommender System	1.	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer
SEMESTER-II			
17	Soft Computing	1.	Sivanandam & Deepa, Principles of Soft Computing, Wiley India
		2.	S. Rajasekaram & G.A. Vijyalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI
18	Big Data Analytics	1.	V.K. Jain, Big Data and Hadoop, Khanna Book Publishing, Delhi
		2.	Maheshwari, Data Analytics, McGraw
		3.	V.K. Jain, Data Science and Analytics, Khanna Publications, Delhi
19	Web Analytics and Development	1.	Avinash Kaushik, Web Analytics: The Art of Online Accountability, Wiley
		2.	Godbole, Web Technologies, TMH
		3.	Rajkamal, Internet and Web Technologies, TMH
20	Advance Algorithms	1.	Gajendra Sharma, Design & Analysis of Algorithms, Khanna Book Publishing, New Delhi
		2.	Udit Agarwal, Algorithms Design and Analysis, Dhanpat Rai
21	Information Theory & Coding	1.	Monica Borda, Fundamentals in Information Theory and Coding, Springer
		2.	Singh & Sapre, Communication Systems, TMH
		3.	Bose, Information Theory, Coding and Cryptography, THM
22	Security Assessment and Risk Analysis	1.	Dwivedi, Mobile Application Security, TMH
23	Biometrics	1.	Anil Jain, Karthik Nanda Kumar, Introduction to Biometric, Springer
		2.	A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, Springer
24	Secure Software Design & Enterprise Computing	1.	Feroz Khan, SMAC: Digital Discipline Building Digital Enterprise, TMH
		2.	Rajesh Ray, Enterprise Resource Planning: Text & Cases, TMH
25	Concurrence,	1.	Elmarsi, Navathe, Somayajulu, Gupta, Fundamentals of Database

	Parallelism and Distributed System		Systems, Pearson Education
26	Parallel Algorithms	1.	Pai, Data Structures and Algorithms, TMH
		2.	Salaria, Data Structures using C, Khanna Publishing House
		3.	Yashwant Kanitkar, Data Structures Through C, BPB
27	IoT Application and Communication Protocol	1.	Raj Kamal, Internet of Things, TMH
		2.	Jeeva Jose, Internet of Things, Khanna Book Publishing
		3.	Bahga, Internet of Things, University Press
28	Network Security	1.	V.K. Jain, Cryptography and Network Security, Khanna Publishing House
		2.	Atul Kahate, Cryptography and Network Security, TMH
29	Advanced Machine Learning	1.	Rajiv Chopra, Deep Learning, Khanna Book Publishing Co., New Delhi
		2.	V.K. Jain, Machine Learning, Khanna Book Publishing Co., New Delhi
		SEMESTER-III	
30	Cloud Computing	1.	Buyya, Cloud Computing, TMH
		2.	Janakiram, Grid and Cloud Computing, TMH
31	Distributed Databases	1.	Channda Ray, Distributed Database Systems, Pearson
		2.	Saheed K. Rahimi, Distributed Database Systems, Wiley India
32	Business Analytics	1.	Business Analytics, U. Dinesh Kuamr, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publications
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House
33	Industrial Safety	1.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		2.	H. P. Garg, Maintenance Engineering, S. Chand and Company
		3.	A.K. Gupta , Industrial Safety and Environment, Laxmi Publications
34	Operations Research	1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,
		2.	Pannerselvam, Operations Research, Prentice Hall of India
34	Cost Management of Engineering Projects	1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher
		2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
		3.	Rangwala, Estimation, Costing and Valuation, Charotar Publishing House
35	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian Ed.
		3.	Narula & Narula, Material Science, TMH
36	Waste to Energy	1.	O.P. Gupta, Energy Technology, Khanna Publishing
		2.	Khandelwal, K. C., Mahdi, Biogas Technology - A Practical Hand Book,

			TMH
		3.	Waste to Resources, TERI Press, New Delhi
37	Data Warehousing & Mining	1.	Vipin Kumar, Introduction to Data Mining, Pearson
		2.	Ikvinderpal Singh, Data Mining & Warehousing, Khanna Publishing House
38	Web Search & Information Retrieval	1.	Chakrabarti, Mining the Web, Elsevier India Pvt. Ltd
		2.	Avinash Kaushik, Web Analytics, Sybex
39	Compiler for HPC	1.	Raghavan, Principles of Compiler Design, TMH
		2.	A.V. Aho, Principles of Compiler Design, Narosa
40	Optimization Techniques	1.	C.B. Gupta, Optimization Techniques, IK International Publications
		2.	Mohan & Deep, Optimization Techniques, Newage Publications
41	Quantum Computing	1.	Singh & Singh, Elements of Quantum Mechanics, S.Chand Publications
		2.	C.T. Bhunia, Introduction to Quantum Computing, Newage Publishers
42	DNA Computing	1.	Rajagopal, Recombinant DNA & Genetic Engineering, TMH
43	IOT and Smart Cities	1.	Jeeva Jose, Internet of Things, Khanna Book Publishing
		2.	Raj Kamal, Internet of Things, TMH
		3.	Bahga, Internet of Things, University Press
44	Emulation and Simulation Methodologies	1.	Averill M Law, Simulation Modeling and Analysis, TMH

CIVIL ENGINEERING			
SEMESTER-I			
S.No.	**COURSES**	**S.No.**	**LIST OF SUGGESTED BOOKS/ PUBLICATIONS**
1	Advanced Structural Analysis	1.	R. Agor, Structural Analysis, Khanna Publishing House, Delhi
		2.	Pandit, G. S. and Gupta S. P., Structural Analysis A Matrix Approach, TMH
		3.	Reddy, Basic Structural Analysis, McGraw Hill India
2	Advanced Solid Mechanics	1.	D.S. Bedi, Strength of Materials, Khanna Book Publishing
		2.	Ghosh D, Advanced Strength of Materials, New Age International
		3.	Kazimi, Advanced Mechanics of Solid, McGraw Hill
3	Theory of Thin Plates and Shells	1.	Chandrashekhara K, Theory of Plates, Universities Press
		2.	Ramaswamy G.S., Design and Construction of Concrete Shells, CBS Publishers
4	Theory and Applications of Cement Composites	1.	Swamy R.N., Blackie, New Concrete Materials, Academic & Professional Publishers
		2.	S.K. Sharma, Civil Engineering Construction Materials, Khanna Books
5	Theory of Structural Stability	1.	Iyengar, N. G. R., Structural Stability of columns and plates, Eastern West
		2.	Ashwini Kumar, Stability Theory of Structures, Allied Publishers
6	Analytical and Numerical Methods for Structural Engineering	1.	Sastry S. S, Introductory Methods of Numerical Analysis, PHI
		2.	RS Salaria, Computer Oriented Numerical Methods, Khanna Publishing
9	Advanced Hydrology	1.	Ojha & Bhunya, Engineering Hydrology, Oxford University Press
		2.	K. Subramanya, Engineering Hydrology, TMH
10	Advanced Fluid Mechanics	1.	SS Rattan, Fluid Mechanics, Khanna Publishing House
		2.	Ojha & Chandaramouli, Fluid Mechanics, Oxford University Press
		3.	Subramanya, Fluid Mechanics and Hydraulic Machines: Problems and Solutions, TMH
11	Fluvial Hydraulics	1.	R.J. Garde, History of Fluvial Hydraulics, Newage Publications
12	Hydraulic Structures	1.	Singh, B., and Varshney, R.S., Embankment Dam and Engineering, Nemchand & Bross
13	Systems Engineering	1.	Rao, S.S., Engineering Optimization, New Age International (P) Ltd., Delhi

14	Water Resources Systems Planning	1.	Vedula S. and Mujumdar, P.P., Water Resources Systems, Tata McGraw
		2.	O. P. Gupta, Elements of Water Pollution Control Engineering, Khanna Publishing House
15	Irrigation and Drainage	1.	Asawa, G.L., Irrigation Engineering, New Age International Publishers
		2.	Majumdar, D.K., Irrigation Water Management, PHI Learning
SEMESTER-II			
16	FEM in Structural Engineering	1.	Singiresu S. Rao, The Finite Element Method in Engineering, Elsevier India, Fifth Edition
		2.	Chandrupatla T. R. and Belegundu A.D., Introduction to Finite Elements in Engineering, PHI
17	Structural Dynamics	1.	Chopra A. K., Structural Dynamics and Introduction to Earthquake Engineering, Pearson
		2.	Manish S, Finite Element Methods and Computational Structural Dynamics, PHI
18	Advanced Steel Design	1.	Subramaniam N., Design of Steel Structures, Oxford University Press
		2.	Ramchandra, Design of Steel Structures - Vol. II, Standard Book House, Delhi
		3.	Arya A. S., Ajmani J. L., Design of Steel Structures, Nemchand and Bros.
19	Design of Formwork	1.	Kumar Neeraj Jha, Formwork for Concrete Structures, Tata McGraw Hill
20	Design of High Rise Structures	1.	Taranath B. S., Structural Analysis and Design of Tall Buildings, TMH
		2.	Manohar S. N., Tall Chimneys, Tata Mc Graw Hill Publishing Company,
21	Design of Masonry Structures	1.	Narendra Taly, Design of Reinforced Masonry Structures, ICC, 2nd Edition
22	Design of Advanced Concrete Structures	1.	Varghese P. C., Advanced Reinforced Concrete Design, PHI Learning
		2.	Krishna Raju N., Advanced Reinforced Concrete Design, CBS Publishers
23	Advanced Design of Foundations	1.	Varghese P. C., Design of Reinforced Concrete Foundations, PHI
24	Soil Structure Interaction	1.	Kurian N. P., Design of Foundation System- Principles & Practices, Narosa Publishing
		2.	Desai C.S., Numerical Methods in Geotechnical Engineering, McGraw Hill
25	Design of Industrial	1.	Punmia, Design of Steel Structures, Laxmi Publications
		2.	Subramaniam N., Design of Steel Structures, Oxford University Press

	Structures		
26	Ground Water Engineering	1.	O. P. Gupta, Elements of Water Pollution Control Engineering, Khanna Publishing House
		2.	H.M. Raghunath, Ground Water, Newage Publishers
27	Free Surface Flows	1.	Choudhary, M.H., Open-Channel Flows, Prentice-Hall
		2.	Ranga Raju, K.G., Flow Through Open Channels, Tata McGraw Hill
		3.	Saiful Islam, Open Channel Flow, Khanna Book Publishing
28	Computational Methods in Fluid Mechanics	1.	Chaudhary, H. M., Applied Hydraulic Transient, McGraw Hill India
		2.	SS Rattan, Fluid Mechanics and Hydraulic Machines, Khanna Publications
29	Theory and Applications of GIS	1.	Ghosh, S.K. and Chandra, A.M., Remote Sensing and GIS, Narosa Publishing House
30	Advanced Numerical Analysis	1.	R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House
		2.	S.S. Sastry, Introductory Methods of Numerical Analysis, PHI
			SEMESTER-III
31	Design of Prestressed Concrete Structures	1.	S.B. Vanakudre, Prestressed Concrete, Khanna Books, Delhi
		2.	Krishnaraju N., Prestressed Concrete, Tata McGraw Hill, New Delhi
32	Analytical and Finite Element Analysis of Laminated Composite Plates	1.	Reddy J. N., Mechanics of Laminated Composites Plates and Shells, CRC Press
33	Fracture Mechanics of Concrete Structures	1.	Suryja Kuamar Maiti, Fracture Mechanics, Cambridge University Press
		2.	Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill
34	Design of Plates and Shells	1.	Ramaswamy G. S., Design and Construction of Concrete Shell Roofs, PHI
		2.	Varghese P. C., Design of Reinforced Concrete Shells & Folded Plate, PHI
35	Business Analytics	1.	U. Dinesh Kumar, Business Analytics, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publishing House
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House
36	Industrial Safety	1.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		2.	H. P. Garg, Maintenance Engineering, S. Chand and Company
		3.	A.K.Gupta, Industrial Safety and Environment, Laxmi Publications
37	Operations Research	1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi

		2.	Pannerselvam, Operations Research, Prentice Hall of India
		3.	Iyer, Operation Research, TMH
38	Cost Management of Engineering Projects	1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler Publisher, Delhi
		2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
		3.	Rangwala, Estimation,Costing and Valuation, Charotar Publishing House
39	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer India
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian Ed.
40	Waste to Energy	1.	O.P. Gupta, Energy Technology, Khanna Publishing House
		2.	Khandelwal, K. C. and Mahdi, Biogas Technology - A Practical Hand Book, TMH
		3.	Waste to Resources, TERI Press New Delhi
41	Computer Methods in Hydraulics and Hydrology	1.	Chaudhry M.H., Open-Channel Flow-2nd Edition, Springer Verlag
		2.	Saiful Islam, Open Channel Flow, Khanna Book Publishing
42	Stochastic Hydrology	1.	P.J.R. Reddy, Stochastic Hydrology, Laxmi Publications, Delhi

MECHANICAL ENGINEERING			
SEMESTER-I			
S.No.	**COURSES**	**S.No.**	**LIST OF SUGGESTED BOOKS/ PUBLICATIONS**
1	Advanced Stress Analysis	1.	Arbind Kumar Singh, Mechanics of Solids, Prentice-Hall of India
		2.	Srinath S L, Advanced Mechanics of Solids, Tata McGraw Hill Education, New Delhi
		3.	M. L. Munjal, Noise and Vibration Control, IISc Press, World Scientific
2	Advanced Vibrations and Acoustics	1.	S.S. Rao, Mechanical Vibrations, Pearson
		2.	Grover G K, Mechanical Vibrations, Nemchand Publishers, Roorki
		3.	Sujatha, Vibrations and Acoustics, TMH
3	Advanced Machine Design	1.	Sadhu Singh, Machine Design, Khanna Publishing House, New Delhi
		2.	Khurmi & Gupta, A Textbook of Machine Design, S.Chand Publications, New Delhi
		3.	Bhandari, Introduction to Machine Design, TMH
4	Design for Manufacturing and Assembly	1.	S.S. Rao, Engineering Optimization, Newage Publications
5	Mathematical Methods in Engineering	1.	J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi
		2.	Chandrika Prasad, Advanced Engineering Mathematics, Khanna Book Publishing Co. (P) Ltd.
		3.	S. P. Gupta, Statistical Methods, S. Chand & Sons
6	Advanced Engineering Materials	1.	Rangwala, Engineering Materials, Charotar Publishing House
		2.	Agarwal, Introduction to Engineering Materials, TMH
7	Mechanics of Composite Materials	1.	Bhagwan D. Agarwal, Analysis and Performance of Fiber, Wiley India
		2.	Madhujit Mukhopadhyay, Mechanics of Composite Materials and Structures, University Press
8	Analysis and Synthesis of Mechanisms	1.	R.V. Dukkipati, Spatical Mechanism, Narosa Publications
9	Thermodynamics and Combustion	1.	Nag, Engineering Thermodynamics, TMH
		2.	Rao Y.V.C., Postulational and Statistical Thermodynamics, Allied Publishers India
		3.	Anil Date, Analytical Combustion, Cambridge India
10	Advanced Fluid Dynamics	1.	S.S. Rattan, Fluid Mechanics, Khanna Book Publishing Co. (P) Ltd.
		2.	Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition
11	Nuclear Engineering	1.	Vaidyananthan, Nuclear Reactor Engineering, S.Chand
		2.	R.K. Singhal, Nuclear eactors, Newage Publications, New Delhi

12	Energy Conservation and Management	1.	O.P. Gupta, Energy Technology, Khanna Book Publishing House
		2.	A. Chakrabarti, Energy Engineering and Management, PHI
		3.	O.P Jahkar, Energy Conservation in Buildings, Khanna Publications
13	Air Conditioning System Design	1.	Sadhu Singh, Refrigeration and Air Conditioning, Khanna Publishing House
		2.	Arora, Refrigeration and Air Conditioning, TMH
		3.	Manohar Prasad, Refrigeration & Air Conditioning, New Age Publishers
14	Gas Turbines	1.	V. Ganesan, Gas Turbines, Tata McGraw Hill
		2.	R. Yadav, Steam and Gas Turbines and Power Plant Engineering, Central Publishing House
15	Research Methodology and IPR	1.	Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, Sage India
		2.	Panneerselvam R., Research Methodology, PHI
		3.	Srivasatava, Business Research Methodology, TMH
SEMESTER-II			
16	Finite Element Method	1.	Chandrupatla & Belegundu, Introduction to Finite Elements in Engineering, PHI
		2.	S.S. Bhavikati, Finite Element Analysis, Newage Publications
		3.	Krishnamurthy, Finite Element Analysis, TMH
17	Computer Aided Design	1.	Anil Kumar, Chemical Process Synthesis and Engineering Design, TMH
		2.	Rao, Computer Aided Manufacturing, TMH
		3.	O.P. Gupta, Chemical Process Technology, KBP, Delhi
18	Robotics	1.	S. Mukherjee, Robotics, Khanna Book Publishing Co., New Delhi
		2.	S.K. Saha, Introduction to Robotics, TMH
		3.	T.C. Manjunath, Fundamentals of Robotics, Nandu Printers and Publishers Private Limited, Mumbai
19	Fracture Mechanics	1.	Prashant Kumar, Elements of Fracture Mechanics, McGraw Hill Education
		2.	Surjya Kumar Maiti, Fracture Mechanics: and applications Fundamentals; Cambridge University Press
		3.	K Ramesh, Engineering fracture Mechanics, NPTEL
20	Multi-body Dynamics	1.	Nikravesh, P.E., Computer Aided Analysis of Mechanical Systems, PHI
21	Optimization Techniques in Design	1.	J. S. Arora, Introduction to Optimum Design, McGraw Hill
22	Advanced Heat Transfer	1.	Gupta and Prakash, Engineering Heat Transfer, New Chand and Bros, Roorkee
		2.	R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd., India
		3.	PK Nag, Heat and Mass Transfer, TMH

23	Steam Engineering	1.	P.K. Nag, Power Plant Engineering, TMH
		2.	Domkundwar, A Course in Power Plant Engineering, Dhanapat Rai
24	Refrigeration and Cryogenics	1.	P. Chatopadhyay, Boiler Operation Engineering: Questions and Answers, Tata McGrawHill
		2.	Sadhu Singh, Refrigeration and Air Conditioning, Khanna Publishing House
		3.	Arora, Refrigeration and Air Conditioning, TMH
25	Design of Heat Exchangers	1.	Ramesh K. Shah, Fundamentals of Heat Exchanger Design, Wiley India
26	Computational Fluid Dynamics	1.	Murlidhar and Sundarrajan, Computational Fluid Flow & Heat Transfer, Narosa Publication
		2.	Dr. Suhas Patankar, Numerical Methods in Fluid Flow & Heat Transfer, CRC Press
27	Modelling of IC Engines	1.	V. Ganesan, Gas Turbines, Tata McGraw Hill
		2.	R. Yadav, Steam and Gas Turbines And Power Plant Engineering, Central Publishing House
SEMESTER-III			
28	Advanced Finite Element Method	1.	Chandrupatla and Belegundu, Introduction to Finite Elements in Engineering, PHI
		2.	S.S. Bhavikati, Finite Element Analysis, Newage Publications
		3.	Krishnamurthy, Finite Element Analysis, TMH
29	Advanced Metallurgy	1.	O.P. Khanna, Text book of Material Science and Metallurgy, Dhanpat Rai
		2.	O.P. Gupta, Objective Type Questions & Answers in Metallurical Engineering, Khanna Book Publishing
30	Industrial Safety	1.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		2.	H. P. Garg, Maintenance Engineering, S. Chand and Company
		3.	A.K.Gupta Industrial Safety and Environment, Laxmi Publications
31	Operations Research	1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi
		2.	Pannerselvam, Operations Research, Prentice Hall of India
		3.	Iyer, Operation Research, TMH
32	Cost Management of Engineering Projects	1.	T.S. Grewal, Cost Accounting, S.Chand Publications
		2.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher
		3.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
33	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian edition

34	Waste to Energy	1.	A. Chandra, Non-Conventional Energy, Khanna Book Publishing Co. Delhi
		2.	O.P. Gupta, Energy Technology, Khanna Publishing House
		3.	Khandelwal, K. C. and Mahdi, Biogas Technology - A Practical Hand Book, TMH
35	Design of Solar and Wind System	1.	Khandelwal, K. C. and Mahdi, S. S., Biogas Technology - A Practical Hand Book-Vol. I & II, Tata
		2.	O.P. Gupta, Energy Technology, Khanna Publishing House
36	Advanced Mathematical Methods in Engineering	1.	J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi
		2.	Chandrika Prasad, Advanced Engineering Mathematics, Khanna Book Publishing Co. (P) Ltd.
		3.	S. P. Gupta, Statistical Methods, S. Chand & Sons
37	Business Analytics	1.	U. Dinesh Kumar, Business Analytics, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publishing House
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House

TELECOMMUNICATION & ELECTRICAL ENGINEERING			
SEMESTER-I			
S.No.	**COURSES**	**S.No.**	**LIST OF SUGGESTED BOOKS/ PUBLICATIONS**
1	Advanced Digital Signal Processing	1.	Shaila D. Apte, Advanced Digital Signal Processing, Wiley India
		2.	Vijay Madisetti, The Digital Signal Processing Handbook, CRC Press
		3.	Salivahanan, Digital Signal Processing, TMH
2	Digital Image and Video Processing	1.	S.Shridhar, Digital Image Processing, Oxford University Press
		2.	M.C. Trivedi, Digital Image Processing, Khanna Book Publishing House
3	DSP Architecture	1.	Venkatraman B. & Bhaskar M., Digital Signal Processors: Architecture, Programming & Applications, TMH
		2.	V. Udayashankara, Modern Digital Signal Processing, PHI
		3.	Jayaraman, Digital Signal Processing, TMH
4	Computer Vision	1.	Dictionary of Computer Vision, Wiley
		2.	Rajiv Chopra, Deep Learning, Khanna Publishing House
		3.	A.Ravichandran, Computers Today
5	Remote Sensing	1.	Chandra, A.M., Remote Sensing and GIS, Ghosh, Narosa Publishing
		2.	Manugula & Bommakanti, Photogrammetry, GIS & Remote Sensing, Educreation Publishing
6	Voice and Data Networks	1.	Kumar, D. Manjunath and J. Kuri, Communication Networking, Elsevier India
		2.	Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Book Publishing, Delhi
		3.	Sanjay Sharma, A course in Computer Networks, Katsons, New Delhi
7	Audio Video Coding & Compression	1.	Mohammed Ghanbari, Standard Codecs: Image Compression to Advanced Video, Institution of Engineering and Technology
		2.	Ranjan Bose, Information Theory, Coding and Cryptography, TMH
8	Advanced Communication Networks	1.	Nader F. Mir, Computer and Communication Networks, Pearson
		2.	ITI Saha Misra, Wireless Communications and Networks, McGraw Hill
9	Wireless and Mobile Communication	1.	V.K. Garg, Principles and Applications of GSM, Pearson
		2.	V.K. Garg, IS-95 CDMA and CDMA 2000, Pearson
10	Wireless Sensor Networks	1.	C.S. Raghavendra, K. M. Sivalingam, T. Znati, Editors, Wireless Sensor Networks, Springer India
		2.	Misra, Wireless Communication and Netorks, McGraw Hill
11	Optical Networks	1.	Rajiv Ramaswami, Sivarajan, Sasaki, Optical Networks, MK, Elsevier India
		2.	Siva Ram Murthy, WDM Optical Networks, Pearson
		3.	Chakrabarti, Optical Fiber Communications, TMH

12	RF and Microwave Circuit Design	1.	R.S. Rao, Microwave Engineering, PHI
		2.	Das, Microwave Engineering, TMH
13	DSP Architecture	1.	Venkatramani B., Bhaskar M., Digital Signal Processors: Architecture, Programming and Applications, McGraw India
		2.	M. Sasikumar, D. Shikhare, Ravi Prakash, Introduction to Parallel Processing, PHI,
		3.	Salivahanan, Digital Signal Processing, TMH
14	Microcontrollers and Programmable Digital Signal Processors	1.	Venkatramani B. and Bhaskar M. Digital Signal Processors: Architecture, Programming and Applications, Mcgraw Higher Ed
		2.	Nagoorkani, Microprocessors and Microcontrollers, TMH
15	Digital Signal and Image Processing	1.	S. K. Mitra, Digital Signal Processing – A Computer based Approach, TMH
		2.	A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall
16	Programming Languages for Embedded Software	1.	Shibu, Introduction to Embedded Systems, McGraw Hill
		2.	R.B. Patel, Expert Data Structures with C, Khanna Publishing House
		3.	R.S. Salaria, Data Strcutures using C++, Khanna Publishing House
17	VLSI Signal Processing	1.	Rishabh Anand, Digital System Design Using VHDL, Khanna Book Publishing, Delhi
		2.	Virendra Kumar, Parallel Algorithms and Computation, BPB
18	Parallel Processing	1.	V. Rajaraman, L. Sivaram Murthy, Parallel Computers, PHI
		2.	Virendra Kumar, Parallel Algorithms and Computation, Khanna Publishing House
19	System Design with Embedded Linux	1.	Karim Yaghmour, Buidling Embedded Linux Systems, Orielly Publishers
		2.	R. Bhardwaj, Mastering Linux Kernel Development, Packt India
20	CAD of Digital System	1.	N.A. Sherwani, Algorithms for VLSI Physical Design Automation, Springer India
		2.	P.P. Sahu, VLSI Design, TMH
SEMESTER-II			
21	Pattern Recognition and Machine Learning	1.	Khandelwal, K. C., Mahdi, S. S., Biogas Technology - A Practical Hand Book-Vol. I & II, Tata
		2.	M. Narasimha Murty, V. Susheela Devi, Pattern Recognition, Springer
		3.	Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi
22	Advanced Compute Architecture	1.	Ikvinderpal Singh, Advanced Computer Organisation Architecture, Khanna Publishing House
		2.	Rajiv Chopra, Advanced Computer Architecture, S.Chand Publications

23	IOT and Applications	1.	Jeeva Jose, Internet of Things, Khanna Book Publishing Co., New Delhi
		2.	Vijay Madisetti and Arshdeep Bahga, Internet of Things, VPT
		3.	Raj Kamal, Internet of Things, First edition, McGraw Hill India
24	Digital Design and Verification	1.	Samir Palnitkar, Verilog HDL: A guide to Digital Design and Synthesis, Prentice Hall
25	Multispectral Signal Analysis	1.	Pramod K. Varshney, Manoj K. Arora, Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data, Springer India
26	Audio Processing	1.	Shaila D. Apte, Speech and audio processing, 2nd Edition, Wiley India
		2.	Bali & bali, Audio Video Systems, Khanna Publishing House
27	Biomedical Signal Processing	1.	D C Reddy, Biomedical Signal Processing, McGraw Hill
		2.	R.M. Rangayyan, Biomedical Signal Analysis, Wiley India
28	Antennas and Radiating Systems	1.	I.J.Bhal and P.Bhartia, Micro-strip antennas, Artech House
		2.	T. K. Sarkar, Smart Antennas, Wiley
29	Advanced Digital Signal Processing	1.	Shaila D. Apte, Advanced Digital Signal Processing, Wiley, India
		2.	Salivahanan, Digital Signal Processing, TMH
30	Satellite Communication	1.	S. K. Raman, Fundamentals of Satellite Communication, Pearson
		2.	Pritchard, Satellite Communications, Pearson
31	Internet of Things	1.	Jeeva Jose, Internet of Things, Khanna Book Publishing Co., New Delhi
		2.	Raj Kamal, Internet of Things, First edition, McGraw Hill
		3.	A Bahaga, V. Madisetti, Internet of Things- Hands on approach, VPT
32	Voice and Data Networks	1.	Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Book Publishing
		2.	Vijay Ahuja, Design and Analysis of Computer Communication Networks, McGraw Hill
33	MIMO System	1.	R.S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, Cambridge University Press
34	Programmable Networks – SDN, NFV	1.	Vivek Tiwari, SDN and OpenFlow for Beginners, Kindle Edition

35	Analog and Digital CMOS VLSI Design	1.	P Rabaey, A P Chandrakasan, B Nikolic, Digital Integrated Circuits: A Design, PHI
36	VLSI Design Verification and Testing	1.	Vijay Ahuja, Communications Network Design and Analysis of Computer Communication Networks, McGraw Hill
		2.	Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Book Publishing
		3.	P.P. Sahu, VLSI Design, TMH
37	Memory Technologies	1.	Ashok K Sharma, Advanced Semiconductor Memories: Architectures, Designs and Applications, Wiley India
38	SoC Design	1.	P Mishra and N Dutt, Processor Description Languages, Morgan Kaufmann
39	Low Power VLSI Design	1.	Kaushik Roy, Sharat C.Prasad, Low Power CMOS VLSI Design, Wiley India
		2.	P. Rashinkar & Singh, Low Power Design Methodologies
		3.	P.P. Sahu, VLSI Design, TMH
40	Network Security and Cryptography	1.	V.K. Jain, Crptography and Network Security, Khanna Book Publishing
		2.	Atul Kahate, Crptography and Network Security, McGraw Hill
41	Physical Design Automation	1.	N.A. Sherwani, Algorithms for VLSI Physical Design Automation, Springer India
		2.	V.K. Jain, Cryptography and Network Security, Khanna Book Publishing
		3.	Atul Kahate, Cryptography and Network Security, McGraw Hill India
SEMESTER-III			
42	Artificial Intelligence	1.	M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, Delhi
		2.	P.Joshi, P.Kulkarni, Artificial Intelligence: Building Intelligent Systems, PHI
		3.	R.B. Mishra, Artificial Intelligence, PHI
43	Optimization Techniques	1.	J. S. Arora, Introduction to Optimum Design, McGraw Hill India
44	Business Analytics	1.	U. Dinesh Kumar, Business Analytics, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publishing House
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House
45	Industrial Safety	1.	L.M. Deshmukh, Industrial Safety Management, Tata McGraw Hill
		2.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		3.	H. P. Garg, Maintenance Engineering, S. Chand and Company

46	Operations Research	1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi
		2.	Pannerselvam, Operations Research, Prentice Hall of India
		3.	Iyer, Operation Research, TMH
47	Cost Management of Engineering Projects	1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler Publisher, Delhi
		2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw
		3.	Rangwala, Estimation, Costing and Valuation, Charotar Publishing House
48	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer India
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian Edition
49	Waste to Energy	1.	O.P. Gupta, Energy Technology, Khanna Publishing
		2.	Khandelwal, K. C. and Mahdi, Biogas Technology - A Practical Hand Book, TMH
		3.	Waste to Resources, TERI Press New Delhi
50	Pattern Recognition and Machine Learning	1.	Khandelwal, K. C. and Mahdi, S. S., Biogas Technology - A Practical Hand Book-Vol. I & II, TMH
		2.	M. Narasimha Murty, V. Susheela Devi, Pattern Recognition, Springer India
		3.	Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi
51	Remote Sensing	1.	Basudeb Bhatta, Remote Sensing and GIS, Oxford Publications
		2.	BC Panda, Remote Sensing, Viva Books
52	Communication Network	1.	Vijay Ahuja, Communications Network Design and Analysis of Computer Communication Networks, TMH
		2.	Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House
53	Nano Materials and Nanotechnology	1.	T. Pradeep, A Textbook of Nanoscience and Nanotechnology, TMH
		2.	Murthy, Shankar, Raj, Textbook of Nanosciene and Nanotechnology, University Press
54	Disaster Management	1.	S.C. Sharma, Disaster Management, Khanna Publishing
		2.	R. Nishith, Singh AK, Disaster Management in India, New Royal Co.
		3.	Mukesh Kapoor, Disaster Management, Saurabh Publishing House

ELECTRICAL ENGINEERING			
SEMESTER-I			
S.No.	**COURSES**	**S.No.**	**LIST OF SUGGESTED BOOKS/ PUBLICATIONS**
1	Electric Drives System	1.	A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House
		2.	R. Krishanan, Electric motor drives modeling, analysis and control, PHI
		3.	Subrahmanyam, Electric Drives, Concepts and Applications, TMH
2	Modeling and Analysis of Electrical Machines	1.	R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, PHI
		2.	P.S. Bimbhra, Electrical Machines, Khanna Book Publishing Co., Delhi
		3.	Vedam Subryamanhyam, Thyristor Control of Electric Drives, Tata McGraw Hill
3	Advanced Power Electronic Circuits	1.	Rashid, Power Electronics, Prentice Hall India
		2.	G.K. Dubey & C.R. Kasaravada Power Electronics & Drives, Tata McGraw Hill
		3.	PC Sen, Modern Power Electronics, S.Chand Publishing
4	Optimal and Adaptive Control	1.	A.P. Sage, Optimal and Adaptive Control, PHI
5	Power Quality	1.	Simmi P Burman and Bipin Singh, Power Quality, S.K.Kataria and Sons
		2.	S.Chattopadhay, Madhuchanda Mitra, Electric Power Quality, Springer
6	Dynamics of Electrical Machines	1.	G.C. Garg, Electrical Machines-I, II Khanna Book Publishing Co., New Delhi
		2.	R Krishnan, Electric Motor Drives, Modeling, Analysis, and Control, Pearson Education
		3.	Mulukutla Sarma, Electric Machines: Steady-State Theory and Dynamic Performance CL Engg., Cengage Learning
7	Static VAR Controllers and Harmonic Filtering	1.	Ned Mohan, Power Electronics, John Wiley and Sons
		2.	JC Das, Power System Harmonics and Passive Filter Design, Wiley IEEE Press
8	PWM converter and Applications	1.	Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design, Wiley
		2.	Satish Kumar Pedapalli, Pulse Width Modulation: Analysis and Performance in Multilevel Inverters, De Gruyter Oldenbourg
9	Power Semiconductor Devices & Modeling	1.	Y P Abbi and Shashank Jain, Handbook on Energy Audit and Environment Management, TERI
		2.	B.Jayant Baliga, Power Semiconductor Devices, Pws Pub Co
		3.	B.J. Baliga, Fundamentals of Power Semiconductor Devices, Springer
10	Research Methodology and IPR	1.	Ranjit Kumar, Research Methodology, Sage Publishing
		2.	R. Pannerselvam, Research Methodology, PHI
		3.	D.Chawla and N.Sondhi, Research Methodology-Concepts & Cases, Vikas Publishing House

11	Mathematical Methods in Control	1.	Papoulis & Pillai, Probability, Random Variable and Stochastic Processes, McGraw Hill
		2.	K.B.Dutta, Mathematical Methods of Science and Engineering: Aided with MATLAB, Cengage Learning India Pvt. Ltd.
12	Non-Linear Systems	1.	V.Lakshimnathan, Practical Stability of Non-Linear Systems, World Scientific
		2.	Khalil, Non-Linear Systems, Pearson
13	Robotics and Automation	1.	S. Mukherjee, Robotics, Khanna Book Publishing Co., New Delhi
		2.	Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers
		3.	K.Goyal and D.Bhandari, Industrial Automation and Robotics, S.K.Kataria and Sons
14	Digital Control	1.	Gopal, Digital Control and State Variable Methods, McGraw Higher Ed
		2.	A. Ambikapathy, Control Systems, Khanna Publishing House, Delhi
		3.	V.I. Goerge, Digital Control Systems, Cengage
15	Non-Linear CONTROL	1.	Khalil, Non-Linear Control, Pearson
		2.	B.N. Sarkar, Advanced Control Systems, PHI
		3.	Gopal, Control Systems, TMH
17	SCADA system and Applications	1.	Rajesh Mehra, PLCs and SCADA: Theory & Practice, Laxmi Publications
		2.	Bisht T k, Scada and Energy Management System, S. Kataria & Sons
18	Renewable Energy Systems	1.	Ranjan Rakesh, Kothari D.P, Singal K.C, Renewable Energy Sources and Emerging Technologies, PHI
		2.	A. Chandra, Non-Conventional Energy Resources, Khanna Book Publishing
		3.	D. Mukherjee, Fundamentals of Renewable Energy, New Age International Publishers
19	Engineering Optimization	1.	S.S. Rao, Engineering Optimization, New Age International (P) Ltd.
		2.	A.Ravindran, Engineering Optimization: Methods & Applications, Wiley
20	Power System Dynamics	1.	P.Kundur, Power System Stability and Control, McGraw Hill India
		2.	A.Chakrbarti, Power System Dynamics and Simulation, PHI
21	High Voltage Engineering	1.	M. S. Naidu, V. Kamaraju, High Voltage Engineering, McGraw-Hill India
		2.	Wadhwa C L., High Voltage Engineering, Wiley Eastern Limited, NewDelhi
22	Switched Mode Power Control	1.	Ned Mohan, Undeland and Robbins, Power Electronics Converters, Applications and Design, Wiley
		2.	S.Manikantla, Switching Power Supply Design and Optimization, McGrawHill Indian Edition

Semester-II			
23	Power Electronic Converters	1.	Ned Mohan, Undeland and Robbin, Power Electronics: converters, Application and design, Wiley
		2.	M.H.Rashid, Power Electronics, Prentice Hall of India
		3.	L.Umanand, Power Electronics: Essentials & Applications, Wiley India
24	Digital Control of Power Electronic and Drive Systems	1.	D.P.Kothari, R.S.Lodhi, Electric Drives, I.K. International Publishing
		2.	Dubey, Doradla, Joshi, Thyristorized Power Controllers, Newage International Publisher
25	Switched Mode and Resonant Converters	1.	Ned Mohan, Power Electronics, John Wiley and Sons
		2.	V.Jagganatham, Power Electronics: Devices and Circuits, PHI
26	Industrial Load Modeling and Control	1.	I.J.Nagarath and D.P.Kothari, Modern Power System Engineering, Tata McGraw Hill
		2.	S.R. Paranjothi, Modern Power Systems, Newage Publishers
27	Advanced Digital Signal Processing	1.	Sanjit K Mitra, Digital Signal Processing: A computer-based approach, Tata McGraw
		2.	Shailaja Apte, Advanced Digital Signal Processing, Wiley India
28	Advanced Microcontroller based Systems	1.	B.P. Singh, Advanced Microprocessors and Microcontrollers, NewAge International Publishers.
		2.	D.P.Kothari, S.K.Vasudevan, Analysis of Microcontrollers, Medtech
		3.	A.K. Gautam, Advanced Microprocessors, Khanna Book Publishing
29	Distributed Generation	1.	K. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill
		2.	Rakesh Ranjan, Kothari, D.P.Singal, Renewable Energy Sources and Emerging Technologies, PHI
30	Smart Grids	1.	A.G.Phadke, Synchronized Phasor Measurement and their Applications, Springer
		2.	A.B.M Shawakat Ali, Smart Grids: Opportunities, Developments, and Trends, Springer
31	Stochastic Filtering and Identification	1.	Papoulis & Pillai, Probability, Random Variable and Stochastic Processes, McGraw Hill
		2.	D.Roy, G.Vishveshwara Rao, Stochastic Dynamics, Filtering and Optimization, Cambridge University Press
32	Advance Control System	1.	M. Gopal, Modern Control System Theory, New Age International (P) Limited
		2.	B.N. Sarkar, Advance Control Systems, PHI
33	Advanced Robotics	1.	Mittel & Nagrath, Robotics and Control, TMH
		2.	S. Mukherjee, Robotics and Automation, Khanna Book Publishing

34	Adaptive Learning and Control	1.	H. K. Khalil, Nonlinear Systems, Prentice Hall
		2.	S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall
		3.	K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, PHI
35	Advanced DSP	1.	Venkatramani B., Bhaskar M., Digital Signal Processors: Architecture, Programming and Applications, McGraw India
36	Digital Power System Protection	1.	A.G. Phadke and J. S. Thorp, Computer Relaying for Power Systems, Wiley India
		2.	S.R. Bhide, Digital Power System Protection, PHI
37	Non-Conventional Electrical Energy Systems	1.	B.H.Khan, Non-Conventional Energy Sources, Tata Mc Graw Hill
		2.	R.K.Rajput, Non-Conventional Energy Sources and Utilisation, S.Chand
		3.	A.Chandra, Non-Conventional Energy Resources, Khanna Book Publishing, New Delhi
38	Artificial Intelligence Techniques	1.	M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, Delhi
		2.	P.Joshi, P.Kulkarni, Artificial Intelligence: Building Intelligent Systems, PHI
		3.	R.B. Mishra, Articificial Intelligence, PHI Learning Pvt. Ltd
39	Energy Conversion Processes	1.	O.P. Gupta, Energy Technology, Khanna Publishing House
		2.	Amlan Chakrabarti, Energy Engineering and Management, PHI
		3.	V.Kadambi, An Introduction to Energy Conversion: Turbomachinery, Newage Publishers
40	Electric and Hybrid Vehicles	1.	A.K. Babu, Electric and Hybrid Vehicles, Khanna Book Publishing, Delhi
		2.	Iqbal Husain, Electric and Hybrid Vehicles, CRC Press
Semester-III			
41	SCADA Systems and Applications	1.	Vikrant Vij, PLC & SCADA, Laxmi Publications
		2.	Tanuj Kumar Bisth, Scada and Energy Management System, SK Kataria & Sons
42	FACTS and Custom Power Devices	1.	R Mohan Mathur, Thyristor Based Facts Control System, Wiley India
		2.	K.R Padiyar, Facts Control in Power Transmission and Distribution system, Anshan
43	HVDC	1.	K. R. Padiyar, HVDC Power Transmission Systems, Wiley India
		2.	S Kamakshaiah, V. Kamaraju, HVDC Transmission, Tata McGraw Hill
44	Business Analytics	1.	U. Dinesh Kuamr, Business Analytics, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publishing
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House

45	Industrial Safety	1.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		2.	H. P. Garg, Maintenance Engineering, S. Chand and Company
		3.	A.K. Gupta, Industrial Safety and Environment, Laxmi Publications
46	Operations Research	1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi
		2.	Pannerselvam, Operations Research, Prentice Hall of India
		3.	Iyer, Operation Research, TMH
47	Cost Management of Engineering Projects	1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler Publisher
		2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
		3.	Rangwala, Estimation, Costing and Valuation, Charotar Publishing House
48	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer India
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian edition
49	Waste to Energy	1.	O.P. Gupta, Energy Technology, Khanna Book Publishing Co., New Delhi
		2.	Khandelwal, K.C. Mahdi, S.S., Biogas Technology A Practical Hand Book-Vol. I & II, TMH
50	Stochastic Control	1.	P.R. Kumar, P. Varaiya, Stochastic Systems, PHI
		2.	G. Visweswara Rao, Stochastic Dynamics, Filtering and Optimization, Debasish Roy, Cambridge University Press
51	Computational Methods	1.	R. B. Bapat, Graphs and Matrices, TRIM Series, Hindustan Book Agency
		2.	S.P. Venkateshan , Prasanna Swaminathan , Computational Methods in Engineering, Ane Books
		3.	R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House
52	Power System Analysis	1.	L.P. Singh, Advanced Power System Analysis and Dynamics, New Age International
		2.	A.Ambikapathy, Power System Analysis, Khanna Book Publishing Co., New Delhi
		3.	Kothari, Modern Power System Analysis, TMH
53	Power System Transients	1.	Indulkar C.S, Power System Transients: A Statistical Approach, PHI
		2.	Prabha Kundur, Power System Stability and Control, McGraw Hill
54	Reliability Analysis and Protection	1.	S.C. Sharma, Reliability Engineering, Khanna Publishing House
		2.	A.K. Gupta, Reliability, Maintenance and Safety Engineering, Laxmi Publications
		3.	Manna Alakesh, A Textbook of Reliability and Maintenance Engineering, I K International

CHEMICAL ENGINNERING			
SEMESTER-I			
S.No.	**COURSES**	**S.No.**	**LIST OF SUGGESTED BOOKS/ PUBLICATIONS**
1	Mathematical and Statistical Methods in Chemical Engineering	1.	Gupta, S.K., Numerical Methods for Engineers, Wiley Eastern, N. Delhi
		2.	R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House
		3.	Das, Statistical Methods, Vol.-I, II, TMH
2	Advanced Separation Processes	1.	Mihir K. Purkait, Randeep Singh, Membrane Technology in Separation Science, CRC Press
		2.	Kaushik Nath, Membrane Separation Processes, PHI Publications
3	Chemical Reactor Analysis	1.	L.K. Doraiswamy, Chemical Reaction Engineering: Beyond the Fundamentals, CRC Press
4	Industrial Pollution Control	1.	O.P. Gupta, Elements of Environmental Pollution Control, Khanna Book Publishing
		2.	Rao C.S., Environmental Pollution Control Engineering, Newage Publishing House
		3.	Gaikwad & Sapkal, Environmental Engineering, Denett Nagpur
5	Application of Nanotechnology in Chemical Engineering	1.	H.D.Kumar, Material Science: Nanotechnology and Applications, I.K. International Publishing
SEMESTER-II			
6	Advances in Transport Phenomena	1.	P. A. Ramachandran, Advanced Transport Phenomena: Analysis, Modeling, and Computations, Cambridge University Press
		2.	Geankopolis, Transport Processes and Unit Operations, PHI
7	Advanced Reaction Engineering	1.	L.K. Doraiswamy, Chemical Reaction Engineering: Beyond the Fundamentals, CRC Press
		2.	K.A. Gavhane, Chemical Reaction Engineering, Vol.-I, II, Nirali Prakashan
8	Modern concepts in Catalysis and Surface Phenomenon	1.	D.K. Chakrabarty, Heterogeneous Catalysis, New Age Science
		2.	B. Viswanathan, S. Kannan, R. c. Deka, Catalysts and Surfaces Characterization Techniques, Narosa Publications
9	Advanced Downstream Processes	1.	Sivshankar, Bioseparations: Principles and Techniques, PHI Publications
		2.	Prasad, Downstream Process Technology: A New Horizon in Biotechnology, PHI

10	Computational Fluid Dynamics	1.	Ranade V.V., Computational Flow Modeling for Chemical Reactor Engineering, Process Engineering Science, Academic Press
		2.	Tapas Sen gupta, Computational Fluid Dynamics, Universities Press
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11	Bioprocess Engineering	1.	Goutam Saha, Alok Barua, Satyabroto Sinha, Bioreactors: Animal Cell Culture Control for Bioprocess Engineering, CRC Press
		2.	D. Govardhan Rao, Introduction to Bio Chemical Engineering, Tata McGraw Hill (India)
12	Phase Transitions in Process Equipment	1.	Ragahavan V., Material Science and Engineering, PHI
13	Micro and Nano Fluidics	1.	T. Pradeep, A Textbook of Nanoscience and Nonotechnology, TMH
		2.	Sarit k.Das, Nanofluids, Wiley India
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14	Business Analytics	1.	U. Dinesh Kumar, Business Analytics, Wiley India
		2.	Krishnan, Bhambri & Chopra, Business Analytics, Khanna Publishing House
		3.	V.K. Jain, Data Science and Analytics, Khanna Publishing House
15	Industrial Safety	1.	L.M. Deshmukh, Industrial Safety Management, Tata McGraw Hill
		2.	S.C. Sharma, Industrial Safety, Khanna Book Publishing
		3.	H. P. Garg, Maintenance Engineering, S. Chand and Company
16	Operations Research	1.	P K Gupta, Operations Research, S.Chand, New Delhi
		2.	J K Sharma, Operation Research -Theory & Application, Laxmi Publications
		3.	Pannerselvam, Operations Research, Prentice Hall of India
17	Cost Management of Engineering Projects	1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher
		2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw
		3.	Rangwala, Estimation Costing and Valuation, Charotar Publishing House
18	Composite Materials	1.	K.K. Chawla, Composite Materials, Springer
		2.	Balasubramaniam, Composite Materials, John Wiley & Sons, Indian edition
19	Computer Aided Design	1.	Anil Kumar, Chemical Process Synthesis and Engineering Design, TMH
		2.	Srinivasa Prakash Regalla, Computer Aided Analysis and Design, I.K International Publishing
		3.	Rao, Computer Aided Design, TMH
20	Disaster Management	1.	S.C. Sharma, Disaster Management, Khanna Publishing
		2	R. Nishith, Singh AK, Disaster Management in India, New Royal Co.
		3.	Mukesh Kapoor, Disaster Management, Saraubh Publishing House

21	Process Modelling and Simulation	1.	R W Gaikawad, Dhirendra Process Modelling and Simulation, Denett Publication, Nagpur
		2.	Amiya K. Jana, Chemical Process Modelling and Computer Simulation, PHI
22	Waste to Energy	1.	O.P. Gupta, Energy Technology, Khanna Publishing House
		2.	Khandelwal, K. C. and Mahdi, Biogas Technology - A Practical Hand Book, TMH
		3.	Waste to Resources, TERI Press, New Delhi

ADDITIONAL BOOKS SUGGESTED FOR AUDIT COURSES			
1	Stress Management by Yoga	1.	Madhusudhan Penna, Yoga-The Heart of Living, Kavi Kulguru Kalidas Sanskrit University, Ramkete, Nagpur
2	Sanskrit for Technical Knowledge	1.	Mohan Khedkar, Kalyani Kale Sanskrit for Technical Knowledge, Kavi Kulguru Kalidas Sanskrit University, Ramkete, Nagpur
3	Personality Development through Life Enlightment Skills	1.	Kalyani Kale, Masterstrokes for Life, Kavi Kulguru Kalidas Sanskrit University, Ramkete, Nagpur