THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE–632115

M.Sc. MATHEMATICS

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

P20

CONTENTS

PREAMBLE

In pursuit of the Higher Education Department Policy Note 2022-23 Demand 20, Section 1.4, Tamil Nādu State Council for Higher Education took initiative to revamp the curriculum. On 27 July 2022, a meeting was convened by the Member-Secretary Dr. S. Krishnasamy enlightening the need of the hour to restructure the curriculum of both Under-graduate and Post-graduate programmes based on the speeches at the Tamil Nādu Legislative Assembly Budget meeting by the Honourable Higher Education Minister Dr K. Ponmudy and Honourable Finance Minister Dr. P. Thiagarajan. At present there are three different modes of imparting education in most of the educational institutions throughout the globe. Outcome Based Education, Problem Based Education, and Project Based Education.

Now our Honourable Higher Education Minister announced Industry Aligned Education. During discussion, the Member Secretary announced the importance of question papers and evaluation as envisaged by the Honourable Chief Secretary to Government Dr, V. IraiAnbu. This is very well embedded in Revised Bloom's Taxonomy.

Taxonomy forms three learning domains: the cognitive (knowledge), affective (attitude), and psychomotor (skill). This classification enables us to estimate the learning capabilities of students.

Briefly, it is aimed to restructure the curriculum as student-oriented, skill-based, and institution-industry-interaction curriculum with the various courses under

"Outcome Based Education with Problem Based Courses, Project Based Courses, and Industry Aligned Programmes" having revised Bloom's Taxonomy for evaluating students skills.

Three domains:

(i) Cognitive Domain

(Lower levels: K1: Remembering ; K2: Understanding ; K3: Applying; Higher levels: K4: Analysing ; K5: Evaluating; K6: Creating)

(ii) Affective Domain

(iii) Psychomotor Domain

Programme	**M.Sc., Mathematics**
Programme Code	
Duration	**PG - 2 years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in

	research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

CREDIT DISTRIBUTION FOR PG PROGRAMME

Semester –I	Credit	Hours	Semester -II	Credit	Hours	Semester -III	Credit	Hours	Semester –IV	Credit	Hours
1.1. Core-I	5	7	2.1. Core-IV	5	6	3.1. Core-VII	5	6	4.1. Core-XI	5	6
1.2 Core-II	5	7	2.2 Core-V	5	6	3.2 Core -VIII	5	6	4.2 Core-XII	5	6
1.3 Core –III	4	6	2.3 Core –VI	4	6	3.3 Core –IX	5	6	4.3 Project with viva voce	7	10
1.4 Discipline Centric Elective -I	3	5	2.4 Discipline Centric Elective –III	3	3	3.4 Core –X	4	6	4.4 Elective VI (Industry/ Entreprene urship) 20% Theory 80% Practical	3	4
1.5 Generic Elective -II:	3	5	2.5 Generic Elective -IV:	3	3	3.5 Discipline Centric Elective -V	3	3	4.5 Skill Enhancem ent course Professional Competency Skill	2	4
			2.6 Skill Enhanceme nt I	2	4	3.6 Skill Enhancem ent course II	2	3	4.6 Extension Activity	1	
			Human Rights	2	2	3.7 Internship/ Industrial Activity	2	-			
			Mooc Course	2	-						
	20	**30**		**26**	**30**		**26**	**30**		**23**	**30**
Total Credit Points -95											

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF)
Guideline Based Credits and Hours Distribution System
for all Post – Graduate Courses including Lab Hours

First Year – Semester – I

Part	List of Courses	Credits	No. of Hours
	Core – I	5	7
	Core – II	5	7
	Core – III	4	6
	Elective – I	3	5
	Elective – II	3	5
		20	**30**

Semester-II

Part	List of Courses	Credits	No. of Hours
	Core – IV	5	6
	Core – V	5	6
	Core – VI	4	6
	Elective – III	3	3
	Elective – IV	3	3
	Skill Enhancement Course [SEC] - I	2	4
	Human Rights	2	2
	Mooc Course	2	-
		26	**30**

Second Year – Semester – III

Part	List of Courses	Credits	No. of Hours
	Core – VII	5	6
	Core – VIII	5	6
	Core – IX	5	6
	Core (Industry Module) – X	4	6
	Elective – V	3	3
	Skill Enhancement Course - II	2	3
	Internship / Industrial Activity [Credits]	2	-
		26	**30**

Semester-IV

Part	List of Courses	Credits	No. of Hours
	Core – XI	5	6
	Core – XII	5	6
	Project with VIVA VOCE	7	10
	Elective – VI (Industry Entrepreneurship)	3	4
	Skill Enhancement Course – III / Professional Competency Skill	2	4
	Extension Activity	1	-
		23	**30**

Total 95 Credits for PG Courses

M.Sc., MATHEMATICS

PROGRAMME SPECIFIC OUTCOMES:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids:

	Pos							PSOs		
	1	2	3	4	5	6	…	1	2	…
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										

LEARNING AND TEACHING ACTIVITIES

Work Load: The information below is provided as a guide to assist students in engagingappropriately with the course requirements.

Activity	**Quantity**	**Workload periods**
Lectures	60	60
Tutorials	15	15
Assignments	5	5
Cycle Test or similar	2	4
Model Test or similar	1	3
University Exam Preparation	1	3
Total		90 Periods

Assessment Principles:

Assessment for this course is based on the following principles

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgments about student performance.
4. Assessment practice must be fair and equitable to students and give them the opportunity to demonstrate what they learned.
5. Assessment must maintain academic standards.

Assessment Details:

Assessment Item	**Distributed Due Date**	**Weightage**	**Cumulative Weightage**
Assignment 1	3rd week	2%	2%
Assignment 2	6th Week	2%	4%
Cycle Test – I	7th Week	6%	10%
Assignment 3	8th Week	2%	12%
Assignment 4	11th Week	2%	14%
Cycle Test – II	12th Week	6%	20%
Assignment 5	14th Week	2%	22%
Model Exam	15th Week	13%	35%
Attendance	All weeks as per the Academic Calendar	5%	40%
University Exam	17th Week	60%	100%

FACULTY COURSE FILE

Contents

a. Academic Schedule

b. Students Name List

c. Time Table

d. Syllabus

e. Lesson Plan

f. Staff Workload

g. Course Design(content, Course Outcomes(COs), Delivery method, mapping of COs with Programme Outcomes(POs), Assessment Pattern in terms of Revised Bloom's Taxonomy)

h. Sample CO Assessment Tools.

i. Faculty Course Assessment Report(FCAR)

j. Course Evaluation Sheet

k. Teaching Materials(PPT, OHP etc)

l. Lecture Notes

m. Home Assignment Questions

n. Tutorial Sheets

o. Remedial Class Record, if any.

p. Projects related to the Course

q. Laboratory Experiments related to the Courses

r. Internal Question Paper

s. External Question Paper

t. Sample Home Assignment Answer Sheets

u. Three best, three middle level and three average Answer sheets

v. Result Analysis (CO wise and whole class)

w. Question Bank for Higher studies Preparation (GATE/Placement)

x. List of mentees and their academic achievements

Credit Distribution for PG Programme in Mathematics

M.Sc., Mathematics

	First Year Semester-I	**Credit**	**Hours per week(L/T/P)**
Part A	CC1 - Algebraic Structures	5	7
	CC2 - Real Analysis I	5	7
	CC3 - Ordinary Differential Equations	4	6
	Elective I(Generic / Discipline Specific)(One from Group A)	3	5(4L + 1T)
	Elective II(Generic / Discipline Specific)(One from Group B)	3	5(4L + 1T)
	Total	**20**	**30**
	Semester-II	**Credit**	**Hours per week(L/T/P)**
Part A	CC4 – Advanced Algebra	5	6
	CC5 – Real Analysis II	5	6
	CC6 - Partial Differential Equations	4	6
	Elective III (Generic / Discipline Specific)(One from Group C)	3	3
	Elective-IV(Computer / IT related) (One from Group D)	3	3

Part B	Skill Enhancement Course -SEC 2 (One from Group G)	2	4
	Human Rights	2	2
	Mooc Course	2	-
	Total	**26**	**30**
	Second Year - Semester-III	**Credit**	**Hours per week(L/T/P**
Part A	CC7 - Complex Analysis	5	6
	CC8 - Probability Theory	5	6
	CC9 – Topology	5	6
	CC10 - Industry Modules	4	6
	Elective V(Generic / Discipline Specific)(One from Group E)	3	3
Part B	Skill Enhancement Course -SEC 3 :Professional Communication Skill -Term paper & Seminar presentation	2	3
	Internship / Industrial Activity (Carried out in Summer Vacation at the end of I year – 30 hours)	2	
	Total	**26**	**30**

	Semester-IV	**Credit**	**Hours per week (L/T/P)**
Part A	CC11–Functional Analysis	5	6
	CC12 - Differential Geometry	5	6
	Project with viva voce	7	10
	Elective VI(Generic / Discipline Specific)(One from Group F)	3	4
Part B	Professional Competency Skill Enhancement Course Training for Competitive Examinations • Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) • General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)	2	4
Part C	Extension Activity	1	
	Total	**23**	**30**

TOTAL CREDITS: 95

Component Wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Core	14	14	19	10	57
Elective	6	6	3	3	18
Project				7	7
Soft Skill		2	2	2	6
Summer Internship / Industrial training			2		2
Human Rights		2			2
Mooc Course		2			2
Extension activity				1	1
Total	**20**	**26**	**26**	**23**	**95**

Template for Semester

Code	Category	Title of the Paper	Marks (Max 100)		Duration for UE	Credits
			CIA	UE		
Semester –I						
Part A	Core I	Algebraic Structure	25	75	3 Hrs	5
	Core II	Real Analysis – I	25	75	3 Hrs	5
	Core III	Ordinary DifferentialEquation	25	75	3 Hrs	4
	Elective I	(Choose one from Group-A)	25	75	3 Hrs	3
	Elective II	(Choose one from Group-B)	25	75	3 Hrs	3
Semester-II						
Part A	Core IV	Advanced Algebra	25	75	3 Hrs	5
	Core V	Real Analysis – II	25	75	3 Hrs	5
	Core VI	Partial Differential Equation	25	75	3 Hrs	4
	Elective III	(Choose one from Group-C)	25	75	3 Hrs	3
	Elective IV	(Choose one from Group-D)	25	75	3 Hrs	3
Part B	Skill Enhancement Course -SEC 2	(Choose one from Group-G)	Internal Assessment			2
	Human Rights	Compulsory	25	75	3 Hrs	2
	Mooc Course	Compulsory				2
Semester-III						
Part A	Core VII	Complex Analysis	25	75	3 Hrs	5
	Core VIII	Probability Theory	25	75	3 Hrs	5
	Core IX	Topology	25	75	3 Hrs	5
	Elective / ED V	(Choose one from Group-E)	25	75	3 Hrs	4

	Core Industry Module	(Choose from outside the Department)	25	75	3 Hrs	3
Part B						
	Skill based (Term paper and Seminar)	Assignment of problem by the faculty Lecture -I (by the student) 25% Lecture-II (by the student) 25% Lecture-III (by the student) 25% Submission of a write-up (10-15 pages using LaTeX) 25% Marks / Grade Point/ Letter Grade as per the Regulation)				2
	Ability Enhancement Course (AECC 3)	Soft Skill III	Performance based assessment			2
	Internship / Industrial - Vacation Activity					2
Semester-IV						
Part A	Core X	Functional Analysis	25	75	3 Hrs	4
	Core XI	Differential Geometry	25	75	3 Hrs	4
	Project with viva voce XIII		25	75	3 Hrs	3
	Elective VI	(Choose one from Group – F)	25	75	3 Hrs	3
Part B	Skill Enhancement Course -SEC 4	Professional Competency Skill Enhancement Course	Internal Assessment			2
	Ability Enhancement Course (AECC4)	Soft Skill IV	Performance based assessment			2
Part C	Extension Activity	Performance based assessment				1
					Total Credits	**95**

The Course of Study and the Scheme of Examination

Sl. No.	Study Components		ins. Hrs/ week	Credit	Title of the Paper	Maximum Marks		
	Course Title					CIA	Uni. Exam	Total
SEMESTER I								
	Part-A	**Core**	7	5	**CC-I** : Algebraic Structures	25	75	100
			7	5	**CC-II** : Real Analysis - I	25	75	100
			6	4	**CC-III** : Ordinary Differential Equations	25	75	100
Elective - I Group A: (PM/AP/IC/ITC) (Choose any one)								
	Part-A	**Elective**	5	3	1.Number Theory and Cryptography 2.Graph Theory and Applications 3.Formal Languages and Automata Theory 4.Programming in C++ and Numerical Methods	25	75	100
Elective – II Group B:(PM/AP/IC/ITC)(Choose any one)								
	Part-A	**Elective**	5	3	1.Lie Groups and Lie Algebras 2.Mathematical Programming 3.Fuzzy Sets and Their Applications 4.Discrete Mathematics	25	75	100
			30	**20**				
SEMESTER II						**CIA**	**Uni. Exam**	**Total**
	Part-A	**Core**	6	5	**CC-IV** : Advanced Algebra	25	75	100
			6	5	**CC-V** : Real Analysis - II	25	75	100
			6	4	**CC-VI** : Partial Differential Equations	25	75	100
Elective – III Group C:**(PM/AP/IC/ITC)** (Choose any one)								
	Part-A	**Elective**	3	3	1.Reliability and Queueing Theory 2.Mathematical Statistics 3. R Programming Language(Only Practical) 4.Tensor Analysis and Relativity	25	75	100
Elective-IV Group D :(PM/AP/IC/ITC)(Choose any one)								
	Part-A	**Elective**	3	3	1.Wavelets 2.Machine Learning and Artificial Intelligence 3.Neural Networks 4.Difference equations	25	75	100
	Compulsory paper		2	2	Human Rights	25	75	100
	Mooc Courses		-	2				100
Skill Enhancement Course - I								
	Part-B	**SEC I**	4	2	1.Computational Mathematics using SageMath 2.Mathematical documentation using			

					LATEX / other packages 3.Office Automation and ICT Tools 4.Numerical analysis using SCILAB 5.Differential equations using SCILAB 6.Industrial Mathematics /Statistics using latest programming packages 7.Research Tools and Techniques			
			30	**26**				

Sl. No.	**Study Components**		**ins. hrs / week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
	Course Title					**CIA**	**Uni. Exam**	**Total**
SEMESTER III								
	Part-A	**Core**	6	5	**CC-VII** : Complex Analysis	25	75	100
			6	5	**CC-VIII** : Probability Theory	25	75	100
			6	5	**CC-IX** : Topology	25	75	100
			6	4	**CC-X** :Mechanics (**Core Industry Module)**	25	75	100
Elective – V Group E: (PM/AP/IC/ITC)(Choose any one)								
		Elective	3	3	1.Algebraic Number Theory 2.Fluid Dynamics 3.Stochastic Processes 4. Mathematical Python	25	75	100
Skill Enhancement Course - II								
	Part-B	**SEC - II**	3	2	Professional Communication Skill : Term paper & Seminar presentation			
		Internship / Industrial Activity	-	2	(Carried out in Summer Vacation at the end of I year–30 hours) Summer Internship Report to be submitted to the Department.			
			30	**26**				
SEMESTER IV						**CIA**	**Uni. Exam**	**Total**
	Part-A	**Core**	6	5	**CC-XI** : Functional Analysis	25	75	100
			6	5	**CC-XII** : Differential Geometry	25	75	100
			6	7	Project with Viva Voce	25	75	100
Elective – VI Group F:(PM/AP/IC/ITC)(Choose any one)								
	Part-A	**Elective**	4	3	1.Financial Mathematics 2.Resource Management Techniques 3.Modeling and Simulation with Excel 4.Mathematical Python - Practical	25	75	100
Skill Enhancement Course – III (Choose any one)								
	Part-B	**SEC-III**	4	2	Professional Competency Skill Enhancement Course 1.Training for Competitive Examinations Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations			

					(2 hours) 2.General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)			
	Part - C	**Extension Activity**		**1**	(Syllabus will be prepared by the University as common course to all PG Programmes)			
			30	**23**				
TOTAL CREDITS				**95**				

Testing Pattern (25+75)

Internal Assessment

Theory Course: For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

Computer Laboratory Courses: For Computer Laboratory oriented Courses, there shall be two tests in Theory part and two tests in Laboratory part. Choose one best from Theory part and other best from the two Laboratory part. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one / one and a half hour. There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

Written Examination : Theory Paper (Bloom's Taxonomy based)

Question paper Model

Intended Learning Skills	**Maximum 75 Marks** **Passing Minimum: 50%** **Duration : Three Hours**
	Part –A (10x 2 = 20 Marks) Answer ALL questions **Each Question carries 2mark**
Memory Recall / Example/ Counter Example / Knowledge about the Concepts/ Understanding	Two questions from each UNIT
	Question 1 to Question 10
	Part – B (5 x 5 = 25 Marks) **Answer ALL questions** **Each questions carries 5 Marks**
Descriptions/ Application (problems)	**Either-or Type** Both parts of each question from the same UNIT

	Question 11(a) or 11(b) To **Question 15(a) or 15(b)**
	Part-C (3x 10 = 30 Marks) **Answer any THREE questions** **Each question carries 10 Marks**
Analysis /Synthesis / Evaluation	There shall be FIVE questions covering all the five units
	Question 16 to Question 20

Each question should carry the course outcome and cognitive level

For instance,1.[CO1 : K2] Question xxxx 2.[CO3 : K1] Question xxxx

Different Types of Courses

(i) Core Courses

1. Algebra
2. Real Analysis
3. Ordinary Differential Equations
4. Partial Differential Equations
5. Topology
6. Complex Analysis
7. Mechanics
8. Functional Analysis
9. Differential Geometry and more

(ii) Elective Courses (ED within the Department Experts)

1. Discrete Mathematics
2. Number Theory and Cryptography
3. Formal Languages and Automata Theory
4. Programming in C++ and Numerical Method
5. Fuzzy Sets and Their Applications
6. Mathematical Programming
7. Algebraic Number Theory
8. Java Programming
9. Analytical Number Theory
10. Tensor Analysis and Relativity
11. Stochastic Processes
12. Algebraic Geometry
13. Fluid Dynamics
14. Financial Mathematics
15. Wavelets
16. Mathematical Statistics and more

(iii)Elective Courses (ED from other Department Experts)

(iv) Skill Development Courses

(v) Institution-Industry-Interaction (Industry aligned Courses)

Programmes /course work/ field study/ Modelling the Industry Problem/ Statistical Analysis / Commerce-Industry related problems / MoU with Industry and the like activities.

SYLLABUS FOR DIFFERENT COURSES OF M.Sc MATHEMATICS

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).
Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)</td></tr>
<tr><td colspan="8">UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules
Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5</td></tr>
<tr><td colspan="8">UNIT-III : Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5</td></tr>
<tr><td colspan="8">UNIT-IV : Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7</td></tr>
<tr><td colspan="8">UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC/ others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.</td></tr>
</table>

Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5.N.Jacobson, *Basic Algebra,* Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups

CLO 2: Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules

CLO 3: Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.

CLO 4: Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.

CLO 5: Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE II</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">6</td><td colspan="2">1</td><td colspan="2">--</td><td>7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I : Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8
Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.
Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler’s summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.
Chapter - 7 : Sections 7.1 to 7.14</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals.
Chapter - 7 : 7.15 to 7.26</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-IV : Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.
Chapter - 8 Sec, 8.20, 8.21 to 8.26
Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem
Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23</td></tr>
</table>

	UNIT-V: Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
Reference Books	1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976. 2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976. 3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991. 4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991. 5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964. 6. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Analyze and evaluate functions of bounded variation and Rectifiable Curves.

CLO2: Describe the concept of Riemann-Stieltjes integral and its properties.

CLO3: Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.

CLO4: Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.

CLO5: Formulate the concept and properties of inner products, norms and measurable functions.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I : Linear equations with constant coefficients
Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.
Chapter 2: Sections 1 to 6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II : Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators.
Chapter 2 : Sections 7 to 12.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III : Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.
Chapter : 3 Sections 1 to 8 (Omit section 9)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV :Linear equation with regular singular points
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967. 2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001 6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Establish the qualitative behavior of solutions of systems of differential equations .

CLO2: Recognize the physical phenomena modeled by differential equations and dynamical systems.

CLO3: Analyze solutions using appropriate methods and give examples.

CLO4: Formulate Green's function for boundary value problems.

CLO5: Understand and use various theoretical ideas and results that underlie the mathematics in this course.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ADVANCED ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Algebraic Structures</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I :Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2</td></tr>
<tr><td colspan="8">UNIT-II : Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="8">UNIT-III : Elements of Galois theory.
Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="8">UNIT-IV : Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)</td></tr>
<tr><td colspan="8">UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.
Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
Chapter 7 : Sections 7.3 and 7.4</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.</td></tr>
</table>

Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II *Rings,*Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Prove theorems applying algebraic ways of thinking.

CLO2: Connect groups with graphs and understanding about Hamiltonian graphs.

CLO3: Compose clear and accurate proofs using the concepts of Galois Theory.

CLO4: Bring out insight into Abstract Algebra with focus on axiomatic theories.

CLO5: Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1
Chapter 12 : Section 12.1 to 12.14 (Apostol)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem- The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Chapter 13 : Sections 13.1 to 13.7 (Apostol)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)
Reference Books	1. Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press, 1951. 2. Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.1971. 3. Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988. 4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979. 5. Malik,S.C. and Savita Arora. *Mathematical Analysis,* Wiley Eastern Limited. New Delhi, 1991. 6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.

CLO2: Analyze the representation and convergence problems of Fourier series.

CLO3: Analyze and evaluate the difference between transforms of various functions.

CLO4: Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

CLO5: Apply the Cauchy integral theorem in its various versions to compute contour integration.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE VI</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>5</td><td>1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)</td></tr>
<tr><td colspan="8">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 4 : Sections 4.1 to 4.11</td></tr>
<tr><td colspan="8">UNIT-III :Method of separation of variables: Separation of variable-Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)</td></tr>
<tr><td colspan="8">UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.
Chapter 8 : Sections 8.1 to 8.9</td></tr>
<tr><td colspan="8">UNIT-V : Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.
Chapter 10 : Section 10.1 to 10.9</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.
Reference Books	1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964. 2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968. 4. M.D.Raisinghania, *Advanced Differential Equations,* S.Chand & Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To understand and classify second order equations and find general solutions

CLO2: To analyse and solve wave equations in different polar coordinates

CLO3: To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations

CLO4: To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions

CLO5: To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE VII</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
6</td></tr>
<tr><td>Pre-requisite</td><td colspan="8">UG level Complex Analysis</td></tr>
<tr><td>Objectives of the Course</td><td colspan="8">To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT-I : Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3
Chapter 4 : Section 3 : 3.1 to 3.4</td></tr>
<tr><td></td><td colspan="8">UNIT-II :The general form of Cauchy's Theorem : Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7
Chapter 4 : Section 5: 5.1 and 5.2</td></tr>
<tr><td></td><td colspan="8">UNIT-III :Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3
Chapter 4 : Sections 6 : 6.1 to 6.3</td></tr>
<tr><td></td><td colspan="8">UNIT-IV :Harmonic Functions and Power Series Expansions:
Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3</td></tr>
<tr><td></td><td colspan="8">UNIT-V: Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem
Chapter 5 : Sections 2.1 to 2.4
Chapter 5 : Sections 3.1 and 3.2</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
Reference Books	1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm& Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Analyze and evaluate local properties of analytical functions and definite integrals.

CLO2: Describe the concept of definite integral and harmonic functions.

CLO3: Demonstrate the concept of the general form of Cauchy's theorem

CLO4: Develop Taylor and Laurent series .

CLO5 Explain the infinite products, canonical products and jensen's formula .

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE VIII</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I : Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2 : Sections 2.1 to 2.9</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II : Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4 : Sections 4.1 to 4.7</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV : Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal- gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz, *Probability Theory and Mathematical Statistics,* John Wiley and Sons, New York, 1963.
ReferenceBooks	1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972 2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974. 4. R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996. 5. V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print). 6. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999. 7. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.

CLO2: To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.

CLO3: To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions

CLO4: To define One point, two-point, Binomial distributions, to solve problems of Hypergeometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions

CLO5: To discuss Stochastic convergence, Bernaulli law of large numbers, to elaborate Convergence of sequence of distribution functions, to prove Levy-Cramer Theorems and de Moivre-Laplace Theorems, to explain Poisson, Chebyshev, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Topological spaces : Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.
Chapter 2 : Sections 12 to 17</td></tr>
<tr><td colspan="8">UNIT-II :Continuous functions: Continuous functions – the product topology – The metric topology.
Chapter 2 : Sections 18 to 21 (Omit Section 22)</td></tr>
<tr><td colspan="8">UNIT-III :Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness.
Chapter 3 : Sections 23 to 25.</td></tr>
<tr><td colspan="8">UNIT-IV : Compactness : Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.</td></tr>
<tr><td colspan="8">UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)</td></tr>
</table>

Reference Books	1. J. Dugundji ,*Topology* , Prentice Hall of India, New Delhi, 1975. 2. George F.Sinmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963 3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York 4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970. 5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space. **CLO2**: Understand continuity, compactness, connectedness, homeomorphism and topological properties.

CLO3: Analyze and apply the topological concepts in Functional Analysis.

CLO4: Ability to determine that a given point in a topological space is either a limit point or not for a given subset of a topological space.

CLO5: Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent(homeomorphic).

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MECHANICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core Industry Module</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Calculus and Differential equations.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. Understand mechanical systems under generalized coordinate systems.
2. Apply mechanics techniques in virtual work.
3. Develop students ability to deal with Energy and momentum.
4. Look at the concept of Hamilton, Lagrange.
5. Discuss the Canonical Transformation.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">Unit – 1: Mechanical Systems
The Mechanical system-Generalized coordinates- Constraints-
Virtual work–Energy and Momentum.
Chapter1: Sections 1.1 to 1.5

Unit – 2: Lagrange’s Equations
Derivation of Lagrange's equations- Examples - Integrals of motion.
Chapter 2: Sections2.1 to 2.3

Unit – 3: Hamilton’s Equations
Hamilton’s Principle - Hamilton's Equation - Other variational principle.
Chapter4: Sections 4.1 to 4.3

Unit – 4: Hamilton-Jacobi Theory
The idea of Public key Cryptography – RSA –Discrete Law– Knapsack –Zero–Knowledge.
Chapter 4: Sections 1 to 5

UNIT–5: Canonical Transformation
Differential forms and generating functions - Lagrange and Poisson brackets.
Chapter 6: Sections6.1 and 6.3</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	D.T.Greenwood, *Classical Dynamics*, Prentice Hall of India,NewDelhi,1985.
Reference Books	1.H.Goldstein,*ClassicalMechanics,*(2ndEdition) Narosa Publishing House, NewDelhi. 2.N.C.RaneandP.S.C.Joag, *ClassicalMechanics*,TataMcGrawHill,1991. 3.J.L.Synge and B.A.Griffth, *Principles of Mechanics* (3rd Edition) McGraw HillBookCo.,New York, 1970.
Website and e-Learning Source	https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

CLO1: Explain the basics concepts of mechanical systems under generalized coordinate systems.

CLO2: Identify the Lagrange's equations and its application. Identify the Lagrange's equations and its application.
CLO3: Derive the Hamilton Equation.

CLO4: Analyze the Hamilton's Principle and Hamilton-Jacobi Equation and separability.
CLO5: Discuss the Lagrange and Poisson brackets.

	Pos						PSOs		
	1	2	2	4	5	6	1	2	3
CLO1	3	2	3	2	1	2	3	1	3
CLO2	2	3	2	3	3	1	2	3	1
CLO3	3	3	2	3	2	1	3	3	2
CLO4	2	1	2	1	3	2	2	1	1
CLO5	3	3	2	3	1	2	2	3	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FUNCTIONAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student's skills and confidence in mathematical analysis and proof techniques.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.
Chapter 9:Sections 46-51</td></tr>
<tr><td colspan="6">UNIT-II :Hilbert Spaces: The definition and some simple properties–Orthogonal complements–Ortho normal sets–The conjugate space H^*-The adjoint of an operator–self-adjoint operators-Normal and unitary operators – Projections.
Chapter10:Sections52-59</td></tr>
<tr><td colspan="6">UNIT-III : Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.
Chapter 11:Sections 60-62</td></tr>
<tr><td colspan="6">UNIT-IV : General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity.
Chapter 12:Sections 64-69</td></tr>
<tr><td colspan="6">UNIT-V: The Structure of Commutative Banach Algebras: The Gelfand mapping – Application of the formula$r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand-Neumark theorem.
Chapter 13:Sections 70-73</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International,1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the Banach spaces and Transformations on Banach Spaces.

CLO2: Prove Hahn Banach theorem and open mapping theorem.

CLO3: Describe operators and fundamental theorems.

CLO4: Validate orthogonal and orthonormal sets.

CLO5: Analyze and establish the regular and singular elements.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">DIFFERENTIAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Linear Algebra concepts and Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.
Chapter I : Sections 1 to 9.</td></tr>
<tr><td colspan="8">UNIT-II :Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.
Chapter II: Sections 1 to 9.</td></tr>
<tr><td colspan="8">UNIT-III : Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss-Bonnet Theorem – Gaussian curvature- surface of constant curvature.
Chapter II: Sections 10 to 18.</td></tr>
<tr><td colspan="8">UNIT-IV : Non Intrinsic properties of a surface:
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.
Chapter III: Sections 1 to 8.</td></tr>
<tr><td colspan="8">UNIT-V :Differential Geometry of Surfaces :
Compact surfaces whose points are umblics- Hilbert’s lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert’s Theorem – Conjugate points on geodesics.
Chapter IV : Sections 1 to 8 (Omit 9 to 15).</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T.J.Willmore, *An Introduction to Differential Geometry,* Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)
Reference Books	1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry,* Inter science Publishers, 1963. 3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag 1979.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.

CLO2: Evaluate these concepts with related examples.

CLO3: Compose problems on geodesics.

CLO4: Recognize applicability of developable.

CLO5: Construct and analyze the problems on curvature and minimal surfaces

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the Course	**PROJECT WITH VIVA VOCE**						
Paper Number							
Category	Core	**Year**	II	**Credits**	7	**Course Code**	
		Semester	IV				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	6	--	10
Pre-requisite	UG Level Mathematics			

ELECTIVE COURSES

Courses are grouped (Group A to Group F) so as to include topics from Pure Mathematics(PM), Applied Mathematics(AM), Industrial Components(IC) and IT Oriented(ITC) courses for flexibility of choice by the stakeholders / institutions.

Semester I : Elective I and Elective II

Elective I to be chosen from Group A and **Elective II** to be chosen from Group B

Group A: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Number Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. Demonstrate ability to learn elementary ideas from number theory which will haveapplications in cryptography.
2.Introduce various cryptosystems and apply them in the necessary fields.
3.Understand the concepts of public key and primality.
4.Learn the public key cryptography and RSA algorithm.
5.Get the knowledge about Factoring concepts.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT–I: Some topics in Elementary Number Theory
Time Estimates for doing arithmetic – Divisibility and
Euclidean Algorithm –Congruence's–Some
applications to Factoring.
Chapter 1</td></tr>
<tr><td colspan="6">UNIT–II: Cryptography
Some simple cryptosystems – Enciphering matrices.
Chapter 3</td></tr>
<tr><td colspan="6">UNIT–III:
Quadratics – Residues and reciprocity.
Chapter 2</td></tr>
<tr><td colspan="6">UNIT–IV: Public Key
The idea of Public key Cryptography – RSA –Discrete Law– Knapsack –Zero–Knowledge.
Chapter 4: Sections 1 to 5</td></tr>
</table>

	UNIT–V: Primality and Factoring Pseudo–primes – The rho method – Fermat factorization and factor bases – The continued fractionmethod – The quadratic sieve method. **Chapter 5: Sections 1 to 5**
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987
Reference Books	1.I.Niven and H.S.Zuckermann, An Introduction to Theory of Numbers(Edn. 3), Wiley Eastern Ltd., New Delhi,1976 2.David M.Burton, Elementary Number Theory, Brown Publishers,Iowa,1989 3.K.Ireland and M.Rosen, A Classical Introduction to Modern NumberTheory, Springer Verlag, 1972 4.N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.
Website and e-Learning Source	1.https://nptel.ac.in/courses/111101137 2.https://archive.nptel.ac.in/courses/106/103/106103015/ 3.https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Acquire the knowledge of elementary number theory

CLO2: Apply various cryptosystems and understand the concepts of quadratic, residues and reciprocity

CLO3: Develop the idea of public key cryptography, RSA Algorithms.

CLO4: Solve problems using the continued fraction method and the quadratic sieve method.

CLO5: Demonstrate ability to apply concepts of Fermat factorization and factor bases.

	Pos						PSOs		
	1	2	2	4	5	6	1	2	3
CLO1	3	3	3	2	2	3	3	3	3
CLO2	3	3	3	2	2	2	3	3	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To study and develop the concepts of graphs, sub graphs, trees, connectivity,Euler tours, Hamilton cycles, matching, coloring of graphs, independent sets, cliques, vertex coloring, and planar graphs</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Graphs, Subgraphs and Trees

Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices- Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

Chapter 1 (Section 1.1 - 1.7) ; Chapter 2 (Section 2.1 - 2.3)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II: Connectivity, Euler Tours and Hamilton Cycles

Connectivity - Blocks - Euler tours – Hamilton

Chapter 3 (Section 3.1 -3.2) ; Chapter 4(Section 4.1 - 4.2)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Matchings, Edge Colourings
Matchings - Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number - Vizing’s Theorem.

Chapter 5 (Section 5.1 - 5.2) ; Chapter 6 (Section 6.1 - 6.2)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV:Independent Sets and Cliques, Vertex Colourings

Independent sets - Ramsey’s Theorem – Chromatic Number - Brooks’ Theorem - Chromatic Polynomials.
Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Planar Graphs
Plane and planar Graphs - Dual graphs - Euler’s Formula - The Five-Colour Theorem andthe Four-Colour Conjecture.

Chapter 9 (Section 9.1 - 9.3, 9.6)</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London,1976.
Reference Books	1.J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi,1995. 2.R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989. 3.A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge,1989. 4.R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley andSons, New York, 1989. 5.R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004,Indian Print. 6.S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.
Website and e-Learning Source	https://nptel.ac.in/courses/111106050/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Grasp features and properties of various types of graphs.

CLO2: Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.

CLO3: Understand the definitions and properties of matching and independent sets.

CLO4: Apply the concepts of graphs to model them in real life situations.

CLO5: Explicate the applications of planarity and colorability..

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	2	2	3	3	3	3
CLO2	3	3	2	2	2	3	3	3	3
CLO3	3	3	2	2	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FORMAL LANGUAGES AND AUTOMATA THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="7">Elementary Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1.The purpose of this course is to acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages.
2.Classify machines by their power to recognize languages.
Employ finite state machines to solve problems in computing.
3.Explain deterministic and non-deterministic machines.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Finite Automata and Regular Expressions
Finite state systems- Deterministic Finite state Automata- Non deterministic Finite Automata- Finite Automata with Epsilon-Transitions – Regular Expressions- Finite Automata and Regular Expressions.</td></tr>
<tr><td colspan="7">UNIT-II: Properties of Regular Languages
The Pumping Lemma for Regular Languages – Application of the Pumping Lemma – Closure Properties of Regular Languages – Reversal – Homomorphism – Decision properties of Regular Languages – Converting NFA’s to DFA’S – Minimization of DFA’s.</td></tr>
<tr><td colspan="2" rowspan="3"></td><td colspan="7">UNIT-III: Context Free Grammars and Languages
Context Free Grammars – Parse Trees – Normal forms for Context Free Grammars – Chomsky Normal Form – Greibach Normal Form.</td></tr>
<tr><td colspan="7">UNIT-IV: Pushdown Automata
Definition – The languages of a PDA – Equivalence of PDA’s and CFG’s – Deterministic Pushdown Automata.</td></tr>
<tr><td colspan="7">UNIT-V: Properties of Context-Free Languages
The Pumping Lemma for Context-free Languages – Closure Properties of Context- Free Languages – Decision properties of CFL’s.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1.Introduction to Automata Theory Languages and Computation‖. Hopcroft H.E. and Ullman J. D. Pearson Education.
2.Introduction to Theory of Computation - Sipser 2nd edition Thomson</td></tr>
</table>

Reference Books	1.Languages and Computation, Pearson Education, 2013. A Salomaa , Formal Languages , Academic press , New York , 1973 2.John C. Martin, Introduction to Languages and theory of Computations (2ndEdn), Tata – McGraw Hill company Ltd., New Delhi, 1997. 3.Dr. Rani Siromoney , Formal Languages and Automata, The Christian Literature Society, 1979.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To gain knowledge of fundamental concepts of automata.
CLO2: To know properties of regular languages.
CLO3: To know finite automata theory.
CLO4: To Understand the concept of context free grammars and normal form.
CLO5: To know push down automata and context free languages.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	2	2	3	3	3	2
CLO2	3	3	2	3	2	3	2	3	3
CLO3	3	2	3	2	2	3	3	2	2
CLO4	3	3	3	3	3	2	2	3	3
CLO5	2	3	3	3	3	3	3	3	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROGRAMMING IN C++ AND NUMERICAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Principles of OOP-Tokens-Expressions, Control Structures Functions-Classes and Objects-constructors and destructors.
Chapter 1 to 6</td></tr>
<tr><td colspan="7">UNIT-II: Operator Overloading and type Conversions - Inheritance - Pointers, Virtual Functions and Polymorphism-Managing Console I/O Operations-Working with Files.
Chapter 7 to 11</td></tr>
<tr><td colspan="7">UNIT-III: Finite Digit Arithmetic and Errors Floating point arithmetic - Propagated Error - Generated Error - Error in Evaluation of a function f(x). - Non-linear Equations: Bisection method- Secant Method - Regula Falsi Method - Newton‘s method - Muller‘s method - Fixed Point method.
Chapters 1,2 : Only 2.1 to 2.6</td></tr>
<tr><td colspan="7">UNIT-IV: System of Linear Equations Gauss- Elimination Method - Crout‘s method - Inverse of a matrix - Condition numbers and errors - Jacobi‘s method - Gauss-Seidel Method - Relaxation method. Numerical Differentiation and Integration: Numerical Differentiation - Numerical Integration - Newton-Cotes Formulas - Gaussian Quadrature - Double Integral.
Chapter 3 and 5 : 5.1 to 5.5 and 5.7(omit 5.6)</td></tr>
<tr><td colspan="7">UNIT-V: Ordinary Differential Equations: Difference equation - Differential Equations:Single Step method-Runge-Kutta Method-Multi-step .
Chapter 6: 6.1 to 6.4 (omit 6.5)</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill, New Delhi, 1999. 2. Devi Prasad, An Introduction to Numerical Analysis (3rd edn) Narosa Publishing House, New Delhi, 2006.
Reference Books	1. D. Ravichandran, Programming with C++, Tata McGraw Hill, New Delhi, 1996 2. Conte and de Boor, Numerical Analysis, McGraw Hill, New York, 1990 3. John H.Mathews, Numerical Methods for Mathematics, Science and Engineering (2nd Edn.), Prentice Hall, New Delhi, 2000
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

CLO1: Know the tokens expressions and control structures in C++.

CLO2: Understand the usage of all basic functions in C++.

CLO3: Comprehend the significance of various types of classes in C++.

CLO4: Acquire the knowledge about solving system of linear equations.

CLO5: Acquire the knowledge about solving ordinary differential equations.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

Group B: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">LIE GROUPS and LIE ALGEBRAS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level linear algebra and matrix groups.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1.In physics, Lie groups appear as symmetry groups of physical systems, and their Lie algebras (tangent vectors near the identity) may be thought of as infinitesimal symmetry motions.
2.Lie algebras and their representations are used extensively in physics, notably in quantum mechanics and particle physics.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I:Matrix Lie Groups
Chapter 1</td></tr>
<tr><td colspan="6">UNIT-II: The Matrix Exponential
Chapter 2</td></tr>
<tr><td colspan="6">UNIT-III:Lie Algebras
Chapter 3</td></tr>
<tr><td colspan="6">UNIT-IV:Basic Representation Theory
Chapter 4</td></tr>
<tr><td colspan="6">UNIT-V:Semisimple Lie Algebras
Chapter 7</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Brain Hall, Lie Groups, Lie Algebras and Representations: An Elementary Introduction (Second Edition), Springer, USA, 2015.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1.V. S. Varadarajan, Lie groups, Lie algebras and their representations,Sringer 1984.
2.Brian Hall, Lie groups, Lie algebras and representations, Springer2003.
3.Barry Simon, Representations of finite and compact groups, AMS1996.
4.A. W. Knapp, Representation theory of semi smiple Lie groups. Anoverview based on examples, Princeton university press 2002.
5.S. Kumaresan S, A course in differential geometry and Lie groups, Texts and Readings in Mathematics, 22. Hindustan Book Agency, New Delhi, 2002.</td></tr>
</table>

Website and e-Learning Source	1. https://archive.nptel.ac.in/courses/111/108/111108134/ 2. https://www.digimat.in/nptel/courses/video/111108134/L42.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: demonstrate systematic understanding of key aspects of Matrix Lie Groups and Lie groups.

CLO 2: Determine the exponential of a matrix.

CLO 3: Differentiate Lie groups and Lie Algebras.

CLO 4: Find the representation of $s_l(2 ; C)$.

CLO 5: Explain reductive Lie algebra

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	2	2	3	2	2
CLO2	2	2	2	2	1	1	3	1	1
CLO3	3	2	2	2	1	1	3	2	2
CLO4	2	2	3	2	2	1	2	2	1
CLO5	3	2	2	2	1	2	2	2	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course introduces advanced topics in Linear and non-linear Programming.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Integer Linear Programming
Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory‘s All Integer Cutting Plane Method - Gomory‘s mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming. Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP.
Chapter-7: 7.1 - 7.7 Chapter-20: 20.1 - 20.5</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II : Classical Optimization Methods
Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe‘s modified Simplex Methods - Beale‘s Method
Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Theory of Simplex Method
Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution.
Chapter-25: 25.1 - 25.4, 25.6-25.9</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV: Revised Simplex Method
Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm
Chapter-26: 26.1 - 26.4 Chapter-28: 28.1, 28.2</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Parametric Linear Programming
Variation in the coefficients cj , Variations in the Right hand side, bi . Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.
Chapter-29: 29.1 - 29.3</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	J.K.Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd.
Reference Books	1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997. 2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7th Edition) TataMcGraw Hill ompany, New Delhi, 2001. 3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979 4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: To know about integer programming.

CLO 2: To know about optimization methods for solving non linear programming problems.

CLO 3: To know simplex method for solving linear programming problems.

CLO 4: To know revised simplex method for solving linear programming problems.

CLO 5: To know parametric linear programming problems.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FUZZY SETS AND THEIR APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="7">Knowledge of graphs, relations, composition</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">Fuzzy is one of the latest topic in Mathematics that has real life applications. Hence it is essential for the students to learn this topic. This topic introduces the concept of uncertainty and fuzziness in logic that will enable the student to develop their intuitive mind further.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Crisp sets and fuzzy sets
Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, fuzzy points, α–cuts – Decomposition Theorems, Extension Principle.</td></tr>
<tr><td colspan="7">UNIT-II: Operation on fuzzy sets
Standard fuzzy operations – Union, intersection and complement – properties De. Morgan's laws - zy sets – Support – Level sets, fuzzy points, α–Cuts of fuzzy operations.</td></tr>
<tr><td colspan="7">UNIT-III: Fuzzy relations
Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets - Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.</td></tr>
<tr><td colspan="7">UNIT-IV:
Decision making in Fuzzy environments General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.</td></tr>
<tr><td colspan="7">Unit-V: Applications
Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">G.J. Klir, and Bo Yuan, Fuzzy Sets and fuzzy Logic: Theory and Applications, Prentice Hall of India Ltd., New Delhi, 2005.</td></tr>
</table>

Reference Books	1.George J.Klir and Bo Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Leaning Private Limited, New Delhi (2009). 2.A. K. Bhargava; Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt. Limited (2013). 3.K.Pundir and R.Pundir, Fuzzy sets and their application, Published by A Pragati edition (2012) 4.H.J.Zimmermann, Fuzzy set theory and its applications, Springer (2012).
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (fo**r Mapping with POs and PSOs)**
Students will be able to
CLO 1: To know the basic concepts of fuzzy logic.
CLO 2: To know about the operations on fuzzy sets.
CLO 3: To know about Fuzzy relations.
CLO 4: To understand decision making in Fuzzy environments
CLO 5: To know the applications of fuzzy logic in various fields.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DISCRETE MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1.Introduce the algebraic structures of lattices and Boolean algebra. Construct the switching circuits with applications.
2.Educate the finite fields and its mathematics properties.
3.Inculcate the polynomials over finite fields, Irreducibility and factorization of polynomials.
4.Indoctrinate the coding theory with the linear and cyclic codes.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I:Lattices
Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials - Minimal Forms of Boolean Polynomials.
Chapter 1: Sections 1–6
UNIT- II :Applications of Lattices
Switching Circuits – Applications of Switching Circuits.
Chapter 2:Sections 7–8
UNIT-III :Finite Fields
Finite Fields.
Chapter 3:Sections 13
UNIT-IV :Polynomials
Irreducible Polynomials over Finite Fields - Factorization of Polynomials over Finite Fields.
Chapter 3:Sections 14–15
UNIT -V:Coding Theory
Linear Codes – Cyclic Codes.
Chapter 4:Sections 17–18</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Indian Reprint, Springer Verlag,NewYork, 2006.</td></tr>
</table>

Reference Books	1.A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey. 2.J.L.Gersting, Mathematical Structures for Computer Science, 3rd Edn., ComputerSciencePress, New York. 3.S.Wiitala,Discrete Mathematics - A Unified Approach, McGraw Hill Book Co.
Website and e-Learning Source	1.http://www.discrete-math-hub.com/resources-and-help.html 2.https://onlinecourses.nptel.ac.in/noc22_cs123/preview 3. https://onlinecourses.nptel.ac.in/noc22_cs85/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Know the algebraic structures of lattices and Boolean algebra, and sketch the minimization of Boolean polynomials.

CLO2: Model the switching circuits with applications.

CLO3: Understand the finite fields and its mathematics properties.

CLO4: Acquire the notions of the polynomials over finite fields, Irreducibility and factorization of polynomials.

CLO5: Apply the coding theory with the linear and cyclic codes in cryptography.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	2	2	3	3	3	3
CLO2	3	3	2	2	3	3	3	3	3
CLO3	3	3	2	2	2	3	3	3	3
CLO4	3	3	2	2	3	3	3	3	3
CLO5	3	3	2	2	3	3	3	3	3

Semester II : Elective III and Elective IV

Elective III to be chosen from Group C and **Elective IV** to be chosen from Group D

Group C: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">RELIABILITY AND QUEUEING THEORY</td></tr>
<tr><td colspan="2"></td><td colspan="8">ELECTIVE</td></tr>
<tr><td colspan="2" rowspan="2">Category Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="3">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="3">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the subject of Reliability Engineering which provides the working knowledge to determine the Reliability of a System and suggests approaches to enhance System Reliability. Also includes Queuing theory, a Mathematical Approach to Analysis of Waiting Lines.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">Unit – I: Reliability Definition and Failure Data Analysis
Introduction – Definition of Reliability – Failure Data – Mean Failure Rate h – Mean Time To Failure(MTTF) – Mean Time Between Failures (MTBF) – Graphical Plots
.
Book – 1: Chapter 2, Sections: 2.1 & 2.2 and
Chapter 3, Sections: 3.2 to 3.6</td></tr>
<tr><td colspan="8">Unit – II: Failure Data Analysis
Four important points – MTTF in terms of Failure density – Generalization – Reliabilityin terms of Hazard rate and failure density – MTTF in integral form.
Book – 1: Chapter 3, Sections: 3.7 to 3.11</td></tr>
<tr><td colspan="8">Unit-III: System Reliability

Introduction – Series Configuration – Parallel Configuration – Mixed Configuration –Application to Specific Hazard Models.

Book 1: Chapter 6, Sections :6.1- 6.5</td></tr>
<tr><td colspan="8">Unit – IV: Introduction to Queueing Processes

Measures of System Performance – Characteristics of Queueing systems – The Experience of waiting – Little’s Law - General results- Simple data book keeping for queues

Book 2: Chapter- 1 Sections: 1.1–1.6</td></tr>
</table>

	Unit-V : Review of Stochastic Processes and Simple Markovian Queueing Models Exponential distribution - Poisson process – Discrete time Markov Chains – Continuous time Markov Chains – Birth and Death Process – Single server Queues M/M/1. **Book 2: Chapter 2 Sections : 2.1 – 2.4,** **Chapter 3, Sections : 3.1, 3.2**
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	1. Srinath. L.S., *Reliability Engineering*, East West Press, 4-ed, New Delhi. Reprint, 2013. 2. Donald Gross, John F. Shortle, James M. Thompson and Carl M. Harris, *Fundamentals of Queueing Theory*, 5th edition, Wiley India. Reprint 2018.
Reference Books	1.Cox. D. R. and H. D. Miller, *Theory of Stochastic Processes*, Methuen, London, 1965. 2.Cramer. H. and M. Leadbetter, *Stationary and Related Stochastic Processes*, Wiley, New York, 1966. 3.Karlin. S and H. Taylor, *A First course in Stochastic Processes*, 2nd edition, Academic Press, New York, 1975.
Website and e-Learning Source	https://en.wikipedia.org/wiki/Reliability_engineering https://en.wikipedia.org/wiki/Queueing_theory

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To Know about reliability function and failure concept.
CLO2: To understand system reliability with hazard function.
CLO3: To Understand the redundancy on system models.
CLO4: To know about basic concepts if queueing theory.
CLO5: To understand performance analysis of some queue systems.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	2	3
CLO2	3	2	1	1	2	1	1	2	3
CLO3	3	3	3	2	3	3	3	2	3
CLO4	3	2	3	3	3	3	3	2	3
CLO5	3	2	2	3	2	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. To know about Statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural etc.
2. To apply problem solving technique to solve real world event and acquire knowledge about hypothesis testing and the significance test.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I :Significance Test(Large samples)
The notion of a sample - The notion of a statistic - The distribution of the arithmetic mean of - independent normally distributed random variables –Test for sample proportions-Test for means.
Chapter 9: Sections 9.1 to 9.4</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-II :Significance Test(Small samples)
The chi-square distribution - The distribution of the statistic - Student’s t-distribution –Fisher’s Z-distribution.
Chapter 9: Sections 9.5 to 9.7</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-III : Significance Test
The concept of a statistical test - Parametric test for small samples - Parametric tests for large – samples- Examples based on small and large samples - The chi – square test - Independence tests by contingency tables.
Chapter 12: Sections 12.1 to 12.4</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-IV :Theory of Estimation
Preliminary notions - Consistent estimate - Unbiased estimate - Sufficiency – efficiency - Asymptotically most efficient estimate - Methods of finding estimates. (K1,K2,K3,K4,K5,K6)
Chapter 13: Sections 12.7, 13.1 to 13.4</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-V : Theory of estimation(contd…)
Aim of the Design of experiments - Basic Principles of Experimental Design - Some Basic Designs of Experiment - Analysis of variance - Comparison of RBD and LSD - Examples based on analysis of variance.
Chapter 13: 13.5 to 13.7</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">1. Marek Fisz - Probability Theory and Mathematical Statistics, 3rd Edition – John Wiley and Sons Inc, 1963.</td></tr>
</table>

Reference Books	1.Suddhenda Biswas and G. L. Sriwastav – Mathematical Statistics – Narosa Publishing House, 2011. 2.Alexander M. Mood, Franklin A.Graybill and Duane C.Bose – Introduction to Theory of Statistics, 3rd Edition - Tata McGraw Hill, 1974. 3.P. Kandasamy, K. Thilagavathy and K. Gunavathy - Probability, Statistics and Queuing Theory, 2nd Edition - Sultan Chand and Sons, 2005.
Website and e-Learning Source	1. https://www.scribd.com/document/294762054/Probability-Theory-and-Mathematical 2. https://r.search.yahoo.com/_ylt=AwrKAnSkarVk9P8.IiPnHgx.;_ylu=Y29sbwMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1689639716/RO=10/RU=https%3a%2f%2fdrive.google.com%2ffile%2fd%2f0B3ouU3Ur4aahVy13TzBfYjdUN3c%2fedit%3fusp%3dsharing/RK=2/RS=cZtZhaJAGtGLVB_.TFsHTeJhluc- 3. http://mathforum.org 4. http://ocw.mit.edu/ocwweb/Mathematics 5. http://www.opensource.org 6. https://nptel.ac.in 7. https://www.probability.net 8. www.coursera.org 9. https://swayam.gov.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the sample moments and their functions and analyze chi-square, Student-t, Fishers-Z distributions.

CLO2: Demonstrate the knowledge of the properties of parametric testing procedures.

CLO3: Estimate population parameters from data sets and use the sampling distributions to compute confidence intervals for these population parameters.

CLO4: Learn the basic components of hypothesis testing and perform hypothesis test on population means.

CLO5: Understand the basic terms used in design of experiments and use appropriate experimental designs to analyze the experimental data.

	Pos						PSOs		
	1	3	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	1	2
CLO3	3	3	3	3	2	1	3	3	3
CLO4	2	3	3	2	3	1	3	1	2
CLO5	3	2	3	3	2	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">R PROGRAMMING LANGUAGE(ONLY PRACTICAL)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>--</td><td colspan="2">--</td><td colspan="2">3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To master the use of R interactive environment with an understanding of the use of R documentation.
2. To use R for descriptive statistics and write simple programs in R.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">1. Perform arithmetic operations.
2. Create a Sequence and find the mean of numbers.
3. Find the first 10 Fibonacci numbers.
4. Find the factors of a given number.
5. Find the Maximum and Minimum of a given vector.
6. Read the CSV file and display the content.
7. Create matrix and perform matrix operations.
8. Create a bar plot,a scatter plot and a line graph.
9. Create a data frame and display the details.
10. Extract rows and columns from a data frame.
11. Create a list containing strings, numbers and vectors.
12. Find the Correlation and the Linear Regression between two variables.
13. Perform conditional executions.
14. Fit Binomial, Poisson and Normal distributions.
15. Perform Chi Square test for independence of attributes.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1.W. John Braun, Duncan J. Murdoch, A first course in statistical programming with R, Cambridge University Press, 2007.</td></tr>
</table>

Reference Books	1.Gardener, M. Beginning R: The statistical programming language, John Wiley & Sons,2012. 2.Martin, T. The Undergraduate Guide to R. A beginner's introduction to R programming Language, 2009. 3.Chambers, J. Software for data analysis: programming with R. Springer Science & Business Media, 2008.
Website and e-Learning Source	1. http://assets.cambridge.org/97805218/72652/frontmatter/9780521872652_frontmatter.pdf 2. http://students.aiu.edu/submissions/profiles/resources/onlineBook/A7E7d8_Beginning%20R%20statistics.pdf 3. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf 4. https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf 5. https://nptel.ac.in/ 6. https://swayam.gov.in/nc_details/NPTEL 7. https://www.coursera.org/ 8. https://spoken-tutorial.org/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Familiarize with basics of R software and built in function of R.

CLO2: Identify the characteristics of datasets and plot the datasets in R using graphical methods.

CLO3: Demonstrate understanding and use data frames.

CLO4: Implement the learning techniques and computing environment that are suitable for the applications under consideration.

CLO5: Compute vectors and matrices, matrix inverse, eigen values and eigen vectors.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	2
CLO1	3	3	3	3	3	1	3	3	2
CLO2	3	2	2	1	2	1	3	2	2
CLO3	2	3	1	2	3	2	3	3	2
CLO4	3	1	3	3	3	3	3	2	1
CLO5	3	2	3	1	3	1	3	3	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">TENSOR ANALYSIS AND RELATIVITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="7">UG level Vector Calculus and Mechanics.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The course aims to introduce vector algebra and vector calculus and special relativity and relativistic kinematics, dynamics and acceleratedsystems.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Tensor Algebra
Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in Sn - Invariants - Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors - Zero Tensor - Tensor Field Algebra of Tensors - Equality of Tensors - Symmetric and Skew – symmetric tensors - Outer multiplication, Contraction and Inner Multiplication - Quotient Law of Tensors - Reciprocal Tensor of Tensor Relative Tensor - Cross Product of Vectors.
Chapter I : I.1 - I.3, I.7 and I.8 and Chapter II : II.1 - II.19</td></tr>
<tr><td colspan="7">UNIT-II: Tensor Calculus
Riemannian Space - Christoffel Symbols and their properties
Chapter III: III.1 and III.2</td></tr>
<tr><td colspan="7">UNIT- III: Tensor Calculus (Contd)
Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation.
Chapter III: III.3 - III.5</td></tr>
<tr><td colspan="7">UNIT- IV: Introduction to Relativity
Introduction- Maxwell’s equation-the ether theory-the principle of relativity-relativistic kinematics –Events and simultaneity – examples</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Introduction to Relativity(Cont…..)
Time dilation – longitudinal contradiction-the invariant interval-proper time and proper distance –the world line line –example addition of velocities-example –the relativistic Doppler effect-example.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I,II and III)
2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (For Units IV and V)
.</td></tr>
</table>

Reference Books	1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949. 2. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930. 3. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942 4.C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938. 5.Goldstein , Classical Mechanics (Addition Wesley) 6.N E Rana & P.S Joag, Classical Mechanics (Tata McGraw Hills) 7. Schaum's outline series, vector analysis metric editions schaum's R.spiegell
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the system of different orders in Tenor Algebra.

CLO2: Explain about Tensor Calculus in Riemann spaces.

CLO3: Understand the concept of Covariant of differentiation and intrinsic differentiation

CLO4: Explain about the theory of relativity and Doppler effect.

CLO5: Analyze about the conservation of mass and energy.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	2	1	2	2	3	2	1
CLO2	2	1	3	1	3	2	3	2	1
CLO3	3	2	1	3	2	1	3	2	1
CLO4	2	3	1	2	3	1	3	2	1
CLO5	3	1	3	2	1	3	3	2	1

Group D: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">WAVELETS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basic Analysis and Linear Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To establish the theory necessary to understand and use wavelets and related constructions.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT I : An Overview
Fourier to Wavelets – Integral Wavelets Transform and Time frequency analysis – Inversion formulas and duals – Classification of Wavelets – Multi-resolution analysis – Spines and Wavelets. Fourier Analysis : Fourier and Inverse Fourier Transformation – Continuous Time Convolution – The delta function – Fourier Transformation of square integrable functions.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT II : Fourier Analysis (Cont…..)
Fourier Series – Basic Convergence Theory – Poisson Summation Formula.
Wavelet Transforms and Time Frequency Analysis
The Gabor Transforms – Short time Fourier Transforms and the uncertainty principle – The integral Wavelet Transform – Dyadic Wavelets – Inversion – Frames – Wavelet Series</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT III : Cardinal Spline Analysis
Cardinal Spline spaces – B-splines and their basic properties – The time scale relation and an interpolating graphical display algorithm – B-Net representations and computation of cardinal splines - Constructions of cardinal splines – constructions of spline application formulas – Construction of Spline interpolation formulas.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT IV : Scaling functions and Wavelets
Multi-resolution analysis – Scaling functions with finite two scale relation – Direction sum Decompositions of - Wavelets and their duals.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT V : Cardinal Splines Wavelets
Interpolating splines wavelets – Compactly supported spline – Wavelets – Computation of Cardinal spline Wavelets – Euler – Frebenious Polynomials.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,
Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Charles K. Chui, An Introduction to Wavelets. Academic Press, 1992.</td></tr>
</table>

Reference Books	1. Chui C. K. (ed), Approximation theory and Fourier Analysis, Academic Press Boston, 1991. 2. Daribechies I, Wavelets, CBMS-NSF Series in Appl, SIAM Philadelphia, 1992. 3. Schurnaker L, L. Spline Functions : Basic Theory, Wiley, New York, 1981. 4. Nurnberger G, Applications to Spline Functions, Springer Verlag, New York, 1989
Website and e-Learning Source	1. https://archive.nptel.ac.in/courses/108/101/108101093/ 2. https://onlinecourses.nptel.ac.in/noc23_ee32/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know Fourier transform and convolution of signals.

CLO 2: Know Fourier analysis and summation of series.

CLO 3: Learn scaling functions and wavelets.

CLO 4: Learn and wavelet transform of digital signals.

CLO 5: Learn interpolation of cardinal spline wavelets.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	2	1	3	2	3	2	1
CLO2	2	3	2	1	2	1	3	2	1
CLO3	3	3	3	1	3	2	2	2	1
CLO4	3	3	3	3	2	3	1	2	1
CLO5	3	2	3	3	2	2	1	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MACHINE LEARNING AND ARTIFICAL INTELLIGENCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1.To Learn about Machine Intelligence and Machine Learning applications
2.To implement and apply machine learning algorithms to real-world applications.
3.To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems. To understand how to perform evaluation of learning algorithms and model selection.
4.To understand about the basic theory of problem solving paradigmsand search strategies in artificial intelligence
5.To make the students familiar with knowledge representation, planning, learning, natural language processing and robotics</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="7">UNIT- I: Introduction
Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.</td></tr>
<tr><td colspan="7">UNIT-II: NeuralNetworks and Genetic Algorithms
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms
– Advanced Topics – Genetic Algorithms– Hypothesis Space Search –Genetic programming –Models of Evaluation and Learning.</td></tr>
<tr><td colspan="7">UNIT-III: Bayesian and Computational Learning
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network –EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT – IV:
Introduction - Intelligent Agents- Problem Solving - by Searching - Informed Search Strategies-Optimization Problems - Adversarial Search-Knowledge and Reasoning - Logical Agents - First-Order Logic - Inference in First-Order Logic - Knowledge Representation</td></tr>
</table>

	UNIT – V: Planning – Planning and Acting in the Real World - Uncertain knowledge and reasoning - Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions
Extended Professional Component	Questions related to the above topics, from various competitive examination UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.Tom M. Mitchell,―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013. 2.Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Third Edition, Prentice Hall of India, New Delhi, 2010.
Reference Books	1. Ethem Alpaydin,―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004. 2. Stephen Marsland,―Machine Learning: An Algorithmic Perspective, CRC Press,2009. 3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, Andreas Beham, ‖Genetic Algorithms and Genetic Programming‖,CRC Press Taylor and Francis Group. 4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017. 5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To understand fundamental issues and challenges of machine learning.

CLO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches

CLO3: Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning

CLO4: Understand the computation intelligence.

CLO5: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	2	2	2	2	3	3	2
CLO2	2	1	2	1	3	2	3	3	3
CLO3	3	2	2	2	2	3	2	2	2
CLO4	2	2	2	2	2	2	3	2	2
CLO5	3	1	2	2	3	3	2	2	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">NEURAL NETWORKS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Familiarity with linear algebra, multivariate calculus and probability theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To know the main fundamental principles and techniques of neural network systems and investigate the principal neural network models and applications.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Neuron Model and Network Architectures
Mathematical Neural Model-Network Architectures-Perceptron-Hamming Network-Hopfield Network-Learning Rules.</td></tr>
<tr><td colspan="8">UNIT-II : Perceptron Architectures
Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.</td></tr>
<tr><td colspan="8">UNIT-III : Supervised Hebbian Learning
The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation-Multilayer Perceptrons.</td></tr>
<tr><td colspan="8">UNIT-IV:Back Propagation
Back Propagation algorithm-convergence and Generalization-Performances surfaces and optimum points-Taylor series.</td></tr>
<tr><td colspan="8">UNIT-V:Performance Surface and Performance Optimizations
Directional derivatives-Minima-Necessary conditions for optimality-Quadratic functions-Performance optimizations-Steepest Descent Newton’s method-Conjugate Gradient.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Martin T. Hagan, Howard B/Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi, 2002.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1. James A.Freeman, David M.Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003.
2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.</td></tr>
</table>

Website and e-Learning Source	1.https://nptel.ac.in/courses/117/105/117105084/ 2. https://nptel.ac.in/courses/106/106/106106184/

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

CLO 1: Understand and analyze different neutron network models

CLO 2: Understand the basic ideas behind most common learning algorithms for multilayer perceptions, radial basis function networks.

CLO 3: Describe Hebb rule and analyze back propagation algorithms with examples.

CLO 4: Study convergence and generalization and implement common learning algorithms.

CLO 5: Study directional derivatives and necessary conditions for optimality and to evaluate quadratic functions.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	2	2	2	1	2	3	3
CLO2	3	2	2	1	1	1	1	2	2
CLO3	1	2	2	3	1	1	1	2	2
CLO4	2	2	1	1	2	1	1	1	2
CLO5	2	2	2	1	1	1	1	3	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DIFFERENCE EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To provide basic knowledge about the discretization process, the discrete version of difference equations and understand the Linear periodic systems.
2. Develop the students ability to difference equations using Z-transforms.
3. Enable to use of Oscillation Theory.
4. Study oscillation and asymptotic behavior of solutions of certain classes of differenceequations.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Linear Difference Equations of Higher Order
Difference Calculus-General Theory of Linear Difference Equations-Linear Homogeneous Equationswith Constant coefficients – Non-homogeneous equations: Method of Undetermined Coefficients, the method of variation of constants - Limiting behavior of Solutions.
Chapter 2: Sections 2.1 to 2.5
UNIT- 2: System of Linear Difference Equations
Autonomous Systems - The Basic Theory - The Jordan form – Linear periodic systems.
Chapter3: Sections 3.1to 3.4
UNIT- 3: The Z-Transform Method
Definitions and Examples, Properties of Z-transform-The Inverse Z-transformand Solutions Difference Equations: Power series method, partial fraction method, the inverse integral method
Chapter 6: Sections 6.1 to 6.3
UNIT- 4: Oscillation Theory
Three-term difference Equations– Self- Adjoint Second Order Equations-Non linear Difference Equations.
Chapter 7: Sections7.1 to 7.3
UNIT- 5: Asymptotic Behaviour of Difference Equation
Tools of Approximation - Poincare‟s Theorem - Asymptotically Diagonal Systems – High-OrderDifference Equations - Second Order Difference Equations.
Chapter 8: Sections 8.1 to 8.5</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	Saber N .Elaydi, An Introduction to Difference Equations, Third Edition, Springer Verlag, NewYork, 2005(First Indian Reprint 2008).
Reference Books	1.RonaldE.Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition, CRC Press, NewYork,2015. 2.R.P.Agarwal.,DifferenceEquationsandInequalities,MarcelDekker,1999. 3.S.Goldberg,IntroductiontoDifferenceEquations,DoverPublications,1986 4.V.LakshmikanthamandTrigiante,Theory of Difference Equations Numerical Methods and Applications, Second Edition, Academic Press, New York,1988. 5.WalterG.Kelly,AllanC.Peterson,DifferenceEquations,AnIntroductionwithApplications, Academic Press, NewYork, 2001(FirstIndianReprint2006).
Website and e-Learning Source	http://people.math.aau.dk/~matarne/11-mat/notes2011a.pdf, http://pj.freefaculty.org/guides/stat/Math/Difference Equations/Difference Equations-guide.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Solve problems on Linear Difference Equations of Higher order.

CLO 2: Understand the system of Linear Difference Equation

CLO 3: Apply Z-transform techniques indifference equations.

CLO 4: Explain on Oscillation Theory.

CLO 5: Discuss on Asymptotic Behavior of Difference Equation.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	1	2	3	1	3
CLO2	2	3	2	3	3	2	2	3	1
CLO3	3	3	1	3	1	3	3	2	1
CLO4	2	1	2	1	3	2	2	3	2
CLO5	3	2	3	3	2	1	2	1	3

Semester III : Elective V

Elective V to be chosen from Group E

Group E: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRAIC NUMBER THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Number Theory and Algebra Concept</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The course aims to provide a study on modules over rings, finite fields, algebraic extensions, number fields and cyclotomic fields, Noetherian rings and modules and Dedekind rings.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Algebraic Background
Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups.
Chapter 1: Sec. 1.1 to 1.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II: Algebraic Numbers
Algebraic numbers - Conjugatesand Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers.
Chapters 2: Sec. 2.1 to 2.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Quadratic and Cyclotomic Fields
Quadratics and cyclotomatic fields : Factorization into irreducibles: Trivial factorization - Factroization into irreducibles - Examples of non-uniquefactorization into irreducibles.
Chapter 3: Sec. 3.1 and 3.2 ; Chapter 4: Sec. 4.2 to 4.4</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- IV:
Prime Factroization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan -Nagell Theorem.
Chapter 4: Sec. 4.5 to 4.9</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- V :Ideals
Prime Factorization of Ideals - The norms of anIdeal - Non-unique Factorization in Cyclotomic Fields..
Chapter 5 : Sec. 5.2 to 5.4</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">I. Steward and D.Tall. Algebraic Number Theory and Fermat‘s Last Theorem (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002.</td></tr>
</table>

Reference Books	1. Z.I.Bosevic and I.R.Safarevic, Number Theory, Academic Press, New York, 1966. 2. J.W.S.Cassels and A.Frohlich, Algebraic Number Theory, Academic Press, New York, 1967. 3. P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972. 4. P. Samuel, Algebraic Theory of Numbers, Houghton Mifflin Company, Boston, 1970. 5. A.Weil. Basic Number Theory, Springer, New York, 1967.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

CLO1: To know about rings, fields and factorization of polynomials .

CLO2: To know about norms and traces over ring of integers.

CLO3: To understand factorization to irreducible polynomials.

CLO4: To understand Euclidean Quadratic fields

CLO5: To know concepts of ideals .

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">FLUID DYNAMICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td colspan="2">--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To discuss Kinematics in motion, to know about three dimensional flow and to analyze viscous flows.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I: Kinematics of Fluids in Motion
Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows –Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples.
Chapter 2: Sections 2.1 to 2.8</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-II: Equations of Motion of Fluid
Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion –Discussion of the case of steady motion under conservative body forces.
Chapter 3: Sections 3.1 to 3.7</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-III: Some Three Dimensional Flows
Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetricflows – Stokes stream function.
Chapter 4: Sections 4.1, 4.2, 4.3, 4.5</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-IV: Some Two Dimensional Flows
The stream function – The complex potential for two dimensional, irrational incompressible flow –Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems –The Milne Thompson circle Theorem.
Chapter 5: Sections 5.3 to 5.8</td></tr>
</table>

	UNIT-V: Viscous Flows Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements –The co-efficient of viscosity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid. **Chapter 8: Sections 8.1 to 8.3, 8.8 and 8.9**
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	F. Chorlton, Text Book of Fluid Dynamics,CBS Publications. Delhi ,1985.
Reference Books	1.R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985. 2.E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005. 3.B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005 4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002. 4.T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics,Springer, Berlin, 2004.
Website and e-Learning Source	http://web.mit.edu/1.63/www/lecnote.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the concepts of kinematics of fluids in motions.

CLO2: Find the pressure at a point in a moving fluid.

CLO3: Discuss Stokes stream function.

CLO4: Analyse complex velocity potential for two dimensional flows.

CLO5: Derive the Navier – Stokes equations of motion of a Viscous fluid

	Pos						PSOs		
	1	2	3	1	5	6	1	2	3
CLO1	3	3	3	2	3	1	3	3	3
CLO2	3	3	2	2	2	2	2	2	3
CLO3	3	3	3	2	3	1	3	3	3
CLO4	3	3	3	3	3	1	3	2	3
CLO5	3	3	3	3	3	3	1	3	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">STOCHASTIC PROCESSES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course aims to introduce advanced topics in Markov process, Markov chains and Renewal theory.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT - I : Stochastic Processes
Stochastic processes – Specification of Stochastic processes – Markov Chains : Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials.
Chapter1 :1.5; Chapter2 :2.1to 2.3

UNIT - II : Markov Chains
Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of states – Reducible chains – Statistical inference for Markovchains.
Chapter2:2.6 to2.10

UNIT - III : Markov Processes with Discrete State Space
Poisson process: Poisson process and Related distributions – Generalizations of Poisson process.
Chapter3 :3.1 to 3.3

UNIT - IV : Markov Processes with Discrete State Space (Cont…..)
Birth and death process – Markov processes with discrete state space (Continuoustime Markov chain).Continuous time Markov chain).
Chapter3 :3.4 and 3.5

UNIT - V : Markov Processes with Continuous State Space
Brownian motion – Weiner process – Differential equations for Weiner Process – Kolmogorov equations – First passage time distribution for Weiner process.
Chapter4 :4.1 to 4.5</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	J. Medhi, Stochastic Processes (3rd Edition), New Academic Science Limited,2012.
Reference Books	1.S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press,1958. 2.U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972. 3.E. Cinlar, Introduction to Stochastic Processes, PHI, 1975 4.S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa, 2003.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To know the classification of stochastic processes.

CLO2: To know Markov chains and the stability condition.

CLO3: To understand Poisson process and its properties.

CLO4: To Discuss about Poisson process and birth and death process.

CLO5: To understand Brownian process and Weiner process.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICALPYTHON</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce to students Python programming.
To learn python coding to implement algorithms for Mathematical problems.</td></tr>
<tr><td colspan="2">CourseOutline</td><td colspan="7">Unit-I:Introduction to Python
Basicsyntax,variabletypes,basicoperators,numbers,strings,lists,tuples, Functions and input/output statements. Some simple programs to understand the relational, conditional and logical operators. Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using whileloop; Finding the factors of a number using for loop; To check the given number is prime or not(useif...elsestatement); Find the factorial of a number (use if...if...else).; Simple programs to illustrate logical operators(and, or, not).

Unit-II: Matrices, Differential Calculus & Analytical Geometry of Three Dimensions
Pythoncommandstoreducegivenmatrixtoechelonformandnormalformwithexamples.Pythonprogram/commandtoestablishtheconsistencyorotherwiseandsolving system of linear equations. Python command to find the nth derivatives. Python program to find nth derivative with and without Leibnitz rule. Obtaining partial derivative of some standard functions Verification of Euler‘s theorem, its extension and Jacobean. Pythonprogram for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder.

Unit-III:Roots of High-Degree Equations-Systems of Linear Equations
Introduction, Simple Iterations Method - Finite Differences Method, Gauss Elimination Method: Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method.</td></tr>
</table>

	Unit-IV: Numerical differentiation, Integration and Ordinary Differential Equations Introduction & Euler's Method, Second Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method, Fourth Order Runge-Kutta'sMethod: Plot Numerical and Exact Solutions.
	Unit-V: Two-Point Boundary Value Problems Introduction to two-point boundary value Problems second order differential equations -Higherorderdifferentialequations-solutionofsecondorderdifferentialequationusing Finite Difference Method.
ExtendedProfessionalComponent	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TNPSC/others tobe solved(TobediscussedduringtheTutorialhour)
Skills acquiredfromthiscourse	Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency, Professional Communication and Transferrable Skill
RecommendedText	1.J.Kiusalaas,Numericalmethodsinengineeringwith Python3.Cambridge UniversityPress, 2013. 2.H.P.Langtangen,SolvingPDEsinPython:theFEniCStutorialI.SpringerOpen,2016
ReferenceBooks	
Websiteand e-LearningSource	1.www.python.org 2.www.rosettacode.org 3.http://faculty.msmary.edu/heinold/python.html

CourseLearningOutcome (forMappingwith POsandPSOs)

Studentswillbeable to

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	2	2	1	2	2	3	2	3
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	1	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	3	3	3

Semester IV : Elective VI
Elective VI to be chosen from Group F

Group F: **(PM/AP/IC/ITC)**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FINANCIAL MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To study financial mathematics through various models and to study the various aspects of financial mathematics.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT – I:
Single Period Models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure.
Chapter 1</td></tr>
<tr><td colspan="7">UNIT – II:
Binomial Trees and Discrete Parameter Martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem – Overture to Continuous models.
Chapter 2</td></tr>
<tr><td colspan="7">UNIT – III:
Brownian Motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.
Chapter 3</td></tr>
<tr><td colspan="7">UNIT – IV:
Stochastic Calculus: Non-differentiability of Stock prices - Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem - Brownian Martingale Representation Theorem – Geometric Brownian Motion - The Feynman - Kac Representation.
Chapter 4</td></tr>
<tr><td colspan="7">UNIT – V:
Block-Scholes Model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends - Bonds – Market price of risk.
Chapter 5</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.
Reference Books	1.Martin Boxter and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996. 2. Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau and Farancois Mantion), 3. Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall,1996. 4. Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988. 5. Robert J.Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets,Springer Verlag, New York, 2001 (3rd Printing)
Website and e-Learning Source	https://archive.org/details/financialmathema032436mbp

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Use discrete and continuous processes in financial modeling.

CLO 2 : Gain knowledge in the relationship between stochastic and deterministic models.

CLO 3: Understand the roles of Put and Call options in risk reduction also

CLO 4 : understand hedging strategies to reduce risk.

CLO 5: Understand the role of the Black-Scholes partial differential equation and its boundary and final conditions in option pricing.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	1	3	1
CLO2	3	3	2	1	2	2	3	2	2
CLO3	3	2	3	2	3	3	2	1	3
CLO4	3	3	3	3	3	3	3	2	3
CLO5	3	2	3	3	3	3	1	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">RESOURCE MANAGEMENT TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">--</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To be familiar with resource management techniques.
2. To Learn to solve problems in linear programming and Integer programming.
3. To understand CPM and PERT techniques in scheduling problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT- I : Linear Programming
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution –Resource allocation problems – Simplex method.</td></tr>
<tr><td colspan="7">UNIT – II: Duality and Networks
Introduction- Definition of dual problem–General Primal– Dual pair – Formulating a dual problem – Dual relationships – Dual simplex methods.</td></tr>
<tr><td colspan="7">UNIT- III: Integer Programming
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.</td></tr>
<tr><td colspan="7">UNIT- IV: Classical Optimisation Theory
Unconstrained external problems, Newton – Ralphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.</td></tr>
<tr><td colspan="7">UNIT- V: Object Scheduling
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">H.A. Taha, ―Operation Research‖, Prentice Hall of India, 2002.</td></tr>
</table>

Reference Books	1. Paneer Selvam, Operations Research', Prentice Hall of India, 2002 2. Anderson Quantitative Methods for Business', 8th Edition, Thomson Learning, 2002. 3. Winston Operation Research', Thomson Learning, 2003. 4. Vohra, Quantitative Techniques in Management', Tata Mc Graw Hill, 2002. 5. Anand Sarma, Operation Research', Himalaya Publishing House, 2003.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: To solve linear programming problems by using simplex method

CLO2: To solve transportation and assignment problems.

CLO3: To solve integer and dynamic programming.

CLO4: To know optimization theory .

CLO5: To know CPM and PERT for project scheduling .

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	3	3	3	3	1	3
CLO2	3	2	2	2	2	2	3	2	2
CLO3	3	3	3	2	3	3	3	3	3
CLO4	3	2	3	3	3	2	2	2	1
CLO5	3	2	3	3	3	3	3	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MODELING AND SIMULATION WITH EXCEL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT–I : Presentation Of Quantitative Data
Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation.
Analysis of Quantitative Data : Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analysis of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data—Forecasting/Data Relationship Tools.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- II : Presentation Of Qualitative Data
Introduction-Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter.
Analysis of Qualitative Data
Introduction-Essentials of Qualitative Data Analysis-PivotChart or PivotTable Reports.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT–III : Inferential Statistical Analysis Of Data
Introduction-χ 2—Chi-Square Test of Independence for Categorical Data-z-Test and t-Test of Categorical and Interval Data-An Example-ANOVA-Experimental Design.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT–IV : Modeling And Simulation: Part 1 Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V : Modeling And Simulation: Part 2
Types of Simulation and Uncertainty-The Monte Carlo Sampling Methodology-A Financial Example—Income Statement-An Operations Example—Autohaus.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Excel data analysis modelling and simulation, Hector Guerrero, Springer-Verlag Berlin Heiddelberg 2010.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="7">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know to present and analyze quantitive data.

CLO 2: Know to present and analyze qualitative data.

CLO 3: Know inferential statistical analysis of data.

CLO 4: Know modeling and simulation for deterministic data.

CLO 5: Know modeling and simulation for non deterministic data.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	3	3	3	3	2
CLO2	2	3	2	1	2	2	3	3	2
CLO3	2	3	3	1	1	2	2	3	2
CLO4	3	3	3	3	2	3	3	3	2
CLO5	3	2	3	3	3	1	2	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL PYTHON - PRACTICAL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>--</td><td colspan="2">--</td><td colspan="2">4</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To Apply basic Python and to solve mathematical problems,
Graphical representation and manipulation of data using python</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">1.Find minimum/maximum in a list / guess an integer in given range
2.Distance between two points
3.Find GCD
4.Sum an array of numbers
5.Linear search
6.Binary search.
7.Find the numbers which are divisible by n in a given range
8.Print first n Fibonacci numbers
9.Selection sort
10.Insertion sort
11.Merge sort
12.Count word frequencies
13.Generate adjacency matrix of any graph on n vertices
14.Find degree of vertices from given adjacency matrix of the graph
16.Find odd number in given array/ Replace odd numbers with given integer in the given array
17.Compute multiplication of two 3x3 matrices
18.Compute mean and standard deviation of given array
19. Create a Barplot/Piechart for comparing three features.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired fromthis course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Allen B. Dowley, Think Python: How to Think Like a Computer Scientist, 2nd Edition.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="7">1.Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018.
2.Jake VanderPlas, Python Data Science Hand Book: Essential Tools</td></tr>
</table>

	for working with Data, O'Reilly, 2017. 3.Wesley J. Chun, *Core Python Programming*, Prentice Hall, 2006. 4.N.Safina Devi and C.Devamanoharan, *Algorithmic Problem Solving and Python- A Beginner's Guide*, Francidev Publications, 2023.
Website and e-Learning Source	1.www.python.org 2.www.rosettacode.org 3.http://faculty.msmary.edu/heinold/python.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Write programs using advanced concepts of Python.
CLO 2: Write, Test and Debug Python Programs.
CLO 3: Implement Conditionals and Loops for Python Programs.
CLO 4: Use functions and represent Compound data using Lists, Tuples and Dictionaries.
CLO 5: Read, write and manipulate data from & to files in Python.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	3	2	3	3	3	3
CLO2	3	2	3	3	2	3	3	3	3
CLO3	3	2	3	3	3	3	3	3	3
CLO4	3	2	3	3	3	3	3	3	3
CLO5	2	2	2	3	3	3	3	3	3

SKILL ENHANCEMENT COURSES

Skill Enhancement Courses are chosen so as to keep in pace with the latest developments in the academic / industrial front and provides flexibility of choice by the stakeholders / institutions.

Group G (Skill Enhancement Courses) SEC

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL COMPUTATION WITH SAGEMATH</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td></td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">2</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT- I: First Steps
The Sage Program -Sage as a Calculator</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- II: Analysis and Algebra
Symbolic Expressions and Simplification – Equations – Analysis Basic Linear Algebra</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- III: Programming and Data Structures
Syntax –Algorithmics -Lists and Other Data Structures</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- IV: Graphics
2D Graphics - 3D Curves</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- V: Computational Domains
Sage is Object-Oriented- Elements, Parents, Categories-Domains with a Normal Form-Expressions vs Computational Domains</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Mathematical Computation with SageMath ,Paul Zimmermann Alexandre Casamayou.</td></tr>
</table>

Reference Books	1.Uri M. Ascher and Linda R. Petzold, Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations. Society for Industrial and Applied Mathematics, 1998, ISBN 0898714128. 2. Noga Alon and Joel H. Spencer, The Probabilistic Method. Wiley-Interscience, 2000, ISBN 0471370460. 3. Bernard Beauzamy, Robust mathematical methods for extremely rare events. On-line, 2009. http://www.scmsa.eu/RMM/BB_rare_ events_2009_08.pdf, 20 pages.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course		**MATHEMATICAL DOCUMENTATION USING LATEX**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	

Objectives of the Course	1. Inculcate the computer knowledge. 2. Introduce the LaTeX software 3. Train in the Preparation of Project and dissertations using LaTex. 4. Educate the Latex coding. 5.Understand the concepts of Cross References, Footnotes, 6.Margin pars and Endnotes
Course Outline	**UNIT – I: Basic Document and Bibliography** What is LATEX – Simple typesetting – Fonts Type size – Document class – page numbering – Formatting lengths – parts of a document – Dividing the document – what next? –Introduction – natbib – The BIBTEX program – BIBTEX Style files – Creating a bibliographicdatabase. **Chapter: 1 to 4**
	UNIT – II: Contents, Index, Glossary, Text, Row and Column Table of contents – Index – Glossary. Borrowed words – Poetry in typing – Making lists – Whenorder matters – Description and definitions. **Chapter: 5 to 6**
	UNIT – III: Typesetting Equations and Theorems Keeping tabs – Tables – The basics – Custom commands – More on mathematics miscellany – New operations– The many fact of mathematics – Symbols – Theory in LATEX – Designer theorem-the amsthm package – Housekeeping. **Chapter: 7 to 9**

	UNIT – IV: Several Kinds of Boxes and Floats LR boxes – Paragraph boxes – Paragraph boxes with specific height – Nested boxes – Roleboxes – The figure environment – The table environment. **Chapter: 10 to 11**	
	UNIT – V: Cross References in Latex, Footnotes, Margin pars and endnotes Why cross reference? – Let LATEX do it – Pointing to a page-the package varioref – Pointing outside-the package xr – Lost the keys? Use lables.tex – Footnotes – Marginal notes – Endnotes. **Chapter: 12 to 13**	**18 hou**
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill	
Recommended Text	A Primer, Latex Tutorials, Indian TEX users group, Trivandrum, India.	
Reference Books	1.Peter Flynn, A beginner"s introduction to typesetting with 2.LATEX,Silmaril Consultants,Textual Therapy Division, 2003. 3.George Gratzer,More Math Into LATEX, 4th Edition, Springer Science (2007). 4.Frank Mittelbach,Michel Goossens,The LaTex Companion, Second Edition, Addison-Wesley, 2004.	
Website and e-Learning Source	https://www.latex-tutorial.com/tutorials/ https://www.latex-tutorial.com/ http://www.tug.org.in/tutorials.html	

Title of the Course		**OFFICE AUTOMATION AND ITC TOOLS**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	
Course Outline		**UNIT- I:** Office Automation-Office and Office Automation					
		UNIT- II: Computer Mail Systems - Telecommunication and Word Processor					

	UNIT- III: WP Hardware Configuration
	UNIT- IV: Reprographics-Electronic Mail and Electronic-Filing
	UNIT- V: Facsimile Transmission and Micrographics -Voice Technology
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	1.Office Automation Tools and Technology (Unit I & Unit-II) 2. Office Automation Tools ,Yatendra kumar & suitha varshney , Naveen prakashan pvt .Ltd
Reference Books	1.Office Automation Tools ,Dr.Rizwan Ahmed , Naveen prakashan pvt .Ltd 2.Office Automation Tools, Dr.Babasaheb Ambedkar
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course		**NUMERICAL ANALYSIS USING SCILAB**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	
Objectives of the Course		To understand numerical analysis by using SCILAB					
Course Outline		**UNIT I** Transcendental and Polynomial Equations					
		UNIT II System of Linear Algebric Equations and Eigenvalue Problems					
		UNIT III Interpolation and Approximation					
		UNIT IV Differentiation and Integration					

	UNIT V Ordinary Differential Equations Initial Value Problems
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.Numerical Methods For Scientific And Engineering Computation by M. K. Jain, S. R. K. Iyengar And R. K. Jain.
Reference Books	1. Numerical Methods and principles analysis and algorithms ,S.Pal ,Oxford University Press
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course		**DIFFERENTIAL EQUATIONS USING SCILAB**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	
Objectives of the Course		1.Understand the basic commands 2.Solve the system of equations 3.Evaluate the polynomials 4.Solve the Ordinary differential equations.					
Course Outline		**UNIT-I: Introduction to Scilabb** Login - Talking between Scilab and the Editor - Basic Commands - Linear Algebra - Loops andConditionals - Help in Scilab. **Chapter 1: Sections 1.1 to 1.7**					
		UNIT-II: Matrix Calculation Matrices and Vectors - Solving Equations - Creating Matrices - Systems of Equations. **Chapter 2: Section 2.2**					
		UNIT-III: Data and Function Plots Plotting Lines and Data - Adding a Line - Hints for Good Graphs – Graphs - Function Plotting –Component Arithmetic - Printing Graphs - Saving Graphs. **Chapter 3: Sections 3.2, 3.3**					

	UNIT- IV: Polynomials Evaluation of Polynomials – Polynomials - Linear Least Squares (Heath Computer Problem). **Chapter 6: Sections 6.2, 6.3, 6.4**
	UNIT-5: Differential Equation Differential Equations - Scalar ODE's - Order 2 ODE's . **Chapter 8: Sections 8.2**
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Graeme Chandler and Stephen Roberts, Scilab Tutorials for Computational Science, 2002.
Reference Books	1.Scilab for very beginners, Scilab Enterprises, S.A.S, 143, bis rue Yves Le Coz – 78000Versailles (France). 2.K. S. Surendran, SCILAB FOR DUMMIES, Version 2.6. 3.Some notes on SCILAB, Universit´e de Nice Sophia-Antipolis.
Website and e-Learning Source	https://www.scilab.org/

Title of the Course		**INDUSTRIAL MATHEMATICS USING LATEST PROGRAMMING PACKAGES**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	
Course Outline		**UNIT- I:** Mathematics in industry- Overview of the case studies-Units and dimensions - Diffusion equations - Heat conduction equations					
		UNIT- II: Boundary conditions -Solving the heat/diffusion equation - Scalingequations - Dimensional analysis					
		UNIT- III: Continuous Casting - Introduction to the case study problem - The Boltzmann similarity solution- A moving boundary problem - The pseudo- steady-state approximate solution-Solving the continuous casting case Study					

	UNIT- IV: Water Filtration - Introduction to the case study problem – Stretching transformations - Diffusion from a point source -Solving the waterfiltration case study
	UNIT- V: Laser Drilling -Introduction to the case study problem - Method of perturbations -Boundary perturbations - Solving the laser drilling casestudy
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Industrial Mathematics Case Studies in the Diffusion of Heat and Matter ,GLENN R. FULFORD PHILIP BROADBRIDGE
Reference Books	
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course		**RESEARCH TOOLS AND TECHNIQUES**					
Paper Number		**SEC**					
Category	Elective	**Year**		**Credits**	2	**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	2		--	4	
Course Outline		**UNIT- I:** Research Process- Research Design					
		UNIT- II: Research Problem-Variables and Their Types					
		UNIT- III: Formulation of Hypothesis– Sampling- Tools of Data Collection					
		UNIT- IV: Data Analysis- Interpretation of Data					
		UNIT- V: Research Methods - Descriptive or Survey Method - ExperimentalMethod					
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)					

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Research Methodology: Tools And Techniques Dr. Prabhat Pandey Dr. Meenu Mishra Pandey © Bridge Center, 2015
Reference Books	1. Ackoff, Russell L. (1961). The Design of Social Research, University of Chicago Press: Chicago. 2. Allen, T. Harrell, (1978). New Methods in Social Research, Praeger Publication: New York. 3. Baker, R.P. & Howell, A.C. (1958). The Preparation of Reports, Ronald Press: New York. 4. Barzun, Jacques & Graff. F. (1990).The Modern Researcher, Harcourt, Brace Publication: New York. 5. Berelson Conard & Colton, Raymond. (1978). Research and Report Writing for Business and Economics, Random House: New York.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course		**HUMAN RIGHTS**						
Paper Number		**COMPULSORY PAPER**						
Category	SEC	**Year**	**II**	**Credits**	**2**	**Course Code**		
		Semester	**II**					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**	
		2	-		-		**2**	
Course outline		**Unit – I :** Definition of Human Rights – Nature, Content, Legitimacy and Priority – Theories of Human Rights – Historical Development of Human Rights.						
		Unit- II: International Human Rights – Prescription and Enforcement upto World War II – Human Rights and the U. N. O. – Universal Declaration of Human Rights – International Covenant on Civil and Political Rights – International Covenant or Economic, Social and Cultural Rights and Optional Protocol.						
		Unit –III: Human Rights Declarations – U.N. Human Rights Declarations – U.N. Human Rights Commissioner.						
		Unit-IV: Amnesty International – Human Rights and Helsinki Process – Regional Developments – European Human Rights System – African Human Rights System – International Human Rights in Domestic courts.						

	Unit-V: Contemporary Issues on Human Rights: Children's Rights – Women's Rights – Dalit's Rights – Bonded Labour and Wages – Refugees – Capital Punishment. Fundamental Rights in the Indian Constitution – Directive Principles of State Policy – Fundamental Duties – National Human Rights Commission.
Reference Magazines	1.The Lawyer, Bombay. 2.Human Rights Today, Columbia University. 3.International Instruments of Human Rights, UN Publication.
Books for Reference	1.International Bill of Human Rights, Amnesty International Publication, 1988. 2.Human Rights, Questions and Answers, UNESCO, 1982. 3.Mausice Cranston- What is Human Rights. 4.Desai, A.R - Violation of Democratic Rights in India. 5.Pandey - Constitutional Law. 6.Timm R.W - Working for Justice and Human Rights. 7.Human Rights- A Selected Bibliography, USIS. 8.J.C. Johari - Human Rights and New World order. 9.G.S. Bajwa - Human Rights in India. 10.Amnesty International - Human Rights in India. 11.P.C. Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security, Social Justice and Human Rights (Vols. 1 - 7). 12.Devasia, V.V - Human Rights and Victimology.

Title of the Course	**TERM PAPER & SEMINAR PRESENTATION**							
Paper Number	**Skill Enhancement Course – II**							
Category SEC	**Year**	**II**	**Credits**	**2**	**Course Code**			
	Semester	**III**						
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**		**Total**	
	2		1		-		**3**	
Course outline	Professional Communication Skill : Term paper & Seminar presentation Assignment of Problem by faculty Lecture - I (by the student) 25% Lecture - II (by the student) 25% Lecture - III (by the student) 25% Submission of a write-up (10 to 15 pages using LaTex) 25% Marks / Grade Points / Lecture Grade as per the Regulation)							

Title of the Course	**INTERNSHIP / INDUSTRIAL ACTIVITY**					
Category	**Year**	**II**	**Credits**	**2**	**Course Code**	
	Semester	**III**				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**			
	--	--	--			

Title of the Course	TRAINING FOR COMPETITIVE EXAMINATIONS							
Paper Number	Skill Enhancement Course - III Professional Competency Skill Enhancement							
Category SEC	Year	II	Credits	2	Course Code			
	Semester	IV						
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total	
	2		2		-		4	
Course Outline	1.Training for Competitive Examinations Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) 2.General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)							

Title of the Course	EXTENSION ACTIVITY							
Paper Number								
Category	Year	II	Credits	1	Course Code			
	Semester	IV						
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total	
	--		--		--		--	
Course Outline	Syllabus will be prepared by the University as a common course to all PG Programmes.							