MAHENDRA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

(Affiliated to Periyar University)

[Accredited by NAAC 'A++' Grade & Recognized u/s 2(f) and 12(B) of the UGC act 1956]

KALIPPATTI-637501

MASTER OF SCIENCE

SYLLABUS FOR M.Sc. MATHEMATICS

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM

FOR THE STUDENTS ADMITTED FROM
THE ACADEMIC YEAR 2023 – 2024 ONWARDS

MAHENDRA ARTS & SCIENCE COLLEGE

(Autonomous)

(Affiliated to Periyar University)

Department of Mathematics

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM

(Effective from the academic year 2023-2024)

I – PREAMBLE

The course aims at motivating the young minds for research in mathematical sciences and to train computational scientists who can work on real-life challenging problems. The main intend of the course is to provide in-depth knowledge to the students in advanced applied mathematics and prepare them for various research activities.

II - GRADUATES ATTRIBUTES

- ***In-depth knowledge and understanding of major concepts:*** Understanding of theoretical principles and experimental findings in different sub-areas available in respective disciplines
- ***Creative and Critical thinking:*** The capability of using creative and critical thinking in respective areas
- ***Analytical ability:*** The ability to analyze issues and problems in all the disciplines
- ***Problem-solving skills:*** The capability towards solving problems
- ***Entrepreneur skills:*** The inclusion of leadership, business management, time management skills
- ***Communication skills:*** The ability to transfer complicated/technical information in a precise manner
- ***Mutual and multidisciplinary competence:*** The ability of teamwork in interdisciplinary fields
- ***Digital literacy:*** The capability of utilizing modern digital tools to carry out the simulation process
- ***Moral and ethical awareness:*** Ability to adopt moral ethics
- ***Social responsibility:*** Creating socially responsible citizens

III - PROGRAMME EDUCATIONAL OBJECTIVES:

- Graduates are prepared to be creators of new knowledge leading to Innovation and entrepreneurship employable in various sectors such as private, government, and research organizations.
- Graduates are trained to evolve new technologies in their own Discipline.
- Exhibit continuous learning and research for the societal upliftment with human values and ethics.
- Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
- Graduates ought to have the ability to communicate their findings effectively by incorporating the existing knowledge.

IV - PROGRAMME OUTCOMES:

- Acquire scientific knowledge leading to creative thinking and research motivations.
- Internalize the learned concepts and that will enable them to become skilled professionals.
- Develop a sense of an interdisciplinary approach to identify and resolve issues through the project, seminars, fieldwork, internships, and industrial visits.
- Become empowered individuals who will emerge as entrepreneurs or be employed in industry, academia, and Government sectors.
- Establish a self-sustained environment for a healthy society.

V – PROGRAMME SPECIFIC OUTCOMES

- Higher degree of technical skills in problem solving and application development.
- Aptitude skills that will help to take up research in pure and applied Mathematics.
- Reasoning skills required to learn advance mathematics and Probing attitude and a search for deeper knowledge in science.
- The relevance and applications of Mathematics in scientific phenomenon Positive approach towards Higher Education in Mathematics.
- Employability Skills that will enable the students to explore career in Teaching and Research in Mathematics.

VI – REGULATIONS:

These regulations shall take effect from the academic year 2023-2024, i.e., for the students admitted to the first year of the programme during the academic year 2023-24 and thereafter.

1. **Eligibility for Admission:**

Candidates who have passed B.Sc., Mathematics / B.Sc., Mathematics (Computer Applications) degree of this University or any of the above degree of any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore are eligible for admission to M.Sc., Degree Programme and shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination in Mathematics of this University.

2. **Duration of the Programme:**

The candidates shall complete all the courses of the programme in 2 years from the date of admission. The programme of study shall consist of four semesters and a total period of two years with a minimum of **92** credits. The programme of study will comprise the courses according to the syllabus.

Candidate should complete the Programme at the maximum of n +3 years, where n denotes the duration of the programme in the same syllabi.

3. **Programme of Study:**

The programme of study for the PG degree programme of all branches shall consist of the following:

(i) Core courses
(ii) Discipline specific Electives
(iii) Skill Enhancement Courses
(iv) Extra Disciplinary Course
(v) Project
(vi) Enhancement Compulsory Courses.
(vii) Internship Course

4. **Examinations:**

The programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subject(s) will be permitted to appear for the same in the subsequent semester examinations.

5. Structure of the Programme:

SEMESTER: I

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-I	ALGEBRAIC STRUCTURES	M23PMA01	6	-	5	25	75	100
CORE COURSE-II	REAL ANALYSIS - I	M23PMA02	6	-	5	25	75	100
CORE COURSE-III	ORDINARY DIFFERENTIAL EQUATIONS	M23PMA03	5	-	4	25	75	100
DISCIPLINE SPECIFIC ELECTIVE - I	ELECTIVE – I- GRAPH THEORY AND APPLICATIONS	M23PMAE01	5	-	3	25	75	100
	ELECTIVE – I- NUMBER THEORY	M23PMAE02						
	ELECTIVE – I- PROGRAMMING IN C++	M23PMAE03						
DISCIPLINE SPECIFIC ELECTIVE - II	ELECTIVE – II- DISCRETE MATHEMATICS	M23PMAE04	5	-	3	25	75	100
	ELECTIVE – II- MATHEMATICAL PROGRAMMING	M23PMAE05						
	ELECTIVE – II- FUZZY SETS AND THEIR APPLICATIONS	M23PMAE06						
SEC-I	SEC-I-LATEX PRACTICAL	M23PMAS01	-	3	2	40	60	100
		Total	**27**	**3**	**22**	**165**	**435**	**600**

SEMESTER :II

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-IV	ADVANCED ALGEBRA	M23PMA04	6	-	5	25	75	100
CORE COURSE-V	REAL ANALYSIS - II	M23PMA05	6	-	5	25	75	100
CORE COURSE-VI	PARTIAL DIFFERENTIAL EQUATIONS	M23PMA06	5	-	4	25	75	100
DISCIPLINE SPECIFIC ELECTIVE -III	ELECTIVE –III-MATHEMATICAL STATISTICS	M23PMAE07	4	-	3	25	75	100
	ELECTIVE – III-TENSOR ANALYSIS AND RELATIVITY	M23PMAE08						
	ELECTIVE – III-STATISTICAL DATA ANALYSIS USING R PROGRAMMING	M23PMAE09						
EDC	-	-	4	-	4	25	75	100
SEC-II	SEC-II-SCILAB PRACTICAL	M23PMAS02	-	3	2	40	60	100
ENHANCEMENT COMPULSORY COURSE	HUMAN RIGHTS	M23PHR01	2	-	2	25	75	100
		Total	**27**	**3**	**25**	**190**	**510**	**700**

SEMESTER:III

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-VII	COMPLEX ANALYSIS	M23PMA07	6	-	4	25	75	100
CORE COURSE-VIII	PROBABLITIY THEORY	M23PMA08	5	-	4	25	75	100
CORE COURSE-IX	TOPOLOGY	M23PMA09	6	-	4	25	75	100
CORE COURSE-X	INDUSTRIAL STATISTICS	M23PMA10	5	-	4	25	75	100
DISCIPLINE SPECIFIC COURSE-IV	ELECTIVE – IV-STOCHASTIC PROCESSES	M23PMAE10	5	-	3	25	75	100
	ELECTIVE – IV-FLUID DYNAMICS	M23PMAE11						
	ELECTIVE – IV-MATHEMATICAL PYTHON	M23PMAE12						
SEC-III	SEC-III-STATISTICAL PACKAGE FOR SOCIAL SCIENCES PRACTICAL	M23PMAS03	-	3	2	40	60	100
Internship/In plant		M23PMAIS01	-	-	2	40	60	100
		Total	**27**	**3**	**23**	**205**	**495**	**700**

SEMESTER:IV

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE-XI	FUNCTIONAL ANALYSIS	M23PMA11	6	-	4	25	75	100
CORE COURSE-XII	DIFFERENTIAL GEOMETRY	M23PMA12	6	-	4	25	75	100
CORE COURSE-XIII	MECHANICS	M23PMA13	5	-	4	25	75	100
CORE PROJECT	PROJECT	M23PMAPR1	5	-	4	40	60	100
DISCIPLINE SPECIFIC COURSE-V	ELECTIVE –V- RESOURCE MANAGEMENT TECHNIQUES	M23PMAE13	5	-	3	25	75	100
	ELECTIVE – V- ALGEBRAIC GEOMETRY	M23PMAE14						
	ELECTIVE – V- FINANCIAL MATHEMATICS	M23PMAE15						
SEC-IV	SEC-IV- TECHNICAL WRITING AND PRESENTATION PRACTICAL	M23PMAS04	-	3	2	40	60	100
Extinction Activities		M23PEX01	-	-	1	-	-	-
Additional Credit for Online Course (SWAYAM / MOOC)**			-	-	-	-	-	-
		Total	**27**	**3**	**22**	**180**	**420**	**600**
		GRAND TOTAL	**108**	**12**	**92**	**740**	**1860**	**2600**

***** Equal credits will be transferred by completing online courses such as MOOC/SWAYAM/NPTEL.

***** On successful completion of Value Added course, the students will gain one extra credit.

ELECTIVE SUBJECTS FOR M.Sc. MATHEMATICS STUDENTS:
(Students can choose any one course from the given list)

Semester		
DISCIPLINE SPECIFIC ELECTIVE – I		
I	**Course Title**	**Course Code**
	ELECTIVE – I- GRAPH THEORY AND APPLICATIONS	M23PMAE01
	ELECTIVE – I- NUMBER THEORY	M23PMAE02
	ELECTIVE – I- PROGRAMMING IN C++ AND NUMERICAL METHODS	M23PMAE03
DISCIPLINE SPECIFIC ELECTIVE – II		
I	**Course Title**	**Course Code**
	ELECTIVE – II- DISCRETE MATHEMATICS	M23PMAE04
	ELECTIVE – II- MATHEMATICAL PROGRAMMING	M23PMAE05
	ELECTIVE – II- FUZZY SETS AND THEIR APPLICATIONS	M23PMAE06
DISCIPLINE SPECIFIC ELECTIVE – III		
II	**Course Title**	**Course Code**
	ELECTIVE – III- MATHEMATICAL STATISTICS	M23PMAE07
	ELECTIVE – III- TENSOR ANALYSIS AND RELATIVITY	M23PMAE08
	ELECTIVE – III- STATISTICAL DATA ANALYSIS USING R PROGRAMMING	M23PMAE09
DISCIPLINE SPECIFIC ELECTIVE – IV		
III	**Course Title**	**Course Code**
	ELECTIVE – IV- STOCHASTIC PROCESSES	M23PMAE10
	ELECTIVE – IV- FLUID DYNAMICS	M23PMAE11
	ELECTIVE – IV- MATHEMATICAL PYTHON	M23PMAE12
DISCIPLINE SPECIFIC ELECTIVE – V		
IV	**Course Title**	**Course Code**
	ELECTIVE – V-RESOURCE MANAGEMENT TECHNIQUES	M23PMAE13
	ELECTIVE – V-ALGEBRAIC GEOMETRY	M23PMAE14
	ELECTIVE – V-FINANCIAL MATHEMATICS	M23PMAE15

GENERIC ELECTIVE COURSES OFFERED FOR OTHER DEPARTMENT STUDENTS[EDC]:

Semester	Course Title	Course Code
II	EDC-Quantitative Aptitude	M23PMAED1
	EDC- Operations Research	M23PMAED2

SKILL ENHANCEMENT COURSE

Semester	Course Title	Course Code
I	SEC-I-LATEX PRACTICAL	M23PMAS01
II	SEC-II-SCILAB PRACTICAL	M23PMAS02
III	SEC-III-STATISTICAL PACKAGE FOR SOCIAL SCIENCES PRACTICAL	M23PMAS03
IV	SEC-IV-TECHNICAL WRITING AND PRESENTATION PRACTICAL	M23PMAS04

Summary of Credits, Hours and Mark Distribution:

Course Category	Credits				Total Credits	Total Hours	No. of Courses	Max. Marks
	I	II	III	IV				
Core Course	14	14	16	12	56	73	13	1300
Discipline Specific Elective	6	3	3	3	15	24	5	500
Generic Elective Course	-	4	-	-	4	4	1	100
Skill Enhancement course	2	2	2	2	8	12	4	400
Core Project	-	-	-	4	4	5	1	100
Enhancement Compulsory Course	-	2	-	-	2	2	1	100
Internship	-	-	2	-	2	-	1	100
Extension Activity	-	-	-	1	1	-	-	-
TOTAL	22	25	23	22	92	120	26	2600

***The students will gain extra credits for successful completion of online courses from SWAYAM / MOOC/ Approved Online Certification Course

IV SCHEME OF EXAMINATION:

QUESTION PATTERN

1. Question Paper Pattern for Theory Papers:

Time: Three Hours Maximum Marks: 75

Knowledge Level	Sections		Marks	Total Marks	Meaning of K's
K1	**Part - A** 10 Questions - Objectives type *1 Marks (No Choice)	Two Questions from each unit	**10**	**75**	**K1- Memory Level** **K2 - Understanding Level** **K3 - Application Level** **K4 - Analytical Level** **K5 - Evaluation Level**
K1, K2	**Part - B** 5 Questions *2 Marks (No Choice)	One Question from each unit	**10**		
K2, K3, K4	**Part - C** 5 Questions (either or type)	One Question from each unit	**25**		
K2, K3, K4, K5	**Part - D** 3 out of 5 Questions	One Question from each unit	**30**		

2. Question Paper Pattern for Practical Papers:

Two either or type questions from the list of practical's – 60 Marks

(2x30 =60)

EXTERNAL MARK: 60 **INTERNAL MARK: 40**

3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory/Practical / Project courses of PG programmes.

EndSE	CIA Total	EA Total	Total Marks Allotted	Passing Minimum for EA	Passing Minimum (ESE)
Theory	25	75	100	38	50
Practical	40	60	100	30	50
Project	40	60	100	30	50
Internship	40	60	100	30	50

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical papers of PG programmes.

THEORY

EVALUATION OF INTERNAL ASSESSMENT

Test	: 10 Marks
Seminar	: 05 Marks
Assignment	: 05 Marks
Attendance	: 05 Marks
Total	: 25 Marks

PRACTICAL

EVALUATION OF INTERNAL ASSESSMENT

Test	: 20 Marks
Attendance	: 10 Marks
Observation	: 10 Marks
Total	: 40 Marks

PROJECT

EVALUATION OF INTERNAL ASSESSMENT

Review 1	: 10 Marks
Review 2	: 10 Marks
Review 3	: 10 Marks
Pre-Viva	: 10 Marks
Total	: 40 Marks

4. Passing Minimum:

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks (out of 75 marks) in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks (out of 60 marks) in the End Semester Practical Examinations.

5. Submission of Record Note Books for Practical Examinations:

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations.

6. Internship/Project:

Internship

Internship training (Minimum two weeks period) is mandatory for all the PG programmes during first year vacation period.

The Internship training should be valued for 100 marks by an internal examiner; however the Viva-Voce examination should be conducted by the internal examiner / guide/ teacher concerned.

1. The Internship training Report may consist of minimum of 30 pages.
2. The candidate has to submit the Internship training Report 20 days before the commencement of the III Semester Examinations.

Project:

The following guidelines to be followed for the Project with Viva-voce:

The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner / guide/ teacher concerned.

1. The Project Report may consist of minimum of 60 pages.
2. The candidate has to submit the Project Report 10 days before the Commencement of the IV Semester Examinations.
3. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

7. Note:

a) SWAYAM / MOOC – Free Online Education:

SWAYAM / MOOC is an instrument for self-actualisation providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

SEMESTER – I

CORE - I	M.Sc. MATHEMATICS	Credits: 5
Course Code: M23PMA01	**ALGEBRAIC STRUCTURES**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on algebra concepts and to develop an idea of abstract algebra. The main objective is to impart the knowledge on fundamental topics such as

- Sylows theorem
- Solvable groups
- Linear Transformations
- Jordan form
- Trace and transpose

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the concept of Sylows theorem.	K1
CO2	Classify the concepts of Solvable groups	K2
CO3	Analyze the concept of Linear Transformations	K4
CO4	Develop the idea about Jordan form	K3
CO5	Apply the concepts of Hermitian, unitary, normal transformations	K5

UNIT I: **(18 Hours)**

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)

UNIT II: **(18 Hours)**

Solvable groups - Direct products - Finite abelian groups- Modules

Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)

Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)

Chapter 4: Section 4.5

UNIT III: **(18 Hours)**

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.

Chapter 6: Sections 6.4, 6.5

UNIT IV: **(18 Hours)**

Jordan form - rational canonical form.

Chapter 6 : Sections 6.6 and 6.7

UNIT V: **(18 Hours)**

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Topics in Algebra	I.N. Herstein	John Wiley and sons, Second Edition	1999

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Algebra	S.Lang	3rd Edition, Addison Wesley	1993
2	A first course in abstract Algebra	John B.Fraleigh	Addison Wesley	1982
3	Algebra	M.Artin	Prentice Hall of India, NewDelhi.	1991
4	Advanced Course In Modern Algebra	Goyal J K; Gupta K P; Gupta G S	Pragati Prakashan	2003

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	M	S
CO2	S	M	M	M	S
CO3	S	S	M	S	M
CO4	M	M	S	S	M
CO5	S	M	S	M	S

S- Strong; **M**-Medium.

SEMESTER – I

CORE - II	M.Sc. MATHEMATICS	Credits: 5
Course Code: M23PMA02	REAL ANALYSIS - I	Contact Hour Per Week: 6

OBJECTIVES

To focuses on analysis concepts and to develop an idea of Real analysis. The main objective is to impart the knowledge on fundamental topics such as

- Functions of bounded variation
- The Riemann - Stieltjes Integral
- Infinite Series and infinite Products
- Sequences of Functions

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the logic behind the Functions of bounded variation	K1
CO2	Compare the concepts of Integration by parts- Change of variable in a Riemann - Stieltjes integral	K2
CO3	Apply the The Riemann - Stieltjes Integral	K3
CO4	Examine the Infinite Series and infinite Products	K4
CO5	Solve the concepts Sequences of Functions	K5

UNIT-I : Functions of bounded variation (18 Hours)

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

UNIT-II : The Riemann - Stieltjes Integral (18 Hours)

Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.

Chapter - 7 : Sections 7.1 to 7.14

UNIT-III : The Riemann-Stieltjes Integral (18 Hours)

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

UNIT-IV : Infinite Series and infinite Products (18 Hours)

Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.

Chapter - 8 Sec, 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23

UNIT-V: Sequences of Functions (18 Hours)

Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Mathematical Analysis	T.M. Apostol	Narosa Publ. House, New Delhi	1985

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Mathematical Anslysis,	Malik,S.C. and Savita Arora	Wiley Eastern Limited.New Delhi	1991
2	Real Analysis	H.L. Royden	Macmillan Publ. Co. Inc. 4th edition, New York	1993
3	Principles of Mathematical Analysis, 3rd edition	Walter Rudin	MC Graw Hill Book Co., Kogaskusha	1976

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	M
CO2	S	S	S	M	S
CO3	M	S	S	S	S
CO4	S	S	S	M	M
CO5	S	S	M	S	S

S- Strong; **M**-Medium.

SEMESTER – I

CORE - III	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA03	ORDINARY DIFFERENTIAL EQUATIONS	Contact Hour Per Week: 5

OBJECTIVES

To focuses on differential equation concepts and to develop an idea of ordinary differential equations. The main objective is to impart the knowledge on fundamental topics such as

- Linear Equations with Constant Coefficients
- Linear Equations with Variable Coefficients
- Linear Equations with Regular Singular Points
- First Order Equation - Existence and Uniqueness

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the Linear Equations with Constant Coefficients, Linear Equations with Variable Coefficients, Linear Equations with Regular Singular Points, First Order Equation - Existence and Uniqueness.	K1
CO2	Identify Linear Equations with Constant Coefficients, Linear Equations with Variable Coefficients, Linear Equations with Regular Singular Points, First Order Equation - Existence and Uniqueness.	K2
CO3	Analyze the concepts of Linear Equations with Constant Coefficients, Linear Equations with Variable Coefficients, Linear Equations with Regular Singular Points, First Order Equation - Existence and Uniqueness.	K4
CO4	Elaborate Linear Equations with Constant Coefficients, Linear Equations with Variable Coefficients, Linear Equations with Regular Singular Points, First Order Equation - Existence and Uniqueness.	K5
CO5	Apply the concepts Linear Equations with Constant Coefficients, Linear Equations with Variable Coefficients, Linear Equations with Regular Singular Points, First Order Equation - Existence and Uniqueness.	K3

UNIT-I : Linear equations with constant coefficients (15 Hours)

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

UNIT-II : Linear equations with constant coefficients (15 Hours)

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.

UNIT-III : Linear equation with variable coefficients (15 Hours)

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)

UNIT-IV : Linear equation with regular singular points (15 Hours)

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)

UNIT-V : Existence and uniqueness of solutions to first order equations:

(15 Hours)

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)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments.

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	An Introduction to Ordinary Differential Equation	E.A.Coddington	Prentice Hall of India, New Delhi	1994

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Ordinary and Partial differential Equations	M. D. Raisinghania	S Chand & Co. New Delhi	2012
2.	Essentials of Ordinary Differential Equation	R.P Agarwal and Ramesh C.Gupta	McGraw, Hill, New York	1991
3.	Ordinary Differential Equations	D.Somasundram	Narosa Publ.House, Chennai	2002

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	M	S
CO2	M	S	M	M	S
CO3	S	M	M	S	M
CO4	S	M	S	M	S
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -I

DSE-I	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE01	**ELECTIVE –I- GRAPH THEORY AND APPLICATIONS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of graph theory. The main objective is to impart the knowledge on fundamental topics such as

- Graphs and Sub graphs
- Trees and Connectivity
- Euler Tours
- Matchings
- Edge Colouring
- Independent sets
- Vertex Colorings
- Planar graphs
- Directed graphs

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the Graphs and Sub graphs, Trees and Connectivity, Euler Tours, Matchings, Edge Colouring, Independent sets, Vertex Colorings, Planar graphs and Directed graphs.	K1
CO2	Illustrate the Graphs and Sub graphs, Trees and Connectivity, Euler Tours, Matchings, Edge Colouring, Independent sets, Vertex Colorings, Planar graphs and Directed graphs..	K2
CO3	Analyze the Graphs and Sub graphs, Trees and Connectivity, Euler Tours, Matchings, Edge Colouring, Independent sets, Vertex Colorings, Planar graphs and Directed graphs.	K4
CO4	Solve the method for Graphs and Sub graphs, Trees and Connectivity, Euler Tours, Matchings, Edge Colouring, Independent sets, Vertex Colorings, Planar graphs and Directed graphs.	K3
CO5	Apply the idea of Graphs and Sub graphs, Trees and Connectivity, Euler Tours, Matchings, Edge Colouring, Independent sets, Vertex Colorings, Planar graphs and Directed graphs.	K5

UNIT I: Graphs and Trees: (15 Hours)

Graphs and simple graphs – Graph isomorphism – Incidence and Adjacency Matrices – Subgraphs – Vertex degrees – Paths and connection – Cycles –Trees – Cut edges and bonds – Cut vertices – Cayley's formula .

(Chapter 1 : Sections 1.1 to 1.7 and Chapter 2: Sections 2.1 to 2.4)

UNIT II: Connectivity and Euler Tours: (15 Hours)

Connectivity – Blocks - Euler Tours – Hamilton cycles

(Chapter 3: Sections 3.1 to 3.2 and Chapter 4: Sections 4.1 to 4.2)

UNIT III: Matchings and Edge Colouring: (15 Hours)

Matchings – Matching and coverings in Bipartite Graphs – Perfect Matchings - Edge Coloring – Edge Chromatic Number – Vizings Theorem .

(Chapter 5: Sections 5.1 to 5.3 and Chapter 6: Sections 6.1 to 6.2)

UNIT IV: Independent sets and Vertex Colorings: (15 Hours)

Ramsey's Theorem – Turan's Theorem- Vertex Colorings – Chromatic Number – Brook Theorem – Hajos conjecture – Chromatic Polynomials – Girth and Chromatic Number .

(Chapter 7: Sections 7.1 to 7.3 and Chapter 8 : Sections 8.1 to 8.5)

UNIT V: Planar Graphs and Directed Graphs: (15 Hours)

Plane and Planar Graphs –Dual graphs –Euler's graphs - Directed graphs – Directed path – Directed cycles.

(Chapter 9: Sections 9.1 to 9.3 and Chapter 10: Sections 10.1 to 10.3)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Graph Theory with Applications	J.A.Bondy and U.S.R. Murty	North Holland, New York	1982

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Graph Theory with Application to Engineering and Computer Science	Narasing Deo	Prentice Hall of India, New Delhi	2003
2	Graph Theory	F. Harary	Addison – Wesely Pub. Co. The Mass	1969
3	Graph Theory Application	L. R.. Foulds	Narosa Publ. House, Chennai	1933
4	A Fist Look At Graph Theory	John Cleark Derek Allen	Allied Publishers Ltd.	1995
5	Introduction To Grap Theory	Dughlas West.B	Pearson Education	2003

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	S	S	S	M	M
CO5	S	M	S	S	S

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -I

DSE-I	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE02	**ELECTIVE-I-NUMBER THEORY**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analytical concepts and to develop an idea of number theory. The main objective is to impart the knowledge on fundamental topics such as

- Divisibility
- Prime numbers
- Congruence's and congruence's with a prime power modulus
- Euler's function and the group of units
- Quadratic residues
- Arithmetic function

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the logic behind the Divisibility, Prime numbers, Congruence's and congruence's with a prime power modulus, Euler's function and the group of units, Quadratic residues and Arithmetic function.	K1
CO2	Compare the Divisibility, Prime numbers, Congruence's and congruence's with a prime power modulus, Euler's function and the group of units, Quadratic residues and Arithmetic function.	K2
CO3	Identify the concepts of Divisibility, Prime numbers, Congruence's and congruence's with a prime power modulus, Euler's function and the group of units, Quadratic residues and Arithmetic function.	K3
CO4	Discover the Divisibility, Prime numbers, Congruence's and congruence's with a prime power modulus, Euler's function and the group of units, Quadratic residues and Arithmetic function.	K4
CO5	Apply the concepts Divisibility, Prime numbers, Congruence's and congruence's with a prime power modulus, Euler's function and the group of units, Quadratic residues and Arithmetic function.	K5

UNIT I: DIVISIBILITY AND PRIME NUMBERS: (15 Hours)

Divisors – Bezouts identity – Least common multiples – Linear Diophantine equations – Prime numbers & Prime – Power Factorizations – Distribution of primes – Fermat and Mersenne primes – Primality – Testing and Factorization.Chapter 1: Sec: 1.1-1.4 & Chapter 2: Sec: 2.1-2.4.

UNIT II: CONGRUENCES AND CONGRUENCES WITH A PRIME POWER MODULUS: (15 Hours)

Modular arithmetic - Linear congruences – Simultaneous Linear congruences – Simultaneous non- linear congruences- An extension of the Chinese remainder theorem – The arithmetic of Z_p – Pseudoprimes & Carmichael numbers - Solving Congruences mod (P^e) .Chapter 3: Sec: 3.1-3.5 & Chapter 4: Sec: 4.1-4.3

UNIT III: EULERS FUNCTION AND THE GROUP OF UNITS: (15 Hours)

Units – Euler's function – Applications of Eulers function – The group U_n – Primitive roots – The group U_2^e - The existence of primitive roots – The algebraic structure of U_n - The universal exponent. Chapter 5: Sec: 5.1-5.3 & Chapter 6: Sec: 6.1-6.8.

UNIT IV: QUADRATIC RESIDUES: (15 Hours)

Quadratic congruence's – The group of quadratic residues – The Legendre symbol – Quadratic reciprocity – Quadratic residues for prime power moduli – Quadratic residues for arbitrary moduli. Chapter 7: Sec: 7.1-7.6.

UNIT V: ARITHMETIC FUNCTION: (15 Hours)

Definition & Examples – Perfect numbers –The mobius inversion formula - Properties of the mobius function – The Dirichlet product. Chapter 8: Sec: 8.1-8.6.

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Elementary Number Theory	Gaveth A. Jones & J.Mary Jones	Springer India Pvt Ltd	1998

REFERENCE BOOKS :

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Beginning Number Theory	Neville Robbins	Springer India Pvt Ltd	1998
2.	Elementary Number Theory	David M. Burton	Mcgraw Hill company	2010 7th Edition
3.	Number Theory	Shailesh Shirail	Indian Acadamy	2003
4.	An Introduction to Theory of Numbers	Ivan Niven and H. Zuckerman	John wiley and sons	2008
5.	Elements of Number theory	S. Kumaravelu and Susheela Kumaravelu	SKV publication	2002

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	M	M	S	M	S
CO3	S	M	M	S	M
CO4	S	S	S	M	S
CO5	S	S	M	M	S

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -I

DSE-I	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE03	**ELECTIVE – I - PROGRAMMING IN C++**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on programming concepts and to develop an idea of application. The main objective is to impart the knowledge on fundamental topics such as

- Inheritance, polymorphism
- Dynamic binding and generic structures to build reusable code
- Composition of objects
- Operator overloads
- Dynamic memory allocation
- File I/O and exception
- File handling

In addition, it also provides technical thinking to the scientific programming related idea to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	Statement	Knowledge Level
CO1	Define structure and object oriented problem solving approaches.	K1
CO2	Infer classes and objects for a given problem.	K2
CO3	Describe the constructors, destructors and type conversions for the problems .	K3
CO4	Illustrate the code reusability and extensibility by means of Inheritance and Polymorphism.	K4
CO5	Apply the concepts in file operations.	K5

UNIT I: **(15 Hours)**

Software Evolution – Procedure oriented Programming – Object oriented programming paradigm – Basic concepts of object oriented programming – Benefits of oops – Object oriented Languages – Application of OOP – Beginning with C++ - what is C++ - Application of C++ - A simple C++ Program – More C++ Statements – An Example with class – Structure of C++ Program.

UNIT II: **(15 Hours)**

Token, Expressions and control structures: Tokens – Keywords – Identifiers and Constants – Basic Data types – User defined Data types – Derived data types – Symbolic Constants in C++ - Scope resolution operator – Manipulators – Type cost operator – Expressions and their types – Special assignment expressions – Implicit Conversions – Operator Overloading – Operator precedence – Control Structure.

UNIT – III: Function in C++: **(15 Hours)**

Main Function – function prototyping – Call by reference – Return by reference – Inline functions – default arguments – Const arguments – Function overloading – Friend and Virtual functions – Math library function.

Class and Objects:

Specifying a class – Defining member functions – A C++ program with class – Making an outside function inline – Nesting of member functions – Private member functions – Arrays within a class – Memory allocations for objects – Static data member – Static member functions – Array of the object – Object as function arguments – Friendly functions – Returning objects – Const member functions – Pointer to members – Local classes.

UNIT IV: Constructors and Destructors: **(15 Hours)**

Constructors – Parameterized Constructors in a Constructor – Multiple constructors in a class – Constructors with default arguments – Dynamic Initialization of objects – Copy constructors – Dynamic Constructors – Constructing Two-dimensional arrays – Const objects -– Destructors. Operator overloading and type conversions: Defining operator overloading – overloading unary operators – overloading binary operators - overloading binary operators using friends – Manipulation of strings using operators – Rules for overloading operators – Type conversions.

UNIT V: Files: (15 Hours)

Introduction – Class for file stream operations – opening and closing a file – detecting End-of file – More about open () File modes – File pointer and their manipulations – Sequential input and output operations. Exception Handling: Introduction – Basics of Exception Handling – Exception Handling Mechanism – Throwing Mechanism – Catching Mechanism – Rethrowing an Exception.

Practical Problems:

1. Create two classes DM and DB, which store the value of distances. DM stores distances in meters and centimeters in DB in feet and inches. Write a program that can create the values for the class objects and add object DM with another object DB.
2. Create a class FLOAT that contains on float data member overload all the four arithmetic operators so that operates on the objects of FLOAT.
3. Design a class polar, which describes a part in a plane using polar coordinates radius and angle. A point in polar coordinates is as shown below. Use the overloads +operator to add two objects of polar. Note that we cannot add polar values of two points directly. The requires first the conversion points into rectangular coordinates and finally creating the result into polar coordinates. [Where rectangle co-ordinates: x = r* cos(a); y = r* sin(a) Polar co-ordinates: a = atan (x/y) r = Sqrt (x*x + y*y)]
4. Create a class MAT of size m*m. Define all possible matrix operations for MAT type objects verify the identity. (A-B)^2+B^2-2*A*B.
5. Area computation using derived class.
6. Define a class for vector containing scalar values. Apply overloading concepts for vector additions, multiplication of a vector by a scalar quantity, replace the values in a position vector.

TEACHING METHODS:

Chalk and Talk / Lab / PowerPoint presentation / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Object-Oriented Programming with C++ 2nd Edition	E.Balagrurusamy	Tata McGraw Hill Pub.	1999

REFERENCE BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	The Waite Group's Object Oriented Programming In Turbo C++	Robert Lafore	Galgotia Publication Pvt. Ltd	1998

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	M	S	S	M
CO3	M	S	M	S	S
CO4	S	S	S	M	S
CO5	S	S	S	S	S

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -II

DSE-II	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE04	**ELECTIVE - II - DISCRETE MATHEMATICS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on logic and technical concepts and to develop an idea of discrete mathematics. The main objective is to impart the knowledge on fundamental topics such as

- Theory of inference
- Set Theory
- Algebraic Structures
- Lattices
- Boolean algebra
- Graph Theory

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the theory of inference, Set Theory, Algebraic Structures, Lattices, Boolean algebra and Graph Theory.	K1
CO2	Illustrate the theory of inference, Set Theory, Algebraic Structures, Lattices, Boolean algebra and Graph Theory.	K2
CO3	Compare the theory of inference, Set Theory, Algebraic Structures, Lattices, Boolean algebra and Graph Theory.	K4
CO4	Make use of theory of inference, Set Theory, Algebraic Structures, Lattices, Boolean algebra and Graph Theory.	K3
CO5	Apply the theory of inference, Set Theory, Algebraic Structures, Lattices, Boolean algebra and Graph Theory.	K5

UNIT I: Theory of inference: (15 Hours)

Consistency of premises validity using truth table – Consistency of premises – Predicates –Statement function, Variables and quantifiers – Predicate formulae – Free and bound variables – Theory of inference for the predicate calculus .

(Chapter 1: Sections 1- 4.1, 1 - 4.2, 1 - 5.1, 1 - 5.2,1 - 5.3, 1 - 5.4, 1 - 6.4)

UNIT II: Set Theory: (15 Hours)

Functions – Definition and introduction – Composition of functions – Inverse functions – Binary and n-ary Operations – Characteristic function of a set – Hashing functions – Peuno axioms and mathematical induction – Cardinality.

(Chapter 2: 2 - 4.1, 2 - 4.2, 2 – 4.3, 2 – 4.4,2 – 4.5, 2 – 4.6, 2 – 5.1, 2 – 5.2)

UNIT III: Algebraic Structures: (15 Hours)

Groups: Definition and Examples – Subgroups and homomorphism – Co-sets and Lagrange's Theorem – Normal subgroups – Algebraic systems with Two Binary Operations.

(Chapter 3 : Sections 3 – 5.1, 3 – 5.2, 3 – 5.3, 3 – 5.4, 3 – 5.5)

UNIT IV: Lattices and Boolean algebra: **(15 Hours)**

Lattices as Algebraic Systems – Sub lattices, direct product and homomorphism – Boolean Algebra Definition and examples – Sub Algebra. Direct Product and homomorphism – Boolean functions, Boolean forms and free Boolean Algebras – Values of Boolean expression and Boolean functions.

(Chapter 4: Sections 4 – 1.3, 4 – 1.4, 4 – 2.2, 4 – 3.4, 4 – 3.2)

UNIT V: Graph Theory: (15 Hours)

Basic definitions – Paths – Rechability and Connectedness – Matrix representation of Graphs – Trees – Finite state machine: Introductory special circuits – Equivalence of finite state machines.

(Chapter 5: 5 – 1.1, 5 - 1.2, 5 – 1.3, 5 – 1.4) and

(Chapter 4: Sections 4 – 6.1, 4 – 6.2)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Discrete Mathematical Structures applications to Computer Science	J.P. Trembley and R.Manohar	Tata McGraw Hills, New Delhi	1997

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Sets, Lattices and Boolean algebra	James C.Abbott	Allya and Bacon Boston	1969
2	Boolean Algebra and its applications	H.G.Flegg	John Wiley and Sons, Inc, NewYork	1974
3.	Discrete Mathematics	Harikishan; Shivraj Pundir	Pragati Prakashan	2004
4	Discrete Mathematics	T.VEERARAJAN	MC GREW HILL	1999

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	S	S	S	M	M
CO5	S	M	S	M	S

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -II

DSE-II	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE05	**ELECTIVE -II-MATHEMATICAL PROGRAMMING**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analytical concepts and to develop an idea of mathematical methods. The main objective is to impart the knowledge on fundamental topics such as

- Connection with Differential Equation - Solution of an Integral Equation
- Solution of Fredholm Integral Equation of the Second Kind by Successive Substitution
- Solution of Volterra Integral Equation of the second kind by successive substitution
- Application of Laplace Transform of Determine the Solution of Volterra Integral Equation with Convolution type Kernels
- Some Results About Fourier Transforms, Euler's equation
- Functional Dependent on the Functions of Several Independent variable

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the Connection with Differential Equation – Solution of an Integral Equation.	K1
CO2	Illustrate the Solution of Fredholm Integral Equation of the Second Kind by Successive Substitution- Solution of Volterra Integral Equation of the second kind by successive substitution.	K2
CO3	Develop Solution of Able's Integral Equation – General Form of Able Singular Integral Equation.	K3
CO4	Inspect method for Application of Laplace Transform of Determine the Solution of Volterra Integral Equation with Convolution type Kernels- Some Results About Fourier Transforms.	K4
CO5	Analyze Euler's equation - Functionals Dependent on the Functions of Several Independent variable.	K5

UNIT I: **(15 Hours)**

Introduction – types of Kernels – Eigen values and Eigen Function – Differentiation under the sign of Integration – Connection with Differential Equation – Solution of an Integral Equation – Conversion of Differential Equations to Integral Equations: Initial value Problem.

CH: 1 – Sec. 1.1- 1.8

UNIT II: **(15 Hours)**

Solution of Homogeneous Fredholm Integral Equation of the Second Kind with Separabel Kernal – Orthogonality and Reality of Eigen Functions- Fredholm Integral Equation with Separable Kernal- Solution of Fredholm Integral Equation of the Second Kind by Successive Substitution- Solution of Volterra Integral Equation of the second kind by successive substitution – Solution of Fredholm integral equation of the second kind by successive Approximation.

CH: 2 – Sec. 2.1-2.3 & CH: 4 – Sec. 4.2-4.5

UNIT III: **(15Hours)**

Singular integral equation- Solution of Able's Integral Equation – General Form of Able Singular Integral Equation – Weakly Singular Kernal- Iteratrion of the singular Equation. CH: 6 – Sec. 6.1-6.5

UNIT IV: **(15 Hours)**

Introduction – Some Special Types of Integral Equations – Application of Laplace Transform of Determine the Solution of Volterra Integral Equation with Convolution type Kernels- Some Results About Fourier Transforms- Application of Fourier Transform to Determine the Solutions of Singular Integral Equations.

CH: 7 – Sec. 7.1-7.5

UNIT V: **(15 Hours)**

Variation and its properties- Euler's equation- Functionals Dependent on the Functions of Several Independent variable – Variational Problems in parametric form.

Second Book CH: 1 – Sec. 1.1 – 1.6

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Integral Equations and Boundary Value Problems	Sudir K.Pundir and Rimple Pundir	Pragati Prakasam, Meerut	2005
2	Calculus of variation with Applications	A.S. Gupta	Prentice Hall of India Pvt. Ltd.	1999

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Methods of Applied Mathematics, Prentice	F.B. Hildebrand	Hall of India Pvt. New Delhi	1968
2	Linear Integral Equations Theory and Techniques	R. P. Kanwal	Academic Press, New York	1971
3	Differential Equations and Calculus of Variations	L. Elsgolts	Mir Publishers, Moscow	1973

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	S
CO2	M	S	S	S	M
CO3	M	M	M	M	S
CO4	S	M	S	M	M
CO5	S	S	S	S	S

S- Strong; **M**-Medium.

SEMESTER – I

DISCIPLINE SPECIFIC ELECTIVE -I

DSE-II	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE06	**ELECTIVE-II-FUZZY SETS AND THEIR APPLICATIONS**	**Contact Hour Per Week: 5**

OBJECTIVES:

To introduces fundamental concepts in Fuzzy sets and Fuzzy logic. It covers concepts such as Form classical sets to fuzzy sets; Fuzzy sets versus crisp sets, Operations on fuzzy sets, Fuzzy arithmetic, Fuzzy relations and Fuzzy Logic. It provides technical skills to understand and develop various ideas about analysis.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Identify the logic behind the execution of the form classical sets to fuzzy sets; Fuzzy sets versus crisp sets	K1
CO2	Understand the concepts of an operations on fuzzy sets.	K2
CO3	Analyze the concept of fuzzy arithmetic	K3
CO4	Develop the idea about the fuzzy relations.	K4
CO5	Apply the concepts to the fuzzy logic and its related theorems.	K5

UNIT I: Form classical sets to fuzzy sets, Fuzzy sets versus crisp sets **(15 Hours)**

Introduction – Crisp sets – Fuzzy sets – Characteristics and significance of the paradigm shift – Additional properties of α – cuts – Representation of fuzzy sets – Extension principal for fuzzy sets.

UNIT II: Operations on fuzzy sets **(15 Hours)**

Types of operations – Fuzzy complements – Fuzzy intersections: t- norms – fuzzy unions: t – conorms – Combinations of operations – Aggregation operations.

UNIT III: Fuzzy arithmetic **(15 Hours)**

Fuzzy numbers – Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on fuzzy numbers – fuzzy equations.

UNIT IV: Fuzzy relations **(15 Hours)**

Crisp versus Fuzzy relation - projections and cylindric extensions - binary fuzzy relations - Binary Relations on a single set - Fuzzy compatibility relations - Fuzzy ordering Relations - Furry Morphisms - Sup-I compositions of Fuzzy Relations - Info compositions of Fuzzy Relations

UNIT V:Fuzzy Logic **(15 Hours)**

Classical Logic- Multivalued Logic – Fuzzy propositions –Fuzzy propositions – Fuzzy Quantifiers –Linguistic Hedges – Inference form conditional fuzzy propositions – Inference from conditional and qualified propositions – Inference form quantified propositions.

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Fuzzy sets and Fuzzy logic Theory and Applications	George J, Klir Bo Yuvan	PHI learning pvt.ltd	2009

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Fuzzy sets , Fuzzy logic and Their Applications	Michael Gr. Voskoglou	MDPI	2020
2.	An Introduction To Fuzzy Control	Priankov .D; Rein Fsank Hellendron	Narosa Publishing House	1997
3.	Fuzzy Sets And Fuzzy Logic Theory And Application	George J. Klir; Bo Yuan	Phi Learning Private Limited	2010

MAPPING WITH PROGRAMME OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	S	S	M
CO3	S	M	M	S	M
CO4	M	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – I

SKILL ENHANCEMENT COURSE-I

SEC - I	M.Sc. MATHEMATICS	Credits: 2
Course Code: M23PMAS01	**SEC-I-LATEX PRACTICAL**	**Contact Hour Per Week: 3**

OBJECTIVES

To focus on Latex concepts and to develop an idea of typesetting. The main objective is to impart the knowledge on fundamental topics such as

- Basic LaTex and alignment
- Typesetting for jobs and Own Bio-Data
- Math miscellany, Math Styles, Bold Math,
- Symbols for number sets, math equation and integral equation
- Insert the image
- PowerPoint presentation

In addition, it also provides technical thinking to the type setting related idea to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Build the logic behind the Basic LaTex and alignment, Typesetting for jobs and Own Bio-Data, Math miscellany, Math Styles, Bold Math, Symbols for number sets, math equation and integral equation.	K3
CO2	Construct the Basic LaTex and alignment, Typesetting for jobs and Own Bio-Data, Math miscellany, Math Styles, Bold Math, Symbols for number sets, math equation and integral equation.	K3
CO3	Identify the concepts of Basic LaTex and alignment, Typesetting for jobs and Own Bio-Data, Math miscellany, Math Styles, Bold Math, Symbols for number sets, math equation and integral equation.	K4

Program	Content
1	Creation of document with different alignments (Left, Right, Center and Justify)
2	Creation of document – Itemization, Enumeration and Description
3	Creation of Letter for Applying Job
4	Creation of Own Bio-Data
5	Creation of Mathematical Statements
6	Creation of Tables
7	Creation of Matrices
8	Creation of Differential Equations
9	Creation of Integral Equations
10	Inserting a Picture in a Latex
11	Creation of Power point Presentation
12	Creation of Article

TEACHING METHODS:

Lab / PowerPoint presentation / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Learning LaTex	David F Griffiths and Desmond J. Higham	SIAM (Society for Industrial and Applied Mathematics)	1996

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	LATEX: A Document Preparation System, User's Guide and Reference Manual	L. Lamport	Addison-Wesley, New York, second edition.	1994
2.	A Student's Guide to the Study, Practice, and Tools of Modern Mathematics	Martin J. Erickson and Donald Bindner	CRC Press, Boca Raton, FL,	2011

SEMESTER – II

CORE-IV	M.Sc. MATHEMATICS	Credits: 5
Course Code: M23PMA04	**ADVANCED ALGEBRA**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on abstract algebra concepts and to develop an idea of linear algebra. The main objective is to impart the knowledge on fundamental topics such as

- Extension fields – Transcendence of e
- Roots or Polynomials
- Elements of Galois theory
- Finite fields
- Solvability by radicals

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Classify the concepts of Extension fields, Transcendence of e	K1
CO2	Explain the logic behind the Roots or Polynomials, More about roots	K2
CO3	Analyze the Elements of Galois theory	K4
CO4	Develop Finite fields	K3
CO5	Apply the concepts Solvability by radicals	K5

UNIT-I : **(18 Hours)**

Extension fields – Transcendence of e.

Chapter 5: Section 5.1 and 5.2

UNIT-II : **(18 Hours)**

Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5

UNIT-III : **(18 Hours)**

Elements of Galois theory.

Chapter 5 : Section 5.6

UNIT-IV : **(18Hours)**

Finite fields - Wedderburn's theorem on finite division rings.

Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT-V : **(18 Hours)**

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

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignment

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Topics in Algebra (II Edition)	I.N. Herstein.	Wiley EasternLimited, New Delhi	1975.

REFERENCES BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Algebra	S.Lang	3rd Edition, Addison Wesley	1993
2	A first course in abstract Algebra	John B.Fraleigh	Addison Wesley	1982
3	Algebra	M.Artin	Prentice Hall of India, NewDelhi	1991
4	Linear Algebra, 2nd Edition,	Kenneth M Hoffman and Ray Kunze	Prentice-Hall of India Pvt. Ltd, New Delhi.	2013
5.	Morden Algbra	Pillai T .K.M. Narayanan	S.Viswanathan & Co	1996
6.	A Text Book Of Morden Algbra	Balakrishnan; Ramab	Vikas Publishing House	1999

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	M
CO2	S	M	M	M	S
CO3	M	S	M	S	M
CO4	M	S	M	S	S
CO5	S	M	S	S	S

S- Strong; **M**-Medium.

SEMESTER – II

CORE - V	M.Sc. MATHEMATICS	Credits: 5
Course Code: M23PMA05	**REAL ANALYSIS - II**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of real analysis. The main objective is to impart the knowledge on fundamental topics such as

- Measure on the Real line
- Integration of Functions of a Real variable
- Fourier Series and Fourier Integrals
- Multivariable Differential Calculus
- Implicit Functions and Extremum Problems

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the Measure on the Real line.	K1
CO2	Build the concepts of Integration of Functions of a Real variable	K2
CO3	Identify the Fourier Series and Fourier Integrals	K3
CO4	Discover the idea of Multivariable Differential Calculus	K4
CO5	Organize the concepts to Implicit Functions and Extremum Problems.	K5

UNIT-I : Measure on the Real line (18 Hours)

Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability.

Chapter - 2 Sec 2.1 to 2.5 (de Barra)

UNIT-II : Integration of Functions of a Real variable (18Hours)

Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals .

Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

UNIT-III : Fourier Series and Fourier Integrals (18 Hours)

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)

UNIT-IV : Multivariable Differential Calculus (18 Hours)

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 : (18 Hours)

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)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Measure Theory and Integration,(for Units I and II)	G. de Barra,	Wiley Eastern Ltd., New Delhi.	1981
2	Mathematical Analysis,2nd Edition(for Units III, IV and V)	T.M. Apostol	Addison-Wesley Publishing Company Inc. New York.	1974.

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Mathematical Analysis	V. Ganapathy Iyer	Tata McGraw Hill, New Delhi	1970
2.	Principles of Mathematical Analysis, 3rd edition	Walter Rudin	MC Graw Hill Book Co., Kogaskusha	1976
3.	Real Analysis	H.L. Royden	Macmillan Publ. Co. Inc. 4th edition, New York	1993
4.	Principles Of Real Analysis	Charalambos D.Aliprantis; Owen Burkinshaw	Academic Press	2010

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	M	S	S	S	M
CO3	M	S	M	M	S
CO4	M	S	M	S	M
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – II

CORE-VI	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA06	**PARTIAL DIFFERENTIAL EQUATIONS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on optimization differential equation concepts and to develop an idea of partial differential equations. The main objective is to impart the knowledge on fundamental topics such as

- Mathematical Models
- Cauchy Problem
- Method of separation of variables
- Boundary Value Problems
- Green's Function

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the logic behind the Mathematical Models	K1
CO2	Choose the Homogeneous wave equation	K2
CO3	Analyze the concepts of Separation of variable-Vibrating string problem and The Diffusion Equation.	K3
CO4	Examine the Boundary Value Problems	K4
CO5	Apply the Green's Function	K5

UNIT-I : **(15 Hours)**

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)

UNIT-II : Cauchy Problem **(15 Hours)**

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

UNIT-III : Method of separation of variables **(15 Hours)**

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)

UNIT-IV : Boundary Value Problems : **(15 Hours)**

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

UNIT-V : Green's Function: **(15 Hours)**

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

Teaching Methods:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments.

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Partial Differential Equations for Scientists and Engineers (Third Edition)	TynMyint-U and Lokenath Debnath	North Holland, New York	1987

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Ordinary and Partial differential Equations	M. D. Raisinghania	S Chand & Co. New Delhi	2012
2	Introduction to partial Differential Equations	K.Sankar Rao	Prentice Hall of India, New Delhi	1995
3	Partial Differential Equation for Engineers and Scientist	J.N. Sharma and K.Singh	Narosa publ. House, Chennai	2001
4	Elemetns of Partial Differeential Equations	I.N.Snedden	McGraw Hill, New York	1964

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	S	S	M	S	M
CO3	S	M	M	S	M
CO4	S	M	S	M	S
CO5	M	S	S	M	S

S- Strong; **M**-Medium.

SEMESTER – II

DISCIPLINE SPECIFIC ELECTIVE -III

DSE - III	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE07	**ELECTIVE-III-MATHEMATICAL STATISTICS**	**Contact Hour Per Week: 4**

OBJECTIVES:

To introduces fundamental and advanced level concepts in probability theory. It covers concepts such as Sample moments and their functions, Students t-distribution, Stochastic convergence of sample quantiles, The expected value and the variance of the number of runs, The concept of a statistical test. It provides technical skills to understand and develop various ideas about Mathematical Statistics.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Find the logic behind the Sample moments and their functions.	K1
CO2	Understand the concepts of limit distributions of sample quantiles and successive sample elements	K2
CO3	Analyze The notion of a run	K3
CO4	Develop the concept of The Z^2 test-Test of the kolmogorov and smirnov type	K4
CO5	Apply the concepts to Asymptotically most efficient estimates	K5

UNIT-I **(12 Hours)**

Sample moments and their functions: The notion of a sample and Statistic -the distribution of the arithmetic mean of independent normally distributed random variables- The Z^2 distribution –The distribution of the statistic $(\bar{X}, S)$ - Students t-distribution – Fisher's Z-distribution. The distribution of $\bar{X}$ for some non-normal populations ,The distribution of regression coefficients. Chapter 9: 9.1 -9.8 and 9.10

UNIT-II **(12 Hours)**

Order Statistics :The notion of an order statistic – The empirical distribution function – Stochastic convergence of sample quantiles- limit distributions of sample quantiles and successive sample elements. The joint distribution of a group of quantiles –The distribution of the sample range.
Chapter 10 : 10.1- 10.8

UNIT –III **(12 Hours)**

The notion of a run – The probability distribution of the number of runs – The expected value and the variance of the number of runs.
Chapter 11 : 11,1 -11.4

UNIT IV **(12 Hours)**

The concept of a statistical test- Parametric tests for small samples and large samples – The Z^2 test-Test of the kolmogorov and smirnov type , The wald –Wolfovitz and wilcoxon – mann-Whitney tests-Independence tests by contingency tables. Chapter 12: 12.1 – 12.7

UNIT –V **(12 Hours)**

Consistent estimates- Unbaised estimates – The sufficiency of an estimate- The efficiency of an stimate – Asyptotically most efficient estimates- Methods of finding estimdates – Confidence intervals- Bayes Theorem and estimation . Chapter 13 : 13.1 -13.9

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Probability Theory and Mathematical Statistics	M.Fisz	John wiley and sons , New York	1963

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	An Introduction to Probability Theory and Mathematical Statistics(3rd Print)	V.K.Rohatgi	Wiley Eastern Ltd., New Delhi	1988
2	A Probability Path	S.I.Resnick	Birhauser, Berlin	1999
3	Modern Probability Theory (3rd Edition)	B.R.Bhat	New Age International (P)Ltd, New Delhi	1999

MAPPING WITH PROGRAMME OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	S	S	M
CO3	S	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – II

DISCIPLINE SPECIFIC ELECTIVE -III

DSE - III	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE08	**ELECTIVE-III- TENSOR ANALYSIS AND RELATIVITY**	**Contact Hour Per Week: 4**

OBJECTIVES:

To introduces fundamental and advanced level concepts in probability theory. It covers concepts such as Sample moments and their functions, Students t-distribution, Stochastic convergence of sample quantiles, The expected value and the variance of the number of runs, The concept of a statistical test. It provides technical skills to understand and develop various ideas about Mathematical Statistics.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Find the logic behind the Operations on Vectors, Linear dependence and linear independence of vectors.	K1
CO2	Understand the concepts of First-Order Tensors (Vectors), Second-Order Tensors.	K2
CO3	Analyze The notion of a Symmetry Properties of Tensors	K3
CO4	Develop the concept of Christoffel symbols, Covariant differentiation of tensors.	K4
CO5	Apply the concepts to Asymptotically most efficient estimates	K5

UNIT –I : VECTOR ALGEBRA **(12 Hours)**

Vectors and Scalars ,Free sliding and bound vectors,. Operations on Vectors, Addition of vectors, Subtraction of vectors, . Projection of a vector onto an axis, . Multiplication of a vector by a scalar,. Bases and Transformations, . Linear dependence and linear independence of vectors, Expansion of a vector with respect to other vectors, Bases and basis vectors, Direct and inverse transformations of basis vectors, Products of Two Vectors, The scalar product, The vector product, Physical examples, Products of Three Vectors, The scalar triple product, The vector triple product, Division of vectors, Reciprocal Bases and Related Topics, Reciprocal bases, The summation convention.

CHAPTER 1: 1.1- 1.6.2

UNIT –II : THE TENSOR CONCEPT **(12 Hours)**

Preliminary Remarks, Zeroth-Order Tensors (Scalars), First-Order Tensors (Vectors), Second-Order Tensors, The stress tensor, The moment of inertia tensor, The deformation tensor, The rate of deformation tensor, Higher-Order Tensors, Transformation of Tensors under Rotations about a Coordinate Axis, Invariance of Tensor Equations, Curvilinear Coordinates, Coordinate surfaces, Coordinate curves,. Bases and coordinates axes, Arc length. Metric coefficients.

CHAPTER 2: 2.1 - 2.8

UNIT –III : TENSOR ALGEBRA **(12 Hours)**

Addition of Tensors, Multiplication of Tensors, Contraction of Tensors, Symmetry Properties of Tensors, Symmetric and antisymmetric tensors, Equivalence of an antisymmetric second- order tensor to an axial vector, Reduction of Tensors to Principal Axes, Statement of the problem, The two-dimensional case, The three-dimensional case,. The tensor ellipsoid.

CHAPTER 3: 3.1 – 3.5

UNIT –IV : VECTOR AND TENSOR ANALYSIS: RUDIMENTS (12 Hours)

The Field Concept, Tensor functions of a scalar argument, Tensor fields, Line integrals. Circulation, . The Theorems of Gauss, Green and Stokes, Gauss' theorem, Green's theorem, Stokes' theorem, Simply and multiply connected regions, Scalar Fields, Level surfaces, The gradient and the directional derivative, Properties of the gradient. The operator ∇. Another definition of grade φ

CHAPTER 4: 4.1 - 4.3

UNIT –V : VECTOR AND TENSOR ANALYSIS: RAMIFICATIONS (12 Hours)

Covariant Differentiation, Covariant differentiation of vectors, Christoffel symbols, Covariant differentiation of tensors, Ricci's theorem, Differential operators in generalized coordinates, Integral Theorems, Theorems related to Gauss' theorem, Theorems related to Stokes' theorem, Green's formulas, Applications to Fluid Dynamics, Equations of fluid motion, The momentum theorem, Potential and Irrotational Fields, Multiple-valued potentials, Solenoidal Fields, Laplacian Fields, Harmonic functions, The Dirichlet and Neumann problems,.

CHAPTER 5: 5.1- 5.6

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Vector and Tensor Analysis with Applications	A. I. Borisenko I. E.Tarapov	Dover Publications, Inc. New York	1979

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Tensor and their Applications	Nazrul Islam	New age publisher	2006
2	Introduction to Tensor Analysis	H.D. Block	Charles E. marrill , Inc.	1978

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	S	S	M	M	S
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – II

DISCIPLINE SPECIFIC ELECTIVE -III

DSE -III	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE09	**ELECTIVE-III-STATISTICAL DATA ANALYSIS USING R PROGRAMMING**	**Contact Hour Per Week: 4**

OBJECTIVES

To focuses on statistical data analysis concepts using and to develop an idea with R programming. The main objective is to impart the knowledge on fundamental topics such as

- Statistical software R
- Descriptive statistics
- Colors and diagrams
- Probability distribution
- Estimation

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the logic behind the Statistical software R	K1
CO2	Choose the Descriptive statistics ideas with R	K2
CO3	Analyze the concepts of Colors and diagrams	K3
CO4	Examine the Probability distribution with R	K4
CO5	Apply the Estimation concept with R	K5

UNIT I: Statistical software R (12 Hours)

R and development history – structure of R – Installation of R – Working with R.

Chapter:1 – Sec. 1.1 -1.4

UNIT II: Descriptive statistics (12 Hours)

Basics – Excursus: Data import and export with R – Import of ICU – Data set – Categorical variables – Metric variables.

Chapter:2 – Sec. 2.1 -2.5

UNIT III: Colors and diagrams **(12 Hours)**

Colors - Excursus: Export of diagrams - diagrams
Chapter:3 – Sec. 3.1 -3.3

UNIT IV: Probability distribution **(12 Hours)**

Discrete distribution – Continuous distribution

Chapter:4 – Sec. 4.1 -4.2

UNIT V: Estimation **(12 Hours)**

Introduction – Point estimation – Confidence intervals

Chapter:5 – Sec. 5.1 -5.3

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Introduction to statistical data analysis with R	Matthias kohl	Bookboon,com The eBook company	2015

REFERENCE BOOK:

S. No	Title of the Book	Author	Publisher	Year of Publication
1	Introductory statistics with R	Peter dalgaard	Springer Science+Business Media, LLC	2008

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	S	S	M	S	M
CO3	S	M	M	S	M
CO4	S	M	S	M	S
CO5	M	S	S	M	S

S- Strong; **M**-Medium.

SEMESTER – II

SKILL ENHANCEMENT COURSE-II

SEC -II	M.Sc. MATHEMATICS	Credits: 2
Course Code: M23PMAS02	**SEC-II- SCILAB PRACTICAL**	**Contact Hour Per Week: 3**

OBJECTIVES

To focuses on programming concepts and to develop an idea of scilab. The main objective is to impart the knowledge on fundamental topics such as

- Math functions and trigonometric functions
- Math miscellany, Math Styles, Bold Math,
- Matrix
- Linear equations
- Control flow and Plotting a function

In addition, it also provides technical thinking to the scientific programming related idea to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Develop the concept of Math functions and trigonometric functions, Math miscellany, Math Styles, Bold Math, Matrix Linear equations and Control flow and Plotting a function.	K3
CO2	Build the knowledge of Math functions and trigonometric functions, Math miscellany, Math Styles, Bold Math, Matrix Linear equations and Control flow and Plotting a function.	K3
CO3	Apply the Math functions and trigonometric functions, Math miscellany, Math Styles, Bold Math, Matrix Linear equations and Control flow and Plotting a function.	K4

Program	Content
1	Elementary math functions and trigonometric functions
2	Creating random numbers defining matrices using colon operator in matrices
3	Matrix indexing, creating sub matrix, deleting row or column, finding dimension of a matrix.
4	Transpose of a matrix and concatenating of a matrix
5	Matrix generators eye, zeros, ones, diag and rand
6	Dot product, matrix multiplication and matrix powers
7	Matrix inverse, determinant and rank of a matrix
8	Eigen values and Eigen vectors

9	Solving linear equations
10	Solve for the roots of quadratic equation regardless type
11	Simple program by control flow
12	Plotting a function

TEACHING METHODS:

Lab / PowerPoint presentation / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Modeling and Simulation in Scilab/Scicos	Stephen L. Cambell, Jean-Philippe Chancelier and Ramine Nikoukhah	Springer	2000

REFERENCE BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Introduction to Scilab	Graeme Chandler And Stephen Roberts	Springer	2002

SEMESTER – II

ENHANCEMENT COMPULSORY COURSE

ECC	M.Sc. MATHEMATICS	Credits: 2
Course Code: M23PHR01	**HUMAN RIGHTS**	**Contact Hour Per Week: 2**

OBJECTIVES

To provides knowledge on the different aspects of human rights and can learn the rights for the duties to be carried out in the days to come.

UNIT - I: Introduction to Human Rights (6 Hours)

Human Rights: Meaning – Definitions – Origin and Growth of Human Rights in the World – Need and types of Human Rights – Theories of Human Rights – UNHRC (United Nations Human Rights) – Human Rights in India – Duties and Responsibilities of Indian Citizens.

UNIT - II: Classification of Human Rights (6 Hours)

Right to Liberty – Right to Life – Right to Equality – Right to dignity – Right to against Exploitation – Educational Rights – Cultural Rights – Economic Rights – political Rights – Social Rights.

UNIT - III: Rights of Women and Children (6 Hours)

Rights of Women – Female feticide and Infanticide and selective abortion – Physical assault and sexual harassment – Domestic Violence – Violence at work place – Remedial Measures. Rights of Children – Protection rights - Survival rights – Participation rights – Development rights – Role of UN on convention on rights of children.

UNIT – IV: Multi-Dimensional aspects of Human Rights (6 Hours)

Labour rights – Bodend Labour – Child Labour – Contract Labour – Migrant Labour – Domestic Women Labour – Gender Equity – Rights of Ethnic refugees – Problems and remedies – Role of trade union in protecting the unorganized labourers.

UNIT – V: Grievance and Redressal Mechanism (6 Hours)

Redressal Mechanism at national level – Structure and functions of National and State level human Rights Commission – Constitutional remedies – Public Interest Litigation (PIL) – Protection of Human Rights Act 1993.

TEXT BOOKS:

S. No	Title of the Book	Author	Publishing Company	Year
1.	Human Rights in a post Human World	Upendra Baxi	Cambridge university Press, New Delhi	2007
2.	Human Rights in India	Asish Kumar Das and Prasant Kumar Monaty	Sarup and Sons, New Delhi	2007
3.	Human Rights Social justice and political change	Bani Bargohain	Kanishka publishers and distributors, New Delhi	2007
4.	Human Rights and Development Issues	G. Velan	Ambala Cantt	2008
5.	Human rights Theory and Practice	P. K. Meena	Murali lal and Sons, New Delhi	2008

REFERENCE BOOKS:

S. No	Title of the Book	Author	Publishing Company	Year
1.	Teaching of Human Rights	Barat Sergio and Swaronjali Ghosh	Dominant Publishers and distributors, New Delhi	2009
2.	Human Rights Achievements and Challenges	A.N. Roy	Vista International Publishing House, Delhi	2005
3.	Human Rights Development and Environmental Law	Bhavani Prasad Panda	Academic Excellence, Delhi.	2007
4.	Human Rights – Twenty first Century Challenges	V. N. Vishvanathan	Kalpaz Publications, New Delhi.	2008
5.	Protecting Human Rights	M. R. Ansari	Max Ford Books, New Delhi.	2006
6.	Social Movements in Indi – Social Movements and Social Transformation in India	M. S. A Rao	Vol 1& 2: Manohar Publications, New Delhi.	1978

SEMESTER – III

CORE-VII	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA07	**COMPLEX ANALYSIS**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of complex analysis. The main objective is to impart the knowledge on fundamental topics such as

- Complex Integration
- Cauchy's Integral Formula
- Local Properties of analytical Functions
- The general Form of Cauchy's Theorem
- Evaluation of Definite Integrals
- Harmonic Functions, Series and Product developments
- Conformal mappings
- Elliptic functions

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the execution of Complex Integration, Local Properties of analytical Functions, The general Form of Cauchy's Theorem, Evaluation of Definite Integrals, Harmonic Functions, Conformal mappings and Elliptic functions.	K1
CO2	Classify the concepts of Complex Integration, Local Properties of analytical Functions, The general Form of Cauchy's Theorem, Evaluation of Definite Integrals, Harmonic Functions Conformal mappings and Elliptic functions	K4
CO3	Build the Complex Integration, Local Properties of analytical Functions, The general Form of Cauchy's Theorem, Evaluation of Definite Integrals, Harmonic Functions, Conformal mappings and Elliptic functions.	K3

CO4	Explain the concept of Complex Integration, Local Properties of analytical Functions, The general Form of Cauchy's Theorem, Evaluation of Definite Integrals, Harmonic Functions, Conformal mappings and Elliptic functions.	K2
CO5	Apply the concepts to Complex Integration, Local Properties of analytical Functions, The general Form of Cauchy's Theorem, Evaluation of Definite Integrals, Harmonic Functions, Conformal mappings and Elliptic functions	K5

UNIT-I : Cauchy's Integral Formula: (18 Hours)

The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:

Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

Chapter 4 : Section 2 : 2.1 to 2.3 &Chapter 4 : Section 3 : 3.1 to 3.4

UNIT-II :The general form of Cauchy's Theorem : (18 Hours)

Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.

Chapter 4 : Section 4 : 4.1 to 4.7 & Chapter 4 : Section 5: 5.1 and 5.2

UNIT-III :Evaluation of Definite Integrals and Harmonic Functions

(18 Hours)

Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

Chapter 4 : Section 5 : 5.3 & Chapter 4 : Sections 6 : 6.1 to 6.3

UNIT-IV :Harmonic Functions and Power Series Expansions: (18 Hours)

Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .

Chapter 4 : Sections 6.4 and 6.5 & Chapter 5 : Sections 1.1 to 1.3

UNIT-V: Partial Fractions and Entire Functions: (18 Hours)

Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem

Chapter 5 : Sections 2.1 to 2.4 & Chapter 5 : Sections 3.1 and 3.2

Teaching Methods:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Complex Analysis, 3rd edition	L.V Ahlfors	Mc Graw Hill Inter., Edition, New York	1979

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Functions of one Complex variable	J.B Conway	Narosa Publ. House, New Delhi	1980
2	Foundations of Complex Analysis	S.Ponnusamy	Narosa Publ. House, New Delhi	2004
3	Complex-Analysis	S.Lang	Addison – Wesley Mass	1977

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	M	S	S	S	M
CO3	S	S	M	M	S
CO4	S	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – III

CORE-VIII	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA08	**PROBABILITY THEORY**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on statistics concepts and to develop an idea of mathematical statistics. The main objective is to impart the knowledge on fundamental topics such as

- Random Events and Random Variables
- A parameters of the Distribution
- Characteristic functions
- Some probability distributions
- Limit Theorems

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the execution of Random Events and Random Variables, A parameters of the Distribution, Characteristic functions, Some probability distributions and Limit Theorems.	K1
CO2	Classify the concepts of Random Events and Random Variables, A parameters of the Distribution, Characteristic functions, Some probability distributions and Limit Theorems.	K2
CO3	Develop Random Events and Random Variables, A parameters of the Distribution, Characteristic functions, Some probability distributions and Limit Theorems.	K3
CO4	Apply the concept of Random Events and Random Variables, A parameters of the Distribution, Characteristic functions, Some probability distributions and Limit Theorems .	K4
CO5	Examine the concepts to Random Events and Random Variables, A parameters of the Distribution, Characteristic functions, Some probability distributions and Limit Theorems.	K5

UNIT-I : Random Events and Random Variables: (15 Hours)

Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Chapter 1: Sections 1.1 to 1.7 Chapter 2 : Sections 2.1 to 2.9

UNIT-II : Parameters of the Distribution : (15 Hours)

Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

Chapter 3 : Sections 3.1 to 3.8

UNIT III: Characteristic functions: (15 Hours)

Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

Chapter 4 : Sections 4.1 to 4.7

UNIT IV: Some probability distributions: (15 Hours)

One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)

UNIT V: Limit Theorems: (15 Hours)

Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12.
(Omit Sections 6.5, 6.10,6.13 to 6.15)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Probability Theory and Mathematical Statistics	M. Fisz	John Wiley and Sons, New York	1963

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Real Analysis and Probability	R.B. Ash	Academic Press, New York	1972
2	A course in Probability	K.L.Chung	Academic Press, New York	1974
3	Probability Theory (2nd Edition)	Y.S.Chow and H.Teicher	Springer Verlag. Berlin	1988
4	Probability (2nd Edition)	R.Durrett	Duxbury Press, New York	1996
5	An Introduction to Probability Theory and Mathematical Statistics(3rd Print)	V.K.Rohatgi	Wiley Eastern Ltd., New Delhi	1988
6	A Probability Path	S.I.Resnick	Birhauser, Berlin	1999
7	Modern Probability Theory (3rd Edition)	B.R.Bhat	New Age International (P)Ltd, New Delhi	1999
8	Probability, Statistics And Random Processes	Veerarajan T	Tata Mcgraw Hill	2005

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	S	S	M
CO3	S	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – III

CORE-IX	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA09	**TOPOLOGY**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of topology. The main objective is to impart the knowledge on fundamental topics such as

- Topological spaces
- Product of spaces
- Identification and Quotient spaces
- Separation axioms, Compactness
- Connectedness, normal spaces
- Uryshons Lemma, Extension theorems

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the logic behind the execution of Topological spaces, Product of spaces, Identification and Quotient spaces, Separation axioms, Compactness, Connectedness, normal spaces, Uryshons Lemma, Extension theorems and Compactifications.	K1
CO2	Classify the concepts of Topological spaces, Product of spaces, Identification and Quotient spaces, Separation axioms, Compactness, Connectedness, normal spaces, Uryshons Lemma, Extension theorems and Compactifications.	K2
CO3	Construct the Topological spaces, Product of spaces, Identification and Quotient spaces, Separation axioms, Compactness, Connectedness, normal spaces, Uryshons Lemma, Extension theorems and Compactifications.	K3
CO4	Compare the concept of Topological spaces, Product of spaces, Identification and Quotient spaces, Separation axioms, Compactness, Connectedness, normal spaces, Uryshons Lemma, Extension theorems and Compactifications.	K4
CO5	Apply the concepts to Topological spaces, Product of spaces, Identification and Quotient spaces, Separation axioms, Compactness, Connectedness, normal spaces, Uryshons Lemma, Extension theorems and Compactifications.	K5

UNIT-I : Topological spaces : **(18 Hours)**

Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.

Chapter 2 : Sections 12 to 17

UNIT-II :Continuous functions: **(18 Hours)**

Continuous functions – the product topology – The metric topology.

Chapter 2 : Sections 18 to 21 (Omit Section 22)

UNIT-III :Connectedness: **(18 Hours)**

Connected spaces- connected subspaces of the Real line – Components and local connectedness.

Chapter 3 : Sections 23 to 25.

UNIT-IV : Compactness : **(18 Hours)**

Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.

UNIT-V: Countability and Separation Axiom: **(18 Hours)**

The Countability
Axioms – The separation Axioms – Normal spaces – The
Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz
extension theorem.
Chapter 4 : Sections 30 to 35.

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Topology(2^{nd} Edition)	James R. Munkers	Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)	2002

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Topology	J. Dugundji	Prentice Hall of India, New Delhi	1975
2	Introduction to Topology and Modern Analysis	G.F.Simmons	McGraw Hill Book Co, New York	1963
3	Elements of General Topology	S.T. Hu	Holden Day, Inc. New York	1965
4.	Topology	Gupta K P; Gupta G S; Gupta S S	Pragati Prakashan	2004

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	S	M	M	S
CO3	M	S	M	S	M
CO4	S	M	S	M	S
CO5	M	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – III

CORE-X	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA10	**INDUSTRIAL STATISTICS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on industrial concepts and to develop an idea of industrial module. The main objective is to impart the knowledge on fundamental topics such as

- Mathematical Expectation
- Special Probability Distribution
- Functions of Random Variables
- Sampling Distributions
- Decision theory

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the execution of mathematical expectation	K1
CO2	Categorize the concepts of special probability distribution	K4
CO3	Extend the concepts of Functions of Random Variables	K2
CO4	Develop the concept of sampling distribution	K3
CO5	Explain the concepts of decision theory and its related result.	K5

UNIT I: Mathematical Expectation (15 Hours)

Introduction - The Expected Value of a Random Variable - Moments - Chebyshev's Theorem - Moment-Generating Functions - Product Moments - Moments of Linear Combinations of Random Variables - Conditional Expectations.

Chapter: 4 – (1-8)

UNIT II: Special Probability Distribution (15 Hours)

Introduction - The Discrete Uniform Distribution - The Bernoulli distribution - The Binomial Distribution - The Negative Binomial and Geometric Distributions - The Hypergeometric Distribution - The Poisson Distribution - The Multinomial Distribution - The Multivariate Hypergeometric Distribution.
Chapter:5 – (1-9)

UNIT III: Special Probability Densities (15 Hours)

Introduction - The Uniform Distribution - The Gamma, Exponential, and Chi-Square Distributions -The Beta Distribution - The Normal Distribution - The Normal Approximation to the Binomial Distribution - The Bivariate Normal Distribution.
Chapter: 6 – (1-7)

UNIT IV: Sampling Distributions (15 Hours)

Introduction -The Sampling Distribution of the Mean - The Sampling Distribution of the Mean: Finite Populations - The Chi-Square Distribution - The t Distribution - The F Distribution - Order Statistics.
Chapter: 8 – (1-7)

UNIT V: Decision theory (15 Hours)

Introduction - The Theory of Games - Statistical Games - Decision Criteria - The Minimax Criterion - The Bayes Criterion
Chapter: 9 – (1-6)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S. No	Title of the Book	Author	Publisher	Year of Publication
1	John E. Freund's Mathematical Statistics with Applications	Irwin Miller Marylees Mille	Pearson New International Edition, New delhi	2014

REFERENCE BOOK:

S. No	Title of the Book	Author	Publisher	Year of Publication
1	Elements of Probability and Statistics	Baisnab A., Jas M	Tata McGraw Hill Education Pvt. Ltd., New Delhi,	1993

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	S	S	M
CO3	S	M	M	S	M
CO4	S	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – III

DISCIPLINE SPECIFIC ELECTIVE -IV

DSE -IV	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE10	**ELECTIVE-IV - STOCHASTIC PROCESSES**	**Contact Hour Per Week: 5**

OBJECTIVES

To course focuses on analysis concepts and to develop an idea of stochastic processes. The main objective is to impart the knowledge on fundamental topics such as

- Stochastic Process
- Markov Chains
- Classification of states and chains
- Stability of Markov chain
- Poisson process
- Markov chain with discrete state space
- Renewal process
- Renewal process in continuous time
- Markov Renewal and semi- Markov processes

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the logic behind the execution of Stochastic Process, Markov Chains, Classification of states and chains, Poisson process, Renewal process in continuous time.	K1
CO2	Classify the concepts of Stochastic Process, Markov Chains, Classification of states and chains, Markov chain with discrete state space, Renewal process, Renewal process in continuous time.	K2
CO3	Construct the Stochastic Process, Markov Chains, Classification of states and chains, Poisson process, Markov chain with discrete state space, Renewal process.	K3
CO4	Develop the Stochastic Process, Markov Chains, Classification of states and chains, Poisson process, Markov chain with discrete state space, Renewal process, Renewal process in continuous time.	K4
CO5	Apply the concepts to Stochastic Process, Markov Chains, Classification of states and chains, Renewal process in continuous time.	K5

UNIT I: **(15 Hours)**

Stochastic Process: Introduction – Specification of Stochastic Processes, Stationary processes, Martingales, Markov Chains: Definitions and Examples, Higher transition probabilities, classification of states and chains.

Chapter2: 2.1 to 2.4; Chapter3: 3.1, 3.2, 3.4 (Example problems only)

UNIT II: **(15 Hours)**

Stability of Markov chain, Markov chains with denumerable number of states, Poisson process. Chapter3: 3.6, 3.8. Chapter4: 4.1 (Example problems only)

UNIT III: **(15 Hours)**

Poisson process and related distributions – Markov chain with discrete state space. Chapter4: 4.2 to 4.5 (Example problems only)

UNIT IV: **(15 Hours)**

Renewal process: Renewal process-Renewal process in continuous time – Renewal equation – Stopping time: Wald's equation – Renewal theorems. Chapter6: 6.1 to 6.5 (Example problems only)

UNIT V: **(15 Hours)**

Markov Renewal and semi-markov processes: Introduction – Definitions and Preliminaries results – Markov renewal equations – Limiting behaviours.

Chapter7: 7.1 to 7.4 (Example problems only)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Stochastic Processes 4th Edition	Prof. J. Medhi	New age International (P) Ltd,new delhi	2017

REFERENCE BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Stochastic Processes	T.Veerarajan	McGraw Hill	2008

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	S	S	M	M	S
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – III

DISCIPLINE SPECIFIC ELECTIVE -IV

DSE -IV	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE11	ELECTIVE- IV- FLUID DYNAMICS	Contact Hour Per Week: 5

OBJECTIVES

To focuses on analytical concepts and to develop an idea of fluid dynamics. The main objective is to impart the knowledge on fundamental topics such as

- Streamlines and path lines, Equation of continuity
- Pressure at a point in a moving fluid
- Some special two dimensional flows
- Impulsive motion, Stokes stream function
- Some special forms of the stream function for Axis symmetric irrotational motions
- Stream function, Complex velocity potential for standard two-dimensional flows
- Milne-Thomson circle theorem
- Some hydro dynamical aspects of conformal transformation

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the logic behind the execution of Streamlines and path lines, Equation of continuity, Pressure at a point in a moving fluid, Some special two dimensional flows, Impulsive motion, Stokes stream function, Stream function and Milne-Thomson circle.	K1
CO2	Utilize the Streamlines and path lines, Equation of continuity, Pressure at a point in a moving fluid, Some special two dimensional flows, Impulsive motion, Stokes stream function and Milne-Thomson circle theorem.	K3
CO3	Classify the concepts of Streamlines and path lines, Equation of continuity, Pressure at a point in a moving fluid, Some special two dimensional flows, Impulsive motion, Stokes stream function, Milne-Thomson circle theorem.	K2

CO4	Discover the Streamlines and path lines, Equation of continuity, Pressure at a point in a moving fluid, Some special two dimensional flows, Impulsive motion, Stokes stream function, Stream function, Milne-Thomson circle theorem.	K4
CO5	Apply the Streamlines and path lines, Equation of continuity, Pressure at a point in a moving fluid, Some special two dimensional flows, Impulsive motion, Stokes stream function, Milne-Thomson circle theorem and Some hydro dynamical aspects of conformal transformation.	K5

UNIT I : (15 Hours)

Real fluids and ideal fluids - Velocity of a fluid at a point - Streamlines and path lines - Steady and unsteady flows. Velocity potential - Vortices vector - Local and particle rates of change - Equation of continuity - Worked examples - Acceleration of a point of a fluid.

Chapter 2 Sections 2.1 to 2.9

UNIT II: (15 Hours)

Pressure at a point in a fluid at rest - Pressure at a point in a moving fluid - Conditions at a boundary of two in viscid Immiscible fluids - Euler's equations of motion - Bernoulli's equation – Worked examples - Some flows involving axial symmetry - Some special two dimensional flows – Impulsive motion. Chapter 3 Sections 3.1 to 3.6, 3.9 to 3.11

UNIT III: (15 Hours)

Some three dimensional flows - Sources, sinks and doublets - Images in a rigid infinite plane -Axis-symmetric flows - Stokes stream function - Some special forms of the stream function for Axissymmetric irrotational motions.

Chapter 4 Sections 4.1 to 4.3, 4.5, 4.5.1

UNIT IV: (15 Hours)

Two dimensional flow - Use of cylindrical polar coordinates - Stream function. Complex potential for two-dimensional irrotational - Incompressible flow - Complex velocity potential for standard two-dimensional flows - Uniform stream, line sources and line sinks, line doublets, line vortices - Worked examples.Chapter 5 Sections 5.1 to 5.6.

UNIT V: **(15 Hours)**

Two dimensional image systems – Milne-Thomson circle theorem - Some applications of the circle theorem - Extension of the circle theorem - Theorem of Blasius - Use of conformal transformation– Some hydro dynamical aspects of conformal transformation - Worked example.

Chapter 5 Sections 5.7 to 5.10.2

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / LAB / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Textbook of Fluid Dynamics	F. Chorlton	CBS Publication and Distribution	2004

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Fluid Dynamics	M.D. Raisinghania	S. Chand	1982
2	An Introduction to Fluid Mechanics	G.K. Batchelor	Foundation Books	1984

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	M	S	S	M	S
CO3	M	S	M	M	S
CO4	S	M	S	M	S
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – III

DISCIPLINE SPECIFIC ELECTIVE -IV

DSE -IV	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE12	**ELECTIVE- IV - MATHEMATICAL PYTHON**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on programming concepts and to develop an idea of Python. The main objective is to impart the knowledge on fundamental topics such as

- The Context of Software Development
- Values and Variables
- Expression and Arithmetic
- Conditional Execution
- Iteration
- Using Functions
- Writing Functions
- Objects
- Handling Exceptions

In addition, it also provides scientific programming thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the logic behind the execution of the Context of Software Development, Values and Variables, Expression and Arithmetic, Conditional Execution, Iteration, Using Functions, Writing Functions, More on Functions, Objects and Handling Exceptions	K1
CO2	Classify the concepts of a Context of Software Development, Values and Variables, Expression and Arithmetic, Conditional Execution, Iteration, Objects and Handling Exceptions.	K2
CO3	Develop the concept of Context of Software Development, Values and Variables, Expression and Arithmetic, Conditional Execution, Iteration, Using FunctionsObjects and Handling Exceptions.	K3
CO4	Analyze the idea about the Context of Software Development, Values and Variables, Expression and Arithmetic, Conditional Execution, Iteration, Objects and Handling Exceptions.	K4
CO5	Apply the concepts to the Context of Software Development, Values and Variables, Expression and Arithmetic, Conditional Execution, Iteration, More on Functions, Objects and Handling Exceptions.	K5

UNIT I: **(15 Hours)**

The Context of Software Development: Software Development Tool-Learning program with Python **-** Writing a Python Program - A Python Interactive shell - A longer Python Program. **Values and Variables:** Integer Values and String values - Variables and Assignments – Identifiers - Floating Point Types - Control Codes with Strings - User Input-Controlling the print Function.

UNIT II: **(15 Hours)**

Expression and Arithmetic: Expressions - Mixed Type Expressions-Operator Precedence and associatively - Formatting Expressions – Comments – Errors - Algorithms. **Conditional Execution:** Boolean Expressions - Simple if Statements - The if/else Statements - The Pass statement - Nested Conditionals - Multi-way Decision Statements - Conditional Expressions - Errors in Conditional Statements.

UNIT III: **(15 Hours)**

Iteration: The While Statement **-** Definite Loop vs Indefinite Loop - The For Statement - Nested Loops-Abnormal Loop Termination. **Using Functions:** Introduction to Using Functions - Functions and Modules - The Built-in-functions - Standard Mathematical Functions - Time Functions - Random Numbers - The eval and exec Functions.

UNIT IV: **(15 Hours)**

Writing Functions: Function Basics - Parameter passing - Document functions - Refactoring to Eliminate Code Duplication - Custom Functions vs. Standard Functions. **More on Functions:** Global Variables - Default Parameters - Introduction to Recursion- Making Functions Reusable - Functions as Data - Lambda Expressions.

UNIT V: **(15 Hours)**

Objects: Using Objects- String Objects **-** File Objects – Fraction Objects - Turtle Graphics Objects - Garbage collection. **Handling Exceptions:** Common Standard Exceptions - Handling Exceptions - Handling Multiple Exceptions - The Catch-all Handler - Raising Exceptions.

Note: Related practical classes also

TEACHING METHODS:

Lab / Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S. No	Title of the Book	Author	Publisher	Year of Publication
1.	Richard L. Halterman	Fundamentals of Python Programming	Southern Adventist University.	2017

REFERENCE BOOKS:

S. No	Title of the Book	Author	Publisher	Year of Publication
1.	1. Richard L. Halterman	"Learn to Program with Python"	Southern Adventist University.	3rd Edition(2011)
2.	Wesley J. Chun	Core Python Programming	Prentice Hall	2nd Edition

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	M	S	S	S	M
CO3	S	M	M	S	M
CO4	M	S	S	M	S
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – III

SKILL ENHANCEMENT COURSE-III

SEC -III	M.Sc. MATHEMATICS	Credits: 2
Course Code: M23PMAS03	**SEC –III- STATISTICAL PACKAGE FOR SOCIAL SCIENCES PRACTICAL**	**Contact Hour Per Week: 3**

OBJECTIVES

- To focus on Statistical concepts and to develop an idea of social data. The main objective is to impart the knowledge on fundamental topics such as
- To help at academic researchers, doctoral, masters and undergraduate students of mathematics, management science, and various other science and social science disciplines, practicing managers, marketing research professionals etc.
- To focus on Statistics and Marketing Research and for use in such courses in business schools and engineering colleges. This course is an effort towards facilitating business managers and researchers in solving statistical problems using computers. We have chosen SPSS, which is a very comprehensive and widely available package for statistical analyses.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Construction of the graphs and diagrams using SPSS.	K3
CO2	Construction of frequency distribution using SPSS.	K3
CO3	Analyze the Regression lines using SPSS.	K4

Program	Content
1	Simple Bar Diagram
2	Multiple Bar Diagram
3	Area Diagram
4	Histogram
5	Pie Diagram
6	Mean, Median and Mode (Individual Series)
7	Mean, Median and Mode (Discrete Series)
8	Mean, Median and Mode (Continuous Series)
9	Skewness and Kurtosis (Individual Series)
10	Skewness and Kurtosis (Discrete Series)
11	Skewness and Kurtosis (Continuous Series)
12	Correlation Co-Eficient
13	Rank Correlation Co-Efficient
14	Regression Lines
15	Test of significance for single mean
16	Test of significance for Difference of mean

TEACHING METHODS:

Lab / PowerPoint presentation / Quiz / Discussion / Assignments

TEXT BOOKS :

S. No	Title of the Book	Author	Publishing Company	Year of Publication
1.	Applied multivariate data analysis	Everitt, B.S and Dunn, G	Arnold London.	2001
2.	Data analysis using SPSS for windows	Jeremy J. Foster	Sage publications. London	New edition. Versions 8-10 2001.

SEMESTER – IV

CORE-XI	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA11	**FUNCTIONAL ANALYSIS**	**Contact Hour Per Week: 6**

OBJECTIVES

T0 focuses on analysis concepts and to develop an idea of functional analysis. The main objective is to impart the knowledge on fundamental topics such as

- Banach Spaces
- Hilbert Spaces
- Finite - Dimensional Spectral Theory
- General Preliminaries on Banach Algebras

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Find the logic behind the execution of Banach Spaces, Hilbert Spaces, Finite - Dimensional Spectral Theory and General Preliminaries on Banach Algebras.	K1
CO2	Demonstrate the concepts of Banach Spaces, Hilbert Spaces, Finite - Dimensional Spectral Theory and General Preliminaries on Banach Algebras.	K2
CO3	Construct Banach Spaces, Hilbert Spaces, Finite - Dimensional Spectral Theory and General Preliminaries on Banach Algebras.	K3
CO4	Develop the concept of Banach Spaces, Hilbert Spaces, Finite - Dimensional Spectral Theory and General Preliminaries on Banach Algebras.	K4
CO5	Analyze the concepts to Banach Spaces, Hilbert Spaces, Finite - Dimensional Spectral Theory and General Preliminaries on Banach Algebras.	K5

UNIT I: BANACH SPACES (18 Hours)

The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.

Chapter 9:Sections 46-51

UNIT II: HILBERT SPACES (18 Hours)

The definition and some simple properties–Orthogonal complements–Ortho normal sets–The conjugate space H^*-The adjoint of an operator–self-adjoint operators-Normal and unitary operators – Projections.

Chapter10:Sections52-59

UNIT III: FINITE-DIMENSIONAL SPECTRAL THEORY (18 Hours)

Matrices – Determinants and the spectrum of an operator –The spectral theorem.

Chapter 11:Sections 60-62

UNIT-IV : GENERAL PRELIMINARIES ON BANACH ALGEBRAS: (18 Hours)

The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity.

Chapter 12:Sections 64-69.

UNIT-V:

THE STRUCTURE OF COMMUTATIVE BANACH ALGEBRAS: (18 Hours)

The Gelfand mapping – Application of the formula$r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand-Neumark theorem.

Chapter 13:Sections 70-73

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Introduction to Topology and Modern Analysis	G.F.Simmons	McGraw Hill Inter. Book Co, New York	1963

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Functional Analysis	W. Rudin	Tata McGraw Hill Publ. Co, New Delhi	1973
2	Functional Analysis	D. Somasundaram	S. Viswanathan Pvt.Ltd., Chennai	1994

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	M	S	S	S	M
CO3	M	S	M	S	S
CO4	M	S	S	S	M
CO5	S	M	S	S	M

S- Strong; **M**-Medium.

SEMESTER – IV

CORE-XII	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA12	**DIFFERENTIAL GEOMETRY**	**Contact Hour Per Week: 6**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of differential geometry. The main objective is to impart the knowledge on fundamental topics such as

- Space curves
- Intrinsic properties of a surface
- Geodesics
- Non intrinsic properties of a surface
- Differential geometry of surfaces

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Define the Space curves, Intrinsic properties of a surface, Geodesics, Non intrinsic properties of a surface and Differential geometry of surfaces.	K1
CO2	Illustrate the Space curves, Intrinsic properties of a surface, Geodesics, Non intrinsic properties of a surface and Differential geometry of surfaces.	K2
CO3	Identify the concept of Space curves, Intrinsic properties of a surface, Geodesics, Non intrinsic properties of a surface and Differential geometry of surfaces	K3
CO4	Inspect the method Space curves, Intrinsic properties of a surface, Geodesics, Non intrinsic properties of a surface and Differential geometry of surfaces.	K4
CO5	Determine Space curves, Intrinsic properties of a surface, Geodesics, Non intrinsic properties of a surface and Differential geometry of surfaces.	K5

UNIT I: SPACE CURVES **(18 Hours)**

Definition of a space curve – Arc length – Tangent – Normal and binormal – Curvature and torsion – Contact between curves and surfaces – Tangent surface – Involutes and evolutes – Intrinsic equations – Fundamental existence theorem for space curves – Helics.

(Chapter I: Sections: 1-9)

UNIT II: INTRINSIC PROPERTIES OF A SURFACE **(18 Hours)**

Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic properties.

(Chapter II: Sections: 1-9)

UNIT III: GEODESICS **(18 Hours)**

Geodesics – Canonical geodesic equations – Normal property of geodesics Existence theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature – Surface of constant curvature.

(Chapter II: Sections: 10-18)

UNIT IV: NON INTRINSIC PROPERTIES OF A SURFACE **(18 Hours)**

The second fundamental form – Principal curvature – Lines of curvature Developable - Developable associated with space curves and with curves on surface – Minimal surfaces – Ruled surfaces.

(Chapter III: Sections: 1-8)

UNIT V: DIFFERENTIAL GEOMETRY OF SURFACES **(18 Hours)**

Compact surfaces whose points are umblics – Hilbert's lemma – Compact surface of constant curvature –Complete surface and their Characterization – Hilbert's Theorem – Conjugate points on geodesics.(Chapter IV: Sections: 1-8)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	An Introduction to Differential Geometry	T. Willmore	Oxford University Press,(17th Impression) New Delhi. (Indian Print)	2002

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Differential Geometry	D. Somasundaram	Narosa publ. House, Chennai	2005
2	Lectures on Classical Differential Geometry	D.T Struik	Addison – Wesely- Mass	1950
3	Elementary Topics in Differential Geometry	J.A. Thorpe	Springer – Verlag, New York	1979

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	M	S	M	S	M
CO3	S	S	S	M	S
CO4	M	M	S	M	S
CO5	S	S	S	S	S

S- Strong; **M**-Medium.

SEMESTER – IV

CORE-XIII	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMA13	**MECHANICS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on mechanics concepts and to develop an idea of classical mechanics. The main objective is to impart the knowledge on fundamental topics such as

- Mechanical System
- Lagrange's Equations
- Hamilton's Equation
- Hamilton – Jacobi Theory
- Canonical Transformation

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Recall the logic behind the execution of Mechanical System**,** Lagrange's Equations, Hamilton's Equation, Hamilton – Jacobi Theory and Canonical Transformation	K1
CO2	Construct the Mechanical System**,** Lagrange's Equations, Hamilton's Equation, Hamilton – Jacobi Theory and Canonical Transformation.	K3
CO3	Explin the concepts of Mechanical System**,** Lagrange's Equations, Hamilton's Equation, Hamilton – Jacobi Theory and Canonical Transformation.	K2
CO4	Analyze the Mechanical System**,** Lagrange's Equations, Hamilton's Equation, Hamilton – Jacobi Theory and Canonical Transformation.	K4
CO5	Apply the concepts to Mechanical System**,** Lagrange's Equations, Hamilton's Equation, Hamilton – Jacobi Theory and Canonical Transformation.	K5

UNIT I: Mechanical Systems: (15 Hours)

The Mechanical System – Generalized co–ordinates – Constraints – Virtual work – Energy and Momentum.

(Chapter 1 Sections 1.1 to 1.5)

UNIT II: Lagrange's Equations: (15 Hours)

Lagrange's Equation – Derivation of Lagrange's Equations – Examples – Integrals of motion.

(Chapter 2 Sections 2.1 to 2.3)

UNIT III: Hamilton's Equation: (15 Hours)

Hamilton's Equation – Hamiltons Principle – Hamilton's Equation – Other Variational Principle.

(Chapter 4 Sections 4.1 to 4.3)

UNIT IV: Hamilton – Jacobi Theory: (15 Hours)

Hamilton – Jacobi Theory – Hamilton Principle Function – Hamilton – Jacobi Equation – Separability.

(Chapter 5 Sections 5.1 to 5.3)

UNIT V: Canonical Transformation: (15 Hours)

Canonical Transformation – Differential forms and generating functions – Special Transformations – Lagrange and poisson brackets.

(Chapter 6 Sections 6.1 to 6.3)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Classical Dynamics	D. Greenwood	Prentice Hall of India, New Delhi	1985

REFERENCE BOOKS:

S. No	Title of the Book	Author	Publisher	Year of Publication
1	Classical Mechanics	H.Goldstein	Narosa Publishing House, NewDelhi	2001
2	Principles of Mechanics	J.L. Synge and B.A. Griffth	McGraw Hill Book Co. New York	1970
3	Classical Mechanics	N.C. Rane and P.S.C. Joag	Tata McGraw Hill, New Delhi	1991

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	M	S
CO2	M	M	S	M	S
CO3	M	M	S	M	S
CO4	S	M	M	S	S
CO5	S	S	S	S	M

S- Strong; **M**-Medium.

SEMESTER – IV

DISCIPLINE SPECIFIC ELECTIVE -V

DSE-V	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE13	**ELECTIVE –V - RESOURCE MANAGEMENT TECHNIQUES**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of Resource management techniques. The main objective is to impart the knowledge on fundamental topics such as

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the Variations affecting feasibility	K1
CO2	Classify the concepts of Importance of integer programming	K2
CO3	Construct the Bellman's principle of optimality	K3
CO4	Develop the Replacement Models	K4
CO5	Apply the concepts to simulation	K5

UNIT- I SENSITIVITY ANALYSIS: (15 Hours)

Introduction – Variations affecting feasibility – Variations in the right side of constraint – Addition of a new constraint – Changes affecting optimality – Variations in $C_j \notin C_B$ - Variations in $C_K \in C_B$ - Variations in the co-efficients a_{ij} of the constraints – Addition of a new activity (or variable)- Deletion of a variable – Deletion of a constraint.

Chapter : 6 Page number- 6.1 to 6.26

UNIT- II INTEGER PROGRAMMING: (15 Hours)

Introduction – Importance of integer programming – Applications of integer programming – Pit falls in routing the optimum solution of an integer programming problem – Methods of integer programming – Gomory's fractional cut algorithm (or) Cutting plane method for pure (all) integer programming problem – Geometrical Interpretation of a cutting plane method - Gomory's mixed integer method – Branch & Bound method.

Chapter :9 Page number- 9.1 to 9.64.

UNIT – III DYNAMIC PROGRAMMING: (15 Hours)

Introduction – Need for Dynamic programming – Bellman's principle of optimality – characteristics of Dynamic programming - Dynamic programming algorithm – Solving a least cost route problem by Dynamic programming problem.

Chapter :10 Page number- 10.1 to 10.38

UNIT – IV REPLACEMENT MODELS: (15 Hours)

Introduction – Replacement policy for items whose maintenance cost increases with time, and money value is not considered – Money value, present worth factor (pwf) and Discount rate – Mortality and staffing.

Chapter :11 Page number- 11.1 to 11.37

UNIT – V SIMULATION: (15 Hours)

Introduction – Monte-Carlo Techniques – Generation of Random Numbers – Steps in simulation – Uses in simulation –Simulation applied to queuing problems – Simulation applied to some other types of problems.

Chapter :17 Page number- 17.1 to 17.16

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Resource Management Techniques	V.Sunderasan, K.S.Ganapathy Subramanian, K.Ganesan	A.R.Publications, Nagapattinam	2007

REFERENCE BOOKS:

S. No	Title of the Book	Author	Publisher	Year of Publication
1	Resource Management Techniques	Dr. B. Sublakshmi & G Josephine santhi	Charulatha publications	2019
2	Operations Research 15th Edition	KantiSwarup, P.K.Guptaand Manmohan	Sultan Chand & Sons, Chennai.	2010
3	Operations Research Principles & Practice	Ravindran A	John Wiley	2005
4	Operations Research An Introduction	Hamdy A.Taha	Prentice Hall Of India	2005

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	S	S	M	M	S
CO5	S	S	M	S	M

S- Strong; **M**-Medium.

SEMESTER – IV

DISCIPLINE SPECIPIC ELECTIVE -V

DSE- V	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE14	**ELECTIVE- V- ALGEBRAIC GEOMETRY**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of Algebraic Geometry. The main objective is to impart the knowledge on fundamental topics such as

- Noetherian rings, Hilbert basis
- Hilbert's Nullstellensatz and applications
- Homogeneous coordinates, hyperplane at infinity,
- projective algebraic sets, homogeneous idealsand projective
- Nullstellensatz
- Hausdorff axiom

In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the Noetherian rings, Hilbert basis theorem	K1
CO2	Classify the concepts of Hilbert's Nullstellensatz and applications	K2
CO3	Construct the Homogeneous coordinates, hyperplane at infinity, projective algebraic sets,	K3
CO4	Develop the Hausdorff axiom	K4
CO5	Apply the concepts to Hausdorff axiom	K5

UNIT I: Affine algebraic sets (15 Hours)

Affine spaces and algebraic sets, Noetherian rings, Hilbert basis theorem, affine algebraic sets as finite intersection of hypersurfaces; Ideal of a set of points, coordinate ring, morphism between algebraic sets, isomorphism. Integral extensions, Noether's normalization lemma

UNIT II: Hilbert's Nullstellensatz and applications (15 Hours)

Correspondence between radical ideals and algebraic sets, prime ideals and irreducible algebraic sets, maximal ideals and points, contrapositive equivalence between affine algebras with algebra homomorphisms and algebraic sets with morphisms, between affine domains and irreducible algebraic sets, decomposition of an algebraic set into irreducible components. Zariski topology on affine spaces, algebraic subsets of the plane.

UNIT III: Projective spaces (15 Hours)

Homogeneous coordinates, hyperplane at infinity, projective algebraic sets, homogeneous ideals and projective Nullstellensatz; Zariski topology on projective spaces. Twisted cubic in P_3(k). Local properties of plane curves: multiple points and tangent lines, multiplicity and local rings, intersection numbers; projective plane curves: Linear systems of curves, intersections of projective curves: Bezout's theorem and applications; group structure on a cubic

UNIT IV: Introduction to sheaves of affine varieties (15 Hours)

Examples of presheaves and sheaves, stalks, sheafification of a presheaf, sections, structure sheaf, generic stalk and function fields, rational functions and local rings, Affine tangent spaces; Projective varieties and morphisms;

UNIT V: Hausdorff axiom (15 Hours)

Hausdorff axiom. Prime spectrum of a ring: Zariski topology, structure aheaf, affine schemes, morphism of affine schemes. Elementary Dimension Theory, Fibres of a morphism, complete varieties, nonsingularity and regular local rings, Jacobian criterion, nonsingular curves and DVR's.

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOKS::

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Abstract Algebra	D. S. Dummitt and R. M. Foote	Wiley, Ch. 15	1985
2	An introduction to algebraic geometry	W.Fulton	Electronic edition	2008
3.	Elementary Geometry of Algebraic Curves	C. G. Gibson	cambridge university	1998

REFERENCES BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Algebraic Geometry,	J. Harris	Springer	2002
2	Elementary Algebraic Geometry	K. Kendig	Springer	1998

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	M	S	S	S
CO3	M	S	M	S	M
CO4	M	S	M	S	M
CO5	S	M	S	M	S

S- Strong; **M**-Medium

SEMESTER – IV

DISCIPLINE SPECIPIC ELECTIVE -V

DSE -V	M.Sc. MATHEMATICS	Credits: 3
Course Code: M23PMAE15	**ELECTIVE- V- FINANCIAL MATHEMATICS**	**Contact Hour Per Week: 5**

OBJECTIVES

To focuses on analysis concepts and to develop an idea of Probability Random Variables . The main objective is to impart the knowledge on fundamental topics such as Brownian Motion and Geometric Brownian Motion, Interest Rates and Present Value Analysis , Pricing Contracts via Arbitrage In addition, it also provides analytical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the Probability Random Variables	K1
CO2	Classify the concepts of Normal Random Variables	K2
CO3	Construct the Brownian Motion and Geometric Brownian Motion	K3
CO4	Develop the Interest Rates and Present Value Analysis	K4
CO5	Apply the concepts to Pricing Contracts via Arbitrage	K5

UNIT-I (15 Hours)

Probability : Probabilities and Events , Conditional Probability , Random Variables and Expected Values , Covariance and Correlation , Conditional Expectation. Chapter1: 1.1-1.5

UNIT-II (15 Hours)

Normal Random Variables : Continuous Random Variables , Normal Random Variables, Properties of Normal Random Variables , The Central Limit Theorem.Chapter2: 2.1-2.4

UNIT-III (15 Hours)

Brownian Motion and Geometric Brownian Motion: Brownian Motion , Brownian Motion as a Limit of Simpler Models, Geometric Brownian Motion, Geometric Brownian Motion as a Limit of Simpler Models ,The Maximum Variable, The Cameron-Martin Theorem. Chapter3: 3.1-3.5

UNIT-IV **(15 Hours)**

Interest Rates and Present Value Analysis: Interest Rates , Present Value Analysis , Rate of Return , Continuously Varying Interest Rates.

Chapter4: 4.1-4.4

UNIT-V **(15 Hours)**

Pricing Contracts via Arbitrage : An Example in Options Pricing , Other Examples of Pricing via Arbitrage, The Arbitrage Theorem , The Multiperiod Binomial Model, Proof of the Arbitrage Theorem

Chapter 5: 5.1-1.2 , Chapter 6: 6.1-6.3

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	An Elementary Introduction to Mathematical Finance	Sheldon M.Ross	Cambridge university press	2011

REFERENCES BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1	Mathematical Finance	M. J. Alhabeeb	A John Wiley & sons Inc, Publication	2012

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	M	S	S	S
CO3	M	S	M	S	M
CO4	M	S	M	S	M
CO5	S	M	S	M	S

S- Strong; **M**-Medium

SEMESTER – IV

SKILL ENHANCEMENT COURSE-III

SEC -IV	M.Sc. MATHEMATICS	Credits: 2
Course Code: M23PMAS04	**SEC –IV -TECHNICAL WRITING AND PRESENTATION PRACTICAL**	**Contact Hour Per Week:3**

OBJECTIVES

The main objective is to impart the knowledge on fundamental topics such as

- networking events
- Presenting message
- Effective visuals
- Speaking and writing documents
- Interactive and encaging.

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Recognize & comply presentation regulations and data	K1
CO2	Understand and practice of soft skills on presentations	K2
CO3	Demonstrate knowledge of concept and principles of basic technical skills and specific area to perform practical operations	K3
CO4	Explain time management and organize related task in day to day work for personal & societal growth	K4
CO5	Analyze Concept check questions and Listing tasks	K5

UNIT – I: (9 Hours)

Introduction - Examples of different types of presentation - nterviews, meetings, networking events, speaking with clients - prepare for audience Q and A - Adjusting tone.

UNIT – II: (9 Hours)

Presenting message – Core message – Supporting Points – Writing outline – Method of communication.

UNIT – III: (9 Hours)

Visuals – Effective visuals – Representation of data – Planning visuals – organizing a presentation

UNIT – IV: **(9 Hours)**

Practice presentation – Speaking and writing documents – Effective methods of documentations – Importance of preparing documentation

UNIT – V: **(9 Hours)**

Interactive and encaging – Active schedule – Concept check questions – Listing tasks – Body language and eye contact

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Professional Report Writing	Mort, S.	United Kingdom: Taylor& Francis.(drawn from the list prescribed by AICTE)	2017

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publisher	Year of Publication
1.	Technical Communication: Principles and Practice	Sharma, S., Raman, M.	India: Oxford	2015
2.	Effective Communication Skills	Lata, P., Kumar, S.	KHANNA Publishers	2016

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	M	S	S	S
CO3	M	S	M	S	M
CO4	M	S	M	S	M
CO5	S	M	S	M	S

S- Strong; **M**-Medium

SEMESTER – II

Extra Disciplinary Course (EDC)

EDC	M.Sc. MATHEMATICS	Credits: 4
Course Code: M23PMAED1	**EDC – QUANTITATIVE APTITUDE**	**Contact Hour Per Week: 4**

OBJECTIVES

To focuses on technical concepts and to develop an idea of quantitative aptitude. The main objective is to impart the knowledge on fundamental topics such as

- Numbers
- Simplification
- Problems on numbers , problems on Ages
- Percentage , Profit and Loss
- Ratio and Proportion , Partnership

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the logic behind the Numbers, Simplification, Problems on numbers, problems on Ages, Percentage , Profit and Loss and Ratio and Proportion and Partnership.	K1
CO2	Illustrate the concepts of Simplification, Problems on numbers, problems on Ages, Percentage , Profit and Loss and Ratio and Proportion and Partnership.	K2
CO3	Choose the Simplification, Problems on numbers, problems on Ages, Percentage , Profit and Loss and Ratio and Proportion and Partnership.	K3
CO4	Simplify the Simplification, Problems on numbers, problems on Ages, Percentage , Profit and Loss and Ratio and Proportion and Partnership.	K4
CO5	Apply the concepts Simplification, Problems on numbers, problems on Ages, Percentage, Profit and Loss and Ratio and Proportion and Partnership.	K5

UNIT I: **(12 Hours)**

Numbers, H.C.F. and L.C.M. of numbers .(Section-I:1,2)

UNIT II: **(12 Hours)**

Simplification , Square roots and Cube Roots , Average.

(Section-I:4,5,6)

UNIT III: **(12 Hours)**

Problems on numbers , problems on Ages. (Section-I:7,8)

UNIT IV: **(12 Hours)**

Percentage , Profit and Loss. (Section-I:10,11)

UNIT V: **(12 Hours)**

Ratio and Proportion , Partnership. (Section-I:12,13)

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Tiltle of the Book	Author	Publishing Company	Year of Publication
1.	Quantitative Aptitude for competitive Examination	R.S.Aggarwal.	S.Chand& company Ltd,152,Anna salai,Chennai.	2014

REFERENCE BOOK:

S. No	Title of the Book	Author	Publisher	Year of Publication
1.	Wiley's Quantitative Aptitude	P.A. Anand	Wiley's Publications	2015 First Edition

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	M	M
CO2	S	M	S	M	S
CO3	M	M	M	S	M
CO4	S	M	S	M	M
CO5	S	M	M	S	S

S- Strong; **M**-Medium.

SEMESTER – II

Extra Disciplinary Course (EDC)

EDC	FOR OTHER DEPARTMENTS	Credits: 4
Course Code: M23PMAED2	**EDC - OPERATIONS RESEARCH**	**Contact Hour Per Week: 4**

OBJECTIVES

To focuses on technical concepts and to develop an idea of operation research. The main objective is to impart the knowledge on fundamental topics such as

- Linear Programming
- Simplex Method
- Big M method
- Transportation Problem
- Assignment problem
- PERT / CPM

In addition, it also provides technical thinking to solve problems related to the above concepts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO NUMBER	STATEMENT	KNOWLEDGE LEVEL
CO1	Identify the logic behind the Linear Programming, Simplex Method, Big M method, Transportation Problem, Assignment problem and PERT / CPM.	K1
CO2	Illustrate the concepts of Linear Programming, Simplex Method, Big M method, Transportation Problem, Assignment problem and PERT / CPM.	K2
CO3	Evaluate the Linear Programming, Simplex Method, Big M method, Transportation Problem, Assignment problem and PERT / CPM.	K5
CO4	Simplify the Simplex Method, Big M method, Transportation Problem, Assignment problem and PERT / CPM.	K3
CO5	Apply the concepts to Simplex Method, Big M method, Transportation Problem, Assignment problem and PERT / CPM.	K4

UNIT I: **(12 Hours)**

Introduction - Definition of O.R. – Scope , phases and Limitations of O.R. – Linear Programming Problem – Definitions – Mathematical Formulation – Characteristic of a LPP – Matrix form of LPP – Graphical Method – Definitions of bounded , unbounded and optimal solutions – procedure of solving LPP by graphical method – problems – Simplex technique - Definitions of Basic , non basic variables – basic solutions – slack variables and optimal solution , simplex procedure of solving LPP – problems.

UNIT II: **(12 Hours)**

Introduction – Big – M method – Definitions of Big – M method , surplus variables and artificial variables – Procedure of solving an LPP by Big – M method – Pseudo optimal solution – Problems – Two – Phase Simplex method – Procedure of solving an LPP by two – phase simplex method – problems.

UNIT III: **(12 Hours)**

Introduction – Balanced and unbalanced T.P , Feasible solution – Basic feasible solution – Optimum solution – Degeneracy in a T.P. – Mathematical formulation – North – West Corner rule – Vogel's approximation method (unit penalty method) - Method of Matrix minima (Least cost Method) – problems – Algorithm of Optimality test (Modi Method) – Problems.

UNIT IV: **(12 Hours)**

Assignment problem – Definition – Mathematical formulation of the Assignment problem – Test for optimality by using Hungarian method - Unbalanced Assignment problem – Degeneracy in Assignment problem - Maximization case in Assignment problem – Restrictions on Assignment problem – Variations in Assignment problem –problems.

UNIT V: **(12 Hours)**

Introduction – Definition of network, event, activity, optimistic time, pessimistic time, the most likely time, critical path, total float and free float – Difference between slack and float – Phases of critical path in a PERT network – difference between CPM and PERT – Problems.

TEACHING METHODS:

Chalk and Talk / PowerPoint presentation/ Seminar / Quiz / Discussion / Assignments

TEXT BOOK:

S.No	Title of the Book	Author	Publishing Company	Year of Publication
1.	Operations Research, Ninth Edition	P.K.Gupta, Man Mohan and Kanti Swarup	Sultan Chand and Sons, New Delhi	2001

REFERENCE BOOKS:

S.No	Title of the Book	Author	Publishing Company	Year of Publication
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2.	Operations Research, Second Edition	P.K.Gupta and D.S.Hira	S.Chand & Co, NewDelhi	2004
3	Operations Research 15th Edition	KantiSwarup, P.K.Guptaand Manmohan	Sultan Chand & Sons, Chennai.	2010
4	Operations Research Principles & Practice	Ravindran A	John Wiley	2005
5	Operations Research An Introduction	Hamdy A.Taha	Prentice Hall Of India	2005

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	S	S
CO2	M	M	S	S	M
CO3	S	S	S	M	S
CO4	M	M	M	M	S
CO5	S	S	M	M	S

S- Strong; **M**-Medium.