GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
Sector – 16C Dwarka, New Delhi – 110078
(Coordination Branch)

F.No. IPU/JR(C)/44th AC/2018/454 **Dated:04/07/2018**

Circular

The 44th meeting of the Academic Council of the University was held on 03/05/2018. Please find enclose herewith the proceedings of the 44th meeting of the Academic Council for kind information.

(Registrar)
coordination112@gmail.com

F.No. IPU/JR(C)/44th AC /2018/ **Dated:04/07/2018**

1) All Deans and Directors of Guru Gobind Singh Indraprastha University
2) Prof. Sanjiv Mittal, Professor, University School of Management Studies
3) Prof. U.K. Mandal, Professor, University School of Chemical Technology
4) Prof. Udayan Ghose, Professor, University School of Information Communication & Technology
5) Dr. Nimisha Sharma, Associate Professor University School of Biotechnology
6) Dr. Gulshan Kumar, Asst. Professor, University School of Basic and Applied Science.

Copy for kind information of the competent authority:
(i) AR to the Vice Chancellor GGSIP University
(ii) SO to the Pro-Vice Chancellor GGSIP University
(iii) AR to the Registrar GGSIP University

(Registrar)
coordination112@gmail.com

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

SECTOR – 16 C, DWARKA, NEW DELHI - 110078

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

FORTY FOURTH MEETING OF THE ACADEMIC COUNCIL

DATE : 03rd May, 2018 (Thursday)

TIME : 03.30 P.M. Onwards

VENUE: (Conference hall, Vice Chancellor's Secretariat)

PROCEEDINGS OF 44th ACADEMIC COUNCIL MEETING

INDEX OF PROCEEDINGS

10	AC44.10	To ratify (i)Syllabus of M.Tech. (Bio Chemical Engg.) for B.Tech./M.Tech.(Bio-Chemical Engineering/Dual Degree Programme (ii) minor modification of Chemical Engg. Courses, being taught at the University School of Biotechnology for B.Tech. (Biotechnology) students, implemented from the Academic Session 2017-2018.	11
11	AC44.11	To consider and approve the harmonization of evaluation structure of LLM (Regular) programme, offered by University School of Law and Legal Studies in accordance with existing norms of Ordinance -11 of the University.	11
12	AC44.12	To consider and approve the harmonization of the Paper Code and Paper ID of Subjects being taught in LLM programme of One year duration offered by University School of Law and Legal Studies.	11
13	AC44.13	To consider and approve the Syllabus, Curriculum, Evaluation Scheme, CET Syllabus and Eligibility Criteria for, Post Basic B.Sc. Nursing Programme to be implemented from the Academic Session 2018-2019.	12
14	AC44.14	To ratify the change in Curriculum of M.Phil. Clinical Psychology programme, implemented from the Academic Session 2017-2018.	12
15	AC44.15	To ratify the minor modification of Ph.D. Course work, offered by University School of Biotechnology, implemented from the Academic Session 2017-2018.	13
16	AC44.16	To ratify the Scheme of Examination and syllabi of Ph.D. Course work, offered by University School of Basic and Applied Sciences, implemented from the Academic Session 2017-2018.	13
17	AC44.17	To ratify the Ph.D. course work, offered by University School of Environment Management, implemented from the Academic Session 2017-2018.	13
18	AC44.18	To consider and approve the recommendations with respect to the grievance of B.Tech. programme students for mandatory papers.	14
19	AC44.19	To ratify the Admission Brochure of the University for the Academic Session 2018-19, Part-A containing details of various Programmes being offered, CET form filling Procedure, CET (s) to be conducted, eligibility conditions, syllabus of CET (s), Counselling Procedures etc., Part-B containing various Appendices, Part-C Counselling Schedule Summary and Part-D Refund Policy .	14

20	AC44.20	To consider and approve the Course outline and Scheme of Examination and detailed Course content of the three year Bachelor of Arts (Honours) English Programme to be implemented from the Academic Session 2018-2019 in various affiliated institutions of the University.	14-15
21	AC44.21	To consider and approve the adoption of the University Grants Commission (Minimum Qualifications for Appointment of Teachers and other Academic Staff in the Universities and colleges and measures for the Maintenance of Standards in Higher Education)(4th Amendment),Regulations,2016 ,notified vide the University Grants Commission notification no.F1-/2016 (PS/Amendment), New Delhi, dated 11th July,2016.	15
22	AC44.22	To consider and approve the Ph.D. Course work offered at University School Information Communication & Technology from the Academic Session 2018-2019 onwards.	15
23	AC44.23	To ratify the Ph.D. Course work offered at University School Information Communication & Technology from the Academic Session 2017-2018 onwards.	15
24	AC44.24	To consider and approve number of credits for the award of B.Voc Printing Technology.	16
25	AC44.25	To consider and approve the change in subject codes of the subjects named as (a) Data Communication and Networks (6th Semester Instrumental and Control Engg) from ETEC 310 - ETIC -312 applicable for batch 2015-2016 onwards for B.Tech. in Affiliated Institutions.	16
26	AC44.26	To consider and approve the suggestions regarding issue of Diploma, Advance Diploma and B. Voc as deliberated by the committee under the chairmanship of Controller of Examinations (O).	16
27	AC44.27	To consider and approve (i) Introduction of two new electives on basic and advanced entrepreneurship as a part of the M.Tech.(Biotechnology) Scheme and curriculum 2016, to be implemented from the Academic Session 2018-2019. (ii) The minor corrections in the course codes as incorporated in the B.Tech.(Biotechnology) Curriculum (2016 scheme) in the subjects taught by the University School of Basic & Applied Sciences as per the original course codes approved by the Board of School of Studies of USBAS.(The remaining scheme and course contents shall remain the same).	17

28	AC44.28	**To consider and approve the revised Course Content, (Syllabus) of MBA (Disaster Management) Weekend Programme, offered by Centre for Disaster Management Studies, to be implemented from Academic Session 2018-2019 onwards.**	17
29	AC44.29	**To co-opt maximum 10 expert members for their special knowledge as per the provisions of Statute 11 Sub-Section (viii) of Section (1) of the Guru Gobind Singh Indraprastha University Act to be members of the Academic Council.**	18
30	AC44.30	**To consider and approve the regulations under Ordinance 12 for programmes leading to the Degree of Doctor of Philosophy (Ph.D.)**	18

Agenda Item No. AC44.15:To ratify the minor modification of Ph.D. Course work, offered by University School of Biotechnology, implemented from the Academic Session 2017-2018.

The Academic Council noted that in accordance to the revised Ph.D Ordinance12 (2017) in the University, the Ph.D course work is made at par with the overall curriculum framework of the University (lecture+ tutorials). The overall credits increased from 3 to 4. This is the minor modification as the rest of scheme and the course titles and contents for the Ph.D course work essentially remain same.

The Academic Council ratified the minor modification of Ph.D. course work, offered by University School of Biotechnology, implemented from the Academic Session 2017-2018.

The ratified minor modification of Ph.D. course work is annexed as Annexure–XII,page(XII-01 to XII-06).

Agenda Item No. AC44.16:To ratify the Scheme of Examination and Syllabi of Ph.D. Course work, offered by University School of Basic and Applied Sciences, implemented from the Academic Session 2017-2018.

The Academic Council noted that in accordance to the revised Ph.D Ordinance12 (2017) in the University, the Ph.D course work is made at par with the overall curriculum framework of the University (lecture+ tutorials). The overall credits increased from 3 to 4. This is the minor modification as the rest of scheme and the course titles and contents for the Ph.D course work essentially remain same.

The Academic Council ratified the Scheme of Examination and Syllabi of Ph.D. Course work, offered the University School of Basic and Applied Sciences, implemented from the Academic Session 2017-2018.

The ratified Scheme of Examination and Syllabi of Ph.D. Course work is annexed as Annexure –XIII ,page (XIII-01).

Agenda Item No. AC44.17: To ratify the Ph.D. course work, offered by University School of Environment Management, implemented from the Academic Session 2017-2018.

The Academic Council noted that in accordance to the revised Ph.D Ordinance12 (2017) in the University, the Ph.D course work is made at par with the overall curriculum framework of the University (lecture+ tutorials). The overall credits increased from 3 to 4. This is the minor modification as the rest of scheme and the course titles and contents for the Ph.D course work essentially remain same.

The Academic Council ratified the Ph.D. Course work offered by the University School of Environment Management, implemented from the Academic Session 2017-2018.

The ratified the Ph.D. Course work is annexed as Annexure –XIV,page (XIV-01).

University School of Basic &Applied Sciences

Guru Gobind Singh Indraprastha University

Scheme and Syllabus for PhD Programmes

In

Mathematics

Scheme and Syllabi

2017-onwards

Entrepreneurship | Employability | Skill Development

Approved in the 44th meeting of the Academic Council held on 03-05-2018 vide agenda item 44.16
w.e.f. 2017

PROGRAMME OUTCOMES

(Ph.D. in MATHEMATICS PROGRAMMES)

PO1KNOWLEDGE, CRITICAL AND CREATIVE THINKING: The student will develop the skills for acquiring the right knowledge, skills and critical and creative ways of approaching and carrying out research

PO2 UNDERSTANDING, GATHERING AND REVIEWING INFORMATION AND DATA: The student will develop a thorough knowledge of literature review and a comprehensive understanding of methods and techniques applicable to their own research.

PO3 THE ABILITY TO CARRY OUT ORIGINAL AND INDEPENDENT RESEARCH: The student will learn to apply advanced and specialized skills and be able to act independently in the planning and implementation of research.

PO4COMMUNICATION AND LEADERSHIP SKILLS: Students participate in seminars, research group meetings, competitions, conference talks, poster presentations, and teaching, and learn to communicate effectively. They also learn leadership through communication and working effectively with others and professional conduct that are needed for the effective management of research.

PROGRAMME SPECIFIC OUTCOMES

The Ph.D. Programmes in Physics, Chemistry and Mathematics deal with areas of research that are specializations of the Faculty of the school which could be experimental or theoretical.

MATHEMATICS

PSO1: Learning to present the problem in the context of the particular research area in mathematics and the work done globally. Detailing the aspects of the system, the models, the experimental/theoretical approach and methodology. Having clarity on all basic concepts.

PSO2: Developing problem solving a techniques in mathematics, numerical and computational techniques, statistical analysis, visualization etc in the particular area of mathematics research

PSO3: Learning to interpret and communicate results effectively. Learning to write a manuscript clearly and professionally and being familiar with all aspects of publishing

MAPPING BETWEEN PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES			
PO/PSO	**PSO1**	**PSO2**	**PSO3**
PO1	**5**	**7**	**5**
PO2	**6**	**8**	**9**
PO3	**4**	**5**	**9**
PO4	**3**	**7**	**8**

SCHEME AND SYLLABUS
for
DOCTOR IN PHILOSOPHY
In Mathematics

S. No.	Code	Paper	L	P	Credits
1.	CWM – 101	Research Methodology for Science & Technology	4	0	4
2.	CWM – 102	Research and Publication Ethics	2	0	NUES
Elective (Choose atleast One)					
3.	CWM – 103	Introduction to MATLAB and Computational Methods	2	0	2
4.	CWM – 104	MATLAB and Computational Method Lab	0	2	2
5.	CWM – 105	Wavelet Analysis	4	0	4
6.	CWM – 106	Stochastic Processes, Queuing Theory & Reliability	4	0	4
7.	CWM – 107	Space Dynamics			
8.	CWM – 108	Nonlinear Dynamics	4	0	4
9.	CWM – 109	Mathematical Modelling and Ecology	4	0	4
10.	CWM – 110	An Introduction to Fuzzy Mathematical Programming	4	0	4
11.	CWM – 111	An Introduction to Financial Mathematics	4	0	4
12.	CWM – 112	Differentiable Manifolds	4	0	4
13.	CWM – 113	Lie groups and Homogeneous spaces	4	0	4

Paper Code: CWM - 101	Paper: RESEARCH METHODOLOGY FOR SCIENCE & TECHNOLOGY	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:

1:	To expose the scholars for some details associated with the theoretical and experimental research in the different branches of sciences and the technologies involved.
2:	Learn methods to devise and design a research set-up
3:	Planning their research career
4:	Conclude research in report writing and meaningful interpretation

Course Outcomes (CO):

CO1:	Students will learn basic concepts of research and importance.
CO2:	Collect data through experiments or survey as per research requirement.
CO3:	Develop understanding on various kinds of research, objectives of doing research, research process
CO4:	Write research report, research proposal with proper citations.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	2	3	2	1
CO3	3	2	3	3
CO4	3	3	2	3

UNIT-I

Basic concepts in Scientific approach to research: Definition, motivation & significance of research, types of research, research process and steps in conducting research; Planning researchProblem identification and formulation; Research design; Application of Research scenario in India.

UNIT-II

Literature survey and Report writing: Review of the publisher research in the relevant field; Re-viewing literature; Report Preparation, Structure of Report, Report Writing Skills, Citations, Research Papers,; formulation of research projects proposal; Types of reports, bibliography.

UNIT-III

Research Ethics & Plagiarism: Values, standards & practices; scientific misconduct; human participants & animal subjects, authorship allocation of credit, competing interests, commitments & values. Definition, types of plagiarism, unintentional plagiarism, mechanisms for avoiding plagiarism.

UNIT-IV

Invention, Innovation, IPR: Understanding of invention & innovation and its role in economic development; patents & copyrights, importance &basic knowledge of Intellectual Property Right (IPR); what can and cannot be protected.

Note: *In the backdrop of the above, the assignments may be in the context of the chosen research field of the scholar, and may be designed to facilitate in identity the topic and in the process of Synopsis preparation for their respective proposed research. The work out format for the assignments must be intensively participatory; may be conducted by way of presentations and participative discussions in cl*

SUGGESTED REFERENCES

1. Research Methodology Methods and Techniquest - C.R. Kothari, New Age Intl. Pub. (2004)
2. Business Statistics for contemporary decision making- Ken Black, John Wiley and Sons, Inc. 2010.
3. Research Methodology (Concept and Cases)-Deepak Chawla &NeenaSodhi, Vikas Publication House (P) Ltd. (2011)
4. Research Methodology- DebashisChokarvaty, Surbhi (P) Ltd. (2010)
5. Research Methodology-Navin Sharma, Deep & Deep (P) Ltd. (2007)
6. Research Methodology -Ranjit Kumar, Delhi Pearson Education (2006)
7. "The Role of Invention, Innovation and The Industrial Property System in Economic Development", www.wipo.int/cdocs/mdocs/innovation/en/.../wipo_inn_cai_97_1.doc
8. MLA Handbook for Writers of Research Papes- Joseph Gibaldi, New Delhi, Affiliated East West Press (1999 15th edition).

Paper Code: CWM - 102	Paper: Research Values and Ethics	L	T/P	C
Paper ID:		**2**		**NUES**

Marking Scheme:

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

Course Objectives:	
1:	To develop a universal approach towards human values
2:	To be able to strike a balance between aspirations and happiness
3:	To understand that humans are a part of nature and how being close to nature bring in joy and satisfaction
4:	Select classical short stories from Indian context will expose the students to diverse and multifaceted subsections in Indian society

Course Outcomes (CO):	
CO1:	The students will get sensitized about the role of value education and learn to balance ambition & happiness
CO2:	The students will be able to understand the importance of living in harmony with nature
CO3:	The students will be able to see the relevance of Professional behavior and ethics
CO4:	They will draw inspiration from the classical Indian literature narrated to them in the form of select short stories

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

CO/PO	PO1	PO2	PO3	PO4
CO1	3	1	3	3
CO2	3	2	2	2
CO3	2	3	2	3
CO4	2	3	3	2

Unit I

The Problem and Paradox of Happiness: Twin goals: happiness and just order; role of value education. Concept of good life-quality of life and subjective well-being; happiness, life satisfaction and positive affect; studying quality of life through surveys; and findings of quality of life surveys. Moral and Institutional approaches; and the inherent conflict between the two. Man and Society

Unit II

Happiness and Nature: Biophilia hypothesis- connections with nature and co-existence with other forms of life, Deep Ecology, Importance of meaningful contact with the natural world, solutions for a healthier, greener tomorrow, Indigenous and traditional knowledge system and its intellectual roots.

Unit III

Basics of Professional Ethics, Ethical Human Conduct:Human Conduct- based on acceptance of basics Human Values, Humanistic Constitution and Universal Human Order-skills, sincerity and fidelity. To identify the scope and characteristics of people-friendly and eco-friendly production systems..

Unit IV
Encompassing Different Stories/ narratives on Human Values from Indian Context.

Suggested Readings and References

1. Gaur, R.R., Sangal, S.andBagaria, G., "A Foundation Course in Human Values and Professional Ethics", New Delhi: Excel Books, 2010.
2. Mike, W. Martin, "Paradoxes of Happiness", Journal of Happiness Studies, 2008, pp. 171-184.
3. Giddens, Anthony, "Sociology", 5th edition, Cambridge: Polity Press, 2006.
4. Ambedkar, B.R., Buddha and his dhamma, http://www.scrubd.com/doc/16634512/Buddha-and-His-Dhamma-by-B-R-Ambedkar-Full [accessed on 21 October, 2010]
5. Beteille Andre, "Antinomies of Society: Essays on Ideologies & Institutions", New Delhi: Oxford University Press, 2000.
6. FikretBerkes, "Sacred Ecology", Second Edition Routledge Taylor & Francis Group, 2008.
7. Richard Louv, "Last Child in the Woods", Algonquin Books, 2008.
8. Ramakrishnan, E.V., "Indian Short Stories": (18700-200). SahityaAkademi, 2012.
9. Davidar, David., "Cluch of Indian Masterpieces", Aleph Book Company, 2016.

"Contemporary Indian Short Stories", SahityaAkademi, 2014.

Paper Code: CWM - 103	Paper: Introduction to MATLAB and Computational Methods	L	T/P	C
Paper ID:		2	-	2

Marking Scheme:

- Teachers Continuous Evaluation: 25 marks
- Term end Theory Examinations: 75 marks

Course Objectives:

1:	Introduce the students from diverse backgrounds to the importance of computational techniques and to expand their mathematical skills in areas of numerical methods.
2:	Introduce and train students in computational methods with MATLAB as the programming language
3:	Expose students to introductory topics and the basics of numerical techniques and programming. Problems are selected from a list which is updated from time to time in tune with the needs of industry/research and topical subjects.
4:	Educate students to learn the logic behind solving problems related to real physical examples, simulation, modelling and designing the algorithms and translating them into programmes

Course Outcomes (CO):

CO1:	The students are expected to develop the flavour of modelling and simulation.
CO2:	To generate working knowledge of MATLAB.
CO3:	To gain working knowledge of Monte Carlo methods, Time series analysis method for application to real life problems.
CO4:	To solve some famous and advanced Mathematics problems using simulation.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	3	3	2	2
CO2	3	2	3	2
CO3	2	3	3	3
CO4	2	3	3	3

UNIT-I

Introduction to the MATLAB programming language: Operations in MATLAB: basic mathematical operations with matrices, arrays, etc. Plotting with MATLAB: line plots, 1-D, 2-D, 3-D, meshgrid, labelling axes, legends, importing and plotting data files in MATLAB; Root finding and curve fitting.

UNIT-II

Numerical methods for solving ordinary differential equations: The Euler method, Programming in MATLAB to solve 1st order and 2nd order ODEs by Euler method, Solving ODEs using inbuilt MATLAB solvers

UNIT-III

Numerical methods for Integration: Rectangular, Trapezoidal, Simpson methods
Using direct MATLAB solvers for integration, Introduction to Monte Carlo methods: random numbers, Monte Carlo Integration. Some examples from linear algebra and matrices; Fractals, polynomial fit and exponential fit.

UNIT-IV
Time Series Analysis Methods: Stationary processes, Lag plots, Auto correlation function, Power spectral density.

References
1. Rudra Pratap, Getting started with MATLAB [Oxford University Press] 2. Chapman, Essentials of MATLAB Programming 3. Balagurusamy, Numerical Methods [Tata McGraw Hill] 4. Tao Pang, An introduction to Computational Physics [Cambridge University Press] 5. Andi Klein and Alexander Godunov, Introductory Computational Physics [Cambridge University Press] 6. Ward Cheney and David Kincaid, Numerical Methods and Computing 7. AlfioQuarteroni and FaustoSaleri, Scientific Computing with MATLAB and Octave 8. S. R. Otto and J. P. Denier, An Introduction to Programming and Numerical Methods in MATLAB

Paper Code: CWM - 104	Paper: MATLAB and Computational Methods Lab	L	T/P	C
Paper ID:		**0**	**2**	**2**

Marking Scheme:

- Teachers Continuous Evaluation: 25 marks
- Term end Theory Examinations: 75 marks

Course Objectives:

1:	Introduce the students from diverse backgrounds to the importance of computational techniques and to expand their mathematical skills in areas of numerical methods. Introduce the concepts and theory of various simple problems and algorithms that can be subsequently applied to programming in MATLAB to solve then in the Lab.
2:	Introduce and hands on training of students in computational methods with MATLAB as the programming language
3:	Problems are selected from a list which is updated from time to time in tune with the needs of industry/research and topical subjects.
4:	Educate students to learn the logic behind solving problems related to real physical examples, simulation, modelling and designing the algorithms and translating them into programmes

Course Outcomes (CO):

CO1:	Studentswill have a workingunderstanding of the mathematicalskillsneeded for programming.
CO2:	Theywillgenerateworkingknowledge of MATLAB.
CO3:	Theywillbe able to solvesomefamous and advancedMathematicsproblemsusing simulation which are otherwisedifficult to solveanalytically.
CO4:	The students are expected to develop the flavour of modelling and simulation.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	3	3	3	2
CO2	2	3	3	1
CO3	3	2	2	3
CO4	3	1	2	3

UNIT-I

Plotting

(a) Eigenvalues & Eigenfunctions for Particle in a Box – 1D & 2D;
(b) Hydrogen atom wave functions

UNIT-II

ODE's – exmples-

(a) Simple, damped and driven Harmonic Oscillator;
(b) Van der Pol Oscillator;
(c) Radioactive Decay;
(d) LCR Circuit;
(e) Schrodinger equation in 1D;
(f) Coupled ODEs – The Lorenz Equations;
(g) Calculation of Eigen functions (π molecular orbitals using HMO theory);
(h) Kinetics of oscillatory reactions.;

UNIT-III

Monte Carlo mthods

(a) Simulate coin toss, die roll etc. using MATLAB's inbuilt commands; (b) Estimating the value of "pi" using random numbers on a circle & sphere; (c) Monte Carlo Integration
UNIT-IV
Time Series Analysis Methods: Stationary Processes, Lag Plots, AutoCo-relation Function, Power Spectral Density

This list may be updates/modified to included related application from time to time

Assignments may be designed relevant to the broad area of research of the research scholar.

References

1. Rudra Pratap: Getting started with MATLAB [Oxford University Press]
2. Chapman: Essentials of MATLAB Programming
3. Tao Pang: An introduction to Computational Physics [Cambridge University Press]
4. Andi Klein and Alexander Godunov: Introductory Computational Physics [Cambridge University Press]
5. Ward Cheney and David Kincaid: Numerical Methods and Computing
6. AlfioQuarteroni and FaustoSaleri: Scientific Computing with MATLAB and Octave
7. S.R. Otto and J.P Denier An Introduction to Programming and Numerical Methods in MATLAB.

Paper Code: CWM - 105	Paper: Wavelet Analysis	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:	
1:	This course will provide an introduction to the theory of wavelets.
2:	This course will develop skills to extract information, analyze and interpret the data
3:	To establish the theory necessary to understand and use wavelets and related transformations.
4:	Explain the properties and application of wavelet transform.

Course Outcomes (CO):	
CO1:	Students will be able to classify various wavelet transforms and will get the systematic importance of it.
CO2:	The students will be able to describe Continuous Wavelet Transform (CWT) and Discrete Wavelet Transform (DWT).
CO3:	The students will be able to develop and realize computationally efficient wavelet based algorithms.
CO4:	The student will have a knowledge of brief features and strength of transform.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	2	3	2	3
CO2	3	2	3	1
CO3	1	1	3	3
CO4	2	3	3	2

Unit-I

Fourier and Inverse Fourier Transforms, Continuous-Time Convolution and the Delta Function, Fourier Transform of Square Integrable Functions. Fourier Series. Basic Convergence Theory and Poisson's Summation Formula.

Unit-II

The Gabor Transform. Basic Properties of Gabor Transforms. The Integral Wavelet Transforms, Dyadic Wavelets and Inversions.

Unit-III

Basic Properties of Wavelet Transforms. The Discrete Wavelet Transforms. Orthonormal Wavelets, Wavelet frames & Multiband, Curvelets. Definition of Multiresolution Analysis and Examples.

Unit-IV

Properties Scaling Functions and Orthonormal Wavelet Bases. Construction of Orthonormal Wavelets. Daubechies' Wavelets and Algorithms.

The selection of programming languages and solving tools for applications will be done accordingly.

References:

1.The Fourier Transform & Its Applications, Ronald Bracewell, 2000, Mc Graw Hill
2.An Introduction to Wavelet, Charles Chui, 1992, Academic Press
3.Wavelets made easy, Yves Nievergelt, 1999, Springer-Verlag
4.Essential Wavelets for Statistical Applications & Data Analysis, Todd Ogden, 1996, Birkhaus Boston

Paper Code: CWM – 106	Paper: Stochastic Processes, Queuing Theory & Reliability	L	T/P	C
Paper ID:		**4**	**-**	**4**

Marking Scheme:

- Teachers Continuous Evaluation: 25 marks
- Term end Theory Examinations: 75marks

Course Objectives:	
1:	To develop the mathematical skill of using various mathematical methods
2:	To give introduction about Random walk.
3:	To give introduction about Poisson process.
4:	To introduce the basic idea of Queuing theory

Course Outcomes (CO):	
CO1:	Students will learn generalized queuing models.
CO2:	Students will learn about Markov process.
CO3:	Students will be familiar to discrete time queuesy.
CO4:	Students will learn Reliability theory.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	2	**2**	3	**2**
CO2	1	3	2	**2**
CO3	**3**	3	3	**2**
CO4	**3**	**2**	3	**2**

Unit I:

Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, stationary distribution, branching processes, Random walk, Gambler's ruin. Markov processes in continuous time, Poisson processes, birth and death processes, Wiener process.

Unit II

General Concept, Generalized Queuing model, M/M/1, M/M/1/N and M/M/s Queue, Bulk Queue, Network of Monrovian Queueing System, Non Markovian Queueing Models, M/G/1, GI/M/1 Queue.

Unit III:

General concept of discrete time queues, Applications of Queuing theory. Introduction to Reliability Theory, System Reliability, Repairable and Non Repairable Systems.

Unit IV:

Markov Modeling in Reliability, Life testing using the exponential and Weibull models, Shock Models and Wear Process, Concept of Redundancy.

The selection of programming languages and solving tools for applications will be done accordingly.

SuggestedReadings and References

1. Stochastic Processes by Sheldon M. Ross, Wiley India Pvt. Ltd., 1995
2. Essentials of Stochastic Processes by Rick Durrett, Springer, 1999
3. Mathematical Methods in Queuing Theory by Kalashnikov, Kluwer Academic Publisher, 2010
4. Reliability Theory and Practice by Igor Bazovsky, Dover Publication, 2004

Paper Code: CWM - 107	Paper: Space Dynamics	L	T/P	C
Paper ID:		**4**	**-**	**4**

Marking Scheme:

- Teachers Continuous Evaluation: 25 marks
- Term end Theory Examinations: 75marks

Course Objectives:

1:	To develop the mathematical skill of using various mathematical methods
2:	To give introduction about different co-ordinate systems.
3:	To give introduction about relativity theory.
4:	To introduce the change of co-ordinate system.

Course Outcomes (CO):

CO1:	Students will learn Kepler's law.
CO2:	Students will learn about angular momentum.
CO3:	Students will be familiar to compute surfaces of zero relative velocity.
CO4:	Students will learn to compute parabolic and hyperbolic orbits.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**1**	**2**
CO2	**3**	**2**	**1**	**2**
CO3	**3**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**2**

Unit I:

Formulation of the Two Body Problem. Integrals of area, angular momentum and energy. Equation of the relative orbit and its solution. Kepler's equation and its solution.

Unit II

Heliocentric and Geocentric Co-ordinates, Parabolic and Hyperbolic orbits, Melnikov's Integral, Orbit computation by Laplace and Gauss methods. Lagrange's solution for the motion of three bodies.

Unit III:

Restricted three body problem. Surfaces of zero relative velocity. Double points. Stability of straight line and equilateral triangle solutions. The ten integrals of motion of the n-body problem.

Unit IV:

Transfer of origin to one of the particles. The perturbing function. Virial theorem. Numerical integration by Cowell's and Encke's methods.

The selection of programming languages and solving tools for applications will be done accordingly.

SuggestedReadings and References

1. Theory of Orbits by V. Szebhely, Academic Press, 1967
2. Theory of Orbits by Boccaletti, Dina etc., Springer, 2004
3. Theory of Orbit Determination by Andrea Milani, Cambridge University Press, 2009.
4. Theory of satellite orbits in an atmosphere by Desmond King-Hele, Butterworths edition, in English, 1987

Paper Code: CWM - 108	Paper: Nonlinear Dynamics	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:

1:	To understand the nonlinear dynamic systems, from periodic to chaotic systems
2:	To understand the basic concepts of fractal geometry and fractals.
3:	To introduce phase space and dynamical system .
4:	oduce mathematical modeling of dynamical system.

Course Outcomes (CO):

CO1:	The students are able to acquire enough knowledge of discrete and continuous dynamical system.
CO2:	This course will enhance the geometrical, computational and analytical thinking.
CO3:	The students will be able to understand the basic classes of nonlinear systems and will be able to analyse them using analytic and diagrammatic methods.
CO4:	The student will have an understanding of how and why a dynamical system becomes chaotic.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	1	2	1	2
CO2	3	3	3	3
CO3	3	3	3	3
CO4	2	2	3	2

Unit-I

Central manifold and Normal form, attractors, 1D map, Logistic map, Poincare' maps, circle map. Bifurcations- Saddle-node, Transcritical, Hopf-bifurcation, Global bifurcations, Poincare's surface of sections, Melnikov's method for homoclinic orbits. Strange attractors & fractals dimentions. Henon map and Rossler system, Box-counting, Hausdorff dimensions. Lyapunov exponent, Horseshoe map chaotic transitions, intermittency, crisis, quasiperiodicity, controlling & synchronization of chaos.

Unit-II

Fractals in nature, Mathematical fractals (the Koch curve and other), Mathematical chaos (the Lorenz attractor). The Cantor set, the Sierpinski triangle and carpet, Self-similar fractals, fractal dimension, modeling of biological growth, Box dimension. Random fractals: Fractal forgeries, Iteration initial value, orbit, fixed point (attracting, repelling, neither), k-cycle (attracting, repelling, neither), fixed points, Period doubling.

Unit-III

The Feigenbaum constant, similarity of the Feigenbaum diagram for different functions. Continuous dynamical systems and strange attractors, Discrete dynamical systems. Phase space. The motion of a pendulum.

Unit-IV
Mathematical modeling, Atractors of typical 2-dimensional systems. Nodes, saddles, focuses, limit cycles, Strange attractors, The Mandelbrot set, the Julia set, geometrical features of Julia and Mandelbrot sets. The selection of programming languages and solving tools for applications will be done accordingly.

References
1.Dynamical Systems, JurgenJost, 2005, Springer 2.Dynamical Systems Stability, Controllability & Chaotic Behaviour, Werner Krabs, 2010, Springer 3.Fractals & Chaos, B.B. Mandelbrot, 2004, Springer 4. Stability of Dynamical Systems Continuous, discontinuous & Discrete Systems, Anthony N. Michel, 2008, Birkhauser Boston

Paper Code: CWM – 109	Paper: Mathematical Modelling & Ecology	L	T/P	C
Paper ID:		**4**	**-**	**4**

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:

1:	To develop the Mathematical skill of using various mathematical methods.
2:	Enable students understand how mathematical models are formulated, solved, and interpreted.
3:	Make students appreciate the power and limitations of mathematics in solving practical real-life problems
4:	**Introduce students to the world of mathematical modelling – the art, the mechanics, the possibilities, and the limitations**

Course Outcomes (CO):

CO1:	Students will develop scientific understanding
CO2:	Students will be able to do sensitivity analysis for the changes in a system.
CO3:	Students will able to take decisions including tactical and strategic decisions.
CO4:	Assess the validity and accuracy of their approach relative to what the problem requires

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

CO/PO	PO1	PO2	PO3	PO4
CO1	**2**	**3**	**3**	**2**
CO2	**1**	**2**	**1**	**3**
CO3	**2**	**2**	**2**	**3**
CO4	**3**	**1**	**3**	**2**

Unit-I

Deterministic and stochastic models, tools, techniques, modeling approaches. Models of single and interacting populations, prey-predator, competition, chemical state, AIDS/HIV/ SARS. Epidemic and genetic models. Model for dialysis, Model for brain tumour.

Unit-II

Single species models, Exponential, logistic, Gompertz growth, Harvest model, Discrete-time and Delay model, Interacting population model, Dynamics of exploited populations, Spatially structured models.

Unit-III

Models for traffic flow, computer data communications, Stock Market, spatio-temporal pattern. Modeling of Physical and Engineering systems -Heating and cooling systems, Henon-Heiles systems, Hydro power plant, fuel injection systems and ankle joint.

Unit-IV

Age-structured models, Leslie matrix, Randomly fluctuating Environment, prey-predator and multi-species models in stochastic environment.

The selection of programming languages and solving tools for applications will be done accordingly.

Recommended Books:

1. Mathematical Modelling by J.N. Kapur, New Age International, 1998
2. Mathematical Biology by J.D. Murray, Springer, 2003
3. Elements of Mathematical Ecology by Mark Kot, Cambridge University Press, 2001
4. Mathematical Models & Methods for Real World Systems by Frauti, Siddiqui, Taylor Francis Group (CRC), 2005

Paper Code: CWM - 110	Paper: An Introduction to Fuzzy Mathematical Programming	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:

1:	To understand the basic concepts of fuzzy set theory
2:	To understand the basic concepts of Linear Programming Problem and Duality.
3:	To know the application of Linear Programming Problem in Game Theory
4:	erstand the application of fuzzy set theory in decision making.

Course Outcomes (CO):

CO1:	The end of the course the students are able to acquire enough knowledge to analyse the set theory and fuzzy set theory
CO2:	This course will help to understand mathematical programming and matrix game theory in a systematic and focused way.
CO3:	The students will study the application of fuzzy sets to decision making. The students will understand fuzzy linear programming and fuzzy matrix game
CO4:	The students will study the application of fuzzy sets to decision making.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	2	3	3	3
CO2	3	2	2	2
CO3	2	2	2	3
CO4	2	2	3	2

UNIT I:

Duality in linear programming, two person zero-sum matrix games, linear programming and matrix game equivalence, two person non-zero sum (bi-matrix) games, quadratic programming and bi-matrix game, constrained matrix games.

UNIT II:

Introduction of fuzzy sets, Basic definitions and terminologies, Fuzzy set theoretic operations, alpha-cuts and their properties, Convex fuzzy sets, Zadeh extension principle, Fuzzy relations, Similarity relation and partitioning, Triangular norms (t-norms) and triangular conorms (t-conorms). Lingustic variable and linguistic Hedges. Fuzzy if-then rule.

UNIT-III

Introduction of fuzzy numbers, Interval arithmetic, Fuzzy numbers and their representation, Arithmetic of fuzzy numbers, Special types of fuzzy numbers and their arithmetic, Ranking of fuzzy numbers.

UNIT-IV

Decision Making in fuzzy environment, Fuzzy linear programming, Quadratic programming in fuzzy environment, A two phase approach for solving fuzzy linear programming, Linear goal programming under fuzzy environment, Matrix game with fuzzy goals, Matrix game with fuzzy pay-offs, Fuzzy Bi-matrix game.

References:
Fuzzy Mathematical Programming and Fuzzy Matrix, Bector, C.R. and Chandra, S.2005, V Games, Springer Fuzzy Sets and Logic: Theoryand Applications, Klir, G.J. and Yaun, B.,2004Prentice Hall ,India Fuzzy Sets Theory and its Appliocations, Zimmermann, H.-J.,2001, 4th edition, Springer Game Theory, G.Owen, 1995, Academic Press, , San Diego

Paper Code: CWM - 111	Paper: An Introduction to Financial Mathematics	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: 25 marks
- Term end Theory Examinations: 75 marks

Course Objectives:

1:	Introduce the concepts of financial mathematics.
2:	Introduce students to the use of mathematical models for financial products
3:	Develop student abilities to create, derive, and apply mathematical models
4:	The course will introduce the concept of risk and return

Course Outcomes (CO):

CO1:	The knowledge of risk and return will be integrated in optimal decision making
CO2:	Develop computational skills in students
CO3:	Develop in students the ability to apply mathematics to real-world problems
CO4:	Promote analytical and critical thinking.

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

CO/PO	PO1	PO2	PO3	PO4
CO1	**3**	**3**	**2**	**3**
CO2	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**2**

Unit-I

Basic Terminology:Financial markets,Interest computation, value, growth and discount factors, derivative products.

Unit-II

Derivative Pricing: Basics of option theory, single and multi-period binomial pricing models, Cox-Ross-Rubinstein (CRR) model, volatility, Black-Scholes formula for option pricing as a limit of CRR model, Greeks and hedging.

Unit-III

Portfolio Optimization: Mean-Variance portfolio theory: Markowitz model, Capital Asset Pricing Model (CAPM), Factor models.

Unit-IV

Interest Rates and Interest Rate Derivatives, Binomial Tree Models.

Suggested Books and References

1. D. G. Luenberger, Investment Science, Oxford University Press, 1999 (new edn. 2013).
2. M. Capińsky and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2004 (new edn, 2011).
3. J C Hull, Options, Futures and other Derivatives, Prentice Hall, 8thedn, (2011).
4. S. Chandra, S. Dharmaraja, A. Mehra and R.Khemchandani, Financial Mathematics: An Introduc Publishing House, 2013.

Paper Code: CWM - 112	Paper: Differentiable Manifolds	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

- Teachers Continuous Evaluation: -- 25 marks
- Term end Theory Examinations: -- 75marks

Course Objectives:

1:	To give basic concepts of differentiable manifolds
2:	To give introduction about calculus on differentiable manifolds
3:	To give introduction about connections, Riemannian metrics and curvatures on differentiable manifolds
4:	To introduce variations of arc length and exponential maps, Jacobi vector field

Course Outcomes (CO):

CO1:	Students will learn basic concepts of manifolds
CO2:	Students will understand to apply calculus on manifolds
CO3:	Students will be familiar to compute Riemannian connections and curvatures
CO4:	Students will learn to compute first and second variation of arc length, exponential maps and its applications on smooth manifolds

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

CO/PO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**1**	**2**
CO2	**3**	**2**	**1**	**2**
CO3	**3**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**2**

Unit I:

Introduction : Topological and differentiable manifold withexamples, product manifolds, vectorfield and tangent space, Lie brackets, differentialmap and Jacobians, immersions and imbeddings, differentialforms and cotangent space, pull back map, geodesic and parallel transportation, covariant derivative and coefficients of affine connections.

Unit II

Calculus on Manifolds : Exteriorderivative, Lie derivative, gradient, curl, divergence, Laplacian, Hessian on manifolds, interiorproduct, orientations and volume element, integration in R^n and itsgeneralisation to manifolds, Stoke'stheorem

Unit III:

Riemannian Connections and Curvatures: Levi-Civita connections, torsions and symmetry, Riemannianmetrics and Riemannian connections, Riemanniancurvature, sectionalcurvature, Ricci curvature, scalarcurvature, connectionforms, structural equations, curvatureforms.

Unit IV:

Variations of Arc Length: First and second variation of arc length, Bonnet Theorem, exponentialmap, Jacobi vectorfields and conjugate points, Submanifoldswithexamples, tangent space and normal space.

SuggestedReadings and References

1. RiemannianGeometry, M. P. Do Carmo, **1992**, Birkhauser Boston
2. The Geometry of Physics, Theodore Frankel, **2011**, Cambridge Universitypress
3. Introduction to Smooth manifolds, J.M.Lee, **2013**, Springer-Verlag New York

Paper Code: CWM - 113	Paper: Lie Groups andHomogeneous Spaces	L	T/P	C
Paper ID:		4	-	4

Marking Scheme:

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

Course Objectives:

1:	To give an introductory course on the theory of Lie groups
2:	To give basic concepts about Representation theory
3:	To give an introductory course on the theory of homogeneous spaces.
4:	To introduce basic concepts about symmetric spaces

Course Outcomes (CO):

CO1:	Students will learn basic concepts of Lie groups
CO2:	Students will understand elementary concepts about Representation theory
CO3:	Students will be familiar with Homogenous spaces and with computation of bi-invariant metrics
CO4:	Students will learn basic concepts about symmetric spaces and with computation of G-invariant metrics

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

CO/PO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**1**	**2**
CO2	**3**	**2**	**1**	**2**
CO3	**3**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**2**

Unit-I

Lie groups, Example of Lie groups, Smooth manifolds: A review, tangent space of a Lie group- Lie algebras, One parameter subgroups, the Campbell-Baker-Hausdorff series, Lie theorems.

Unit-II

Representation theory: elementary concepts, Adjoint representation, Killing form, tori, Classification of compact and connected Lie groups, Complex semisimple Lie algebras.

Unit-III

Left invariant and bi-invariant metrics, Geometrical aspect of a compact Lie group, Homogeneous spaces, Coset manifolds, Reductive homogeneous spaces, Isotropy representation.

Unit-IV

G-invariant metrics, Riemannian connection, Curvature, Symmetric spaces, structure of symmetric space, Geometry of symmetric space, duality, Hypersurfaces in metric Lie groups.

Text books/Reference books:

1. Lie Groups: An Introduction through Linear Groups, WulfRossmann, Oxford Graduate Texts in Mathematics, Oxford University Press Inc., New York.
2. Naive Lie Theory, John Stillwell, Springer, 2008.
3. Matrix Groups: An Introduction to Lie Group Theory, Andrew Baker, Springer, 2003.
4. Lie Groups, Lie Algebras, and Representations: An Elementary Introduction, Brian C. Hall, Springer, 2004.
5. Lie Groups: An Approach through Invariants and Representations, Claudio Procesi, Springer, 2006.
6. Lie Groups beyond an Introduction, Anthony W. Knapp, Birkhauser, 2002.
7. Differential Geometry, Lie Groups, and Symmetric Spaces, SigurdurHelgason, American Mathematical Society, 2001.