MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

DEPARTMENT OF MATHEMATICS

M.Sc. MATHEMATICS

SYLLABUS TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2023-2024

(Choice Based Credit System)

As per the Guidelines Tamil Nadu State Council for Higher Education (TANSCHE)

Mother Teresa Women's University, Kodaikanal

Department of Mathematics

Choice Based Credit System (CBCS)

(2023-2024 onwards)

M.Sc. Mathematics

1. About the Programme:

The M. Sc Mathematics curriculum is dedicated to preparing students for productive careers after
3-5 years of graduation.

1. Apply their knowledge in modern industry or teaching or secure acceptance in High quality
graduate programs in mathematics

2. Development in their chosen profession and/or progress toward an advanced degree

3. The trust and respect of others as effective and ethical team members.

4. Graduates will become effective collaborators and innovators, leading or participating In efforts to address social, technical and business challenges.

5. Promote the culture of interdisciplinary research among all disciplines and applied Mathematics

2 Programme Educational Objectives (PEOs)

3.. Eligibility :B.Sc. Mathematics , B.Sc. Applied Mathematics B.Sc. Mathematics with Computer Applications

General Guidelines for PG Programme:

1. Duration: The programme shall extend through a period of 4 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.

2. Medium of Instruction: English

3. Evaluation: Evaluation of the candidates shall be through Internal and External assessment. The ratio of formative and summative assessment should be 25:75 for both Core and Elective papers.

Evaluation Pattern

	Theory		**Practical**	
	Min	**Max**	**Min**	**Max**
Internal	**13**	**25**	**13**	**25**
External	**38**	**75**	**38**	**75**

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz (5) = 25**
- **External Theory: 75**

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

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Different Types of Courses

Project Report

A student should select a topic for the Project Work at the end of third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman 12 font size with 1.5 line space. .

Evaluation:

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks, Viva: 75 Marks)

Minimum credits required to pass - 91.

5.Conversion of Marks to Grade Points and letter Grade(Performence in a Course/Paper)

Range of Marks	**Grade Points**	**Letter Grade**	**Description**
90-100	**9.00-10.00**	**O**	**Outstabding**
80-89	**8.0-8.9**	**D^+**	**Excellent**
75-79	**7.5-7.9**	**D**	**Distinction**
70-74	**7.0-7.4**	**A^+**	**VeryGood**
60-69	**6.0-6.9**	**A**	**Good**

50-59	**5.0-5.9**	**B**	**Average**
00-49	**0.0-4.9**	**U**	**Re-Appear**
ABSENT	**0.0**	**AAA**	**ABSENT**

5. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination, Students with 71% to 74% of attendance must apply for condonation in the prescribed form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students with attended less than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, principal and the Registrar of the University.

6.Maternity Leave – The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and The Registrar.

7.Any Other Information:

In addition to the above regulations, any other common regulations pertaining to the PG Programmes are also applicable for this programme

Post Graduate Programme

Programme Outcomes:

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an Post graduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.

PO4: Analytical & Scientific Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Research related skills: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned research perspective; Sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and effect relationships / define problems. Formulate hypothesis, Test / analyse / Interpret the results and derive conclusion, formulation and designing mathematical models

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

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 skills, which 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		
		2	3	4	5	6	…	1	2	…
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										

3. Learning and Teaching Activities

3.1 Topic wise Delivery method

Hour Count	Topic	Unit	Mode of Delivery

3.2 Work Load

The information below is provided as a guide to assist students in engaging appropriately 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

1. **Tutorial Activities**

Tutorial Count	**Topic**

2. **Laboratory Activities**
3. **Field Study Activities**
4. **Assessment Activities**

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%

TEACHING METHODOLOGIES

Traditional Teaching methods like Chalk and Board, Virtual Classroom, LCD projector, Smart Class, Video Conference, Guest Lectures.

Asking students to formulate a problem from a topic covered in a week's time

Assignment, Class Test, Slip test

Asking students to use state-of-the-art technologies/software to solve problems

Applications, Use of Mathematical software

Introducing students to applications before teaching the theory

Training students to engage in self-study without relying on faculty (for example – library and internet search, manual and handbook usage, etc.)

Library, Net Surfing, Manuals, NPTEL Course Materials published in the website

Other university websites.

Faculty Course File Structure

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

M.Sc. Mathematics- Curriculum

PART	Course Code	Course Title	Credits	Hours per week(L/T/P)	CIA	ESE	Total
Semester I							
PART A	P23MTT11	CC1 - Algebraic Structures	5	7(6L+1T)	25	75	100
	P23MTT12	CC2 - Real Analysis I	5	7(6L+1T)	25	75	100
	P23MTT13	CC3 - Ordinary Differential Equations	4	6(5L+1T)	25	75	100
	P23MTE1A / P23MTE1B / P23MTE1C	Elective-I (Departmental Elective) – a. Number Theory and Cryptography b. Graph Theory and Applications c. Formal Languages and Automata Theory d. Programming in C++ and Numerical Methods	3	5(4L+ 1T)	25	75	100
	P23WSG11	Elective - II (Generic Elective - Women Empowerment)	3	5(4L+ 1T)	25	75	100
		Total	**20**	**30**	**-**	**-**	**500**
Semester II							
PART A	P23MTT21	CC4 – Advanced Algebra	5	6(5L+1T)	25	75	100
	P23MTT22	CC5 – Real Analysis II	5	6(5L+1T)	25	75	100
	P23MTT23	CC6 - Partial Differential Equations	4	6(5L+1T)	25	75	100
	P23MTE2A / P23MTE2B / P23MTE2C / P23MTE2D	Elective III (Department Elective) – a. LIE Groups and ANDLIE Algebra b. Mathematical Programming c. Fuzzy Sets and their	3	4(3L+ 1T)	25	75	100

		Applications d. Discrete Mathematics a.					
	P23CSG22	Elective – IV (Generic Elective - Cyber Security	3	4(3L+2T)	25	75	100
	P23MTN21	NME-Skill Enhancement Course -SEC 1	2	4	Internal Assessment		100
		Total	**22**	**30**	**-**	**-**	**600**

Elective Courses

Semester I : Elective I to be chosen from Group A

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

1..Number Theory and Cryptography

2.Graph Theory and Applications

3.Formal Languages and Automata Theory

4.Programming in C++ and Numerical Methods

Semester II : Elective IIIto be chosen from Group B

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

1. Lie Groups and Lie Algebras
2. Mathematical Programming
3. Fuzzy Sets and Their Applications
4. Discrete Mathematics

SEMESTER -II -NME-SEC I

GROUP- C

NME -Skill Enhancement Courses -SEC-I

Students from other Departments may also choose any one of the following as NME

NME -I: Mathematics for Life Sciences/ Differential Equations

NME-II: Mathematics for Social Sciences/ Numerical Methods

NME -III: Statistics for Life and Social Sciences/ Statistics

NME -IV: Game Theory and Strategy/ Operation Research

NME -V: History of Mathematics/ Mathematical Aptitude

Outside class hours

- Health, Yoga and Physical Fitness
- Library Information access and utilization
- Employability Training
- Students Social Responsibility

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.

(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 M.Sc. MATHEMATICS

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ALGEBRAIC STURUCTURES</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">P23MTT11</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 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 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"></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 - Direct products - Finite abelian groups- Modules
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>
</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	I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi 2002.
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 nil potence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nil potence 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="6">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE II</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">P23MTT12</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
6</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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="6">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="6">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 theorem
Chapter - 7 : Sections 7.1 to 7.14</td></tr>
<tr><td colspan="2"></td><td colspan="6">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>
</table>

	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 – Cesarosummability - 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**
	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 ,9.11and 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">P23MTT13</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
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>
</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	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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Establish the qualitative behaviour of solutions of systems of differential equations **CLO2:**Recognize the physical phenomena modelled 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 themathematics 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="6">ADVANCED ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">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">P23MTT21</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>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">Algebraic Structures</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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="6">UNIT-I : Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2</td></tr>
<tr><td colspan="6">UNIT-II : Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="6">UNIT-III : Elements of Galois theory.
Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="6">UNIT-IV : Finite fields - Wedder burn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)</td></tr>
<tr><td colspan="6">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="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>
<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">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 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>Title of the Course</td><td colspan="6">REAL ANALYSIS II</td></tr>
<tr><td>Paper Number</td><td colspan="6">CORE V</td></tr>
<tr><td rowspan="2">Category 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">P23MTT22</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td 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>Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">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 rowspan="3">Course Outline</td><td colspan="6">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="6">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="6">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>
</table>

	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)**
	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)**
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="6">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE VI</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">P23MTT23</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 partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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="4">Course Outline</td><td colspan="6">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="6">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="6">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="6">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>
</table>

	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**
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.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

ELECTIVE COURSES

SEMESTER -I -ELECTIVE -I-GROUP A

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">1. NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>P23MTE1A</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3"></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">To provide an introduction to analytic number theory and recent topics of Cryptography with applications.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I : Introduction – Conjectures, Theorems, and Proofs-Well Ordering and Induction- Sigma Notation and Product Notation- Binomial Coefficients- Greatest Integer Functions- Divisibility, Greatest Common Divisor, Euclid ‘s algorithm; GCD via Euclid ‘s algorithm- Least Common Multiple- Representation of integers.
Chapter 1: Sections1.1-1.6 and Chapter 2: Sections 2.2-2.4 of Text Book 1.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II: Introduction –Primes, Prime Counting Function, Prime Number Theorem; Test of Primality by Trial Division –Sieve of Eratosthenes, Canonical Factorization, Fundamental Theorem of Arithmetic.
Chapter 3: Sections 3.1-3.3 of Text Book 1.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III : Congruences and Equivalence Relations-Linear Congruences -Linear Diophantine Equations and the Chinese Remainder Theorem- Polynomial Congruences – Modular Arithmetic: Fermat’s Theorem –Wilson’s Theorem and Fermat Numbers.
Chapter 4: Sections 4.2-4.7 of Text Book 1.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV: Introduction-Sigma Function. Tau Functions. Dirichlet Product –Dirichlet Inverse, Moebius Function, Euler’s Function, Euler’s Theorem.
Chapter 5: Sections 5.1 – 5.3 of Text Book 1.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V: Cryptography: Introduction – Some simple crypto systems –Enciphering Matrices–The idea of Public key Cryptography– RSA.
Chapter III: Sections 1-2 and Chapter IV: Sections 1-2 of Text Book 2.</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. Neville Robbins; Beginning Number Theory, Second Edition, Narosa, 2006. 2. Neal Koblitz: A Course in Number Theory and Cryptography, Second edition, Springer-Verlag Newyork-1994.
Reference Books	1. Tom. M. Apostol; Introduction to analytic Number theory, Narosa Publishing House, 1998. 2. Ivan Nivan, H. S. Zuckerman and H. L. Montgomery; An introduction to the theory of Number, 5th Ed paperback-International Edition, 1991.
Website and e-Learning Source	https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/applications-number-theory-cryptography, https://mathstats.uncg.edu/number-theory/ https://en.wikipedia.org/wiki/Number_theory https://en.wikibooks.org/wiki/Cryptography

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the problems in elementary number theory

CLO 2: apply elementary number theory to Cryptography

CLO 3:develop a deep understanding of theoretical basis of number theory and cryptography.

CLO 4:identify how number theory is related and applied in Cryptography

CLO 5: develops the knowledge of encryption and decryption and their application in Managing the security of data.

	POs						**PSOs**		
	1	2	3	4	5	6	1	2	3

CLO1	3	3	3	2	1	2	3	3	2
CLO2	2	3	3	3	2	2	2	3	2
CLO3	3	2	2	2	1	1	3	2	1
CLO4	2	3	1	2	2	3	2	2	2
CLO5	3	1	2	2	2	1	3	2	1

SEMESTER -I -ELECTIVE -I-GROUP A

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">2. GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE1A</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="6">UG level Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study the graph theoretical concepts and algorithms that help to model real life situations.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I: Trees, Cut Edges and Bonds, Cut Vertices, Cayley's Formula –Applications: The Connector Problem – Connectivity, Blocks – Applications: Construction of Reliable Communication Networks.
Chapter 2 : Sections 2.1-2.5 and Chapter 3: Sections 3.1-3.3</td></tr>
<tr><td colspan="6">UNIT II: Euler Tours, Hamiltonian Cycles –Applications: The Chinese Postman Problem, The Travelling Salesman Problem.
Chapter 4: Sections 4.1-4.4.</td></tr>
<tr><td colspan="6">UNIT III: Matching's, Matching's and Coverings in Bipartite Graphs, Perfect Matching – Applications: The Personnel Assignment Problem, The Optimal Assignment Problem.
Chapter 5: Sections 5.1-5.5</td></tr>
<tr><td colspan="6">UNIT IV: Chromatic Number, Brook's Theorem, Hajos' Conjecture, Chromatic Polynomials, Girth and Chromatic Number – Applications: A Storage Problem.
Chapter 8: Sections 8.1-8.6.</td></tr>
<tr><td colspan="6">UNIT V: Directed Graphs, Directed Paths, Directed Cycles – Applications: A Job Sequencing Problem, Designing as Efficient Computer Drum, Making a Road System One-Way.
Chapter 10: Sections 10.1-10.6.</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	J.A Bondy and U.S.R Murty, Graph Theory with Applications, North Holland, 1976.
Reference Books	1. John Clark and D. Allan Holton; Graph theory World Scientific Publishing Co. Pvt.Ltd, 1991. 2. Narsingh Deo; Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, 1974.
Website and e-Learning Source	https://www.zib.de/groetschel/teaching/WS1314/BondyMurtyGTWA.pdf, http://ignited.in/I/a/252519, https://www.mygreatlearning.com/blog/application-of-graph theory/https://in.coursera.org/learn/graphs, https://neo4j.com/blog/top-13-resources-graph-theory-algorithms/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1:study the properties of Trees, Connectivity and Blocks with its applications.

CLO 2:discuss Euler tour, Hamiltonian cycles and its suitable applications.

CLO 3:understand the concepts of Matching's, Coverings and Perfect Matching's.

CLO 4:apply domain knowledge in Chromatic number, Brook's Theorem, Hajos' Conjecture

and Chromatic polynomials.

CLO 5:define Directed graphs, Directed paths and Directed cycles and apply results to Practical problems.

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

SEMESTER -I -ELECTIVE -I-GROUP A

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">3. FORMAL LANGUAGES AND AUTOMATA THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE1C</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="6">UG level Discrete Mathematics, e.g., graphs, trees, logic, and proof techniques.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the notion of effective computability by studying Finite Automata, Regular Expressions, Regular Languages and Free Grammars.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I: Why Study Automata Theory? -Introduction to Formal Proof- Additional Forms of Proof-Inductive Proofs.
Chapter 1: Sections 1.1 – 1.4</td></tr>
<tr><td colspan="6">UNIT II: An Informal Picture of Finite Automata-Deterministic Finite Automata-Non-Deterministic Finite Automata-An Application: Text Search.
Chapter 2: Sections 2.1 – 2.4</td></tr>
<tr><td colspan="6">UNIT III: Regular Expressions-Finite Automata and Regular Expressions-Application of Regular Expressions-Algebraic Laws of Regular Expressions.
Chapter 3: Sections 3.1 – 3.4</td></tr>
<tr><td colspan="6">UNIT IV: Proving Languages are Not Regular-Closure Properties of Regular Languages-Decision Properties of Regular Languages-Equivalence and Minimization of Automata.
Chapter 4: Sections 4.1 – 4.4</td></tr>
<tr><td colspan="6">UNIT V: Context-Free Grammars-Parse Trees-Application of Context-Free Grammar-Ambiguity in Grammars and Languages.
Chapter 5: Sections 5.1 – 5.4</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 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	J. E. Hopcroft, R. Motwani and J.D. Ullman; Introduction to Automata Theory, Languages, and Computation. Second Edition, Pearson Edition, 2001.
Reference Books	1. P.K. Srimani and S.F.B. Nasir; A text book on Automata theory, Cambridge University press, 2007. 2. J.P. Tremblay and R. Manohar; Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Education (India) Pvt Ltd, 2017.
Website and e-Learning Source	https://en.wikipedia.org/wiki/Automata_theory, https://en.wikiversity.org/wiki/Automata_theory,

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the basic properties of formal languages and grammars.

CLO 2: make grammars to produce strings from a specific language..

CLO 3: design sample Automata

CLO 4: minimize Finite Automata and grammar of context-free languages.

CLO 5: differentiate regular, context-free and recursively enumerate languages.

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

SEMESTER -I -ELECTIVE -I-GROUP A

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">4.PROGRAMMING IN C++ AND NUMERICAL METHODS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE1A</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">---</td><td colspan="2">1</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basics of Differentiation and Integration</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To develop the skills of solving algebraic, transcendental, differential and integral equations numerically and C++ Programme.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT I: Method of False Position - Bisection Method - Iterative Method - Newton-Raphson Method - Graeffe Root Squaring Method - Programme for Bisection Method.
Chapter 2: Sections 2.2, 2.3, 2.4, 2.5, 2.8 and 2.11.1</td></tr>
<tr><td colspan="7">UNIT II: Gauss Elimination Method – Jordan Method – Jacobi Iteration Method – Gauss-Seidel Iterative Method – Eigen Value Problem – Programme for Gauss Elimination Method.
Chapter 3: Sections 3.3, 3.4, 3.7, 3.8, 3.13 and 3.15.1.</td></tr>
<tr><td colspan="7">UNIT III: Curve Fitting -Fitting a Straight Line by the Method of Group Averages – Least Square Curve Fitting Method – Method of Moments – Weighted Least Squares Method – Programme to Fit a Straight Line Using Group Average Method.
Chapter 4: Sections 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6.1</td></tr>
<tr><td colspan="7">UNIT IV: Finite Differences – E, μ and D Operators – Gregory-Newton Forward Interpolation Formula - Gregory-Newton Backward Interpolation Formula – Gauss Forward Interpolation Formula – Gauss Backward Interpolation Formula – Programme for Interpolating Using Gregory-Newton Forward Interpolation.
Chapter 5: Sections 5.1, 5.2, 5.7, 5.8, 5.9, 5.10 and 5.23.1</td></tr>
<tr><td colspan="7">UNIT V: Numerical Differentiation – Trapezoidal – Simpson’s 1/3 Rule - Simpson’s 3/8 Rule – Romberg Formula – Programme to Find Derivative at Initial Point by Newton Forward Formula.
Chapter 6: Sections 6.1, 6.6, 6.7, 6.8, 6.11 and 6.16.1</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.Nita H. Shah, Numerical Methods With C++ Programming, PHI Learning Private Limited, 2009.
Reference Books	1. C.F.Gerald and P.O.Wheatly; Applied Numerical Analysis, Addison Wesley, Fifth Edition, 1998. 2. V. Rajaraman, Computer Oriented Numerical Methods, PHI, 3rd Edition, 2006. 3. E.V.Krishnamurthy and S.K. Sen, Computer Based Numerical Algorithms, Affiliated East-west Press Pvt Ltd, 1st Ediiton, 2009. 4. M.K.Jain, S.R.K.Iyengar and R.K.Jain; Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, Fourth Edition, 2013.
Website and e-Learning Source	https://www.codesansar.com/numerical-methods/, https://www.phindia.com/Books/BookDetail/9788120335967/numerical-methods-with-c--programming-shah, https://www.udemy.com/course/learn-numerical-methods-using-c/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understandthe iterative methods for finding the roots of transcendental and algebraicequations with C++ Programme.

CLO 2: solve a system of linear algebraic equations and study Convergence of iterative methods.

CLO 3: fit a Curve for given set of data through C++ Programme.

CLO 4: approximate the polynomial by interpolation method via C++ Programme.

CLO 5: analyse Numerical Differentiation and Integration using Programming in C++.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3

CLO1	3	2	3	2	1	2	3	2	2
CLO2	3	2	3	2	1	2	3	2	2
CLO3	3	2	3	2	1	2	3	2	2
CLO4	3	2	3	2	1	2	3	2	2
CLO5	3	2	3	2	1	2	3	2	2

SEMESTER -II -ELECTIVE -III-GROUP B

Title of the Course		**1. LIE GROUPS ANDLIE ALGEBRAS**					
Paper Number		**ELECTIVE III**					
Category	**ELECTIVE COURSE**	**Year**	I	**Credits**	**3**	**Course Code**	**P23MTE2A**
		Semester	II				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		3	**1**		**4**		
Pre-requisite		Basics set theory and Groups					
Objectives of the Course		To introduce the concept of Lie Algebras and Lie Groups and to study their properties					
Course Outline		**UNIT I:**Lie groups, Subgroups, and cosets, Action of Lie groups on manifolds and representations, Orbits and homogeneous spaces, Left, right, and adjoint action, Classical groups. **Chapter** 2: 2.1-2.5					
		UNIT II: : Exponential map, The commutator, Adjoint action and Jacobi identity. **Chapter** 3: 3.1-3.3					
		UNIT III: Subalgebras, ideals, and centre, Lie algebra of vector fields, Stabilizers and the center. **Chapter** 3: 3.4-3.6					
		UNIT IV: Campbell-Hausdorff formula, Fundamental theorems of Lie theory, Complex and real forms, Example: $\boldsymbol{so}(3, \mathbb{R})$, $\boldsymbol{su}(2)$, and $\boldsymbol{sl}(2, \mathbb{C})$ **Chapter** 3: 3.7-3.10					

	UNIT V: Basic definitions, Operations on representations, Irreducible representations, Intertwining operators and Schur lemma. **Chapter** 4 : 4.1-4.4
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. 1.Alexander Kirillov J.R. Introduction to Lie Algebras and Lie Groups SUNY ATSTONY BROOK ,NY 11794
Reference Books	1..Alexander Kirillov J.R Lie Groups , Lie Algebras, and Representations. 2..Alexander Kirillov J.R Introduction to Lie Algebras and representation theory. 3..Alexander Kirillov J.R Introduction to Lie Algebras
Website and e-Learning Source	URL:http//www.math.sunysb.edu/"kirillov/liegroup

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understandthe definition of Lie Groups and Lie Algebras.

CLO 2: studied exponential map, The commutator, Adjoint action and Jacobi identity.

CLO 3: gained the Subalgebras, ideals, and centre, Lie algebra of vector fields, Stabilizers and the center.

CLO 4: Campbell-Hausdorff formula, Fundamental theorems of Lie theory, Complex and real forms, Example: ***so***(3, ℝ), ***su***(2), and ***sl***(2, ℂ)

CLO 5: Operations on representations, Irreducible representations, Intertwining operators and Schur lemma.

	POs	PSOs

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

SEMESTER -II -ELECTIVE -III-GROUP B

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">2.MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE2B</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">Pre-requisite</td><td colspan="7">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To understand the methods of optimization techniques, the theory of optimization techniques and familiar in solving techniques, analysing the results and propose recommendations to the decision making process.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT I:Integer Linear Programming
Introduction - Illustrative application integer programming solution algorithms, Branch and Bound Algorithm –zero-one implicit enumeration algorithm- Cutting plane algorithm
Chapter 9: 9.1, 9.2.1, 9.2.3</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT II: Deterministic Dynamic Programming
Introduction- Recursive nature of computation in DP- Forward and Backward recursion- Selected DP applications cargo- Loading model- - Work force size model- Equipment – replacement model- Inventory models
Chapter10:10.1 to 10.3</td></tr>
</table>

	UNIT III: Decision Analysis and Games: Decision environment- Decision making under certainty (Analytical Hierarchy approach). Decision making under risk- Expected value criterion- Variations of the expected value criterion – Decision under uncertainty Game theory. Optimal solution of Two – Person zero-Sum games- Solution of mixed strategy games **Chapter 14**: 14.1 to 14.4
	UNIT IV:Simulation Modeling : What is simulation? Monte Carlo Simulation- Types of simulation- Elements of Discrete Event simulation- Generic definition of events- Sampling from probability distributions. Methods for gathering statistical observations – Sub Interval method- Republican method- Regenerate (Cycle Method)- Simulation Languages **Chapter 18**: 18.1 to 18.7
	UNIT V: Nonlinear Programming Algorithm Unconstrained nonlinear Programming algorithm- Direct search method- Gradient method Constrained algorithms: Separable programming- Quadratic programming- Geometric programming- Stochastic programming- Linear Combination Method- SUMT algorithm **Chapter** 21: 21.1, 21.2
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.Hamdy A.Taha, Operation Research an Introduction, 6th edition, University of Arkansas Fayetteville

Reference Books	1.F.S. Hillier and G. J. Liberman Introduction to operation Research 4th Edition, Mc Gno Hill Book Compnany, New York, 1989 2.B.E.Gillett, Operation Research- A computer oriented algorithmic Approach, TMH Edition NewDelhi, 1976
Website and e-Learning Source	www.pearsonglobaleditions.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Integer Linear Programming

CLO 2: Deterministic dynamic Programming

CLO 3: Decision analysis and games

CLO 4: Simulation Modeling

CLO 5: Nonlinear Programming algorithm

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

SEMESTER -II -ELECTIVE -III-GROUP B

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">3. FUZZY SETS AND THEIR APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE2C</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td></td><td colspan="2"></td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2"></td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level sets and functions</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concept of fuzzy theory and study its application in real problems. To study the uncertainty environment through the fuzzy sets that incorporates . To understand the fuzzy relations and fuzzy arithmetic</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">UNIT-I: From Classical Sets To Fuzzy Sets
From Classical Sets To Fuzzy Sets: A Grand paradigm shift, Introduction - Fuzzy Sets Verses Crisp Sets : An Overview - Fuzzy Sets : Basic types – Fuzzy sets : Basic Concepts – Characteristics and Significance of the paradigm shift – Additional Properties of α – cuts – Representations of Fuzzy sets – First Dcomposition theorem – Second Decomposition theorem– Third Decomposition theorem- Extension Principle for fuzzy sets.
Chapter 1 Sections 1.3, 1.4, Chapter :2 Sections 2.1 and 2.</td></tr>
<tr><td colspan="6">UNIT-II: Operations on Fuzzy Sets
Operations on Fuzzy Sets:Types of operations – Fuzzy complements – First Characterization Theorem of Fuzzy Complements - Second Characterization Theorem of Fuzzy Complements - Fuzzy Intersections: t-Norms – Some classes of Fuzzy Intersections (t–Norms) - Fuzzy Unions: t- Conorms - Some classes of Fuzzy Unions (t– Conorms) - Combinations of Operations – Aggregation Operations.
Chapter 3 Sections 3.1, 3.2, 3.3, 3.4, 3.5</td></tr>
</table>

	UNIT-III: Fuzzy Arithmetic: Fuzzy Arithmetic introduction -Fuzzy Numbers – Membership functions of Fuzzy numbers theorem - Linguistic variables - Arithmetic operations on intervals –Arithmetic operations on Fuzzy numbers – Lattice of Fuzzy numbers – Fuzzy Equations – Equation A + X = B and Equation A * X = B. **Chapter 4 Sections 4.1, 4.2, 4.3, 4.4.-**
	UNIT-IV: Fuzzy Relations Fuzzy Relations introduction Crisp and Fuzzy Relations – Projections and Cylindric Extensions – Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations –Fuzzy Ordering Relations – Fuzzy Morphisms – SUP-i Compositions of Fuzzy Relations – INF-omega Compositions of Fuzzy Relations. **Chapter 5 Sections 5.3, 5.4, 5.5, 5.6, 5.7, 5.8**
	UNIT-V: Fuzzy Decision Making and Applications Fuzzy Decision Making introduction -General Discussion - Individual decision making – Multiperson Making – Multicriteria Decision Making – Multistage Decision Making – Fuzzy Ranking methods – Fuzzy Linear programming. ltiperson Decision Making-Ranking methods – Fuzzy Linear programming Applications: Medicine- Economics-Fuzzy systems and Genetic applications- Fuzzy Regression- Interpersonal communication-Other Applications **Chapter 15 Sections 15.2,15.3, 15.6, 15.7** **Chapter 17Sections 17.1 to17.7**
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..George J. Klir and Bo Yuan**, "Fuzzy sets and Fuzzy Logic Theory and Applications", Prentice Hall of India, (2005).

Reference Books	1.A.K. Bhargava: Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt limited, 2013 2.S. Rajasekaran& Y.A. VijiaylakshmiPai, Neural Networks, Fuzzy logic and genetic algorithms, Prentice Hall of India 3. H.J. Zimmermann, "Fuzzy Set Theory and its Applications", Allied Publishers Limited (1991). 4. M. Ganesh**,** "Introduction to Fuzzy sets and Fuzzy logic", Prentice Hall of India, New Delhi (2006).
Website and e-Learning Source	-http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www. Fuzzylogic .net

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Crisp sets and fuzzy sets

CLO 2: Operation on Fuzzy sets

CLO 3: Fuzzy relation

CLO 4: Decision making in Fuzzy environment

CLO 5: Applications

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

SEMESTER -II -ELECTIVE -III-GROUP B

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">4.DISCRETE MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</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">P23MTE2D</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>3</td><td colspan="2">1</td><td colspan="2"></td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level sets and functions</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the basic idea of semi groups, monoids, Lattices, Boolean Algebra, Grammer and Languages</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">UNIT I: Mathematical Logic:
Introduction – Statements And Notation – Connectives : Negation, Conjunction – Disjunction – Statement Formulas And Truth Tables – Conditional And Biconditional – Well Formed Formulas – Tautotogies – Equivalance of Formulas – Duality Law – Tautological Implications – Formulas With Distinct Truth Tables – Funtionally Complete Sets of Connectives – Other Connectives – Normal Farms: Disjunctive Normal Forms – Conjunctive Normal Forms – Principal Disjunctive Normal Forms – Principal Conjunctive Normal Forms
Chapter1 : Section 1.1to 1.3</td></tr>
<tr><td colspan="6">UNIT II: The Theory Of Inference for The Statement Calculus:
Validity Using Truth Tables – Rules of Inference – Consistency of Premises And Indirect Method of Proof – The Predicate Calculus: predicates – The Statement Functions, Variables And Quantifiers – Predicate Formulas – Free And Bound Variables – The Universe of Discourse. Inference Theory of The Predicate Calculus : Valid Formulas And equivalences – Some Valid Formulas Over Finite Universes – Special Valid Formulas Involving Quantities – Theory of Inference For The Predicate Calculus – Formulas Involving More Than One Quantifier

Chapter1 : Section 1.4 and 1.5</td></tr>
</table>

	UNIT III: Lattices: Lattices as partially ordered sets and their properties, Lattices as algebraic systems, sublattices, Direct products and homomorphisms, Some special lattices such as complete, complemented and distributive lattices **Chapter4: Section 4.1, 4.1.3 to 4.1.5**
	UNIT IV: Boolean Algebra Boolean Algebra as Lattices, Various Boolean identities, The switching algebra example, Sub-algebras, direct product and homomorphisms, join-irreducible elements, Atoms and minterms, Boolean forms and their equivalence, Minterms Boolean forms, sum of products, canonical forms, Minimization of Boolean forms **Chapter 4: Section 4.2.1 to 4.2.2**
	UNIT V: Boolean functions: Boolean forms and Free Boolean Algebras, Values of Boolean expressions and Boolean functions. Representation and minimization of Boolean functions **Chapter 4: Section 4.3 and 4.4**
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.J.P Trumbly and R. Monohar , Discrete Mathematical Structure and its application to computer Science, Tata McGraw Hills, New Delhi.
Reference Books	1 Kenneth H Rosan, Discrete Mathematics and its applications, 7th edition, WCB/McGraw Hill Educations, New York 2008 2 C.L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill Publishing Company Limited
Website and e-Learning Source	-http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www. discreate .net

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Semigroups and Monoids

CLO 2: Lattices

CLO 3: Grammars and Languages

CLO 4: Boolean Algebra

CLO 5: Boolean functions:

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

NME- OTHER DEPARTMENTS(NOT FOR MATHEMATICS STUDENT)- SEC I

SEMESTER -II -NME-SEC I

GROUP- C

<table>
<tr><td colspan="2">TITLE OF THE COURSE</td><td colspan="6">1. MATHEMATICS FOR LIFE SCIENCES-</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">NME I-SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">P23MTN21</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">Pre-requisite</td><td colspan="6">+2 level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the basic mathematical concepts such as sequence, vectors, matrices used in Life sciences and give some applications in life science.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI :
Sequences and Discrete Difference Equations, Sequences, Limit of a Sequence, Discrete Difference Equations, Geometric and Arithmetic Sequences, Linear Difference Equation with Constant Coefficients, Introduction to Pharmacokinetics
Chapter 5</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II :
Vectors and Matrices, Vector Structure: Order Matrices Vector Algebra, Dynamics: Vectors Changing over Time
Chapter 6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III :
Matrix Algebra, Matrix Arithmetic, Applications
Chapter 7</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV :
Long-Term Dynamics or Equilibrium, Notion of an Equilibrium, Eigenvectors, Stability
Chapter 8</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V:
Leslie Matrix Models and Eigenvalues, Leslie Matrix Models, Long-Term Growth Rate (Eigenvalues), Long-Term Population Structure (Corresponding Eigenvectors)
Chapter 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 and the (To be discussed during the Tutorial hour)
Skills acquired from this course	Ability to model and solve the discrete biological models.
Recommended Text	1.E.N. Bodine, S. Lenhart, and L. J. Gross, Mathematics for the Life Sciences, Princeton University Press, 2014.
Reference Books	1. L. J. S. Allen, An Introduction to Mathematical Biology, Pearson, 2006 2. J.D. Murray, Mathematical Biology - I. An Introduction, Springer-Verlag, 2002.
Website and e-Learning Source	https://www.classcentral.com/course/swayam-biostatistics-and-mathematical-biology-13925

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Define sequence, difference equations, limit of sequence and study the difference equations.

CLO 2: Define the vectors and matrix, find the order of matrix and study the dynamics of vectors

CLO 3: Define arithmetic on matrices and applications of matrices.

CLO 4: Define Eigen values and eigen vectors and study the equilibrium and stability.

CLO 5: Develop Leslie matrix models and long term population structure of the corresponding models.

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

SEMESTER -II -NME-SEC I

GROUP- C

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">2.MATHEMATICS FOR SOCIAL SCIENCES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">NME II-SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">P23MTN22</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>3</td><td colspan="2">1</td><td colspan="2"></td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">+2 level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the mathematical concepts linear algebra calculus using social sciences.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :
Linear Algebra, Vectors and Matrices, Operations on Vectors, Matrices-Determinants, Rank of a Matrix
Chapter 1:1.1 to 1.5</td></tr>
<tr><td colspan="6">UNIT-II :
Statistical Applications of Linear Algebra, Linear Applications, Linear Algebraic Systems, Applications to Networks, Some Complements on Square Matrices
Chapter 1:1.6 to 1.10</td></tr>
<tr><td colspan="6">UNIT-III :
Differential Calculus, What’s a Function, Local Behavior and Global Behavior, What’s a Function of a Vector
Chapter 2</td></tr>
<tr><td colspan="6">UNIT-IV :
Integral Calculus, Integrals and Areas, Fundamental Theorem of Integral Calculus, Antiderivative Calculus, An Immediate Application: Mean and Expected Values, Frequency/Probability Density Functions: Some Cases, People Survival
Chapter 3</td></tr>
<tr><td colspan="6">UNIT-V:
Dynamic Systems-Introduction, Local Information: The Motion Law, Extracting Info from a Motion Law, Classic Approach, Numerical Approach, Qualitative Approach, A Newcomer: The Phase Diagram, Some Politically Relevant Applications
Chapter 4</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	Ability to create and analyse the mathematical models arise in social science.
Recommended Text	1.L. Peccati, M. D'Amico, M. Cigola, Maths for Social Sciences, Springer, 2018.
Reference Books	1. S. Tan, Mathematics For Management, Life And Social Sciences, Brooks/Cole, 1996 2. H. Anton, B. Kolman, Mathematics with Applications for the Management, Life, and Social Sciences, 2nd edition, Academic Press, 2014.
Website and e-Learning Source	https://www.classcentral.com/course/swayam-biostatistics-and-mathematical-biology-13925

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Define vectors and matrices and operations on vectors and matrices and calculate the rank and determinants.

CLO 2: Solve the system of linear equations and apply the matrix theory to networks and other fields

CLO 3: Define the derivative of the functions and able to analyze the local and global behaviour of the continuous functions.

CLO 4: Define integration and able to calculate the area of the continuous curve and able to calculate the expected values of continuous random variables.

CLO 5: Able to study the dynamical behaviour of the social science problems.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3

CLO3	3	2	3	2	3	3	2	2	3
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

SEMESTER -II -NME-SEC I

GROUP- C

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">3.STATISTICS FOR LIFE AND SOCIAL SCIENCES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">NME III-SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">P23MTN23</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">3</td><td colspan="2">1</td><td colspan="2"></td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">+2 level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To enhances basic skills in the areas of data collection.To acquaint the student with the average calculation in various situation.To study about deviation of data from the central values.To know the testing tools and methods .</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNITI :
Primary and Secondary data: Collection of Data –Primary data-Secondary data-choice of methods-Direct personal Observation-Indirect oral Interview-Information Through Agencies-Mailed questionnaire Schedules send through Enumerators, Sources of secondary data- Data precautions in the in the use of secondary data- Sample questionnaire

Chapter 4</td></tr>
</table>

	UNIT II : **Central Tendency and Dispersion:** Measure of Central Tendency- Meaning- Definition – Arithmetic Mean - Median- Definition Mode - Definition -Geometric mean- Definition- Harmonic mean – Definition- Individual data- Discrete series and continuous series – Problem in all the three types. **Dispersion**: Measure of dispersion- range- Quartail deviation- Mean Deviation Standard deviation - Individual data- Discrete series and continuous series – Problem in all the three types., Computation of Quartiles, Decides, Percentiles, Etc. Significance of Measuring Variation,Range, The Interquartile Range or the Quartile Deviation, Merits and Limitations, The Standard Deviation **Chapter 9 and Chapter 10**
	UNIT III : **Correlation and Regression:** Correlation and Regression introduction -Types of correlation graphical representation of Correlation - Karl Pearson's coefficient of correlation – Rank correlation- Coefficient of rank correlation. Regression: Significance of regression-difference between correlation and regression-RegressionLines - Regression equations **Chapter 12 and Chapter 13**
	UNIT IV : **Theoretical distributions:** Theoretical distributions introduction - Binomial distribution –properties of binomial distribution- simple problems in binomial distribution - Poisson distribution- simple problems in Poisson distribution -Normal distributions – properties of Normal distributions - practical problems in Normal distributions. **Chapter 19**

	UNIT V: **Sampling Theory and Testing of Significance:** Sampling Theory and Testing of Significance introduction - Estimation-Hypothesis-Test of significance- Small sample test - Student 't' test –Large sample test for significance of average- Student F-test- Chi –Square test for Goodness of fit-Simple practical problems using - Chi –Square test **Chapter 20**
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	Ability to collect and analyse the data using the statistical methods.
Recommended Text	1.R.S.N. Pillai and V.Bagavathi,, "Statistics", Sultan Chand, New Delhi, 2008 .
Reference Books	**1.** .S. P. Gupta, Statistical Methods, Forty Sixth Revised Edition, Sultan Chand & Sons, New Delhi, 2021 **2.**S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statisitics", Sultan Chand and Sons, New Delhi -2, 2011 **3**.Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta **4.**G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.
Website and e-Learning Source	https://alison.com/course/the-fundamentals-of-statistics?utm_source=google&utm_medium=cpc&utm_campaign=PPC_Tier-4_First-Click_Courses-_Broad_&utm_adgroup=Course-2075_The-Fundamentals-of-Statistics&gclid=CjwKCAjw6IiiBhAOEiwALNqncf9ojFI3Uc738RVoW7KdG4FiGqFXcEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_BwE

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Collect the data, frame the questions and to find the sample size for their study.

CLO 2: Classify the samples and to calculate the mean, median, mode, standard deviation for discrete as well as continuous data.

CLO 3: Define the probability and random variables, some special probability distributions and do the hypothesis testing of their samples .

CLO 4:.Define Chi-square test, Yates corrections, when to use and not to use the Chi-square test.

CLO 5: Do the F-test and for the samples.

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

SEMESTER -II -NME-SEC I

GROUP- C

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">4.GAME THEORY AND STRATEGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">NME IV-SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">P23MTN24</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>3</td><td colspan="2">1</td><td colspan="2"></td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">+2 level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To enhances basic skills in the areas of resource utilization, game theory and replacement strategies</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="8">UNITI :
Linear Programming problem:
Introductions- Linear Programming: Mathematical formulation of linear programming problem- Basic Solution - Solving Linear Programming problem using Graphical solution- Unbounded and Infeasible solution in graphical methods

Chapter 3</td></tr>
<tr><td colspan="8">UNIT II :
Transportation Problem:
Transportation Problem introduction- Mathematical formulation of the problem - Finding Initial Basic Feasible Solution using North - West Corner Rule - Row minima methods- Column minima method - Matrix Minima Method - Vogel’s Approximation Method – Optimum solution – MODI method
Chapter 10</td></tr>
<tr><td colspan="8">UNITIII :
Assignment Problem:
Assignment Problem: Introduction – Definition of Assignment Problem -Mathematical formulation of Assignment Problem - Assignment Algorithm – Problem solving using Assignment Algorithm- Application of Assignment Problem: Minimization case routing problem
Chapter 11</td></tr>
</table>

	UNITIV : **Game Theory :** Two person Zero Sum Game –Maximin-Minimax principles- Game without saddle point –Mixed integers –Graphic Solution of 2 x n and mx2 Games –Dominance properties **Chapter 17**
	UNITV: **Replacement Problem:** Replacement Problem: Introduction about Replace problem – Definition Replace problem -and System Reliability – Replacement of Equipment that Deteriorates Gradually- Exercise Problems - Replacement of Equipment the Fails Suddenly-problems in replacement of Equipment the Fails Suddenly **Chapter 18**
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	Ability to collect and analyse the data using the statistical methods.
Recommended Text	1. **Kanti Swarup, P.K. Gupta, Man Mohan,** "Operations Research", Sultan Chand & Sons, Educational Publishers, New Delhi.2013 .

Reference Books	1.**Panneerselvam.R**, "Operations Research", 2nd Edition, PHI Learning Private Limited, Delhi, 2015 2 .**Prem Kumar Gupta.Er, Hira.D.S**. "Operations Research",7th Edition,S.Chand & Company Pvt.Ltd.2014 3. **Hiller.F.S & Lieberman.J** "Introduction to Operation Research ",7th Edition, Tata– MCGraw Hill Publishing Company, NewDelhi, 2001. 4..**G. Srinivasan,** "Operations Research principles and applications", Second Edition, PHI Learning Private Limited, New Delhi-110001, 2012. 5. **Taha H.A., "**Operations ResearchAn introduction" Prennce Hall of India Private Ltd 1st Edition New Delhi (2008) .
Website and e-Learning Source	https://alison.com/course/the-fundamentals-of-statistics?utm_source=google&utm_medium=cpc&utm_campaign=PPC_Tier-4_First-Click_Courses-_Broad_&utm_adgroup=Course-2075_The-Fundamentals-of-Statistics&gclid=CjwKCAjw6IiiBhAOEiwALNqncf9ojFI3Uc738RVoW7KdG4FiGqFXcEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_BwE

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the application of OR and frame a LP Problem with solution – graphic and through solver add in excel.

CLO 2: Analyze and interpret results of transportation and problem using appropriate

CLO 3: Analyze and interpret results method Solutions of assignment and problem using appropriate method.

CLO 4:.Define Game theory and finding solution in different strategy

CLO 5: Find the replacement period of equipment that fails suddenly/gradually.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3

CLO3	3	2	3	2	3	3	2	2	3
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

SEMESTER -II -NME-SEC I

GROUP- C

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">5. HISTORY OF MATHEMATICAL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">NME- V-SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">P23MTN25</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>3</td><td colspan="2">1</td><td colspan="2"></td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">+2 level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To impart skills in numerical and quantitative techniques.
Able to critically evaluate various real life situations by resorting to Analysis of key issues and factors. Able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNITI :
Numbers – HCF – LCM – Square Roots & Cube Roots- Problems on numbers.
Chapters 1, 2 ,5, 7</td></tr>
<tr><td colspan="6">UNIT II :
Decimal Fractions , Simplification, Time & Distance.
Chapter 3,4,17</td></tr>
<tr><td colspan="6">UNITIII :
Surds and Indices – Percentage – Profit and Loss- Simple Interest.
Chapters 9, 10,11, 21</td></tr>
</table>

	UNITIV : Ratio and Proportion – Partnership – Allegation or Mixture-Probability. Chapters 12, 13, 20, 31
	UNITV: Average – Problems on Age-Calender. Chapters 6,8,27
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 / / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Ability to solve problems using the mathematical l methods.
Recommended Text	1.**Text Book:** **Dr.R.S.Aggarwal,** "Quantitative Aptitude for Competitive Examinations" , S.Chand & Company Ltd., Ram Nagar, New Delhi - 2007. .
Website and e-Learning Source	Link: https://books.shunyafoundation.com/book-quantitative-aptitude-by-r-s-aggarwal-published-by-s-chand-english/dp/ODTRGH2E

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Collect the data, frame the questions and to find the sample size for their study.

CLO 2: Classify the samples and to calculate the mean, median, mode, standard deviation for discrete as well as continuous data.

CLO 3: Define the probability and random variables, some special probability distributions and do the hypothesis testing of their samples .

CLO 4:.Define Chi-square test, Yates corrections, when to use and not to use the Chi-square test.

CLO 5: Do the F-test for the samples.

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