SCHEME AND SYLLABI FOR
BACHELOR OF TECHNOLOGY /MASTER OF TECHNOLOGY
(DUAL DEGREE PROGRAMMES)

IN

1. COMPUTER SCIENCE AND ENGINEERING
2. COMPUTER SCIENCE AND ENGINEERING – ARTIFICIAL INTELLIGENCE
3. COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE
4. INFORMATION TECHNOLOGY
5. ELECTRONICS AND COMMUNICATIONS ENGINEERING

OFFERED BY

UNIVERSITY SCHOOL OF INFORMATION, COMMUNICATION AND TECHNOLOGY
AT DWARKA CAMPUS OF THE UNIVERSITY

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

AN UNIVERSITY ESTABLISHED BY THE GOVERNMENT OF NCT OF DELHI

Approval History

1. 1st year scheme and syllabus (1st to 2nd semester) and Framework for higher semesters (3rd to 8th semesters or 2nd to 4th year) implemented from 2025-26 batch approved by Board of Studies of USICT on 28.07.2025.
2. 1st year scheme and syllabus (1st to 2nd semester) and Framework for higher semesters (3rd to 8th semesters or 2nd to 4th year) implemented from 2025-26 batch approved by Academic Council Sub-committee on 01.08.2025.
3. 1st and 2nd year scheme and syllabus (1st to 4th semester) and Framework for higher semesters (5thto 8thsemesters or 3rd and 4th year) implemented from 2025-26 batch approved by Board of Studies of USICT on 08.08.2026.
4. 1st and 2nd year scheme and syllabus (1st to 4th semester) and Framework for higher semesters (5thto 8thsemesters or 3rd and 4th year) implemented from 2025-26 batch approved by Academic Council Sub-committee on 19.08.2026.

Vision of the School

Create high-quality engineering and computer application 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 environment.

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 maybe 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 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**

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

1. **Teachers Continuous Evaluation: 100 marks**

Introduction

The University School of Information, Communication and Technology (USICT) offers Bachelor of Technology / Master of Technology (Dual Degree) programme(s) of study in the following five disciplines of 4+2 years duration. Namely:

1. Computer Science and Engineering
2. Information Technology
3. Electronics and Communications Engineering
4. Computer Science and Engineering – Artificial Intelligence
5. Computer Science and Engineering – Data Science

In addition, the School offers four regular programmes at Master of Technology Level and a programme at the level of Master of Computer Applications.

This document describes the Bachelor of Technology part of the dual degree programmes for the following programmes (major discipline):

a) Computer Science and Engineering - Major Discipline

This document shall describe and define the scheme of examinations and syllabi for the 4 year part.

The document is prepared after extensive discussion among the stakeholders. The following has been guiding principles for the design of this document:

1. AICTE Handbook 2024-25 applicable till 2026-27
2. The eligibility conditions for the admissions to these programmes. The eligibility conditions for these programmes of studies do not require chemistry to be studied at the 10+2 level.
3. The multiple entry and multiple exit principle of NEP requires a major overhaul of the structure of the scheme and syllabi. This requires that a minimum knowledge of the specific discipline be taught in the first year itself so that a Certificate may be awarded.
4. Minor specializations shall be offered. This allows the students to study not only the core foundational papers / subjects in the discipline but also subjects in the focus areas and emerging areas of technology that are relevant to the discipline and of related disciplines.
5. Subject of Graduate Aptitude Test in Engineering (GATE), for these disciplines shall be studied by the students, as core subjects.
6. Multiple Exit and re-entry after completion of every academic year of study.
7. Multiple routes for the award of the degree. This leads to a major revision of the scheme of examinations, as it implies that engineering papers have to be offered in the 1st year.
8. Value Added Course on “Environment Studies” of 2 credits to be taught by faculty from University School of Environment Management.
9. Value Added Course on “Human Values and Ethics” of 2 credits to be taught by faculty from University Centre for Human Values.
10. Value Added Course on “Science and Practice of Happiness” of 2 credits to be taught by faculty from University School of Environment Management.
11. Inter-diciplinary Courses of 9 Credits to be studied by students from other discipline than their own.
12. Maximum Credits: 176
13. Minimum Credits 160

Note:

A. The document currently specifies the following:
   1. The scheme framework for the 4 year Bachelor of Technology part of the Dual Degree programme.
   2. The scheme and syllabus of the first and second year.
   3. The regulation for exit and re-entry into the programme after completion of every academic year.
   4. The regulation for the award of the degree.

B. The document only provides for the framework for the following (the detailed and finalization of these shall occur in subsequent meeting of the Board of Studies of the School):
   1. The final scheme and syllabus of the third to fourth year of study.
   2. The minor specializations that may be offered to the students.

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.
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 or offered through SWAYAM / NPTEL MOOCs platform.

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 part of the Dual Degree programme.

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.

Paper / Course shall be treated as synonyms. A paper is one unit of curriculum taught, in general, in one particular semester.

NOTE: THE CURRENT DOCUMENT DEFINES THE FRAMEWORK FOR THE SCHEME OF THE FIRST 4 YEARS (8 SEMESTER) CORRESPONDING TO THE BACHELOR OF TECHNOLOGY FOR THE COMPUTER SCIENCE AND ENGINEERING DISCIPLINE, WHICH IS THE 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 DETAILED SCHEME AND SYLLABUS FOR THE FIRST AND SECOND YEAR IS APPROVED.

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.

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 Science and Engineering to successfully complete hardware and/or software/hardware-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)

First Year Scheme of Examinations for

1. COMPUTER SCIENCE AND ENGINEERING
2. COMPUTER SCIENCE AND ENGINEERING – ARTIFICIAL INTELLIGENCE
3. COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE
4. INFORMATION TECHNOLOGY
5. ELECTRONICS AND COMMUNICATIONS ENGINEERING

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ICT-101	Programming for Problem Solving	3	-	3
ES	ICT-103	Basics of Electrical Engineering	3	-	3
ES	ICT-105	System Modeling Techniques – I	3	-	3
MDC	ICT-107	Engineering Mechanics	3	-	3
AEC	ICT-109	Communication Skills	3	-	3
VAC	HVEE-113	Human Values & Ethics[1+]	2	-	2
MDC		Multidisciplinary Course (One paper to be offered to the students by the school)			
	ICT-111	PCB design	3	-	3
	ICT-121	Introduction to Manufacturing Process	3	-	3
		* Any other course / paper offered by any other school in the Dwarka campus of the University of three credits		-	3
Practical/ Viva Voce					
ES	ICT-151	Programming for Problem Solving Lab	-	2	1
ES	ICT-153	Basics of Electrical Engineering Lab	-	2	1
Total					**22**

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

Note: Orientation/ Student Induction program will be offered to the students, right at the start of the first semester.

[+]This is an NUES paper. Comprehensive evaluation of the students by the concerned teacher, out of 100. All assessment shall be conducted by the concerned teacher. There shall not be any term end / semester end examinations

**This is an NUES paper. 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 Coordinators 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 6thsemester only.

[1]This paper/course shall be taught by faculty of the University Centre for Human Values. The syllabus shall be provided by the University Centre for Human Values.

Note:

1. ICT-111 are offered from the Electronics and Communication Engineering discipline while ICT-121 is offered from the Mechanical and Automation Engineering Discipline.

Second Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ICT-102	Data Structures	3	-	3
SEC	ICT-104	Python Programming	3	-	3
ES	ICT-106	Digital Electronics and Computer Organization	3	-	3
ES	ICT-108	System Modeling Techniques - II	3	-	3
ES	ICT-110	Semiconductor Engineering and its applications	3	-	3
VAC	ICT-112	Environment Studies[1+]	2	-	2
Practical/ Viva Voce					
ES	ICT-152	Data Structures Lab	-	2	1
SEC	ICT-154	Python Programming Lab	-	2	1
ES	ICT-156	Digital Electronics and Computer Organization Lab	-	2	1
ES	ICT-158	System Modeling Techniques Lab	-	2	1
ES	ICT-160	Semiconductor Engineering and its applications lab	-	2	1
Total					**22**

[1]This paper/course shall be taught by faculty of the University School of Environment Management.

[+]This is an NUES paper. Comprehensive evaluation of the students by the concerned teacher, out of 100. All assessment shall be conducted by the concerned teacher. There shall not be any term end / semester end examinations

Note:

2. Students admitted through lateral entry[1] as per provision of the university in the 2nd year of the respective programme shall be exempt from the 1st year credits. The lateral entry students shall not study the subjects/courses being offered in the 1st year.

[1]Lateral entry is admissions after a diploma in engineering, in a running batch of admitted students of a Bachelor of Engineering / Technology programme, in the third semester or beginning of the 2nd year of study of the regular batch admitted in 1st semester in the previous year, as compared to the lateral entry admission year.

Second Year Scheme of Examinations For

1. COMPUTER SCIENCE AND ENGINEERING
2. COMPUTER SCIENCE AND ENGINEERING – ARTIFICIAL INTELLIGENCE
3. COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE

Third Semester					
Group	**Code**	**Paper**	**L**	**P**	**C**
Theory Papers					
PC	ICT-201T	Foundations of Computer Science	4	-	4
PC	ICT-203T	Database Management Systems	3	-	3
PC	ICT-205T	Object Oriented Programming using C++	3	-	3
PC	ICT-207T	Design and Analysis of Algorithms	3	-	3
MDC		Multidisciplinary Course (Any one to be taken by the students)			
	ICT-213	Digital System Design	3	-	3
	ICT-215	Microprocessor Architecture	3	-	3
		* Any other course / paper offered by any other school in the Dwarka campus of the University			
		One of the following papers shall be offered to the student of a section by the school	3	-	3
PCE	ICT-209T	Computational Methods			
PCE	ICT-211T	Computer Graphics			
Practical/ Viva Voce					
PC	ICT-203P	Database Management Systems Lab	-	2	1
PC	ICT-205P	Object Oriented Programming using C++	-	2	1
PC	ICT-207P	Design and Analysis of Algorithms Lab	-	2	1
		#The laboratory course offered shall correspond to the Theory paper offered from ICT 209T, ICT211T).	-	2	1
PCE	ICT-209P	Computational Methods Lab			
PCE	ICT-211P	Computer Graphics Lab			
Total					**23**

Fourth Semester					
Group	**Code**	**Paper**	**L**	**P**	**C**
Theory Papers					
PC	ICT-202	Theory of Computation	3	-	3
PC	ICT-204T	Artificial Intelligence and Machine Learning	3	-	3
PC	ICT-206	Probability and Stochastic Systems for Engineers	3	-	3
PC	ICT-208T	Operating Systems	3	-	3
MDC	 ICT-214T ICT-216T	Multidisciplinary Course (Any one to be taken by the students) Signal and Systems Introduction to Robotics Engineering * Any other course / paper offered by any other school in the Dwarka campus of the University	 3 3	 - -	 3 3
VAC	HVEE-210	*Science and Practice of Happiness[2]	2	-	2
AEC	ICT-212	*Scientific Writing using Latex	2	-	2
Practical/ Viva Voce					
PC	ICT-204P	Artificial Intelligence and Machine Learning Lab	-	2	1
PC	ICT-208P	Operating Systems Lab	-	2	1
Total					**21**

*This is an NUES paper. Comprehensive evaluation by the concerned teacher, out of 100 marks.
[2]This paper/course shall be taught by faculty of the University Centre for Human Values. The syllabus shall be provided by the University Centre for Human Values.

Second Year Scheme of Examinations For

1. INFORMATION TECHNOLOGY

Third Semester					
Group	**Code**	**Paper**	**L**	**P**	**C**
Theory Papers					
PC	ICT-201T	Foundations of Computer Science	4	-	4
PC	ICT-203T	Database Management Systems	3	-	3
PC	ICT-205T	Object Oriented Programming using C++	3	-	3
PC	ICT-207T	Design and Analysis of Algorithms	3	-	3
PC	ICT-217T	Operating Systems	3	-	3
MDC	 ICT-213 ICT-215	Multidisciplinary Course (Any one to be taken by the students) Digital System Design Microprocessor and Interfacing * Any other course / paper offered by any other school in the Dwarka campus of the University	 3 3	 - -	 3 3
Practical/ Viva Voce					
PC	ICT-203P	Database Management Systems Lab	-	2	1
PC	ICT-205P	Object Oriented Programming using C++	-	2	1
PC	ICT-207P	Design and Analysis of Algorithms Lab	-	2	1
PC	ICT-217P	Operating Systems Lab	-	2	1
Total					**23**

Fourth Semester					
Group	**Code**	**Paper**	**L**	**P**	**C**
Theory Papers					
PC	ICT-202	Theory of Computation	3	-	3
PC	ICT-204T	Artificial Intelligence and Machine Learning	3	-	3
PC	ICT-206	Probability and Stochastic Systems for Engineers	3	-	3
VAC	ICT-210	*Science and Practice of Happiness[2]	2	-	2
AEC	ICT-212	*Scientific Writing using Latex	2	-	2
MDC		Multidisciplinary Course (Any one to be taken by the students)			
	ICT-214T	Signal and Systems	3	-	3
	ICT-216T	Introduction to Robotics Engineering	3	-	3
		* Any other course / paper offered by any other school in the Dwarka campus of the University			
		One of the following papers shall be offered to the student of a section by the school	3	-	3
PCE	ICT-218T	Computational Methods			
PCE	ICT-220T	Computer Graphics			
Practical/ Viva Voce					
PC	ICT-204P	Artificial Intelligence and Machine Learning Lab	-	2	1
		%One of the following papers shall be offered to the student of a section by the school		2 -	1
PCE	ICT-218P	Computational Methods			
PCE	ICT-220P	Computer Graphics			
Total					**21**

*This is an NUES paper. Comprehensive evaluation by the concerned teacher, out of 100 marks.
[2]This paper/course shall be taught by faculty of the University Centre for Human Values. The syllabus shall be provided by the University Centre for Human Values.

Second Year Scheme of Examinations
For
1. ELECTRONICS AND COMMUNICATIONS ENGINEERING

Third Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-219	Signals and Systems	3	-	3
PC	ICT-221T	Engineering Electromagnetics	3	-	3
PC	ICT-223T	Analog Circuits	3	-	3
PC	ICT-225T	Analog Communications	3	-	3
MDC	ICT-217T	Multidisciplinary Course (Any one to be taken by the students) Operating Systems * Any other course / paper offered by any other school in the Dwarka campus of the University	3	-	3
PC	ICT-227T	Probability and Stochastic Systems for Engineers	3	-	3
Practical/ Viva Voce					
PC	ICT-221P	Engineering Electromagnetics	-	2	1
PC	ICT-223P	Analog Circuits	-	2	1
PC	ICT-225P	Analog Communications	-	2	1
Total					**21**

Fourth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-222T	Network Analysis and Synthesis	3	-	3
PC	ICT-224T	Digital Communications	3	-	3
MDC		Multidisciplinary Course (Any one to be taken by the students)			
	ICT-216T	Introduction to Robotics Engineering	3	-	3
	ICT-204T	Artificial Intelligence and Machine Learning	3	-	3
		* Any other course / paper offered by any other school in the Dwarka campus of the University			
VAC	ICT-210	*Science and Practice of Happiness[2]	2	-	2
AEC	ICT-212	*Scientific Writing using Latex	2	-	2
PCE	ICT-218T	Computational Methods	3	-	3
SEC	ICT-226T	Digital Systems Design	3	-	3
Practical/ Viva Voce					
PC	ICT-224P	Digital Communications Lab	-	2	1
		One of the following papers shall be offered to the student of a section by the school	-	2	1
PCE	ICT-218P	Computational Methods			
PCE	ICT-220P	Computer Graphics			
PC	ICT-226P	Digital Systems Design Lab	-	2	1
PC	ICT-222P	Network Analysis and Synthesis Lab	-	2	1
Total					**23**

*This is an NUES paper. Comprehensive evaluation by the concerned teacher, out of 100 marks.
[2]This paper/course shall be taught by faculty of the University Centre for Human Values. The syllabus shall be provided by the University Centre for Human Values.

Syllabus of Papers / Courses

Note: This appendix is to be read together with the scheme of examinations of the corresponding programmes of study.

Syllabus of First Year Papers / Courses

Paper Code(s): ICT-101	L : 3
Paper: Programming for Problem Solving	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Ability to develop simple algorithms for arithmetic and logical problems and implement tthem 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

Structure of a C program, Basic data types (int, char, float, double, bool, fixed-width integers), Declarations and initializations, Constants using const and #define, Operators and expressions (arithmetic, relational, logical, bitwise, assignment, conditional, increment/decrement), Type conversions (implicit, explicit casting), Input/output (printf, scanf, format specifiers), Compound statements (blocks), Conditional statements (if, if-else, else-if, switch), Loops (while, do-while, for, infinite loops, early exit), break, continue, goto, return, Algorithm development including flowcharts, pseudocode representation, Tracing and dry run, structured programming. C89, C99, C11 and C23 extensions and usage

Unit II

Function declaration, definition, and invocation, Argument passing (by value, recursion), Inline functions and macro functions, Storage classes (auto, static, extern, register, thread_local), Scope and lifetime of variables, Header files and modular program design, One- and two-dimensional arrays (declaration, access, memory layout), Bubble sort, selection sort, insertion sort, linear and binary search, String input/output (gets, puts, fgets, fputs), Standard string manipulation (strlen, strcpy, strcat, strcmp, etc.), Arrays of strings, Command-line arguments. Root finding of a positive floating point number.

Unit III

Structures (struct definition, nested structures, array of structures, pointer to structures), Unions (union, use-cases, memory layout), Enumerated types (enum, typedef enum), Bit fields, Memory layout and alignment, Pointers (declaration, dereferencing, pointer arithmetic, arrays vs pointers, pointer to pointer), Dynamic memory allocation (malloc, calloc, realloc, free), Memory leak prevention, NULL and null pointer checks, Compound literals, Representation and Arithmetic on polynomials with floating point coefficients. Matrices and arithmetic operations on them (addition, subtraction and multiplication). File I/O (opening, closing, reading, writing text and

binary files, fopen, fclose, fprintf, fscanf, fread, fwrite, fgets, fputs), Error handling using errno, Command-line parameters

Unit IV

Abstract Data Types (ADTs), Singly and doubly linked lists , Stack (array and linked list implementation), Infix-to-postfix conversion, Parenthesis balancing, Queue (linear, circular, priority) (array and linked list implementation), Traversal, insertion, deletion in lists, Binary tree basics (creation, inorder, preorder, postorder traversal), Function pointers, Pointers to arrays and functions, Idea of Generic code using macros, _Generic for type-generic programming, Assertions and diagnostics (assert, _Static_assert), Safer macros and expressions, Forward declaration, Program segmentation, Header hygiene, recursion.

Textbooks:

1. *The C programming language*, B W Kernighan and D M Ritchie, Pearson Education, 1988.
2. Modern C,Jens Gustedt, O'Reilly, 2020
3. *ISO/IEC 9899-XXXX,* The ISO Standard for the C language.

References:

1. *Modern C,* Zoran Pavlovic, Manning Publications, 2020
2. *21st Century C*, Ben Klemens, O'Reilly Media, 2014
3. *C: How to Program*, Paul Deitel and Harvey Deitel, 8th Edition, Pearson, 2016
4. *Engineering Problem Solving With C,* Delores M. Etter, Pearson, 2013.
5. *Problem Solving and Program Design in C,* Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
6. *C Programming: A Modern Approach*, K. N. King, W. W. Norton, 2008
7. MIT 6.087 Course Notes, Practical C Programming

Paper Code(s): ICT-151	**P : 2**
Paper: Programming for Problem Solving Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-101 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(s): ICT-103 / ICT-118	L : 3
Paper: Basics of Electrical Engineering	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 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

Electric charge, current, voltage, energy, power, independent and dependent sources, Ohm's law, series and parallel resistors, voltage and current division, ideal and real circuit elements, source transformations, Kirchhoff's current law, Kirchhoff's voltage law, basic circuit modeling, practical resistor behavior, power calculations in resistive circuits.

Unit II

Nodal analysis, mesh analysis, linearity and superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, circuit simplification strategies, controlled sources in analysis, transient analysis of first-order circuits, natural and step response of RL circuits, natural and step response of RC circuits.

Unit III

Sinusoidal signals and phasors, impedance and admittance in frequency domain, node and mesh analysis in phasor domain, power in AC circuits, average and reactive power, complex power, power factor and correction, resonance in series and parallel RLC circuits, balanced three-phase circuits, phase sequence, line and phase quantities, power in three-phase loads.

Unit IV

Magnetic circuits, Faraday's and Lenz's laws, inductance and mutual inductance, ideal transformer model, introduction to real transformer behavior, energy conversion principles, operating principles of DC machines, types and characteristics of DC motors and generators, basic concepts of three-phase induction motors, concept of torque and slip, circuit protection devices, electrical safety and grounding, power systems overview for digital infrastructure, energy auditing and efficiency principles.

Textbooks:

1. *Fundamentals of Electric Circuits*, Charles K. Alexander and Matthew N. O. Sadiku, McGraw-Hill Education, Latest Edition

References:

1. *Basic Electrical Engineering*, D. P. Kothari and I. J. Nagrath, McGraw-Hill Education, Latest Edition.
2. *Electrical Engineering Fundamentals*, Vincent Del Toro, Prentice Hall, 2nd Edition
3. *Electric Machinery,* A. E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans, McGraw-Hill Education, Latest Edition.
4. MIT OpenCourseWare – "Circuits and Electronics" (6.002X)

Paper Code(s): ICT-153 / ICT-162	**P : 2**
Paper: Basics of Electrical Engineering Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-103/ICT-118 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(s): ICT-105	L : 3
Paper: System Modeling Techniques – I	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 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. Integration, Differentiation under Integral sign, Jacobians and transformations of coordinates. Taylor's and Maclurian Series. 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. 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

Unit II

Power Series Method for solution of ODEs, Bessel's Equation, Legendre's Equation, Hermite's equation, Laguerre's Equations. Corresponding Special Functions, Recurrence Relations for these special functions, their properties. Gamma and Beta functions and their properties

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. Gram-Schmidt process. Cayley – Hamilton Theorem (without proof). LU and Cholesky decomposition, applications to systems of equations, Singular Value Decomposition (SVD) with applications.

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.

Textbooks:

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

References:

1. Engineering Mathematics by K.A. Stroud with Dexter J. Booth, Macmillan, 2020.
2. Special Functions of Mathematics for Engineers. Larry C. Andrews, OUP, 1998
3. Advanced Engineering Mathematics by Larry Turyn, Taylor and Francis, 2014.
4. Advanced Engineering Mathematics by Dennis G. Zill, Jones & Bartlett Learning, 2018.
5. Advanced Engineering Mathematics with MATLAB by Dean G. Duffy, Taylor and Francis, 2017.
6. Advanced Engineering Mathematics by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.

Paper Code(s): ICT-107 / ICT-120	L : 3
Paper: Engineering Mechanics	C : 3
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 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, Varignon'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.

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.

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.

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.

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.*

Paper Code(s): ICT-109	L : 3
Paper: Communications Skills	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 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,

Unit II

Basic Language Efficiency 2: Writing Skills: Types of Writing, Paragraph writing,Paraphrasing, Summarizing, Précis Writing

Unit III

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

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.

Paper Code(s): ICT-111	L : 3
Paper: PCB Design	C : 3
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Understand and Design PCB
CO2	Understand Component placement strategies and layout validation
CO3	Understand PCB fabrication steps
CO4	Design simple Single -layer and double-layer PCBs

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
CO2	3	3	3	3	3	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	-	1

Unit I

PCB types (single-layer, double-layer, multilayer), through-hole vs. SMD components, PCB materials and substrates, structure of a PCB (pads, vias, traces, silkscreen, solder mask), design workflow overview, schematic capture, netlists, introduction to EDA tools (KiCAD, Eagle, Altium Designer), library creation and part symbols.

Unit II

Component placement strategies, design for manufacturability (DFM), trace width and spacing calculation, ground and power planes, decoupling and bypass capacitors, differential pair routing, impedance matching basics, EMI/EMC guidelines, schematic to layout process, netlist management, layout validation (DRC, ERC), use of design constraints.

Unit III

PCB fabrication steps (photoresist, etching, plating, solder mask), via types (through-hole, blind, buried), panelization, surface finish types (HASL, ENIG), soldering methods (wave, reflow, hand soldering), SMD rework tools, bill of materials (BoM), Gerber file generation, pick-and-place file, understanding fabrication drawings.

Unit IV

Design of simple single-layer and double-layer PCBs:

- Power supply board (linear and switching)
- Microcontroller breakout board
- Sensor interface (e.g., temperature or motion)
- LED driver circuit

Signal integrity simulation basics, thermal considerations, component derating, PCB testing and debugging, integration with embedded systems.

Textbooks:

1. *Printed Circuit Board Design using KiCad,* Peter Dalmaris, Tech Explorations, Latest Edition.

2. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner, Newnes (Elsevier).

References:

1. *PCB Design for Real-World Design*, Chris Schroeder, Prentice Hall. Latest Edition
2. *High-Speed Digital Design: A Handbook of Black Magic*, Howard Johnson & Martin Graham, Prentice Hall. Latest Edition
3. *Signal and Power Integrity – Simplified,* Eric Bogatin, Pearson. Latest Edition
4. Texas Instruments and Analog Devices App Notes on PCB Layout. Latest Edition
5. IPC Standards (IPC-2221, IPC-7351, IPC-A-600) – for layout, land patterns, and acceptability.

Paper Code(s): ICT-113	**L : 2**
Paper: Human Values and Ethics	**C : 2**
Prerequisites: None	

The syllabus and the marking scheme for this paper shall be provided by the University Centre for Human Values.

Paper Code(s): ICT-121	L : 3
Paper: Introduction to Manufacturing Process	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Understand casting process.
CO2	Understand joining process.
CO3	Understand forging and sheet metal work.
CO4	Basic understanding of new technology for manufacturing

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.

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.

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.

Unit IV

Ideation: Introduction, Steps of Ideation, Introduction of Product Design, Development and Prototyping.

3D Printing: Definition, Types, History, Feasibility of Rapid Prototyping Technology (RPT), Role of CAD in RPT, 3D Modeling software and its role in RPT, Creation of STL file from CAD model and FDM.

Laser Cutting and engraving: Definition, Types, History, 3D Modeling software, and Creation of compatible file format for Laser Cutting and engraving.

Wood Routing: Definition, Types, History, 3D Modeling software, and Creation of compatible file format for Wood Routing.

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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.

Paper Code(s): ICT-119T	L : 2
Paper: Programming in C++	C : 2

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Ability to write procedural C++ programs
CO2	Ability to use dynamic memory allocation in C++
CO3	Ability to use simple STL templates
CO4	Ability to write object oriented 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	3	3	3	-	-	-	-	-	-	1
CO2	3	3	3	3	3	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	-	1

Unit I

Differences in program structure between C and C++, header files and compilation model, scope resolution operator ::, namespaces and using, input/output using cin, cout, and manipulators, auto and type inference, reference variables, default function arguments, function overloading and name mangling, const, constexpr, inline, strongly typed enums (enum class), compile-time expressions and usage of decltype.

Unit II

Dynamic memory management (new, delete, nullptr, RAII), smart pointers (unique_ptr, shared_ptr, weak_ptr), const correctness with pointers, function pointers and lambdas (syntax and closures), default constructors, copy constructors and assignment operators, function templates, compile-time polymorphism using templates, basics of SFINAE and type traits.

Unit III

Standard containers: vector, array, list, map, set, unordered_map, iterators and range-based for loops, algorithms from <algorithm> (sort, find, count, accumulate, for_each), lambdas with STL, std::pair, std::tuple, structured bindings, introduction to std::optional, std::variant, and std::any.

Unit IV

Structures with methods, difference between struct and class, member functions, encapsulation, access specifiers, this pointer, static class members, constructors and destructors, initialization lists, RAII principles, function templates and class templates, template specialization, separating interface and implementation in modular design.

Textbooks:

1. *Programming: Principles and Practice Using C++,* Bjarne Stroustrup, 2nd Edition, Addison-Wesley, 2014.

References:

1. *The C++ Programming Language,* Bjarne Stroustrup, 4th Edition, Addison-Wesley, 2013.

2. *A Tour of C++,* Bjarne Stroustrup, 2nd Edition, Addison-Wesley, 2018.
3. *Effective Modern C++,* Scott Meyers, O'Reilly Media, 2014.
4. *Accelerated C++,* Andrew Koenig & Barbara Moo, Addison-Wesley, 2000.
5. *C++ Primer*, Stanley B. Lippman, Josée Lajoie, and Barbara Moo, 5th Edition, Addison-Wesley, 2012.
6. *Object-Oriented Design with Applications*, Grady Booch, 3rd Edition, Addison-Wesley, 2007
7. *C++ Software Design*, Klaus Iglberger, Manning Publications, 2023
8. *Clean Code in C++,*Stephan Roth, Packt Publishing, 2020
9. *Clean Architecture: A Craftsman's Guide to Software Structure and Design*, Robert C. Martin, Prentice Hall, 2017
10. *ISO/IEC 14882.xxxx*, C++ ISO /IEC standards

Paper Code(s): ICT-119P	**P : 2**
Paper: Programming in C++ Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-119T as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-102	L : 3
Paper: Data Structures	C : 3
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	To be able to understand difference between structured data and data structure
CO2	To be able to create common basic data structures and trees
CO3	To have a knowledge of sets, heaps and graphs
CO4	To have basic knowledge of sorting and searching 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*
CO1	3	2	2	2	3	-	-	-	2	2	2	3
CO2	3	2	2	2	3	-	-	-	2	2	2	3
CO3	3	2	2	2	3	-	-	-	2	2	2	3
CO4	3	2	2	2	3	-	-	-	2	2	2	3

Unit I

Abstract Data Types (specification, performance implications), growth of functions and asymptotic analysis, Master's theorem (without proof). Analysis of array vs linked representations of lists/stacks/queues, Sparse Matrices (transpose and multiplication), Comparison-based sorting: insertion, shell, merge, quick, heap sort — algorithm and comparisons, Time and space complexity, Stability and adaptivity of sorts, Sorting in practice: library sorting functions, Sorting linked lists, Divide and conquer review via mergesort/quick sort, Introduction to non-comparison-based sorting (counting, radix — concept only).

Unit II

Binary trees: traversal techniques, recursive vs non-recursive, Binary Search Trees (BST): insertion, deletion, search, AVL Trees: balancing, rotations, complexity, Heaps and priority queues: heapify, build-heap, insert/delete, Applications: expression trees, interval trees, use of recursion and stack in tree processing, Performance trade-offs among tree variants. Multi-way search trees: m-ary search tree, B-Trees (order, height, node structure, insertion, deletion), B+ Trees (leaf-level chaining, indexing applications), Search operations in B+ Trees

Unit III

Hash tables: hash function design, collision handling (chaining, open addressing), Load factor, rehashing strategies, Dictionary ADT and map APIs, Trie data structure: insertion, search, memory model, Disjoint Sets (Union-Find) with path compression and union by rank, Bit-fields and memory efficiency

Unit IV

Graph representations: adjacency list, adjacency matrix, edge list, Graph traversal algorithms (BFS, DFS) and applications (cycle detection, component labeling), Minimum Spanning Tree (Kruskal, Prim), Shortest paths (Dijkstra, Bellman-Ford), Graph design for real applications (idea of social networks, compiler dependency graphs)

Textbooks:

1. *Data Structures and Algorithm Analysis in C,* Mark Allen Weiss, Pearson Education India, Latest Edition.
2. *Fundamentals of Data Structures in C*, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Universities Press (India) Pvt. Ltd., 2008

References:

1. *Data Structures with C*, Seymour Lipschutz, McGraw-Hill Education, 2010
2. Data Structures and Algorithms, Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Addison-Wesley, 1983
3. *Data Structures: A Pseudocode Approach with C,* Richard Gilberg , Behrouz A. Forouzan Cengage Learning, Latest Edition
4. *Data Structures and Program Design in C*, Robert Kruse, Pearson, Latest Edition
5. *Data structures using C*, Y. Langsam, M. J. Augenstein and A. M. Tanenbaum, PHI

Paper Code(s): ICT-152	**P : 2**
Paper: Data Structures Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-102 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(s): ICT-104	L : 3
Paper: Python Programming	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Translate procedural C concepts into Pythonic idioms, memory management, and dynamic typing principles..
CO2	Design modular software solutions using core Object-Oriented concepts (Encapsulation, Inheritance, Polymorphism, Abstraction).
CO3	Implement robust file handling, custom exception hierarchies, and software testing practices.
CO4	Apply fundamental Python data structures and algorithmic patterns to construct object-oriented 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*
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, indentation, comments, documentation strings, Unicode and encoding, data types and type hints, object identity vs equality, operator precedence and associativity, input/output (print formatting with f-strings, format(), old %), command-line arguments using sys.argv, control flow: if, elif, else, match statement (PEP 634), loops: for, while, break, continue, else with loops, iterator protocol (__iter__, __next__), comprehensions (list, set, dict, nested), unpacking and zipping, enumerate, zip, range.

Unit II

Defining and calling functions, arguments: positional, keyword, default, variable-length (*args, **kwargs), recursion, anonymous functions with lambda, map, filter, reduce, any, all, sorted, min, max with custom keys, first-class functions, closures, decorators (basic and with arguments), generators (yield, send), iterators vs generators, import system, module search path, creating and importing user-defined modules, packages and __init__.py, virtual environments and dependency management, built-in collections: list, tuple, dict, set, frozenset, Counter, defaultdict, OrderedDict, deque.

Unit III

Classes and objects, class and instance attributes, methods (self), constructor (__init__), attribute access control, class variables and methods (@classmethod, @staticmethod), inheritance, method overriding, composition vs inheritance, super(), abstract classes and interfaces using abc, operator overloading (__add__, __eq__, etc.), duck typing, multiple inheritance, MRO (Method Resolution Order), introspection (dir(), hasattr(), getattr()), exception hierarchy, custom exceptions, structured exception handling (try-except-else-finally), resource management with with, file I/O, JSON and CSV processing, pickling, error and exception best practices.

Unit IV

Modeling with Python data structures (lists, stacks, queues, dictionaries, sets), simulation problems, trees: node-based and list-based representations, binary tree traversal, recursion vs iteration, search and sorting using Pythonic methods, time and space complexity analysis using empirical profiling, introduction to timeit and cProfile, unit testing (unittest, doctest, pytest), assertions, type checking (mypy, typeguard), type annotations and gradual typing (PEP 484), introduction to NumPy arrays, basic file-based or JSON-based persistence, project structure, naming conventions (PEP 8), packaging and publishing modules, documentation with pydoc and sphinx.

Textbooks:

1. *Fluent Python*, Luciano Ramalho, O'Reilly Media, Latest Edition.

References:

1. *Think Python: How to Think Like a Computer Scientist*, Allen B. Downey, Green Tea Press, Latest Edition.

2. *Effective Python*, Brett Slatkin, Addison-Wesley, Latest Edition.
3. *Python for Everybody*, Charles Severance, Open Access Edition.
4. *Automate the Boring Stuff with Python*, Al Sweigart, No Starch Press, Latest Edition.

Paper Code(s): ICT-154	**P : 2**
Paper: Python Programming Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-104 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(s): ICT-106 / ICT-115	L : 3
Paper: Digital Electronics and Computer Organization	C : 3
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Ability to understand codes and minimize Boolean expression
CO2	Design and Implement Combinational and Sequential Circuits
CO3	Ability to Design Finite state machines of the Moore and Mealy types
CO4	Understand functioning of a digital computer

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
CO2	3	3	3	3	3	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	-	1

Unit I

Number systems: binary, octal, decimal, hexadecimal, base conversions, complements (1's, 2's, 9's, 10's), binary arithmetic, signed number representations (sign-magnitude, 1's and 2's complement), overflow conditions. Binary codes: BCD, Gray code, ASCII, parity bits, Hamming codes. Boolean algebra: axioms and theorems, switching algebra, logic gates and their realization, truth tables, canonical forms, minterms and maxterms. Logic simplification using Boolean algebra and Karnaugh maps (up to 5 variables), don't care conditions, NAND-NAND and NOR-NOR networks. Quine-McClusky's Algorithm. Combinational hazards, static-1 and static-0 hazards, hazard-free realization.

Unit II

Design and implementation of: adders (half, full, carry lookahead), subtractors, comparators, encoders, decoders, priority encoders, multiplexers, demultiplexers. Function realization using MUX, DEMUX, and ROM. Design of arithmetic circuits: 4-bit adders/subtractors, BCD adders. Magnitude comparator, code converters , parity generator/checker. Use of standard ICs and programmable logic devices (PLA, PAL — basic introduction). Binary multipliers: combinational array multiplier. Introduction to Verilog-based truth-table and logic-level modeling.

Unit III

Bistable elements: latches (SR, D), flip-flops (SR, D, JK, T — level and edge-triggered), characteristic equations, excitation tables, timing diagrams. Flip-flop timing: setup, hold, propagation delay, metastability. Counters: asynchronous, synchronous, up-down, modulus-n, Johnson, ring counters. Shift registers and bidirectional shift registers. Sequential design methodology using state diagrams, Moore and Mealy machines, state reduction. Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Design of sequence detectors, control logic with FSMs. Classification of memories: ROM, RAM, static and dynamic RAM, memory cell design concepts, memory timing, address decoding logic.

Unit IV

Functional components of a digital computer: control unit, ALU, registers, memory, and interconnect. Instruction cycle: fetch, decode, execute. Register transfer language (RTL), micro-operations, and control signals. Control unit design: hardwired control logic (detailed), microprogramming (basic concepts only). Introduction to bus structures, memory read/write sequences. Addressing modes: immediate, direct, indirect, register, indexed. I/O mechanisms: program-controlled, interrupt-driven, DMA overview. Basic instruction format and design: 1-address, 2-address, 3-address machine. Conceptual design of a simple accumulator-based computer..

Textbooks:

1. *Digital Logic and Computer Design*, M. Morris Mano, Pearson Education, Latest Edition.

References:

1. *Digital Design and Computer Architecture*, David Harris & Sarah Harris, Morgan Kaufmann, Latest Edition.
2. *Computer System Architecture*, M. Morris Mano, Rajib Mall Pearson Education, 2017
3. *Computer Organization and Embedded Systems*, Carl Hamacher, Z. Vranesic, S. Zaky, McGraw-Hill, Latest Edition.
4. *Fundamentals of Digital Logic with Verilog Design*, Stephen Brown and Zvonko Vranesic, McGraw-Hill, Latest Edition.
5. *Digital Systems: Principles and Applications*, Ronald J. Tocci, Neal S. Widmer, Pearson, Latest Edition.
6. *Computer System Architecture*, M. Morris Mano, Pearson Education, Latest Edition.
7. *Fundamentals of Logic Design*, Charles H. Roth, Jr., Larry L. Kinney, Cengage, Latest Edition.
8. *Computer Organization and Embedded Systems*, Hamacher, Vranesic, Zaky, McGraw Hill, Latest Edition.
9. *Computer Architecture: A Quantitative Approach*, John L. Hennessy and David A. Patterson, Morgan Kaufmann, Latest Edition.

Paper Code(s): ICT-154 / ICT-155	**P : 2**
Paper: Digital Electronics and Computer Organization Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-106/ICT-115 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(s): ICT-108	L : 3
Paper: System Modelling Techniques - II	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Ability to do line integration
CO2	Ability to use the residue theorem to solve problems
CO3	Use Laplace and Fourier methods to solve ODE
CO4	Ability to solve simple PDE

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	-	-	-	-	-	-	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2

Unit I

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.

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

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.

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.

Textbooks:

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

References:

1. *Engineering Mathematics* by K.A. Stroud with Dexter 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.

Paper Code(s): ICT-158	**P : 2**
Paper: System Modelling Techniques Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-105 and ICT-108 as this is the practical component of these theory papers. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-110 / ICT-117	L : 3
Paper: Semiconductor Engineering and its applications	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Understand the semiconductor material
CO2	Understand different types of diodes and their properties
CO3	Understand Bipolar Junction transistor structures and their properties
CO4	Understand IC fabrication techniques

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
CO2	3	3	3	3	3	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	-	1

Unit I

Crystal lattices, unit cells, Miller indices, crystal directions, energy levels and energy bands, direct and indirect bandgap materials, semiconductor materials (Si, Ge, GaAs), intrinsic and extrinsic semiconductors, carrier concentration, Fermi energy, density of states, drift and diffusion of carriers, mobility, conductivity and resistivity, carrier generation and recombination, Einstein relation

Unit II

PN junction formation, equilibrium conditions, built-in potential, depletion region, Poisson's equation, carrier injection and current flow under bias, I-V characteristics, junction capacitance, temperature effects, Zener and avalanche breakdown, diode models and approximations, switching behavior, small signal analysis, real diode characteristics, metal-semiconductor contacts (ohmic and Schottky), Schottky diode, tunneling process, tunnel diodes.

Unit III

Bipolar junction transistor structure, modes of operation, current components, configurations and I-V characteristics, large signal current gains, Early effect, JFET structure and operation, MOSFET types (enhancement and depletion), MOSFET I-V characteristics, light-matter interaction in semiconductors, LEDs and photodiodes, photoconductivity, solar cells, phototransistors, laser diodes (introductory), PIN and avalanche photodiodes, applications in sensors and communication systems

Unit IV

Overview of IC fabrication, crystal growth and wafer preparation, oxidation, diffusion, ion implantation, photolithography, etching, metallization, cleanroom protocols, device modeling basics, continuity equation, drift-diffusion model, small-signal and large-signal models for PN junctions and optoelectronic devices, introduction to TCAD simulation tools (conceptual overview only)

Textbooks:

1. *Semiconductor Physics and Devices*, Donald A. Neamen, McGraw-Hill, Latest Edition.
2. *Solid State Electronic Devices*, Ben G. Streetman and Sanjay Banerjee, Pearson Education, Latest Edition.

References:

1. *Fundamentals of Semiconductor Devices*, Anderson and Anderson, McGraw-Hill, Latest Edition.
2. *Physics of Semiconductor Devices*, S.M. Sze and Kwok K. Ng, Wiley-Interscience, Latest Edition.
3. *Semiconductor Device Fundamentals*, Robert F. Pierret, Addison-Wesley, Latest Edition.
4. *Introduction to Microelectronic Fabrication*, Richard C. Jaeger, Prentice Hall, Latest Edition.
5. *Electronic Devices and Circuit Theory,* Robert L. Boylestad and Louis Nashelsky, Pearson Education, Latest Edition.

Paper Code(s): ICT-160 / ICT-157	**P : 2**
Paper: Semiconductor Engineering and its applications Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-110/ICT-117 as this is the practical component of these theory papers. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-112	L : 2
Paper: Environmental Studies	C : 2
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 100 marks
2. This is NUES, non-credit and qualifying Paper. All evaluations to be conducted by the concerned teacher.

Course Outcomes (CO):

CO1	Understand Environment as a System of interconnected components
CO2	Understand environmental resources, renewable and non-renewable
CO3	Understand causes of different types of pollutions of the Environment and its effect on climate change
CO4	Understand regulations and policies related to 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
CO1	-	-	-	-	-	3	3	3	-	-	-	-
CO2	-	-	-	-	-	3	3	3	-	-	-	-
CO3	-	-	-	-	-	3	3	3	-	-	-	-
CO4	-	-	-	-	-	3	3	3	-	-	-	-

Unit I

Introduction to Environmental Studies, Scope and importance, Key environmental, Historical perspectives on human-environment interactions, Basic ecological principles and concepts, Levels of organization in ecology, Ecosystem components (biotic and abiotic), Energy flow in ecosystems, Biogeochemical cycles, Biodiversity and its conservation, Importance of biodiversity, Threats to biodiversity, Ecosystem services and their value.

Unit II

Renewable and non-renewable resources, Principles of sustainable resource use, Water resources and management, Global water distribution and availability, Water pollution , Challenges in water management, Land resources and degradation, Soil formation and types, Soil degradation processes, Land use patterns and their environmental impacts, Mineral resources and environmental consequences of extraction, Energy resources, Environmental impacts associated with different energy sources, Forests and wildlife resources, Importance of forests, Causes and effects of deforestation, Principles of wildlife conservation, Role of protected areas.

Unit III

Air pollution, Water pollution, Soil pollution, Noise pollution, Marine pollution, Thermal pollution, Hazardous waste management (sources, effects, mitigation for different pollution type). Electronic Waste (E-Waste) Management, Environmental toxicology, Public health and environment, Climate change (greenhouse effect, greenhouse gases, evidence of global warming and its impacts), Ozone layer depletion, Acid rain, Smog, Environmental disasters (overview of major natural and man-made disasters).

Unit IV

Overview of environmental legislation and policies, Role of government agencies in environmental protection, Concept and purpose of Environmental Impact Assessment (EIA), Sustainable development, Environmental ethics and philosophy (anthropocentrism, biocentrism, ecocentrism, deep ecology), Population and environment Urbanization and its environmental challenges, Role of environmental movements and Non-Governmental Organizations (NGOs), Importance of public participation in environmental decision-making, Case studies of environmental challenges and solutions, Individual actions for environmental protection and sustainability.

Textbooks:

1. *Environmental Studies*, Erach Bharucha, Orient Blackswan, 3rd edition, 2020.

References:

1. Environmental Science: Earth as a Living Planet, Daniel B. Botkin and Edward A. Keller, John Wiley & Sons, 11th edition, 2022.
2. Silent Spring, Rachel Carson, Houghton Mifflin, 1st edition, 2002.
3. Fundamentals of Ecology, Eugene P. Odum and Gary W. Barrett, Brooks Cole, 5th edition, 2005.
4. Living in the Environment, G. Tyler Miller and Scott Spoolman, Cengage Learning, 21st edition, 2021.
5. Environmental Science: Toward a Sustainable Future, Richard T. Wright and Dorothy F. Boorse, Pearson, 14th edition, 2021.
6. Environment, Peter H. Raven, David M. Hassenzahl, and Linda R. Berg, John Wiley & Sons, 11th edition, 2023.
7. The Human Impact on the Natural Environment, Andrew Goudie, Wiley Blackwell, 8th edition, 2018.

8. Energy and Civilization: A History, Vaclav Smil, MIT Press, 1st edition, 2017.
9. Environmental Chemistry, Colin Baird and Michael Cann, W. H. Freeman, 5th edition, 2012.
10. Environmental Chemistry, Stanley E. Manahan, CRC Press, 10th edition, 2017.
11. Environmental and Occupational Medicine, William N. Rom and Steven B. Markowitz (Eds.), Lippincott Williams & Wilkins, 5th edition, 2017.
12. The Limits to Growth, Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, Universe Books, 1st edition, 1972.
13. Environmental Ethics, Kristin S. Shrader-Frechette, Rowman & Littlefield Publishers, 3rd edition, 2002.
14. Environmental Geography, H. M. Saxena, Rawat Publications, 2nd edition, 2006.
15. Ecology, Environmental Science and Conservation, J. S. Singh, S. P. Singh, and S. R. Gupta, S. Chand & Company, 1st edition, 2014.
16. Environmental and Natural Resource Economics, Tom Tietenberg and Lynne Lewis, Pearson, 12th edition, 2022.
17. Principles of Ecosystem Stewardship: Resilience, Self-Organization, and Adaptation in Social-Ecological Systems, F. Stuart Chapin III, Margaret A. Palmer, and Osvaldo E. Sala (Eds.), Springer, 1st edition, 2010.
18. Studies and articles on the informal e-waste recycling sector in India.
19. United Nations Environment Programme (UNEP) publications on various environmental issues.
20. United Nations Sustainable Development Goals (SDGs) reports and official website.
21. United States Environmental Protection Agency (EPA) publications on pollution control.
22. World Health Organization (WHO) reports on environmental health.
23. World Wildlife Fund (WWF) reports on forest and wildlife conservation.

Syllabus of Second Year Papers / Courses

Paper Code(s): ICT-201T	**L : 4**
Paper: Foundations of Computer Science	**C :4**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Apply propositional and predicate logic, proof techniques, induction principles, and mathematical reasoning to formulate and solve problems arising in Computer Science.
CO2	Analyze sets, functions, relations, elementary number theory, Boolean algebra, and algebraic structures for modeling computational systems and solving problems in algorithms and cryptography.
CO3	Solve combinatorial problems and recurrence relations, including divide-and-conquer recurrences using the Master Theorem, and apply these techniques in the mathematical analysis of algorithms.
CO4	Apply graph theory, tree structures, and discrete mathematical models to the design and analysis of algorithms, computing systems, and applications in theoretical computer 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*
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

Propositional logic, Logical connectives, Truth tables, Logical equivalence, Tautologies and contradictions, Normal forms (CNF and DNF), Predicate logic, Quantifiers, Rules of inference, Mathematical proofs (direct proof, proof by contraposition, proof by contradiction, proof by cases), Mathematical induction, Strong induction, Structural induction, Recursive definitions, Recursive algorithms, Principle of Inclusion and Exclusion, Pigeonhole Principle and applications, Mathematical reasoning in Computer Science.

Unit II

Sets and set operations, Cartesian products, Power sets, Countable and uncountable sets.

Functions, Injective, Surjective and Bijective functions, Composition and inverse of functions.

Relations and their properties, Equivalence relations, Partitions, Partial order relations, Posets, Hasse diagrams, Lattices.

Elementary Number Theory: Divisibility, Prime numbers, Fundamental Theorem of Arithmetic (statement and applications), Greatest Common Divisor (GCD), Least Common Multiple (LCM), Euclidean Algorithm, Extended Euclidean Algorithm, Linear Diophantine equations, Congruences, Modular arithmetic, Residue classes, Modular inverses, Chinese Remainder Theorem (statement, proof and applications), Fermat's Little Theorem (statement, proof and applications), Euler's Totient Function, Euler's Theorem, Introduction to RSA cryptosystem.

Boolean algebra, Boolean functions, canonical forms, minimization of Boolean expressions, Karnaugh maps, Quine-McCluskey minimization algorithm.

Introduction to Algebraic Structures: Semigroups, Monoids, Groups, Rings and Fields with applications in computing.

Unit III

Fundamental principles of counting, Permutations and combinations, Binomial and multinomial coefficients, Binomial theorem, Inclusion–Exclusion applications, Generating functions (introductory concepts).

Recurrence relations: Recursive sequences, Linear recurrence relations with constant coefficients, Homogeneous and non-homogeneous recurrence relations, Characteristic equation method, Repeated roots, Particular solutions, Initial conditions, Matrix method for solving recurrence relations, Fibonacci sequence and related recurrences, Generating-function approach (introductory concepts).

Divide-and-conquer recurrence relations, Recursion tree method, Master Theorem (statement and complete proof), Applications of recurrence relations in the analysis of recursive algorithms, Introduction to asymptotic growth of recursive functions.

Unit IV

Graphs: Basic terminology, Directed and undirected graphs, Weighted graphs, Graph representations, Graph

isomorphism, Degree sequences, Bipartite graphs, Connected graphs, Eulerian and Hamiltonian graphs, Graph traversals (Breadth First Search and Depth First Search), Shortest path concepts, Spanning trees, Minimum spanning trees (Prim's and Kruskal's algorithms), Graph colouring, Planar graphs, Matchings (introductory concepts), Hall's Marriage Theorem (statement and applications).
Trees: Rooted trees, Binary trees, Binary Search Trees (introductory concepts), Tree traversals, Expression trees, Huffman trees.

Textbooks:

[1] K. H. Rosen, Discrete Mathematics and Its Applications, 8th ed. New York, NY, USA: McGraw-Hill Education, 2019.
[2] J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill, Latest Edition

References:

[1] R. P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th ed. Boston, MA, USA: Pearson, 2004.
[2] C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, 4th ed. New York, NY, USA: McGraw-Hill Education, 2017.
[3] N. Deo, Graph Theory with Applications to Engineering and Computer Science. New Delhi, India: Prentice Hall of India, Reprint Edition.
[4] V. Shoup, A Computational Introduction to Number Theory and Algebra, 2nd ed. Cambridge, U.K.: Cambridge University Press, 2009.
[5] R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics: A Foundation for Computer Science, 2nd ed. Boston, MA, USA: Addison-Wesley, 1994.

Paper Code(s): ICT-203T	**L : 3**
Paper: Database Management Systems	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Design conceptual and logical database models using ER/EER modeling techniques and map them to relational database schemas.
CO2	Develop relational databases using SQL, including queries, views, stored procedures, functions, triggers, and integrity constraints.
CO3	Apply normalization techniques and transaction management principles to design efficient, reliable, and consistent relational database systems.
CO4	Analyze indexing, query optimization, concurrency control, recovery mechanisms, distributed databases, NoSQL databases, and emerging database technologies for modern computing 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*
CO1	3	3	2	1	2	-	-	-	2	2	1	3
CO2	3	3	2	1	2	-	-	-	2	2	1	3
CO3	3	3	3	2	2	-	-	-	2	2	1	3
CO4	3	3	3	3	2	-	-	-	2	2	1	3

Unit I

Introduction to database systems, Characteristics of the database approach, Evolution of database systems, Database users and administrators, Applications of database systems, Advantages and limitations of DBMS, Database architecture, Three-schema architecture, Data independence, Database languages (DDL, DML, DCL, TCL), Database system environment.

Data models, Entity-Relationship (ER) model, Enhanced Entity-Relationship (EER) model, Entities, Attributes, Relationships, Keys, Cardinality constraints, Participation constraints, Weak entities, Specialization, Generalization, Aggregation, Conceptual database design, Mapping ER/EER diagrams to relational schemas.

Unit II

Relational model, Domains, Relations, Tuples, Attributes, Super keys, Candidate keys, Primary keys, Alternate keys, Foreign keys, Integrity constraints (Entity integrity and Referential integrity), Relational algebra, Relational calculus (introductory concepts).

Structured Query Language (SQL): Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL), Transaction Control Language (TCL).

SQL programming: Database creation, Table creation, Constraints, INSERT, UPDATE, DELETE, SELECT, Ordering, Aggregate functions, GROUP BY, HAVING, Joins (Inner, Outer, Self and Cross joins), Nested queries, Set operations (UNION, INTERSECT, EXCEPT), Views, Sequences, Indexes, Stored procedures, Functions, Triggers, Introduction to embedded SQL.

Unit III

Functional dependencies, Attribute closure, Canonical cover, Lossless decomposition, Dependency preservation.

Normalization: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF), Introduction to Fourth Normal Form (4NF) and Fifth Normal Form (5NF).

Transaction processing, ACID properties, Transaction states, Schedules, Serial and concurrent schedules, Conflict serializability, View serializability (introductory concepts), Concurrency control, Lock-based protocols, Two-Phase Locking (2PL), Timestamp ordering protocol, Deadlocks, Deadlock prevention and detection, Database recovery, Log-based recovery, Checkpointing.

Unit IV

Physical database design, File organization, Indexing techniques, B-Trees, B+ Trees, Hash indexing, Query processing, Query optimization (introductory concepts).

Distributed databases (overview), Client-server database architecture, Object-oriented databases (introductory concepts), Object-relational databases, NoSQL databases (Key-value, Document, Column-family and Graph

databases), CAP theorem (introductory concepts), Database security and authorization, Backup and recovery, Introduction to data warehousing, OLTP and OLAP systems, Applications of database systems.

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, *Database System Concepts*, 7th Edition, McGraw-Hill Education, 2020.

References:

1. Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, 7th Edition, Pearson, 2017.
2. Raghu Ramakrishnan and Johannes Gehrke, *Database Management Systems*, 3rd Edition, McGraw-Hill Education, 2002.
3. C. J. Date, *An Introduction to Database Systems*, 8th Edition, Addison-Wesley, 2006.
4. Thomas Connolly and Carolyn Begg, *Database Systems: A Practical Approach to Design, Implementation, and Management*, 6th Edition, Pearson, 2015.
5. Carlos Coronel and Steven Morris, *Database Systems: Design, Implementation, and Management*, 13th Edition, Cengage Learning, 2019.

Paper Code(s): ICT-203P	**P : 2**
Paper: Database Management System Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **3.** The course objectives and course outcomes are identical to that of ICT-203T as this is the practical component of the corresponding theory paper. **4.** The practical list shall be notified by the teacher in the first week of the class commencement. **5.** There should be at least 10 practical exercises	

Paper Code(s): ICT-205T	**L : 3**
Paper: Object Oriented Programming using C++	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Design and implement object-oriented programs using classes, objects, constructors, inheritance, encapsulation, and polymorphism in Modern C++.
CO2	Develop reusable software components using advanced C++ language features, operator overloading, templates, dynamic memory management, and resource management techniques.
CO3	Apply generic programming concepts, exception handling, the Standard Template Library, lambda expressions, and modern programming practices to solve engineering problems efficiently.
CO4	Design maintainable object-oriented software using UML, SOLID principles, and fundamental design patterns while applying Modern C++ in real-world software 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*
CO1	3	3	2	2	1	-	-	-	1	-	1	3
CO2	3	3	2	2	1	-	-	-	1	-	1	3
CO3	3	3	3	2	1	-	-	-	1	-	1	3
CO4	3	3	3	2	1	-	-	-	2	1	2	3

Unit I

Evolution of C++, Features of Modern C++ (C++11/C++14/C++17/C++20 overview), Structure of a C++ program, Tokens, Identifiers, Keywords, Variables, Constants, References, Type deduction using auto, Scope resolution operator, Operators and expressions, Input/output streams, Namespaces.

Object-oriented programming concepts: Objects, Classes, Abstraction, Encapsulation, Data hiding, Modularity, Inheritance, Polymorphism, Dynamic binding, Message passing.

Classes and objects, Access specifiers, Constructors (default, parameterized, copy), Destructor, Inline functions, Friend functions and friend classes, Static data members and member functions, Constant member functions, Objects as function arguments and return values, Delegating constructors, Defaulted and deleted functions.

Unit II

Operator overloading, Unary and binary operator overloading, Stream insertion and extraction operators.

Inheritance: Single, Multiple, Multilevel, Hierarchical and Hybrid inheritance, Access control, Constructors and destructors in inheritance, Virtual base classes.

Compile-time polymorphism, Function overloading, Function overriding, Virtual functions, Pure virtual functions, Abstract classes, Dynamic binding, Virtual destructors, Object slicing.

Dynamic memory management, new and delete, Copy constructor, Assignment operator, Rule of Three, Introduction to Rule of Five, Move constructor and move assignment (concepts), Resource Acquisition Is Initialization (RAII), Smart pointers (unique_ptr, shared_ptr, weak_ptr).

Unit III

Function templates, Class templates, Template specialization, Generic programming concepts.

Exception handling: Exception hierarchy, try, throw, catch, Multiple catch blocks, Stack unwinding, User-defined exceptions, noexcept, Assertions.

Lambda expressions, Function objects (functors), Iterators.

Standard Template Library (STL): Sequence containers (vector, deque, list), Associative containers (set, multiset, map, multimap), Unordered containers (unordered_set, unordered_map), Container adapters (stack, queue, priority_queue), STL algorithms (sort, find, binary_search, transform, count, copy, remove, etc.), Introduction to ranges (overview), Practical applications of STL.

Unit IV

File handling using stream classes, Text and binary files, Command-line arguments.

Introduction to Unified Modeling Language (UML): Class diagrams, Object diagrams, Sequence diagrams.

Software design principles: Coupling and cohesion, SOLID principles (overview), Interface-based programming, Generic programming.

Introduction to Design Patterns: Design pattern concepts, Creational, Structural and Behavioural patterns, Detailed study of **Singleton**, **Factory Method**, **Strategy**, and **Observer** patterns, Applications of object-oriented programming and Modern C

Textbooks:

[1] B. Stroustrup, *Programming: Principles and Practice Using C++*, 3rd ed. Boston, MA, USA: Addison-Wesley Professional, 2024.
[2] S. B. Lippman, J. Lajoie, and B. E. Moo, *C++ Primer*, 5th ed. Boston, MA, USA: Addison-Wesley Professional, 2012.
[3] N. M. Josuttis, *The C++ Standard Library: A Tutorial and Reference*, 2nd ed. Boston, MA, USA: Addison-Wesley Professional, 2012.
[4] E. Gamma, R. Helm, R. Johnson, and J. Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*. Boston, MA, USA: Addison-Wesley Professional, 1994.

References:

[1] B. Stroustrup, *The C++ Programming Language*, 4th ed. Boston, MA, USA: Addison-Wesley Professional, 2013.
[2] S. Meyers, *Effective Modern C++: 42 Specific Ways to Improve Your Use of C++11 and C++14*. Sebastopol, CA, USA: O'Reilly Media, 2014.
[3] A. Alexandrescu, *Modern C++ Design: Generic Programming and Design Patterns Applied*. Boston, MA, USA: Addison-Wesley Professional, 2001.
[4] R. C. Martin, *Clean Code: A Handbook of Agile Software Craftsmanship*. Upper Saddle River, NJ, USA: Pearson, 2008.
[5] M. Reddy, *API Design for C++*. Burlington, MA, USA: Morgan Kaufmann, 2011.
[6] H. Sutter and A. Alexandrescu, *C++ Coding Standards: 101 Rules, Guidelines, and Best Practices*. Boston, MA, USA: Addison-Wesley Professional, 2004.
[7] A. Williams, *C++ Concurrency in Action*, 2nd ed. Shelter Island, NY, USA: Manning Publications, 2019.
[8] J. Lakos, *Large-Scale C++ Software Design*. Boston, MA, USA: Addison-Wesley Professional, 1996.
[9] J. Lakos, *Large-Scale C++*, Vol. 1: *Process and Architecture*. Boston, MA, USA: Addison-Wesley Professional, 2019.
[10] K. Henney, *97 Things Every C++ Programmer Should Know*. Sebastopol, CA, USA: O'Reilly Media, 2020.
[11] R. C. Martin, *Agile Software Development: Principles, Patterns, and Practices*. Upper Saddle River, NJ, USA: Prentice Hall, Latest Edition.
[12] M. Fowler, *Refactoring: Improving the Design of Existing Code*, 2nd ed. Boston, MA, USA: Addison-Wesley Professional, 2018.

Paper Code(s): ICT-205P	**P : 2**
Paper: Object Oriented Programming using C++ Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-205T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-207T	**L : 3**
Paper: Design and Analysis of Algorithms	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Analyze the correctness, efficiency and computational complexity of algorithms using formal mathematical techniques
CO2	Design efficient solutions using divide-and-conquer and greedy paradigms and justify their correctness.
CO3	Develop optimization algorithms using dynamic programming and evaluate their computational trade-offs.
CO4	Classify computational problems using complexity theory and apply advanced algorithmic techniques including backtracking, branch-and-bound, approximation and randomized 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*
CO1	3	3	2	3	1	-	-	-	1	1	1	3
CO2	3	3	2	2	2	-	-	-	1	1	1	3
CO3	3	3	3	3	2	-	-	-	1	1	1	3
CO4	3	3	3	3	2	-	-	-	1	1	1	3

Unit I

Introduction to algorithm design and analysis, characteristics of algorithms, algorithm specification and pseudocode, computational models and performance measures, analysis of algorithms, best-case, average-case and worst-case analysis, asymptotic notations, growth of functions, logarithmic, polynomial and exponential growth rates, summation techniques for algorithm analysis.lower bounds, decision-tree model, comparison-based sorting lower bounds, Loop invariants concept, initialization, maintenance termination and proofs of correctness.Divide-and-conquer paradigm, merge sort, quick sort, deterministic and randomized quicksort, selection problem, median-of-medians algorithm, Strassen matrix multiplication, recurrence relations arising from these algorithms and their solutions using substitution method, iteration method, recursion-tree method and Master theorem.Non-Comparison based average case linear time soring algorithms: counting sort, radix sort and bucket sort.

Unit II

Dynamic programming methodology, overlapping subproblems, optimal substructure, principle of optimality, memoization and tabulation, dynamic programming versus divide-and-conquer, rod cutting problem, matrix chain multiplication, optimal binary search tree, longest common subsequence problem.

Greedy method, characteristics of greedy algorithms, greedy-choice property and optimal substructure, exchange arguments, comparison of Greedy v/s Dynamic approach using Knapsack problem and activity selection problem as case study. Huffman coding algorithm.

Unit III

Graph Algorithms : Analysis and correctness of Prim's and Kruskal's algorithm for finding minimum cost spanning trees, Dijkastra's and Bellman Ford algorithm for single source shortest path. Floyd Warshall algorithm for all pair shortest path.

String Matching algorithms: The Rabin Karp algorithm, sting matching using finite automata, The Knuth Morris Pratt algorithm.

Unit IV

Overview of Backtracking and Branch-and-Bound techniques for solving problems like N-Queens, graph coloring, Hamiltonian cycle, travelling salesman. Definition and concept of P, NP, NP-hard and NP-complete class of problems, Polynomial time verification and reduction, 3-CNF satisfiability problem, Cook-Levin theorem (statement and significance), NP-completeness proofs of some problems like Clique, Vertex Cover, Subset-Sum. Approximation algorithms for problems like Vertex Cover, The travelling salesman problem in Planar Graph with triangular inequality, the set covering problem.

Textbooks

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press, Latest Edition.
2. Algorithm Design, Jon Kleinberg and Éva Tardos, Pearson Education, Latest Edition.

References

1. A. V. Aho, J. E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley, 1974.
2. E. Horowitz, S. Sahni and S. Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, Latest Edition.
3. S. S. Skiena, The Algorithm Design Manual, Springer, Latest Edition.
4. R. Sedgewick and K. Wayne, Algorithms, Addison-Wesley, Latest Edition.
5. S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, Algorithms, McGraw-Hill Education, Latest Edition.
6. D. Harel and Y. Feldman, Algorithmics: The Spirit of Computing, Adisson-Wesley, Latest Edition.

Paper Code(s): ICT-207P	**P : 2**
Paper: Object Design and Analysis of Algorithms **Lab**	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-207T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-213/ICT226T	**L : 3**
Paper: Digital System Design	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Develop Verilog HDL models using behavioural, dataflow, structural, and RTL modeling techniques for digital system design.
CO2	Design and verify combinational, sequential, and finite state machine-based digital systems using Verilog HDL.
CO3	Apply simulation, synthesis, memory modeling, and FPGA implementation techniques for realizing digital hardware systems.
CO4	Design modular digital systems using Verilog HDL and implement processor components and FPGA-based applications following modern digital design methodologies.

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

Digital design flow, HDL-based design methodology, Design abstraction levels, Behavioural, Dataflow, Structural and Register Transfer Level (RTL) modeling, FPGA and ASIC design flow, Design entry, Simulation, Synthesis, Place-and-route, Timing analysis.

Introduction to Verilog HDL, Lexical conventions, Data types, Nets and variables, Constants, Operators, Expressions, Module declaration, Ports, Continuous assignments, Procedural blocks, Initial and always blocks, Blocking and non-blocking assignments, Conditional statements, Case statements, Loop constructs, Tasks and Functions.

Unit II

RTL modeling of combinational circuits, Multiplexers, Decoders, Encoders, Comparators, Arithmetic circuits, ALU, Barrel shifters, Priority encoders.

RTL modeling of sequential circuits, Latches, Flip-flops, Registers, Shift registers, Counters, Ring and Johnson counters.

Finite State Machine (FSM) design methodology, Moore and Mealy state machines, State assignment, State minimization, Sequence detectors, Control unit design using FSMs.

Introduction to parameterized modules and reusable RTL design.

Unit III

Simulation and verification methodology, Test benches, Stimulus generation, Monitoring and waveform analysis, Assertions (introductory concepts), Timing simulation.

Memory modeling in Verilog, ROM, RAM, Register files, Memory initialization, Tri-state buses.

Synthesis concepts, Technology mapping, Timing constraints, Resource utilization.

Introduction to FPGA architecture, Configurable Logic Blocks (CLBs), Look-Up Tables (LUTs), Routing resources, Block RAMs, DSP slices, Clock management.

FPGA implementation flow using industry-standard CAD tools.

Unit IV

Hierarchical design methodology, Modular system design, Arithmetic Logic Unit (ALU), Register file, Datapath and control-path design, Bus-based systems.

Design of simple processor components using Verilog, Controller and datapath integration, UART (introductory implementation), PWM generator, Timer and Counter modules.

Introduction to pipelining, Hardware/software co-design (overview), Design optimization for area, speed, and power.

Applications of Verilog.

Textbooks

[1] S. Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis*, 2nd ed. Upper Saddle River, NJ, USA: Prentice Hall, 2003.
[2] M. D. Ciletti, *Advanced Digital Design with the Verilog HDL*, 2nd ed. Upper Saddle River, NJ, USA: Pearson, 2010.
[3] Z. Navabi, *Verilog Digital System Design*, 2nd ed. New York, NY, USA: McGraw-Hill Education, 2006.

References

[4] S. Brown and Z. Vranesic, *Fundamentals of Digital Logic with Verilog Design*, 3rd ed. New York, NY, USA: McGraw-Hill Education, 2013.
[5] M. Morris Mano and M. D. Ciletti, *Digital Design*, 6th ed. Boston, MA, USA: Pearson, 2018.
[6] P. J. Ashenden, *The Designer's Guide to Verilog*, 2nd ed. Burlington, MA, USA: Morgan Kaufmann, 2007.
[7] D. Harris and S. Harris, *Digital Design and Computer Architecture*, 3rd ed. Cambridge, MA, USA: Morgan Kaufmann, 2021.
[8] C. H. Roth Jr. and L. L. Kinney, *Fundamentals of Logic Design*, 7th ed. Boston, MA, USA: Cengage Learning, 2014.
[9] J. Bhasker, *A Verilog HDL Primer*, 3rd ed. Noida, India: BSP Books, 2007.
[10] Xilinx Inc., *Vivado Design Suite User Guide* (latest available documentation).

Paper Code(s): ICT-226P	**P : 2**
Paper: Digital System Design Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-226T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-215	**L : 3**
Paper: Microprocessor Architecture	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):

CO1	Explain the architecture, instruction set organization, and operation of modern microprocessors.
CO2	Develop assembly language programs using processor instructions, addressing modes, procedures, and system resources.
CO3	Analyze processor datapaths, pipelining, memory hierarchy, and performance enhancement techniques.
CO4	Evaluate modern processor architectures and their applications in embedded, parallel, and intelligent 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*
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

Evolution of microprocessors, Von Neumann and Harvard architectures, CISC and RISC architectures, Processor organization, Register organization, Arithmetic Logic Unit (ALU), Control Unit, Instruction execution cycle.
Instruction Set Architecture (ISA), Instruction formats, Addressing modes, Data representation, Arithmetic, Logical, Branch, Shift, Compare, Stack and Control instructions.
Processor status flags, Exceptions and interrupts, Privileged and user modes, Overview of x86, ARM and RISC-V processor architectures.

Unit II

Assembly language fundamentals, Assemblers, Linkers and Loaders, Program structure, Labels, Directives, Constants and Variables.
Arithmetic and logical programming, Conditional and unconditional branching, Looping constructs, Procedures and subroutines, Stack organization, Parameter passing, Recursion (introductory concepts), String manipulation, Modular programming.
Program development tools, Debugging techniques, Program optimization and performance considerations.

Unit III

Register Transfer Level (RTL), Datapath organization, Hardwired and microprogrammed control.
Instruction pipelining, Pipeline hazards, Operand forwarding, Branch prediction (introductory concepts), Instruction-Level Parallelism (ILP), Superscalar processors (overview).
Memory hierarchy, Cache organization, Cache mapping techniques, Virtual memory (introductory concepts), Performance evaluation using CPU execution time, CPI and speedup.

Unit IV

Multicore processors, Symmetric multiprocessing, Shared memory systems, SIMD and vector processors, Graphics Processing Units (GPUs) (overview).
Embedded processors, ARM Cortex architecture (introductory concepts), RISC-V architecture (introductory concepts), Low-power processor design.
Processor communication interfaces, Memory interfaces, Peripheral interfaces (overview), Applications of microprocessors.

Textbooks

[1] B. Brey, The Intel Microprocessors: Architecture, Programming, and Interfacing, 9th ed. Boston, MA, USA: Pearson, 2021.

References

[2] D. A. Patterson and J. L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 6th ed. Cambridge, MA, USA: Morgan Kaufmann, 2021.
[3] J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 6th ed. Cambridge, MA, USA: Morgan Kaufmann, 2019.
[4] A. K. Ray and K. M. Bhurchandi, Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing. New Delhi, India: McGraw-Hill Education, 2013.
[5] M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd ed. Hoboken, NJ, USA: Pearson, 2006.
[6] J. Yiu, The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, 3rd ed. Oxford, U.K.: Newnes, 2014.

Paper Code(s): ICT209T/ICT218T	**L : 3**
Paper: Computational Methods	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Analyze numerical errors and develop computational algorithms for solving nonlinear equations and systems of linear algebraic equations.
CO2	Apply interpolation, numerical differentiation, numerical integration, and computational techniques for evaluating special functions arising in engineering and scientific applications.
CO3	Develop numerical solutions for ordinary differential equations using finite difference, Runge-Kutta, and predictor-corrector methods, and analyze their accuracy and convergence.
CO4	Apply elementary finite difference methods for the numerical solution of partial differential equations and interpret computational solutions of engineering boundary-value 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	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 computational methods, Mathematical modelling and scientific computing, Floating-point arithmetic, Machine precision, Absolute and relative errors, Propagation of errors, Conditioning and stability of numerical algorithms.

Solution of nonlinear equations: Bisection method, Regula-Falsi method, Fixed-point iteration, Newton-Raphson method, Secant method, Convergence criteria and stopping conditions.

Solution of systems of linear algebraic equations: Gaussian elimination, Partial pivoting, LU decomposition, Gauss-Jordan elimination, Jacobi and Gauss-Seidel iterative methods, Introduction to sparse linear systems.

Unit II

Polynomial interpolation: Lagrange interpolation, Newton's divided difference interpolation, Cubic spline interpolation.

Least-squares approximation and polynomial curve fitting.

Numerical differentiation using finite difference approximations.

Numerical integration: Trapezoidal rule, Simpson's one-third rule, Gaussian quadrature.

Computational evaluation of special functions: Gamma and Beta functions, Error function, Bessel functions, Legendre polynomials, Hermite polynomials, Laguerre polynomials, Chebyshev polynomials, Recurrence relations, Stable numerical evaluation, Orthogonality, Gaussian quadrature using orthogonal polynomials, Engineering applications.

Unit III

Initial value problems, Euler method, Modified Euler method, Taylor series method, Fourth-order Runge-Kutta method.

Predictor-Corrector methods: Adams-Bashforth and Adams-Moulton methods (elementary treatment).

Boundary value problems, Shooting method, Finite difference method for ordinary differential equations.

Error estimation, Stability and convergence of numerical methods for ordinary differential equations.

Engineering applications involving population growth, electrical circuits, heat transfer, vibration, and chemical kinetics.

Unit IV

Introduction to partial differential equations and mathematical modelling, Classification of second-order partial differential equations (elliptic, parabolic, and hyperbolic), Initial and boundary value problems.

Finite Difference Method (FDM): Forward, backward, and central difference approximations, Finite difference approximations to first- and second-order derivatives, Discretization of computational domains and mesh generation.

Numerical solution of Laplace equation in one and two dimensions, Heat equation using explicit finite difference method, Wave equation using finite difference method.
Elementary concepts of truncation error, consistency, stability, and convergence. Introduction to iterative solution of finite difference equations using Jacobi and Gauss-Seidel methods.
Applications to steady-state heat conduction, transient heat diffusion, electrostatic potential problems, groundwater flow, diffusion processes, and vibrating strings.

Textbooks

1. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2011.
2. S. C. Chapra and R. P. Canale, *Numerical Methods for Engineers*, 8th ed. New York, NY, USA: McGraw-Hill Education, 2020.
3. R. L. Burden, J. D. Faires, and A. M. Burden, *Numerical Analysis*, 11th ed. Boston, MA, USA: Cengage Learning, 2019.

References

1. K. E. Atkinson, *An Introduction to Numerical Analysis*, 2nd ed. Hoboken, NJ, USA: John Wiley & Sons, 1989.
2. W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, *Numerical Recipes: The Art of Scientific Computing*, 3rd ed. Cambridge, U.K.: Cambridge University Press, 2007.
3. G. H. Golub and C. F. Van Loan, *Matrix Computations*, 4th ed. Baltimore, MD, USA: Johns Hopkins University Press, 2013.
4. L. C. Andrews, *Special Functions of Mathematics for Engineers*, 2nd ed. Bellingham, WA, USA: SPIE Press, 1998.
5. J. H. Mathews and K. D. Fink, *Numerical Methods Using MATLAB*, 4th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2004.
6. D. Kincaid and W. Cheney, *Numerical Analysis: Mathematics of Scientific Computing*, 3rd ed. Providence, RI, USA: American Mathematical Society, 2009.

Paper Code(s): ICT-209P/ICT218P	**P : 2**
Paper: Computational Methods Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-209T/ICT218P 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT211T/ICT220T	**L : 3**
Paper: Computer Graphics	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Apply fundamental computer graphics algorithms for scan conversion, two-dimensional transformations, viewing and clipping operations.
CO2	Develop and analyze three-dimensional graphical models using transformation, projection and geometric representation techniques.
CO3	Apply visible surface detection, illumination and shading algorithms for realistic rendering of graphical scenes.
CO4	Explain rendering, animation and modern graphics pipeline concepts and evaluate their applications in engineering and interactive visualization 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*
CO1	3	3	2	2	2	-	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	1	-	2
CO3	3	3	3	2	2	-	-	-	-	1	-	2
CO4	3	3	3	2	2	-	-	-	1	1	1	3

Unit I

Introduction to computer graphics, applications of computer graphics, graphics systems, components of interactive graphics systems, graphics input and output devices, raster scan and random scan display systems, frame buffer, pixels and resolution, colour representation and graphics standards. Scan conversion algorithms: point plotting, Digital Differential Analyzer (DDA) algorithm, Bresenham's line drawing algorithm, midpoint circle algorithm, Bresenham's circle algorithm and midpoint ellipse algorithm. Anti-aliasing concepts. Two-dimensional geometric transformations: translation, scaling, rotation, reflection and shearing, homogeneous coordinate representation, composite transformations, transformations about arbitrary points. Two-dimensional viewing pipeline, window and viewport transformation, clipping concepts, point clipping, line clipping algorithms including Cohen–Sutherland and Liang–Barsky algorithms, polygon clipping using Sutherland–Hodgman algorithm.

Unit II

Three-dimensional coordinate systems, homogeneous coordinates and representation of three-dimensional objects. Three-dimensional transformations: translation, scaling, rotation, reflection, shearing, composite transformations, rotation about coordinate axes and arbitrary axes. Three-dimensional viewing pipeline, viewing coordinate systems, parallel projections including orthographic, axonometric and oblique projections, perspective projections, viewing transformations and viewport mapping. Geometric modeling: parametric representation of curves and surfaces, polynomial curves, Hermite curves, Bézier curves and their properties, B-spline curves and their properties. Surface representation using polygon meshes, Bézier surfaces and B-spline surfaces. Introduction to solid modeling concepts including boundary representation (B-rep) and constructive solid geometry (CSG).

Unit III

Visible surface determination, classification of hidden surface removal algorithms, object-space and image-space approaches, back-face detection, depth-buffer (Z-buffer) algorithm, scan-line algorithm, Painter's algorithm and Binary Space Partitioning (BSP) technique. Illumination models: light sources, ambient, diffuse and specular reflection models, Phong illumination model, surface properties and normal vectors. Shading techniques: flat shading, Gouraud shading and Phong shading, comparison of shading methods. Colour models: RGB, CMY, CMYK, HSV and HSL colour models and their applications.

Unit IV

Rendering concepts, texture mapping, texture representation and mapping techniques, shadow generation, reflection, transparency and refraction concepts. Introduction to ray tracing: ray generation, ray-object intersection, recursive ray tracing concepts and limitations. Computer animation principles, key-frame

animation, interpolation techniques, transformation-based animation, tweening and morphing. Introduction to graphics programming concepts, graphics primitives, coordinate systems, overview of graphics libraries and modern graphics pipelines including vertex processing, rasterization and fragment processing. Applications of computer graphics.

Textbooks

[1] D. Hearn and M. P. Baker, *Computer Graphics with C*, 2nd ed. Upper Saddle River, NJ, USA: Prentice Hall, 1997.
[2] D. Hearn, M. P. Baker, and W. Carithers, *Computer Graphics with OpenGL*, 4th ed. Boston, MA, USA: Pearson Education, 2014.

References

[1] J. D. Foley, A. van Dam, S. K. Feiner, and J. F. Hughes, *Computer Graphics: Principles and Practice*, 3rd ed. Boston, MA, USA: Addison-Wesley Professional, 2014.
[2] D. F. Rogers, *Procedural Elements for Computer Graphics*, 2nd ed. New York, NY, USA: McGraw-Hill, 1998.
[3] F. S. Hill Jr., *Computer Graphics Using OpenGL*, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 2007.
[4] P. Shirley and S. Marschner, *Fundamentals of Computer Graphics*, 5th ed. Boca Raton, FL, USA: CRC Press, 2021.
[5] T. Akenine-Möller, E. Haines, and N. Hoffman, *Real-Time Rendering*, 4th ed. Boca Raton, FL, USA: CRC Press, 2018.
[6] J. Vince, *Mathematics for Computer Graphics*, 2nd ed. London, U.K.: Springer, 2017.

Paper Code(s): ICT211P/ICT220P	**P : 2**
Paper: Computational Methods Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT211T/ICT220T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-202	**L : 3**
Paper: Theory of Computation	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Construct and analyze finite automata, regular expressions and regular languages using formal methods.
CO2	Model context-free languages using grammars and pushdown automata and analyze their computational properties.
CO3	Turing machine models and reduction techniques to study computability and undecidability.
CO4	Classify computational problems using complexity theory and evaluate their computational tractability.

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
Mathematical preliminaries, alphabets, strings and languages, operations on languages, formal language hierarchy, deterministic finite automata (DFA), nondeterministic finite automata (NFA), equivalence of DFA and NFA, ε-NFA and ε-transitions, conversion of ε-NFA to NFA and DFA, minimization of finite automata, Moore and Mealy Machines, Myhill-Nerode theorem and applications, regular expressions, Arden's theorem, conversion between regular expressions and finite automata, regular grammars, closure properties of regular languages, decision properties of regular languages, pumping lemma for regular languages and applications.

Unit II
Context-free grammars (CFGs), derivations, parse trees, ambiguity in grammars, inherently ambiguous languages, simplification of CFGs, elimination of useless symbols, null productions and unit productions, Chomsky Normal Form (CNF), Greibach Normal Form (GNF), closure properties of context-free languages, pumping lemma for context-free languages, pushdown automata (PDA), deterministic and nondeterministic PDA, acceptance by final state and empty stack, equivalence of CFGs and PDAs, applications of context-free languages in programming language design and parsing.

Unit III
Turing machines, formal definition and operation of Turing machines, language acceptance by Turing machines, design of Turing machines for computational problems, variants of Turing machines, multitape Turing machines, nondeterministic Turing machines, universal Turing machine, Church-Turing thesis, recursively enumerable languages, recursive languages, decidability, undecidability, halting problem, Post correspondence problem, reductions and undecidability proofs, Rice's theorem and applications.

Unit IV
Computational complexity measures, time and space complexity of Turing machines, complexity classes P, NP, co-NP, PSPACE and EXPTIME, polynomial-time reductions, NP-hard and NP-complete problems, Cook-Levin theorem (statement and significance), satisfiability problem, 3-SAT problem, clique problem, independent set problem, vertex cover problem, travelling salesman problem, approximation and tractability concepts, hierarchy of language classes, introduction to probabilistic computation and complexity.

Textbooks
1. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson Education, Latest Edition.
2. Introduction to the Theory of Computation, Michael Sipser, Cengage Learning, Latest Edition.

References

1. J. C. Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Education, Latest Edition.
2. H. R. Lewis and C. H. Papadimitriou, Elements of the Theory of Computation, Pearson Education, Latest Edition.
3. D. I. A. Cohen, Introduction to Computer Theory, Wiley India, Latest Edition.
4. K. L. P. Mishra and N. Chandrasekaran, Theory of Computer Science: Automata, Languages and Computation, PHI Learning, Latest Edition.
5. P. Linz, An Introduction to Formal Languages and Automata, Jones and Bartlett Learning, Latest Edition.
6. J. E. Hopcroft and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Addison-Wesley, Classic Edition.

Paper Code(s): ICT-204T	**L : 3**
Paper: Artificial Intelligence and Machine Learning	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Explain the foundations of Artificial Intelligence and develop intelligent agents using problem-solving and search techniques.
CO2	Apply knowledge representation, logical reasoning, and uncertainty modelling techniques for AI-based decision making.
CO3	Develop and evaluate machine learning models using supervised and unsupervised learning algorithms for data-driven applications.
CO4	Analyze advanced AI techniques including reinforcement learning, neural networks, deep learning, and emerging AI 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*
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 Artificial Intelligence, history and evolution of AI, foundations and applications of AI, intelligent agents, rational agents, characteristics of intelligent agents, agent architectures, environment types, PEAS representation, problem-solving agents.

Problem formulation, state-space representation, search strategies: uninformed search techniques including breadth-first search, depth-first search, uniform cost search, iterative deepening search, informed search techniques including greedy best-first search and A* algorithm, heuristic functions, admissibility and consistency of heuristics.

Constraint satisfaction problems, backtracking search, local search techniques, hill climbing, simulated annealing, and applications of search techniques in AI.

Unit II

Knowledge representation and reasoning, propositional logic, predicate logic, inference mechanisms, forward chaining and backward chaining, resolution principle, knowledge-based systems, semantic networks, frames and ontologies.

Uncertainty reasoning, probability-based reasoning, Bayes theorem, Bayesian networks, fuzzy logic and fuzzy inference systems.

Introduction to Machine Learning, learning paradigms, supervised, unsupervised and reinforcement learning, machine learning workflow, data representation, feature extraction and feature selection, training, validation and testing concepts, model evaluation and performance measures.

Unit III

Regression techniques: Linear regression, multiple linear regression, polynomial regression, regularization concepts.

Classification techniques: Logistic regression, k-nearest neighbour (KNN), decision trees, random forests, Naive Bayes classifier, support vector machines, classification boundaries and kernel concept.

Artificial neural networks: Biological inspiration, perceptron model, multilayer perceptron, activation functions, backpropagation algorithm, training neural networks, overfitting and regularization.

Unsupervised learning: Clustering concepts, k-means clustering, hierarchical clustering, density-based clustering, dimensionality reduction, Principal Component Analysis (PCA), applications of clustering and feature reduction.

Unit IV

Reinforcement learning: Markov decision processes, states, actions, rewards, policies, value functions, Q-learning algorithm and applications.

Introduction to deep learning: Deep neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), applications in image processing, natural language processing and time-series analysis.
Introduction to generative AI concepts: Generative models, autoencoders, generative adversarial networks (GANs), large language models (overview).
AI applications, Ethical issues in AI

Textbooks

[1] S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Hoboken, NJ, USA: Pearson, 2021.
[2] T. M. Mitchell, Machine Learning. New York, NY, USA: McGraw-Hill Education, 1997.
[3] I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. Cambridge, MA, USA: MIT Press, 2016.

References

[1] E. Rich, K. Knight, and S. B. Nair, Artificial Intelligence, 3rd ed. New Delhi, India: McGraw-Hill Education, 2017.
[2] S. Haykin, Neural Networks and Learning Machines, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 2009.
[3] C. M. Bishop, Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006.
[4] K. P. Murphy, Machine Learning: A Probabilistic Perspective. Cambridge, MA, USA: MIT Press, 2012.
[5] P. Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge, U.K.: Cambridge University Press, 2012.
[6] A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

Paper Code(s): ICT204P	**P : 2**
Paper: Artificial Intelligence and Machine Learning **Lab**	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT204T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-206	L : 3
Paper: Probability and Stochastic Processes for Engineers	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1:	Analyze multivariate random variables and probability models for engineering applications.
CO2:	Characterize random processes using statistical measures such as correlation functions, stationarity, and spectral density.
CO3:	Apply Markov chains, Poisson processes, and queueing models for performance analysis of stochastic engineering systems.
CO4:	Develop stochastic and reliability models for analyzing uncertain engineering systems and real-world 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*
CO1	3	3	1	1	1	-	1	-	-	-	1	2
CO2	3	3	1	1	3	-	-	-	-	-	1	2
CO3	3	3	2	2	2	2	2	-	-	-	2	2
CO4	3	3	3	3	2	1	1	-	-	-	2	2

Unit I

Review of random variables and probability distributions, Joint probability distributions, Marginal and conditional probability distributions, Independence of random variables, Functions of two or more random variables, Transformation of random variables, Distribution of functions of random variables, Mathematical expectation of functions of random variables, Joint moments, Covariance and correlation coefficients, Moment generating functions, Characteristic functions, Applications of random variable models in engineering systems.

Unit II

Introduction to random processes, Classification of random processes, Discrete-time and continuous-time random processes, Ensemble averages, Mean function, Autocorrelation function, Cross-correlation function, Covariance function, Stationary random processes, Wide-sense stationary processes, Ergodic processes, Gaussian random processes, White noise processes, Power spectral density, Relationship between autocorrelation and power spectral density, Linear systems with random inputs.

Unit III

Markov chains, Discrete-time Markov chains, Transition probability matrix, Chapman–Kolmogorov equations, Classification of states, Periodicity and recurrence, Steady-state probabilities, Continuous-time Markov chains (basic concepts), Poisson processes, Birth-death processes, Introduction to queueing theory, Queueing models and Kendall notation, M/M/1 and M/M/c queueing systems, Little's theorem, Applications of queueing models in computer and communication networks.

Unit IV

Reliability concepts, Reliability function, Failure rate and hazard function, Mean time to failure, Series and parallel reliability models, Standby systems, Availability and maintainability, Renewal process (basic concepts), Monte Carlo simulation methods for stochastic systems, Applications of stochastic processes in communication systems, signal processing, computer networks, manufacturing systems, and machine learning.

Textbook

1. A. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd ed. Boston, MA, USA: Pearson, 2008.

References

2. A. Papoulis and S. U. Pillai, Probability, Random Variables, and Stochastic Processes, 5th ed. New York, NY, USA: McGraw-Hill Education, 2002.
3. S. M. Ross, Introduction to Probability Models, 12th ed. Amsterdam, The Netherlands: Academic Press, 2019.
4. R. D. Yates and D. J. Goodman, Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, 3rd ed. Hoboken, NJ, USA: John Wiley & Sons, 2014.

5. H. Stark and J. W. Woods, Probability, Random Processes, and Estimation Theory for Engineers, 4th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2011.
6. D. P. Bertsekas and J. N. Tsitsiklis, Introduction to Probability, 2nd ed. Nashua, NH, USA: Athena Scientific, 2008.

Paper Code(s): ICT-217T/208T	**L : 3**
Paper: Operating Systems	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):	
CO1	Explain operating system structures, process management concepts, and CPU scheduling algorithms for efficient management of computational resources.
CO2	Analyze synchronization problems and apply synchronization mechanisms and deadlock handling techniques for concurrent systems.
CO3	Apply memory management and virtual memory concepts including paging, segmentation, and page replacement strategies.
CO4	Explain file systems, storage management, protection mechanisms, and modern operating system 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*
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, Processes and CPU Scheduling
Introduction to operating systems, evolution and objectives of operating systems, functions and services of operating systems, operating system structures, system calls and system programs, kernel organization, monolithic, layered, microkernel and hybrid kernel architectures. Process concept, process states, process control block (PCB), process creation and termination, context switching, cooperating processes and inter-process communication. Threads and multithreading, user-level and kernel-level threads, multithreading models and benefits. CPU scheduling concepts, scheduling criteria, preemptive and non-preemptive scheduling, First Come First Serve (FCFS), Shortest Job First (SJF), Shortest Remaining Time First (SRTF), priority scheduling, Round Robin scheduling, multilevel queue scheduling, multilevel feedback queue scheduling. Introduction to real-time scheduling, Rate Monotonic Scheduling and Earliest Deadline First scheduling.

Unit II: Process Synchronization and Deadlocks
Process synchronization, race conditions, critical section problem, requirements for critical section solutions, software and hardware approaches to synchronization, Peterson's solution, atomic operations. Semaphores, mutex locks, monitors and condition variables. Classical synchronization problems including producer-consumer problem, readers-writers problem and dining philosophers problem. Deadlocks, system model, resource allocation graph, characterization of deadlocks, necessary conditions for deadlock occurrence, deadlock prevention, deadlock avoidance, Banker's algorithm, deadlock detection and recovery techniques.

Unit III: Memory Management and Virtual Memory
Memory management concepts, logical and physical address spaces, address binding, dynamic loading and linking, contiguous memory allocation, fixed and variable partitioning, fragmentation. Paging concepts, page tables, translation lookaside buffer (TLB), multilevel paging, inverted page tables. Segmentation and segmentation with paging. Virtual memory concepts, demand paging, page faults, effective access time, copy-on-write mechanism. Page replacement algorithms including FIFO, Optimal, Least Recently Used (LRU) and Clock algorithms. Thrashing, working set model and page fault frequency approach. Overview of advanced memory allocation techniques including buddy system and slab allocation.

Unit IV: File Systems, Storage Management and Modern Operating Systems
File system concepts, file attributes and operations, file access methods, directory structures, file system organization, file allocation methods and free space management. Storage management, disk organization, disk scheduling algorithms including FCFS, SSTF, SCAN, C-SCAN, LOOK and C-LOOK. Input/output management, I/O hardware, device controllers, device drivers, interrupt handling and Direct Memory Access (DMA). Protection and

security mechanisms, access control models, authentication and authorization, operating system security threats. Modern operating system concepts including virtualization, virtual machines, containers, mobile operating systems, cloud operating systems and introduction to Linux/Unix system architecture.

Textbooks

[1] A. Silberschatz, P. B. Galvin, and G. Gagne, Operating System Concepts, 10th ed. Hoboken, NJ, USA: Wiley, 2018.
[2] A. S. Tanenbaum and H. Bos, Modern Operating Systems, 5th ed. Boston, MA, USA: Pearson, 2022.
[3] W. Stallings, Operating Systems: Internals and Design Principles, 9th ed. Boston, MA, USA: Pearson, 2018.

References

[1] R. Love, Linux Kernel Development, 3rd ed. Upper Saddle River, NJ, USA: Addison-Wesley, 2010.
[2] M. J. Bach, The Design of the UNIX Operating System. Englewood Cliffs, NJ, USA: Prentice Hall, 1986.
[3] D. P. Bovet and M. Cesati, Understanding the Linux Kernel, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2005.
[4] G. Nutt, Operating Systems: A Modern Perspective, 3rd ed. Boston, MA, USA: Addison-Wesley, 2004.
[5] T. Anderson and M. Dahlin, Operating Systems: Principles and Practice, 2nd ed. Recursive Books, 2014.
[6] M. K. McKusick and G. Neville-Neil, The Design and Implementation of the FreeBSD Operating System, 2nd ed. Boston, MA, USA: Addison-Wesley, 2014.

Paper Code(s): ICT208P	**P : 2**
Paper: Operating Systems **Lab**	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT208T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-214T/ICT219	**L : 3**
Paper: Signal and Systems	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Analyze continuous-time and discrete-time signals and systems using time-domain techniques and convolution.
CO2	Apply Fourier series and Fourier transform techniques for frequency-domain analysis of signals and linear systems.
CO3	Analyze continuous-time systems using Laplace transform techniques and evaluate system stability and frequency response.
CO4	Apply Z-transform methods for discrete-time system analysis and relate transform techniques to engineering 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*
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: Continuous-Time and Discrete-Time Signals and Systems
Introduction to signals and systems, classification of signals: continuous-time and discrete-time signals, deterministic and random signals, periodic and aperiodic signals, energy and power signals, even and odd signals, elementary signals including unit impulse, unit step, ramp, exponential, sinusoidal and complex exponential signals. Basic operations on signals including amplitude scaling, time shifting, time scaling, time reversal and folding. Systems and their classification, properties of systems including linearity, time invariance, causality, memory, invertibility, stability and bounded-input bounded-output (BIBO) stability. Linear time-invariant (LTI) systems, impulse response, convolution integral for continuous-time systems, convolution sum for discrete-time systems, graphical interpretation and properties of convolution, realization of LTI systems using differential and difference equations.

Unit II: Fourier Analysis of Signals and Systems
Orthogonal functions and signal representation, Fourier series of continuous-time periodic signals, trigonometric and exponential Fourier series, properties of Fourier series, Gibbs phenomenon. Continuous-time Fourier transform (CTFT), properties of the Fourier transform, Fourier transform of standard signals, frequency response of LTI systems, distortionless transmission, Parseval's theorem, energy spectral density and power spectral density. Discrete-time Fourier transform (DTFT), properties of DTFT, frequency response of discrete-time systems, sampling theorem, aliasing, reconstruction of sampled signals and ideal reconstruction filter.

Unit III: Laplace Transform and Continuous-Time System Analysis
Laplace transform, existence conditions, unilateral and bilateral Laplace transforms, properties of Laplace transforms, inverse Laplace transform, region of convergence, poles and zeros, system transfer function, frequency response from Laplace transform, analysis of continuous-time LTI systems using Laplace transform, differential equation representation, stability analysis using pole locations, network functions, block diagram representation, signal flow graphs and introduction to state-variable representation of continuous-time systems.

Unit IV: Z-Transform and Discrete-Time System Analysis
Z-transform, unilateral and bilateral Z-transform, region of convergence, properties of Z-transform, inverse Z-transform, poles and zeros, stability and causality in the Z-domain. Analysis of discrete-time LTI systems using Z-transform, solution of difference equations, transfer function representation, realization of discrete-time systems. Introduction to discrete-time state-space representation. Relationship among Fourier transform, Laplace transform and Z-transform. Applications of signals and Systems Concepts and Techniques.

Textbooks
[1] A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Signals and Systems, 2nd ed. Upper Saddle River, NJ, USA: Pearson Education, 1997.
[2] S. Haykin and B. Van Veen, Signals and Systems, 2nd ed. Hoboken, NJ, USA: John Wiley & Sons, 2003.

[3] H. P. Hsu, Signals and Systems, 3rd ed. New York, NY, USA: McGraw-Hill Education, 2010.

References

[1] B. P. Lathi, Linear Systems and Signals, 3rd ed. New York, NY, USA: Oxford University Press, 2018.
[2] M. J. Roberts, Signals and Systems: Analysis Using Transform Methods and MATLAB, 2nd ed. New York, NY, USA: McGraw-Hill Education, 2011.
[3] A. Anand Kumar, Signals and Systems, 3rd ed. New Delhi, India: PHI Learning, 2013.
[4] C. L. Phillips, J. M. Parr, and E. A. Riskin, Signals, Systems and Transforms, 5th ed. Upper Saddle River, NJ, USA: Pearson Education, 2014.
[5] S. K. Mitra, Signals and Systems. New York, NY, USA: McGraw-Hill Education, Latest Edition.
[6] R. F. Ziemer, W. H. Tranter, and D. R. Fannin, Signals and Systems: Continuous and Discrete, 4th ed. Upper Saddle River, NJ, USA: Pearson Education, 1998.

Paper Code(s): ICT-216T	**L : 3**
Paper: Introduction to Robotics Engineering	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Explain the fundamentals of robotics, including robot anatomy, actuators, sensors, end effectors, and the role of robotics in automation and intelligent systems.
CO2	Analyze the kinematics of robotic manipulators using coordinate transformations, Denavit–Hartenberg representation, forward and inverse kinematics, velocity analysis, and Jacobian concepts.
CO3	Describe the principles of mobile robotics, including locomotion, localization, navigation, path planning, obstacle avoidance, and the use of robotic simulation environments.
CO4	Explain robot control strategies, introductory robotic programming concepts, and evaluate the application of robotic systems in industrial, medical, domestic, and autonomous environments while considering ethical, societal, and economic implications.

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:Definition, scope and brief history of robotics, robotics and automation, classification of robots, components of a robotic system, types of joints and links, robot workspace, Degree of Freedom, End effectors.
Actuation systems: Basics of motors (DC, stepper, servo), how actuators produce motion, working principles (non-mathematical).
Overview of robotic perception: Sensors Classification, sensor characterization, encoders, heading/orientation sensors, active ranging sensors, motion/speed sensors, vision-based sensors.

Unit II

Kinematics of robots: Description of positions, orientation and frames, simple 2D and 3D transformations, Introduction to Denavit-Hartenberg notation (for 2 link arms), introduction to forward and inverse kinematics (intuitive treatment), Linear and rotational velocity, Velocity propagation from link to link, Jacobians.

Unit III

Mobile Robots: Introduction to mobile robots, basic features of locomotion, navigation architecture, introduction to autonomous vehicle, Map representation, Path planning and obstacle avoidance.
Overview of robotic simulators, sensor-based behavior design using block diagrams

Unit IV

Robot controls: Point to point control, continuous path control, motion interpolation, adaptive control.
Introduction to robotic programming.
Case studies: application of robots in material handling, home automation, medical robots, assembly and inspection. Ethical issues and economial issues of robots.

Textbooks:

1. *Mikell P. Groover, Mitchel Weiss, Roger N Nagel, Nicholas G. Odrey, Ashish Dutta, "Industrial Robotics: Technology programming and Applications", McGraw Hill, 2012.*
2. *John J. Craig. "Introduction to Robotics- Mechanics and Control", Third Edition,Addison- Wesley, 2004.*
3. *Introduction to Robotics, Saeed B. Niku, Wiley, 4th Edition, 2019.*
4. *Roland Siegwart & Illah R. Nourbaksh , "Introduction to Autonomous Mobile Robots", Prentice Hall of India, 2004.*

References:

5. *Learning Robotics Using Python*, Lentin Joseph, Packt Publishing, 2015.
6. *Robotics for Beginners*, Aaron Martinez & Enrique Fernández, Packt, 2021.

7. *Introduction to Autonomous Mobile Robots*, Roland Siegwart, Illah Nourbakhsh, MIT Press, 2nd Edition, 2011.
8. *Hands-On Robotics with LEGO Mindstorms EV3*, Lorenz Meier, No Starch Press, 2014.
9. *Open Roberta Tutorials and Online Resources*, Fraunhofer IAIS (latest online version).

Paper Code(s): ICT-212	L : 3
Paper: Scientific Writing using Latex	C : 3

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Prepare professional scientific documents using LaTeX with appropriate formatting, mathematical notation, and document structure.
CO2	Typeset equations, figures, tables, algorithms, and cross-references to produce publication-quality technical documents.
CO3	Prepare research papers and technical reports using BibTeX/BibLaTeX with IEEE-style citations while adhering to research ethics and publication standards.
CO4	Develop complete project reports, dissertations, presentations, and scholarly documents using advanced LaTeX features and collaborative document preparation 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	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 Scientific Writing and LaTeX

Introduction to scientific and technical writing, characteristics of scientific documents, structure of scientific reports and research papers, principles of clear and concise scientific writing. Introduction to LaTeX, installation and compilation using TeX Live, MiKTeX and Overleaf, document structure, document classes, packages, source files, compilation process, text formatting, sections, lists, quotations, page layout, fonts, spacing, special characters, comments and document organization.

Unit II: Mathematical Typesetting and Scientific Document Preparation

Typesetting mathematical expressions, mathematical symbols, equations, matrices, aligned equations, theorem-like environments, definitions, lemmas, propositions and proofs. Cross-referencing, labels, hyperlinks and automatic numbering. Preparation of tables, figures, graphics, captions, floating environments, subfigures, drawing with TikZ (basic introduction), inclusion of external graphics, preparation of algorithms and pseudocode using LaTeX packages.

Unit III: Bibliography, Research Ethics and Scientific Publications

Preparation of bibliographies using BibTeX and BibLaTeX, IEEE bibliography style, citation management, referencing scholarly literature. Preparation of research papers using IEEE and ACM document classes, abstracts, keywords, appendices and indexes. Plagiarism, research ethics, authorship, copyright, open-access publishing, preprints, digital object identifiers (DOIs), literature survey techniques, use of digital libraries and scholarly databases.

Unit IV: Advanced Scientific Writing and Presentations

Preparation of technical reports, project reports, laboratory manuals, dissertations and theses using LaTeX. Custom commands, environments, page styles, headers, footers and templates. Preparation of presentation slides using Beamer, scientific posters, tables of contents, glossaries and acronyms. Introduction to collaborative writing using Git and Overleaf, version control for scientific documents, reproducible research, preparation of publication-ready manuscripts and complete scientific document workflow using LaTeX.

Textbooks

[1] L. Lamport, LaTeX: A Document Preparation System, 2nd ed. Boston, MA, USA: Addison-Wesley, 1994.
[2] F. Mittelbach and M. Goossens, The LaTeX Companion, 3rd ed. Boston, MA, USA: Addison-Wesley Professional, 2023.

References

[1] H. Kopka and P. W. Daly, A Guide to LaTeX, 5th ed. Boston, MA, USA: Addison-Wesley, 2014.
[2] G. Grätzer, More Math into LaTeX, 5th ed. Cham, Switzerland: Springer, 2016.
[3] R. A. Day and B. Gastel, How to Write and Publish a Scientific Paper, 9th ed. Santa Barbara, CA, USA: Greenwood, 2022.

[4] J. M. Hofmann, Scientific Writing and Communication: Papers, Proposals, and Presentations, 4th ed. New York, NY, USA: Oxford University Press, 2019.
[5] IEEE, IEEE Editorial Style Manual, Latest Edition.
[6] M. Alley, The Craft of Scientific Writing, 4th ed. New York, NY, USA: Springer, 2018.

Paper Code(s): ICT221T	**L : 3**
Paper: Engineering Electromagnetics	**C : 3**
Prerequisites: None	

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Apply vector calculus and electrostatic field theory to analyze electric fields, potentials, capacitance, and dielectric media.
CO2	Analyze magnetostatic fields and time-varying electromagnetic fields using Maxwell's equations and related electromagnetic principles.
CO3	Analyze electromagnetic wave propagation, polarization, reflection, transmission, and power flow in different media.
CO4	Apply transmission line and waveguide theories to solve engineering problems and explain the role of electromagnetics in communication, microwave, sensing, and electrical engineering 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*
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: Vector Analysis and Electrostatic Fields
Review of vector algebra and vector calculus, Cartesian, cylindrical and spherical coordinate systems, gradient, divergence, curl and Laplacian operators, divergence theorem, Stokes' theorem and Green's theorem. Coulomb's law, electric field intensity, electric flux density, Gauss's law and its applications, electric potential, relationship between electric field and potential, Poisson's and Laplace's equations, uniqueness theorem, boundary conditions for electrostatic fields, method of images (introduction), capacitance, electrostatic energy and energy density. Electrostatic fields in dielectric media, polarization, dielectric constant, electric susceptibility, dielectric boundary conditions and dielectric breakdown.

Unit II: Magnetostatic Fields and Maxwell's Equations
Biot–Savart law, Ampère's circuital law, magnetic flux density, magnetic field intensity, magnetic vector potential, magnetic scalar potential (introduction), magnetic materials, magnetization, magnetic boundary conditions, inductance, self and mutual inductance, magnetic energy and energy density. Time-varying fields, Faraday's law of electromagnetic induction, displacement current, continuity equation, Maxwell's equations in differential and integral forms, physical interpretation of Maxwell's equations, boundary conditions for time-varying electromagnetic fields.

Unit III: Electromagnetic Wave Propagation
Wave equation for electromagnetic fields, uniform plane waves, propagation in free space, dielectric media and conducting media, intrinsic impedance, propagation constant, attenuation constant, phase constant, skin depth, polarization of electromagnetic waves, Poynting theorem, power flow and energy transport, reflection and transmission of electromagnetic waves at normal and oblique incidence, Brewster angle, total internal reflection, standing waves and standing wave ratio (SWR), electromagnetic interference (EMI) and electromagnetic compatibility (EMC) concepts.

Unit IV: Transmission Lines, Waveguides and Applications
Transmission line parameters, transmission line equations, characteristic impedance, reflection coefficient, voltage standing wave ratio, impedance matching techniques, Smith chart (introduction and applications). Waveguides, rectangular waveguides, dominant mode, cutoff frequency, phase and group velocities, cavity resonators (introduction). Introduction to optical fibers and electromagnetic wave propagation in optical media. Applications of electromagnetics in antennas, microwave engineering, radar systems, wireless communication, satellite communication, electrical machines, medical imaging, electromagnetic sensors and modern electronic systems.

Textbooks

1. Matthew N. O. Sadiku, Elements of Electromagnetics, 7th ed., Oxford University Press, Latest Edition.
2. William H. Hayt, John A. Buck, and M. Jaleel Akhtar, Engineering Electromagnetics, 9th ed., McGraw-Hill Education, Latest Edition.
3. David K. Cheng, Field and Wave Electromagnetics, 2nd ed., Pearson Education, Latest Edition.

References

1. Edward C. Jordan and Keith G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd ed., Pearson Education.
2. Constantine A. Balanis, Advanced Engineering Electromagnetics, 2nd ed., Wiley.
3. John D. Kraus and Daniel A. Fleisch, Electromagnetics with Applications, 5th ed., McGraw-Hill Education.
4. Nathan Ida, Engineering Electromagnetics, 3rd ed., Springer.
5. Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson Education.
6. Ramo, Whinnery, and Van Duzer, Fields and Waves in Communication Electronics, 3rd ed., Wiley.

Paper Code(s): ICT221P	**P : 2**
Paper: Computational Methods Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT221T 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. **3.** There should be at least 10 practical exercises	

Paper Code(s): ICT-223T	**L : 3**
Paper: Analog Circuits	**C : 3**
Prerequisites: ICT117 Semiconductor Engineering and its applications	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 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 question of total 12 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 12. 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 Outcomes (CO):

CO1	Able to understand diode applications and transistor biasing techniques
CO2	Able to analyze Transistor amplifiers and understand low & high frequency response
CO3	Able to understand Multistage amplifiers, coupling methods and Power amplifiers
CO4	Able to understand Feedback concepts in amplifiers and various types of sinusoidal oscillator

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	1	-	2
CO2	3	3	3	3	2	1	1	-	1	1	-	2
CO3	3	3	3	3	2	1	1	-	1	1	-	2
CO4	3	3	3	3	2	1	1	-	1	1	-	2

Unit I

Diode circuit applications: clipping, clamping, rectifiers, rectifiers with filters, Zener-based regulation, BJT and MOSFET I–V characteristics (revisited), Biasing of BJTs and MOSFETs, operating regions, (fixed bias, self-bias, voltage divider), stability analysis using biasing resistors, load line analysis, thermal effects and bias point drift, constant current sources, current mirrors using BJT and MOSFET.

Unit II

Single stage BJT amplifiers (CE, CB, CC), Mid band small signal Analysis of BJT amplifiers, Low frequency hybrid models, Analysis of BJT amplifier circuit using h parameters, mid-band gains, input/output resistance, MOSFET amplifiers (CS, CG, CD), Low-and high-frequency small signal models of MOSFETs, Miller effect, gain-bandwidth product, Frequency response of amplifier, low & high frequency, parasitic capacitances, dominant pole approximation, -3dB bandwidth, gain roll-off, Bode plot interpretation

Unit III

Multistage amplifier design (cascade, cascode), loading effects and impedance matching, coupling techniques, two stage RC coupled Amplifier and its frequency response, effect of coupling and bypass capacitors, differential amplifier principles, common-mode rejection, practical design constraints in amplifier chains.
Power amplifier classes (A, B, AB, C), crossover distortion, efficiency and thermal management, push–pull amplifier design.

Unit IV

Feedback in amplifiers, types and topologies of negative feedback, effect on input/output resistance, gain stability, bandwidth, distortion, loop gain, and Barkhausen criterion.
sinusoidal oscillators (RC: phase shift and Wien bridge; LC: Hartley and Colpitts), startup condition, frequency stability, crystal oscillators

Textbooks:

1. *Microelectronic Circuits, Adel S. Sedra and Kenneth C. Smith, Oxford University Press, Latest Edition.*
2. *Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson Education, Latest Edition.*

References:

1. *Design of Analog CMOS Integrated Circuits*, Behzad Razavi, McGraw-Hill Education, Latest Edition.
2. *Integrated Electronics: Analog and Digital Circuits and Systems*, Jacob Millman and Christos C. Halkias, McGraw-Hill Education, Latest Edition.
3. *Electronic Principles*, Albert Paul Malvino and David J. Bates, McGraw-Hill Education, Latest Edition.
4. *Fundamentals of Microelectronics*, Behzad Razavi, Wiley, Latest Edition.

Paper Code(s): ICT-223P	**P : 2**
Paper: Analog Circuits Lab	**C : 1**
Prerequisites: ICT-157 Semiconductor Engineering and its applications Lab	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-223T as this is the practical component of thetheory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-225T	L : 3
Paper: Analog Communications	C : 3

Prerequisites:

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Explain the principles of analog communication systems and analyze amplitude modulation techniques and their demodulation methods.
CO2	Analyze angle modulation and pulse modulation techniques and compare their characteristics and applications.
CO3	Evaluate the performance of analog communication systems in the presence of noise and analyze receiver characteristics.
CO4	Explain the operation of analog communication receivers and relate analog communication principles to broadcasting, telemetry, and modern communication 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*
CO1	3	3	3	3	2	1	1	-	1	1	-	2
CO2	3	3	3	3	2	1	1	-	1	1	-	2
CO3	3	3	3	3	2	1	1	-	1	1	-	2
CO4	3	3	3	3	2	1	1	-	1	1	-	2

Unit I: Fundamentals of Communication Systems and Amplitude Modulation

Introduction to communication systems, elements and block diagram of a communication system, electromagnetic spectrum and frequency allocation, communication channels, baseband and passband transmission, bandwidth, signal-to-noise ratio, decibel representation, information-carrying signals, Fourier representation of communication signals. Amplitude modulation (AM), modulation index, generation of AM using square-law and switching modulators, demodulation using envelope detector and synchronous detector, power relations in AM, Double Sideband Suppressed Carrier (DSB-SC) modulation and demodulation, Single Sideband (SSB) modulation using filter and phase-shift methods, Vestigial Sideband (VSB) modulation and applications, comparison of amplitude modulation techniques.

Unit II: Angle Modulation and Pulse Modulation

Need for angle modulation, frequency modulation (FM) and phase modulation (PM), mathematical representation, modulation index, narrowband and wideband FM, relationship between FM and PM, bandwidth of FM, Carson's rule, generation of FM by direct and indirect methods, demodulation of FM using slope detector, Foster-Seeley discriminator, ratio detector and phase-locked loop (PLL), pre-emphasis and de-emphasis, comparison of AM, FM and PM systems. Pulse modulation techniques, sampling theorem, natural and flat-top sampling, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), pulse modulation generation and detection, time-division multiplexing.

Unit III: Noise in Analog Communication Systems

Introduction to random signals and noise, sources of noise, external and internal noise, thermal noise, shot noise, white noise and Gaussian noise, signal-to-noise ratio, noise figure, equivalent noise temperature, narrowband noise representation. Performance of analog communication systems in the presence of noise, noise analysis in AM receivers, DSB-SC and SSB receivers, threshold effect in FM systems, noise performance of FM and PM, comparison of AM and FM with respect to noise immunity, introduction to phase-locked loop applications in communication receivers.

Unit IV: Analog Receivers and Communication Applications

Radio receivers, Tuned Radio Frequency (TRF) receiver, superheterodyne receiver, image frequency and image rejection, intermediate frequency (IF) amplifiers, automatic gain control (AGC), automatic frequency control (AFC), frequency synthesizers (introduction). Analog multiplexing techniques including Frequency Division Multiplexing (FDM). Introduction to analog television and radio broadcasting, microwave analog communication systems, satellite analog links, telemetry systems, analog communication in instrumentation and control,

comparison of analog and digital communication systems, overview of the evolution toward modern digital communication.

Textbooks

1. Simon Haykin, Communication Systems, 5th ed., Wiley, Latest Edition.
2. B. P. Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, 5th ed., Oxford University Press, Latest Edition.
3. H. Taub and D. L. Schilling, Principles of Communication Systems, 3rd ed., McGraw-Hill Education, Latest Edition.

References

1. John G. Proakis and Masoud Salehi, Fundamentals of Communication Systems, 2nd ed., Pearson Education.
2. Dennis Roddy and John Coolen, Electronic Communications, 4th ed., Pearson Education.
3. Wayne Tomasi, Electronic Communication Systems: Fundamentals Through Advanced, 5th ed., Pearson Education.
4. George Kennedy and Bernard Davis, Electronic Communication Systems, 5th ed., McGraw-Hill Education.
5. Leon W. Couch II, Digital and Analog Communication Systems, 8th ed., Pearson Education.
6. Martin S. Roden, Analog and Digital Communication Systems, 5th ed., PHI Learning.

Paper Code(s): ICT-225P	**P : 2**
Paper: Analog Communications Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-225T as this is the practical component of thetheory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-222T	L : 3
Paper: Network Analysis and Synthesis	C : 3

Prerequisites:

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Apply classical circuit analysis techniques and network theorems to analyze linear electrical networks under DC and AC excitation.
CO2	Analyze transient behavior and topological properties of electrical networks using graph-theoretic and differential equation approaches.
CO3	Analyze electrical networks using Laplace transform techniques, network functions, and two-port network parameters.
CO4	Synthesize passive electrical networks and explain the design principles of classical filter networks for engineering 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*
CO1	3	3	3	3	2	1	1	-	1	1	-	2
CO2	3	3	3	3	2	1	1	-	1	1	-	2
CO3	3	3	3	3	2	1	1	-	1	1	-	2
CO4	3	3	3	3	2	1	1	-	1	1	-	2

Unit I: Network Elements and Circuit Analysis Techniques

Introduction to electrical networks, active and passive elements, linear and nonlinear elements, bilateral and unilateral elements, lumped and distributed parameters, independent and dependent sources, source transformation. Kirchhoff's Voltage Law and Kirchhoff's Current Law, node-voltage analysis, mesh-current analysis, supernode and supermesh techniques. Network theorems including superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, reciprocity theorem, Millman's theorem, compensation theorem and Tellegen's theorem. Duality in electrical networks. Analysis of DC and sinusoidal AC circuits using phasor representation, impedance and admittance concepts, complex power, active, reactive and apparent power, power factor and power factor correction.

Unit II: Network Topology and Transient Analysis

Graph theory applied to electrical networks, oriented graphs, incidence matrix, tie-set matrix, cut-set matrix, loop and node equations, tree, co-tree, fundamental loops and cut-sets. Initial conditions in electrical networks, transient analysis of RL, RC and RLC circuits using differential equations, complete and particular solutions, natural and forced responses, first-order and second-order circuits, underdamped, critically damped and overdamped responses, resonance in series and parallel RLC circuits, quality factor and bandwidth.

Unit III: Laplace Transform, Network Functions and Two-Port Networks

Laplace transform and inverse Laplace transform, properties of Laplace transform, analysis of electrical networks using Laplace transform, transformed circuit elements, network functions, driving-point and transfer functions, poles and zeros, stability of networks, frequency response, Bode plots (introduction). Two-port networks, terminal variables, impedance (Z), admittance (Y), hybrid (h), inverse hybrid (g) and transmission (ABCD) parameters, interconnection of two-port networks, applications in amplifier and communication circuits.

Unit IV: Network Synthesis and Filter Fundamentals

Positive real functions, Hurwitz polynomials, properties of positive real functions, Foster and Cauer forms of network realization, synthesis of one-port LC, RC and RL driving-point impedance and admittance functions. Introduction to passive filters, low-pass, high-pass, band-pass and band-stop filters, constant-k filters, m-derived filters, image impedance, attenuation characteristics, insertion loss concept (overview). Applications of network synthesis in communication systems, analog circuits, signal processing and control engineering.

Textbooks

1. M. E. Van Valkenburg, Network Analysis, 3rd ed., Pearson Education, Latest Edition.
2. F. F. Kuo, Network Analysis and Synthesis, 2nd ed., Wiley.
3. W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, Engineering Circuit Analysis, 9th ed., McGraw-Hill Education, Latest Edition.
4. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Publishers, Latest Edition.

References

1. Sudhakar and S. P. Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th ed., McGraw-Hill Education.
2. M. Nahvi and J. Edminister, Schaum's Outline of Electric Circuits, 7th ed., McGraw-Hill Education.
3. J. D. Irwin and R. M. Nelms, Basic Engineering Circuit Analysis, 12th ed., Wiley.
4. Carlson, Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, Cengage Learning.
5. Chakrabarti, Circuit Theory (Analysis and Synthesis), Dhanpat Rai Publications.

Paper Code(s): ICT-222P	**P : 2**
Paper: Network Analysis and Synthesis **Lab**	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of ICT-222T as this is the practical component of thetheory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): ICT-224T	L : 3
Paper: Digital Communications	C : 3

Prerequisites:

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 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 question of total 12 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 12.
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 Outcomes (CO):

CO1	Apply the fundamental concepts of information theory and source coding to analyze information sources and coding efficiency.
CO2	Analyze digital baseband transmission and digital modulation techniques and evaluate their bandwidth and error performance.
CO3	Apply channel coding, synchronization, and equalization techniques to improve the reliability of digital communication systems.
CO4	Explain spread spectrum, multiple access, and modern digital communication technologies used in wireless, optical, satellite, and broadband communication 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*
CO1	3	3	3	3	2	1	1	-	1	1	-	2
CO2	3	3	3	3	2	1	1	-	1	1	-	2
CO3	3	3	3	3	2	1	1	-	1	1	-	2
CO4	3	3	3	3	2	1	1	-	1	1	-	2

Unit I: Information Theory and Source Coding

Introduction to digital communication systems, elements of a digital communication system, comparison of analog and digital communication, communication channels, signal space representation and optimum detection in additive white Gaussian noise. Information sources, information content, self-information, entropy, joint entropy, conditional entropy, mutual information, relative entropy (introduction), discrete memoryless sources, source coding theorem, Shannon's noiseless coding theorem, Huffman coding, Shannon-Fano coding, arithmetic coding (overview), run-length coding, source redundancy, efficiency of source codes.

Unit II: Digital Baseband Transmission and Digital Modulation

Sampling theorem, pulse amplitude modulation, pulse code modulation (PCM), differential PCM (DPCM), adaptive DPCM, delta modulation (DM), adaptive delta modulation (ADM), quantization and quantization noise, companding. Line coding techniques including unipolar, polar, bipolar, Manchester and differential Manchester coding, scrambling techniques, intersymbol interference, Nyquist criterion, raised cosine filtering, eye diagrams. Digital modulation techniques including ASK, FSK, BPSK, DPSK, QPSK, M-PSK, QAM and M-ary modulation schemes, coherent and non-coherent detection, constellation diagrams, bandwidth and power efficiency, probability of error analysis.

Unit III: Channel Coding and Synchronization

Communication over noisy channels, discrete memoryless channels, channel capacity, Shannon's channel coding theorem, error detection and correction, Hamming distance, linear block codes, Hamming codes, cyclic redundancy check (CRC), cyclic codes, convolutional codes, Viterbi decoding, Reed-Solomon codes (introduction), Turbo codes and LDPC codes (overview). Carrier synchronization, clock synchronization, frame synchronization, phase-locked loops, Costas loop, equalization techniques, adaptive equalizers.

Unit IV: Spread Spectrum, Multiple Access and Modern Digital Communication Systems

Spread spectrum communication, direct sequence spread spectrum (DSSS), frequency hopping spread spectrum (FHSS), processing gain, pseudo-random sequences, Code Division Multiple Access (CDMA). Multiple access techniques including FDMA, TDMA, CDMA and OFDMA. Introduction to Orthogonal Frequency Division Multiplexing (OFDM), Multiple Input Multiple Output (MIMO) systems, digital microwave communication, satellite communication, optical fiber communication, mobile communication systems, software-defined radio, Internet of Things (IoT) communication, overview of 4G, 5G and emerging 6G communication technologies.

Textbooks

1. John G. Proakis and Masoud Salehi, Digital Communications, 5th ed., McGraw-Hill Education, Latest Edition.
2. Simon Haykin, Digital Communications, 2nd ed., John Wiley & Sons, Latest Edition.
3. Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd ed., Pearson Education, Latest Edition.

References

1. Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, 2nd ed., Wiley.
2. Robert G. Gallager, Information Theory and Reliable Communication, Wiley.
3. B. P. Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, 5th ed., Oxford University Press.
4. Leon W. Couch II, Digital and Analog Communication Systems, Pearson Education.
5. Simon Haykin and Michael Moher, Modern Wireless Communications, Pearson Education.
6. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd ed., Pearson Education.

Paper Code(s): ICT-224P	**P : 2**
Paper: Digital Communications Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **3.** The course objectives and course outcomes are identical to that of ICT-222T as this is the practical component of thetheory paper. **4.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Third and Fourth Year Scheme of Examinations
For
1. COMPUTER SCIENCE AND ENGINEERING

Third Year Scheme of Examinations

Note: The minor specializations are offered through two routes:

a. Program Core Electives: Groups of 5 courses / papers are offered for specific minor specialization groups.
b. Emerging Area Elective: Groups of 5 courses / papers are offered for specific minor specialization groups. These specialization groups are offered by USICT as detailed in this document. Or, they may be offered by other schools of the University at the Dwarka campus of the University. These groups, if offered by other schools shall be called Open elective groups / minor specializations. The open elective groups must be offered as per the framework specified in this document.

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-301	Compiler Design	3	-	3
PC	ICT-303	Computer Networks	4	-	4
SEC	ICT-305	Software Engineering	3	-	3
PCE		#Program Core Elective - 1		-	4
EAE/OAE		#Emerging/Open Area Elective – 1		-	4
Practical/ Viva Voce					
PC	ICT-301P	Compiler Design Lab	-	2	1
PC	ICT-303P	Computer Networks Lab	-	2	1
SEC	ICT-305P	Software Engineering Lab	-	2	1
One paper/course from ICT-311/ICT-313					
AEC	ICT-311	*Summer Training (after 4th Semester) Report and Presentation	-	-	1
AEC	ICT-313	**Summer Project (after 4th Semester) Report and Presentation	-	-	1
Total				**6**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 4th semester. The student must submit the project proposal in the 4th semester, duly signed by the concerned project mentor to the class incharge of the 4th semester, before the end of classes of the 4th semester.

Students may choose from one group for a minor specialization (that is one group of papers for programme core elective (PCE) based minor specialization and the other for emerging area elective (OEA/EAE) based specializations. Such courses/papers(including subsequent semesters), if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits. Minor specialization is awarded only if all 20 credits are awarded / earned from the group of minor specialization specified.

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-302T	Java Programming	3	-	3
PCE		#Program Core Elective - 2	4	-	4
PCE		#Program Core Elective - 3	4	-	4
EAE/OAE		#Emerging/ Open Area Elective – 2	4	-	4
EAE/OAE		#Emerging/ Open Area Elective – 3	4	-	4
Practical/ Viva Voce					
PC	ICT-302P	Java Programming Lab	-	2	1
VAC	ICT-310	**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total				**2**	**22**

**NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs,out of 100 marks, 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.

#Such courses/papers, if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits.

Fourth Year Scheme of Examinations

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

a. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester. This route may lead to the award of two minor specializations.

b. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

c. **Research route:** The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation.

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Program Core Elective – 4 / MOOCs[1]	-	-	4
PCE		Program Core Elective – 5 / MOOCs[1]	-	-	4
EAE/OAE		Emerging/ Open Area Elective – 4 / MOOCs[1]	-	-	4
EAE/OAE		Emerging/ Open Area Elective – 5 / MOOCs[1]	-	-	4
Practical/ Viva Voce					
PC	ICT-405	***Minor Project – Report (Dissertation) and Viva Voce	-	-	4
PC	ICT-405	***Minor Project – Progress Evaluation	-	-	1
One paper/course from ICT-401/ICT-403					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-403	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**22**

***The student shall be allocated a supervisor / guide for project work at the endof 6thsemester 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. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th

semester, before the end of classes of the 6th semester.

[1] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed paper through MOOCs and shall be marked as such by the school for transfer of marks to examination division.

Note:

1. Minor Project – Report paper/course is a mandatory paper to be passed for the award of the degree.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PCE		MOOC[2]			4
PCE		MOOC[2]			4
PC / Internship	[1]ICT-405	Internship – I Report and Viva Voce#	-	-	7
	[1]ICT-407	Internship – I Progress Evaluation***	-	-	1
Practical/ Viva Voce					
PC	ICT 405	***Minor Project – 1 Report and Viva Voce	-	-	4
PC	ICT 405	***Minor Project – 1 Progress Evaluation	-	-	1
One paper/course from ICT-401/ICT-403					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-403	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**22**

Students are allowed to do internship in this semester, if following this route for the award of the degree. 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. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marks by a benchof the internal mentor and the external examiner deputed by examinations division(COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend

in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PCE		MOOC[2]			4
PCE		MOOC[2]			4
PC / Research	[1]ICT-409	Research Work Report – I and Viva Voce#	-	-	10
	[1]ICT-411	Research Work – I Progress Evaluation***	-	-	3
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-403					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-403	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**21**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours.The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

***NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks..

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC	[1]ICT-402	Major Project – Report (Dissertation) and Viva Voce	-	-	18
	[1]ICT-406	Major Project Progress Evaluation*	-	-	4
Internship Route					
PC	[1]ICT-408	Internship – II Report and Viva Voce	-	-	10
	[1]ICT-410	Internship Progress Evaluation*	-	-	1
	ICT 412[1]	Minor Project – II Report and Viva Voce			10
	ICT 414[1]	Minor Project – II Progress Evaluation*			1
Research Route					
PC / Research	[1]ICT-416	Thesis Evaluation and Viva Voce**	-	-	18
	[1]ICT-418	Research Work Progress Evaluation*	-	-	4
Total			**-**	**-**	**22**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

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

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in Computer Science and Engineering programme, offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

Electives are papers/courses that the student is allowed to choose from a specified list of papers. The electives shall be offered in two sections, namely:

1. The program core elective section
2. The emerging area elective section

Within each section of the electives, the student has to study a set/group of 5 papers. Some of the papers of the elective groups may be combined into minor specializations groups and shall be enumerated in this document. No minor specialization outside the list specified shall be allowed. A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keepinginview that twopapersstudied by thestudentshouldnothave a substantial overlap. Allpapersstudiedby the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Detailed Syllabus

The detailed syllabus of the courses / papers is present in the Appendix A.

D. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have to study two papers / courses, namely(first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor 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.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

E. Promotion to the Master of Technology part of the degree

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 Bachelor of Technology degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations of the Bachelor of Technology part of the dual degree programme and the applicable Ordinance.

F. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

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.

G. Members of APC

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.

H. Medium of Instructions

The medium of instructions and examinations shall be English.

I. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering**, offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

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.

3. 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 exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 176 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause8a, 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 for this purpose.
   (b) 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 school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.
   (c) 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student is fail in any of the paper offered to the student, at the time of verifying for award of the degree. That is the Honours degree shall be conferred only on students with full credits (176).

(j) No Honours shall be conferred if the student has taken any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Undergraduate Certificate in Computer Science and Engineering	Has earned at least 40 credits in the 1st year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the first year. The training has to be completed after the completion of the first year examinations. All mandatory papers of the first year have to be passed.*	Shall not be allowed to reappear in any failed paper of 1st year on re-joining% in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 80 credits upto and including the 2nd year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 80 credits earned upto and	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		including the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers upto and including the second year have to be passed.*	
3rd Year	Bachelor of Science in Computer Science and Engineering	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered.$	This is a three year degree (Interim Degree). Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

* The students desirous of taking the exit after 1st or 2nd year,shall apply to the school (University School of Information, Communication and Technology) before the completion of examinations of 1st semester or 3rd semester, respectively. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 2nd or the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The school shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above, applicable to lateral entry students and any degree that is, interim or final, shall only be awarded if the student has passed the bridge course(s)), and shall be as follows:

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 40 credits in the 2nd year from the subjects / courses / papers offered and provided they have undergone a minimum	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining%% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers of the first year have to be passed.**	
3rd Year	Bachelor of Science in Computer Science and Engineering	Has earned at least 80 credits upto and including the 3rd year from the subjects / courses / papers offered.$$	This is an Interim Degree. Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining%% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 120 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

** The students desirous of taking the exit after 2nd year (of the curriculum),shall apply to the school before the completion of examinations of 3rd semester. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The concerned institution shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 160 (for regular students) and 120 (for lateral entry students). The student has to acquire at least 160 credits for regular students (120 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit** for the award of the final degree is 176 (for regular students) and 132 (for lateral entry students). The student has to study and appear in examinations for at least 176 credits for regular students (132 for lateral entry students), other than the credits for Honours (if any).

8. The following degree route can be taken by a student:
   a. **Regular Route**
      i. ***Degree with two minor specializations:***
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student.
         3. Has earned 20 credits each from two minor specialization group (for a total of 40 credits).
         4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering with minor specializations in <First Minor Specialization Group Name> and <First Minor Specialization Group Name >**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Computer Science and Engineering (Honours)with minor specializations in <First Minor Specialization Group Name> and <Second Minor Specialization Group Name >**";

      ii. ***Degree with one minor specializations:***
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has earned 20 credits from one minor specialization group.
         3. Has cleared all mandatory papers to be passed, offered to the student..
         4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering with minor specialization in <Minor Specialization Group Name>**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Computer Science and Engineering (Honours)with minor specialization in < Minor Specialization Group Name>**";

      iii. **Degree with no minor specialization:**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Computer Science and Engineering (Honours)**";

   b. **Internship Route**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering with Internship**"

   c. **Research Route**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

10. This regulation has to be read together with the rest of this document.

Third and Fourth Year Scheme of Examinations
For

1. COMPUTER SCIENCE AND ENGINEERING – ARTIFICIAL INTELLIGENCE

Third Year Scheme of Examinations

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-301	Compiler Design	3	-	3
PC	ICT-303	Design and Analysis of Algorithms	3	-	3
SEC	ICT-305	Java Programming	3	-	3
PC	[1]ICT-307	Artificial Intelligence & Knowledge Based Systems	3	-	3
PC	[1]ICT-309	Fundamentals of Machine Learning & Neural Networks	3	-	3
Practical/ Viva Voce					
PC	ICT-323	Compiler Design Lab	-	2	1
PC	ICT-325	Design and Analysis of Algorithms Lab	-	2	1
SEC	ICT-327	Java Programming Lab	-	2	1
PC	[1]ICT-329	Artificial Intelligence & Knowledge Based Systems Lab	-	2	1
PC	[1]ICT-331	Fundamentals of Machine Learning & Neural Networks Lab	-	2	1
One paper/course from ICT-321/ICT-349					
AEC	ICT-321	*Summer Training (after 4th Semester) Report and Presentation	-	-	2
AEC	ICT-349	**Summer Project (after 4th Semester) Report and Presentation	-	-	2
Total			**15**	**6**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 4th semester. The student must submit the project proposal in the 4th semester, duly signed by the concerned project mentor to the class incharge of the 4th semester, before the end of classes of the 4th semester.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree.

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-302	Software Engineering	3	-	3
PC	ICT-304	Introduction to Data Analytics and Data Visualisation	3	-	3
PC	[1]ICT-306	Optimization Techniques for Machine Learning	3	-	3
PC	ICT-308	Deep Learning and Reinforcement Learning	3	-	3
PC	[1]ICT-310	Big Data Analytics and Distributed ML	3	-	3
Practical/ Viva Voce					
PC	ICT-324	Software Engineering Lab	-	2	1
PC	ICT-326	Optimization Techniques for Machine Learning Lab	-	2	1
PC	[1]ICT-328	Deep Learning Lab	-	2	1
PC	ICT-330	Search-based methods for Machine Learning Lab	-	2	1
PC	[1]ICT-332	Reinforcement Learning and Sequential Decision Making Lab	-	2	1
VAC	ICT-322	**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total				**2**	**22**

**NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 marks, 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.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree.

Fourth Year Scheme of Examinations

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

d. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester.

e. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

f. **Research route:** The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more. The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation.

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Papers					
PC	ICT-417T	Large Language Models and Generative AI	3	-	3
	ICT-417P	Large Language Models and Generative AI Lab	-	2	1
		OR			
		MOOCs[1]			4
PC	ICT-419T	Probabilistic Graphical Models and Bayesian Learning	3	-	3
	ICT-419P	Probabilistic Graphical Models and Bayesian Learning Lab	-	2	1
		OR			
		MOOCs[1]			4
PCE		Elective – 1 / MOOCs[1]	-	-	4
PCE		Elective – 2 /MOOCs[1]	-	-	4
Practical/ Viva Voce					
PC	ICT-403	*** Project 1 - Report	-	-	4
One paper/course from ICT-321/ICT-349					
AEC	ICT-421	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-423	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**22**

*** 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. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

[1] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed paper through MOOCs and shall be marked as such by the school for transfer of marks to examination division.

Note:

2. Minor Project – Report paper/course is a mandatory paper to be passed for the award of the degree.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Internship	PC 485[1]	Internship Report – I #	-	-	8
	PC 487[1]	Internship – I Viva Voce	-	-	4
	PC 489[1]	Internship – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
PC	PC 483	Minor Project[1]	-	-	8
AEC	ICT-421	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-423	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**26**

[1] Mandatory Paper, this paper must be passed by the student for award of the degree. The student shall be allocated a supervisor / guide for project work at the end of 6thsemester 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.

Students are allowed to do internship in this semester, if following this route for the award of the degree. 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. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

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

** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship

and may not be able to attend in the physical mode.
Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marksby a benchof the internal mentor and the external examiner deputed by examinations division(COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Research	PC 491[1]	Research Work Report – I #	-	-	14
	PC 493[1]	Research Work – I Viva Voce	-	-	4
	PC 495[1]	Research Work – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
AEC	ICT-421	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-423	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours.

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

*NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]ICT-402	Project 2 – Report	-	-	16
	[1]ICT-404	Major Project Viva Voce	-	-	4
	[1]ICT-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
Internship	PC 408[1]	Internship Report – II	-	-	6
	PC 410[1]	Internship Viva Voce	-	-	2
	PC 412[1]	Internship Progress Evaluation*	-	-	2
	PC 414[1]	Major Project – Report			8
	PC 416[1]	Major Project Viva Voce			2
	PC 418[1]	Major Project Progress Evaluation*			2
Research Route					
PC / Internship	[1]ICT-414	Thesis**	-	-	16
	[1]ICT-416	Internship Viva Voce	-	-	4
	[1]ICT-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**22**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

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

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering – Artificial Intelligence** programme offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.
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 (with separate paper code) studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Detailed Syllabus

The detailed syllabus of the courses / papers is present in the Appendix A.

D. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely (first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor 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.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

E. Promotion to the Master of Technology part of the degree

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 Bachelor of Technology degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations of the Bachelor of Technology part of the dual degree programme and the applicable Ordinance.

F. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

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.

G. Members of APC

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.

H. Medium of Instructions

The medium of instructions and examinations shall be English.

I. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in Computer Science and Engineering programme – Artificial Intelligence, offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

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.

3. 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 exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 176 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, 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 for this purpose.
   (b) 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 school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.
   (c) 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student is fail in any of the paper offered to the student, at the time of verifying for award of the degree. That is the Honours degree shall be conferred only on students with full credits (176).

(j) No Honours shall be conferred if the student has taken any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Undergraduate Certificate in Computer Science and Engineering	Has earned at least 40 credits in the 1st year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the first year. The training has to be completed after the completion of the first year examinations. All mandatory papers of the first year have to be passed.*	Shall not be allowed to reappear in any failed paper of 1st year on re-joining% in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 80 credits upto and including the 2nd year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 80 credits earned upto and	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		including the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers upto and including the second year have to be passed.*	
3rd Year	Bachelor of Science in Computer Science in Engineering – Artificial Intelligence	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered.$	This is a three year degree (Interim Degree). Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

* The students desirous of taking the exit after 1st or 2nd year, shall apply to the school (University School of Information, Communication and Technology) before the completion of examinations of 1st semester or 3rd semester, respectively. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 2nd or the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The school shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above , applicable to lateral entry students), and shall be as follows:

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 40 credits in the 2nd year from the subjects / courses / papers offered and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining%% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		weeks of training over and above the 40 credits earned in the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers of the first year have to be passed.**	
3rd Year	Bachelor of Science in Computer Science and Engineering – Artificial Intelligence	Has earned at least 80 credits upto and including the 3rd year from the subjects / courses / papers offered.$$	This is an Interim Degree. Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining%% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 120 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

** The students desirous of taking the exit after 2nd year (of the curriculum), shall apply to the school before the completion of examinations of 3rd semester. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.
Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.
Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The concerned institution shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.
Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.
$$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.
%%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 160 (for regular students) and 120 (for lateral entry students). The student has to acquire at least 160 credits for regular students (120 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit** for the award of the final degree is 176 (for regular students) and 132 (for lateral entry students). The student has to study and appear in examinations for at least 176 credits for regular students (132 for lateral entry students), other than the credits for Honours (if any).

8. The following degree route can be taken by a student:
   - **a. Regular Route**
     1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
     2. Has cleared all mandatory papers to be passed, offered to the students.
     3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Artificial Intelligence**"; if criteria / point 6 is not satisfied for Honours. Otherwise,

if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Computer Science and Engineering – Artificial Intelligence (Honours)**";

b. **Internship Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the students..
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Artificial Intelligence**"

c. **Research Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the students..
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Artificial Intelligence with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.
10. This regulation has to be read together with the rest of this document.

Third and Fourth Year Scheme of Examinations
For
1. COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE

Third Year Scheme of Examinations

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-301	Compiler Design	3	-	3
PC	ICT-303	Design and Analysis of Algorithms	3	-	3
PC	ICT-305	Java Programming	3	-	3
PC	[1]ICT-311	Statistics and Statistical Modelling	3	-	3
PC	[1]ICT-309	Introduction to Data Analytics and Data Visualisation	3	-	3
Practical/ Viva Voce					
PC	ICT-323	Compiler Design Lab	-	2	1
PC	ICT-325	Design and Analysis of Algorithms Lab	-	2	1
PC	ICT-327	Java Programming Lab	-	2	1
PC	[1]ICT-333	Statistics and Statistical Modelling Lab	-	2	1
PC	[1]ICT-331	Introduction to Data Analytics and Data Visualisation Lab	-	2	1
One paper/course from ICT-321/ICT-349					
AEC	ICT-321	*Summer Training (after 4th Semester) Report and Presentation	-	-	1
AEC	ICT-349	**Summer Project (after 4th Semester) Report and Presentation	-	-	1
Total			**15**	**6**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.
**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 4th semester. The student must submit the project proposal in the 4th semester, duly signed by the concerned project mentor to the class incharge of the 4th semester, before the end of classes of the 4th semester.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree.

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-302	Software Engineering	3	-	3
PC	ICT-304	Advanced Machine Learning	3	-	3
PC	[1]ICT-306	Data Warehousing and Business Intelligence	3	-	3
PC	[1]ICT-312	Big Data Analytics	3	-	3
PC	[1]ICT-314	Time Series Analysis and Forecasting	3	-	3
Practical/ Viva Voce					
PC	ICT-324	Software Engineering Lab	-	2	1
PC	ICT-326	Advanced Machine Learning Lab	-	2	1
PC	[1]ICT-328	Data Warehousing and Business Intelligence Lab	-	2	1
PC	[1]ICT-334	Big Data Analytics Lab	-	2	1
PC	[1]ICT-336	Time Series Analysis and Forecasting Lab	-	2	1
VAC	ICT-322	**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total				**2**	**22**

**NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 marks, 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.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree.

Fourth Year Scheme of Examinations

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

g. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester.

h. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

i. **Research route:** The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more. The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation.

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Papers					
PC	ICT-421T	Probabilistic Graphical Models and Bayesian Learning	3	-	3
	ICT-421P	Probabilistic Graphical Models and Bayesian Learning Lab	-	2	1
		OR			
		MOOCs[1]			4
PC	ICT-423T	Optimization Techniques for Data Science	3	-	3
	ICT-423P	Optimization Techniques for Data Science Lab	-	2	1
		OR			
		MOOCs[1]			4
EAE		Elective – 1 / MOOCs[1]	-	-	3
EAE		Elective – 2 / MOOCs[1]	-	-	4
Practical/ Viva Voce					
PC	ICT-403	***Minor Project - Report	-	-	4
One paper/course from ICT-321/ICT-349					
AEC	ICT-321	*Summer Training (after 6th Semester) Report and Presentation	-	-	1
AEC	ICT-349	**Summer Project (after 6th Semester) Report and Presentation	-	-	1
Total			**-**	**-**	**22**

*** 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. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

[1] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed paper through MOOCs and shall be marked as such by the school for transfer of marks to examination division.

Note:

3. Minor Project – Report paper/course is a mandatory paper to be passed for the award of the degree.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-405	Internship Report – I #	-	-	14
	[1]ICT-407	Internship – I Viva Voce	-	-	4
	[1]ICT-409	Internship – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do internship in this semester, if following this route for the award of the degree. 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. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

*** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marks by a bench of the internal mentor and the external examiner deputed by examinations division (COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend

in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-411	Research Work Report – I #	-	-	14
	[1]ICT-413	Research Work – I Viva Voce	-	-	4
	[1]ICT-415	Research Work – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours. The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.
**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

***NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks..

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]ICT-402	Major Project – Report	-	-	16
	[1]ICT-404	Major Project Viva Voce	-	-	4
	[1]ICT-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
PC / Internship	[1]ICT-408	Internship Report – II	-	-	16
	[1]ICT-410	Internship Viva Voce	-	-	4
	[1]ICT-412	Internship Progress Evaluation*	-	-	2
Research Route					
PC / Internship	[1]ICT-414	Thesis**	-	-	16
	[1]ICT-416	Internship Viva Voce	-	-	4
	[1]ICT-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**22**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

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

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering – Data Science** programme offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

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 (with separate paper code) studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Detailed Syllabus

The detailed syllabus of the courses / papers is present in the Appendix A.

D. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely (first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor 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.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

E. Promotion to the Master of Technology part of the degree

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 Bachelor of Technology degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations of the Bachelor of Technology part of the dual degree programme and the applicable Ordinance.

F. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

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.

G. Members of APC

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.

H. Medium of Instructions

The medium of instructions and examinations shall be English.

I. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in Computer Science and Engineering – Data Science, programme offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

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.

3. 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 exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 176 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, 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 for this purpose.
   (b) 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 school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.
   (c) 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student is fail in any of the paper offered to the student, at the time of verifying for award of the degree. That is the Honours degree shall be conferred only on students with full credits (176).

(j) No Honours shall be conferred if the student has taken any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Undergraduate Certificate in Computer Science and Engineering	Has earned at least 40 credits in the 1st year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the first year. The training has to be completed after the completion of the first year examinations. All mandatory papers of the first year have to be passed.*	Shall not be allowed to reappear in any failed paper of 1st year on re-joining% in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 80 credits upto and including the 2nd year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 80 credits earned upto and	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		including the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers upto and including the second year have to be passed.*	
3rd Year	Bachelor of Science in Computer Science in Engineering – Data Science	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered.$	This is a three year degree (Interim Degree). Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

* The students desirous of taking the exit after 1st or 2nd year, shall apply to the school (University School of Information, Communication and Technology) before the completion of examinations of 1st semester or 3rd semester, respectively. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 2nd or the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The school shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above , applicable to lateral entry students), and shall be as follows:

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Undergraduate Diploma in Computer Science and Engineering	Has earned at least 40 credits in the 2nd year from the subjects / courses / papers offered and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining%% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		weeks of training over and above the 40 credits earned in the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers of the first year have to be passed.**	
3rd Year	Bachelor of Science in Computer Science and Engineering – Data Science	Has earned at least 80 credits upto and including the 3rd year from the subjects / courses / papers offered.$$	This is an Interim Degree. Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining%% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 120 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

** The students desirous of taking the exit after 2nd year (of the curriculum), shall apply to the school before the completion of examinations of 3rd semester. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.
Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.
Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The concerned institution shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.
Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.
$$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.
%%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 160 (for regular students) and 120 (for lateral entry students). The student has to acquire at least 160 credits for regular students (120 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree
And, the **maximum credit** for the award of the final degree is 176 (for regular students) and 132 (for lateral entry students). The student has to study and appear in examinations for at least 176 credits for regular students (132 for lateral entry students), other than the credits for Honours (if any).

8. The following final degree route can be taken by a student:
   - **a. Regular Route**
     1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
     2. Has cleared all mandatory papers to be passed, offered to the students.
     3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Data Science**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall

be as: "**Bachelor of Technology in Computer Science and Engineering – Data Science (Honours)**";

b. **Internship Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the students..
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Data Science with Internship**"

c. **Research Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the students..
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Computer Science and Engineering – Data Science with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.
10. This regulation has to be read together with the rest of this document.

Third and Fourth Year Scheme of Examinations For

1. INFORMATION TECHNOLOGY

Third Year Scheme of Examinations

Note: The minor specializations are offered through two routes:

c. Program Core Electives: Groups of 5 courses / papers are offered for specific minor specialization groups.

d. Emerging Area Elective: Groups of 5 courses / papers are offered for specific minor specialization groups. These specialization groups are offered by USICT as detailed in this document. Or, they may be offered by other schools of the University at the Dwarka campus of the University. These groups, if offered by other schools shall be called Open elective groups / minor specializations. The open elective groups must be offered as per the framework specified in this document.

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-301	Compiler Design	3	-	3
PC	ICT-303	Design and Analysis of Algorithms	3	-	3
SEC	ICT-307	Computer Networks	3	-	3
PCE		#Program Core Elective – 1		-	4
EAE		#Emerging Area Elective – 1		-	4
Practical/ Viva Voce					
PC	ICT-323	Compiler Design Lab	-	2	1
PC	ICT-325	Design and Analysis of Algorithms Lab	-	2	1
SEC	ICT-329	Computer Networks Lab	-	2	1
One paper/course from ICT-321/ICT-349					
AEC	ICT-321	*Summer Training (after 4th Semester) Report and Presentation	-	-	2
AEC	ICT-349	**Summer Project (after 4th Semester) Report and Presentation	-	-	2
Total				**6**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 4th semester. The student must submit the project proposal in the 4th semester, duly signed by the concerned project mentor to the class incharge of the 4th semester, before the end of classes of the 4th semester.

Students may choose from one group for a minor specialization (that is one group of papers for programme core elective (PCE) based minor specialization and the other for emerging area elective (AEA) based specializations. Such courses/papers (including subsequent semesters), if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits. Minor specialization is awarded only if all 20 credits are awarded / earned from the group of minor specialization specified.

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-302	Software Engineering	3	-	3
PCE		#Program Core Elective - 2	4	-	4
PCE		#Program Core Elective - 3	4	-	4
EAE		#Emerging Area Elective – 2	4	-	4
EAE		#Emerging Area Elective – 3	4	-	4
Practical/ Viva Voce					
PC	ICT-324	Software Engineering Lab	-	2	1
VAC	ICT-322	**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total				**2**	**22**

**NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 marks, 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.

#Such courses/papers, if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits.

Fourth Year Scheme of Examinations

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

j. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester. This route may lead to the award of two minor specializations.

k. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

l. **Research route:** The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more. The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation.

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Program Core Elective – 4 / MOOCs[1]	-	-	4
PCE		Program Core Elective – 5 / MOOCs[1]	-	-	4
EAE		Emerging Area Elective – 4 / MOOCs[1]	-	-	4
EAE		Emerging Area Elective – 5 / MOOCs[1]	-	-	4
Practical/ Viva Voce					
PC	ICT-403	***Minor Project - Report	-	-	4
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

*** 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. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th

semester, before the end of classes of the 6th semester.

[1] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed paper through MOOCs and shall be marked as such by the school for transfer of marks to examination division.

Note:

4. Minor Project – Report paper/course is a mandatory paper to be passed for the award of the degree.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-405	Internship Report – I #	-	-	14
	[1]ICT-407	Internship – I Viva Voce	-	-	4
	[1]ICT-409	Internship – I Progress Evaluation***	-	-	2
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do internship in this semester, if following this route for the award of the degree. 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. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

*** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marks by a bench of the internal mentor and the external examiner deputed by examinations division (COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-411	Research Work Report – I #	-	-	14
	[1]ICT-413	Research Work – I Viva Voce	-	-	4
	[1]ICT-415	Research Work – I Progress Evaluation***	-	-	2
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours. The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.
**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

***NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks..

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]ICT-402	Major Project – Report	-	-	16
	[1]ICT-404	Major Project Viva Voce	-	-	4
	[1]ICT-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
PC / Internship	[1]ICT-408	Internship Report – II	-	-	16
	[1]ICT-410	Internship Viva Voce	-	-	4
	[1]ICT-412	Internship Progress Evaluation*	-	-	2
Research Route					
PC / Internship	[1]ICT-414	Thesis**	-	-	16
	[1]ICT-416	Internship Viva Voce	-	-	4
	[1]ICT-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**22**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

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

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in Information Technology programme, offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

Electives are papers/courses that the student is allowed to choose from a specified list of papers. The electives shall be offered in two sections, namely:

3. The program core elective section
4. The emerging area elective section

Within each section of the electives, the student has to study a set/group of 5 papers. Some of the papers of the elective groups may be combined into minor specializations groups and shall be enumerated in this document. No minor specialization outside the list specified shall be allowed. A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

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.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Detailed Syllabus

The detailed syllabus of the courses / papers is present in the Appendix A.

D. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely (first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor 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.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

E. Promotion to the Master of Technology part of the degree

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 Bachelor of Technology degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations of the Bachelor of Technology part of the dual degree programme and the applicable Ordinance.

F. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

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.

G. Members of APC

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.

H. Medium of Instructions

The medium of instructions and examinations shall be English.

I. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Information Technology**, offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

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.

3. 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 exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 176 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, 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 for this purpose.
   (b) 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 school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.
   (c) 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.

(d) 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.
(e) 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.
(f) 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.
(g) 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 8 also.
(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
(i) No Honours shall be conferred if the student is fail in any of the paper offered to the student, at the time of verifying for award of the degree. That is the Honours degree shall be conferred only on students with full credits (176).
(j) No Honours shall be conferred if the student has taken any of the interim degrees (as specified in the Table of the Clause 7.)
(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:
A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Undergraduate Certificate in Information Technology	Has earned at least 40 credits in the 1st year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the first year. The training has to be completed after the completion of the first year examinations. All mandatory papers of the first year have to be passed.*	Shall not be allowed to reappear in any failed paper of 1st year on re-joining% in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Undergraduate Diploma in Information Technology	Has earned at least 80 credits upto and including the 2nd year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 80 credits earned upto and including the second	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		year. The training has to be completed after the completion of the second year examinations. All mandatory papers upto and including the second year have to be passed.*	
3rd Year	Bachelor of Science in Information Technology	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered.$	This is a three year degree (Interim Degree). Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

* The students desirous of taking the exit after 1st or 2nd year, shall apply to the school (University School of Information, Communication and Technology) before the completion of examinations of 1st semester or 3rd semester, respectively. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 2nd or the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The school shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above, applicable to lateral entry students and any degree that is, interim or final, shall only be awarded if the student has passed the bridge course(s)), and shall be as follows:

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Undergraduate Diploma in Information Technology	Has earned at least 40 credits in the 2nd year from the subjects / courses / papers offered and provided they have undergone a minimum skill-enhancement	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining%% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers of the first year have to be passed.**	
3rd Year	Bachelor of Science in Information Technology	Has earned at least 80 credits upto and including the 3rd year from the subjects / courses / papers offered.$$	This is an Interim Degree. Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining%% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 120 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

** The students desirous of taking the exit after 2nd year (of the curriculum), shall apply to the school before the completion of examinations of 3rd semester. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The concerned institution shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 160 (for regular students) and 120 (for lateral entry students). The student has to acquire at least 160 credits for regular students (120 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit** for the award of the final degree is 176 (for regular students) and 132 (for lateral entry students). The student has to study and appear in examinations for at least 176 credits for regular students (132 for lateral entry students), other than the credits for Honours (if any).

8. The following final degree route can be taken by a student:
   a. Regular Route
      i. Degree with two minor specializations:
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student.
         3. Has earned 20 credits each from two minor specialization group (for a total of 40 credits).
         4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in** Information Technology **with minor specializations in <First Minor Specialization Group Name> and <First Minor Specialization Group Name >**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Information Technology (Honours) with minor specializations in <First Minor Specialization Group Name> and <Second Minor Specialization Group Name >**";

      ii. ***Degree with one minor specializations:***
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has earned 20 credits from one minor specialization group.
         3. Has cleared all mandatory papers to be passed, offered to the student..
         4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Information Technology with minor specialization in <Minor Specialization Group Name>**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Information Technology (Honours) with minor specialization in < Minor Specialization Group Name>**";

      iii. **Degree with no minor specialization:**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Information Technology**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Information Technology (Honours)**";

   b. **Internship Route**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Information Technology with Internship**"

   c. **Research Route**
         1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Information Technology with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

10. This regulation has to be read together with the rest of this document.

Third and Fourth Year Scheme of Examinations For

1. ELECTRONICS AND COMMUNICATIONS ENGINEERING

Third Year Scheme of Examinations

Note: The minor specializations are offered through two routes:

e. Program Core Electives: Groups of 5 courses / papers are offered for specific minor specialization groups.

f. Emerging Area Elective: Groups of 5 courses / papers are offered for specific minor specialization groups. These specialization groups are offered by USICT as detailed in this document. Or, they may be offered by other schools of the University at the Dwarka campus of the University. These groups, if offered by other schools shall be called Open elective groups / minor specializations. The open elective groups must be offered as per the framework specified in this document.

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-313	Digital Signal Processing	3	-	3
PC	ICT-315	Microprocessors and Interfacing	3	-	3
PC	ICT-307	Computer Networks	3	-	3
PCE		#Program Core Elective – 1		-	4
EAE		#Emerging Area Elective – 1		-	4
Practical/ Viva Voce					
PC	ICT-335	Digital Signal Processing Lab	-	2	1
PC	ICT-337	Microprocessorsand Interfacing Lab	-	2	1
SEC	ICT-329	Computer Networks	-	2	1
One paper/course from ICT-321/ICT-349					
AEC	ICT-321	*Summer Training (after 4th Semester) Report and Presentation	-	-	2
AEC	ICT-349	**Summer Project (after 4th Semester) Report and Presentation	-	-	2
Total				**6**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 4th semester. The student must submit the project proposal in the 4th semester, duly signed by the concerned project mentor to the class incharge of the 4th semester, before the end of classes of the 4th semester.

#Students may choose from one group for a minor specialization (that is one group of papers for programme core elective (PCE) based minor specialization and the other for emerging area elective (AEA) based specializations. Such courses/papers (including subsequent semesters), if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits. Minor specialization is awarded only if all 20 credits are awarded / earned from the group of minor specialization specified.

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT-316	Linear Integrated Circuits	3	-	3
PC	ICT-318	Control Systems	3	-	3
PCE		#Program Core Elective – 2	4	-	4
EAE		# Program Core Elective – 3	4	-	4
EAE		#Emerging Area Elective – 2	4	-	4
Practical/ Viva Voce					
PC	ICT-338	Linear Integrated Circuits Lab	-	2	1
PC	ICT-340	Control Systems Lab	-	2	1
VAC	ICT-322	**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total				**2**	**22**

**NUES : Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs,out of 100 marks, 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.

#Such courses/papers, if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits.

Fourth Year Scheme of Examinations

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

m. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester. This route may lead to the award of two minor specializations.

n. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

o. **Research route:** The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more. The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation.

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Program Core Elective – 4 / MOOCs[1]	-	-	4
PCE		Program Core Elective – 5 / MOOCs[1]	-	-	4
EAE		Emerging Area Elective – 3/ MOOCs[1]	-	-	4
EAE		Emerging Area Elective – 4/ MOOCs[1]	-	-	4
EAE		Emerging Area Elective – 5/ MOOCs[1]	-	-	4
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

[1] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed

paper through MOOCs and shall be marked as such by the school for transfer of marks to examination division.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-405	Internship Report – I #	-	-	14
	[1]ICT-407	Internship – I Viva Voce	-	-	4
	[1]ICT-409	Internship – I Progress Evaluation***	-	-	2
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do internship in this semester, if following this route for the award of the degree. 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. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.

**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

*** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marksby a benchof the internal mentor and the externalexaminer deputed by examinations division(COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]ICT-411	Research Work Report – I #	-	-	14
	[1]ICT-413	Research Work – I Viva Voce	-	-	4
	[1]ICT-415	Research Work – I Progress Evaluation***	-	-	2
Practical/ Viva Voce					
One paper/course from ICT-401/ICT-449					
AEC	ICT-401	*Summer Training (after 6th Semester) Report and Presentation	-	-	2
AEC	ICT-449	**Summer Project (after 6th Semester) Report and Presentation	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours.The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. Summer training shall be in an industrial organization (including Information Technology organization) with the approval of the Training and Placement officer of the School. It shall be of 4-6 week duration.
**NUES: Summer Project shall be under the supervision of a faculty of the University or any other academic organization with the approval of the class incharge of the 6th semester. The student must submit the project proposal in the 6th semester, duly signed by the concerned project mentor to the class incharge of the 6th semester, before the end of classes of the 6th semester.

***NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks..

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]ICT-402	Major Project – Report	-	-	16
	[1]ICT-404	Major Project Viva Voce	-	-	4
	[1]ICT-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
PC / Internship	[1]ICT-408	Internship Report – II	-	-	16
	[1]ICT-410	Internship Viva Voce	-	-	4
	[1]ICT-412	Internship Progress Evaluation*	-	-	2
Research Route					
PC / Research	[1]ICT-414	Thesis**	-	-	16
	[1]ICT-416	Internship Viva Voce	-	-	4
	[1]ICT-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**22**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

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

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to anyfaculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in Electronics and Communications Engineering programme, offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

Electives are papers/courses that the student is allowed to choose from a specified list of papers. The electives shall be offered in two sections, namely:

5. The program core elective section
6. The emerging area elective section

Within each section of the electives, the student has to study a set/group of 5 papers. Some of the papers of the elective groups may be combined into minor specializations groups and shall be enumerated in this document. No minor specialization outside the list specified shall be allowed. A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keepinginview that twopapersstudied by thestudentshouldnothave a substantial overlap. Allpapersstudiedby the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Detailed Syllabus

The detailed syllabus of the courses / papers is present in the Appendix A.

D. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely(first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor 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.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

E. Promotion to the Master of Technology part of the degree

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 Bachelor of Technology degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations of the Bachelor of Technology part of the dual degree programme and the applicable Ordinance.

F. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

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.

G. Members of APC

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.

H. Medium of Instructions

The medium of instructions and examinations shall be English.

I. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Electronics and Communications Engineering**, offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

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.

3. 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 exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 176 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, 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 for this purpose.
   (b) 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 school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.
   (c) 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student is fail in any of the paper offered to the student, at the time of verifying for award of the degree. That is the Honours degree shall be conferred only on students with full credits (176).

(j) No Honours shall be conferred if the student has taken any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Undergraduate Certificate in Electronics and Communications Engineering	Has earned at least 40 credits in the 1st year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the first year. The training has to be completed after the completion of the first year examinations. All mandatory papers of the first year have to be passed.*	Shall not be allowed to reappear in any failed paper of 1st year on re-joining% in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Undergraduate Diploma in Electronics and Communications Engineering	Has earned at least 80 credits upto and including the 2nd year and provided they have undergone a minimum skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 80 credits earned upto and	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		including the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers upto and including the second year have to be passed.*	
3rd Year	Bachelor of Science in Electronics and Communications Engineering	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered.$	This is a three year degree (Interim Degree). Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

* The students desirous of taking the exit after 1st or 2nd year,shall apply to the school (University School of Information, Communication and Technology) before the completion of examinations of 1st semester or 3rd semester, respectively. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 2nd or the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The school shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above, applicable to lateral entry studentsand any degree that is, interim or final, shall only be awarded if the student has passed the bridge course(s)), and shall be as follows:

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Undergraduate Diploma in Electronics and Communications Engineering	Has earned at least 40 credits in the 2nd year from the subjects / courses / papers offered and provided they have undergone a minimum	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining%% in the third year to complete the requirement for the award of the degree. (Interim Degree)

		skill-enhancement course(s) equivalent to at least 4 credits or 4 weeks of training over and above the 40 credits earned in the second year. The training has to be completed after the completion of the second year examinations. All mandatory papers of the first year have to be passed.**	
3rd Year	Bachelor of Science in Electronics and Communications Engineering	Has earned at least 80 credits upto and including the 3rd year from the subjects / courses / papers offered.$$	This is an Interim Degree. Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining%% in the fourth year to complete the requirement for the award of the final 4-year degree.
4th Year	See Clause 8	Has earned at least 120 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

** The students desirous of taking the exit after 2nd year (of the curriculum),shall apply to the school before the completion of examinations of 3rd semester. The students shall specify the specific skill based course(s) / training of at least 4 weeks, that they are desirous of completing for taking the exit route. All such cases shall be put before a sub-committee of the Academic Programme Committee (APC) of the programme of study by the Dean, USICT. The APC sub-committee meeting in this regard shall be chaired by the Dean of the School and three faculty deputed by the APC shall be the members. The student(s) may be asked to appear before this sub-committee. The sub-committee may change the course(s) or the training programme to be completed by the student, as proposed by the student. The sub-committee should ensure that the course(s) opted by the student are relevant skill based course(s) and shall not be (majorly) part of any course taught or to be taught as a part of the complete curricula of the programme of study. The student shall proceed to study the course(s) / training as approved by this committee. The list of such students shall be forwarded by the school before the commencement of the examinations of the 4th semester as applicable, to the Controller of Examinations of the University, together with the minutes of the sub-committee.

Also, if such a student, who is allowed to take the exit route, but does not desire to take it, and wants to continue of the subsequent year of study, such students shall be allowed. However, the course(s) / training, if completed, shall not be taken on record of examinations.

Also, all expenses related to these additional course(s) / training shall be borne by the concerned student. The student must submit the certificate of successful completion of such course(s) / training by 31st July of the academic session after which the exit is desired. The concerned institution shall submit the complete documentation for these cases to the Examinations Division of the University on or before 31st August of the same year.

Also, the credits awarded by the concerned authority from where the student pursues the course(s) / training for completing the requirements of the exit shall not be recorded by the examinations division of the University. Only the fact of successful completion of the course(s) / training shall be recorded by the Examinations Division of the University.

$$The student desirous of taking the interim degree (exit) after the 3rd year must apply to the concerned institution before the commencement of examinations of the 6th semester. The concerned institution must forward the list of all such cases to the Controller of Examinations of the University before beginning of classes of the 7th semester.

%%The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 160 (for regular students) and 120 (for lateral entry students). The student has to acquire at least 160 credits for regular students (120 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit**for the award of the final degree is 176 (for regular students) and 132 (for lateral entry students). The student has to study and appear in examinations for at least 176 credits for regular students (132 for lateral entry students), other than the credits for Honours (if any).

8. The following final degree route can be taken by a student:

a. Regular Route

i. ***Degree with two minor specializations:***
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the student.
   3. Has earned 20 credits each from two minor specialization group (for a total of 40 credits).
   4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Electronics and Communications Engineering(Honours) with minor specializations in <First Minor Specialization Group Name> and <First Minor Specialization Group Name >**"; if criteria / point 7 is not satisfied for Honours. Otherwise, if criteria / point 7 is met, then the degrees shall be an Honours degree and the nomenclature shall be as:"**Bachelor of Technology in Electronics and Communications Engineering(Honours) with minor specializations in <First Minor Specialization Group Name> and <First Minor Specialization Group Name >**";

ii. ***Degree with one minor specializations:***
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has earned 20 credits from one minor specialization group.
   3. Has cleared all mandatory papers to be passed, offered to the student.
   4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Electronics and Communications Engineering with minor specialization in <Minor Specialization Group Name>**"; if criteria / point 7 is not satisfied for Honours. Otherwise, if criteria / point 7 is met, then the degrees shall be an Honours degree and the nomenclature shall be as:"**Bachelor of Technology in Electronics and Communications Engineering(Honours) with minor specialization in < Minor Specialization Group Name>**";

iii. **Degree with no minor specialization:**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed, offered to the student.
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology (Electronics and Communications Engineering)**"; if criteria / point 7 is not satisfied for Honours. Otherwise, if criteria / point 7 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in Electronics and Communications Engineering (Honours)**";

b. **Internship Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed.
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Electronics and Communications Engineering with Internship**"

c. **Research Route**
   1. The student acquires at least 160 credits (as per the scheme of examinations for this route).
   2. Has cleared all mandatory papers to be passed.
   3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in Electronics and Communications Engineering with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.
10. This regulation has to be read together with the rest of this document.

Appendix A

Paper Code(s): BC-001	**L : 4**
Paper: Bridge Course in Mathematics	**C : 4**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 100 marks 2. This is NUES, non-credit and qualifying Paper. All evaluations to be conducted by the concerned teacher.	
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 DifferentiationIntegration: 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-002	L : 4
Paper: Bridge Course in Programming in C	C :4
Prerequisites: None	

Marking Scheme:

1. Teachers Continuous Evaluation: 100 marks
2. This is NUES, non-credit and qualifying Paper. All evaluations to be conducted by the concerned teacher.

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).