RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS), SULUR, COIMBATORE-641402

DEPARTMENT OF MATHEMATICS

M.Sc., MATHEMATICS

Syllabus effective for the students admitted during the Academic Year 2021 Batch &onwards

(2021 - 2023)

HOD **PRINCIPAL** **COE**

PROGRAMME OUTCOMES (POs):

PO1	To provide outcome based education in the respective disciplines and to impart skills which will enable the students secure job in their core disciplines in this digitally transforming era.
PO2	To develop the art of critical thinking, creativity and to imbibe emerging trends thereby to excel in their interested domains of specializations.
PO3	To inculcate and develop research competence systematically besides the capacity to analyze the viability of new ideas, entrepreneurship and professionalism based on the students' choice and aptitude.
PO4	To instill a culture of life-long learning and the ability to understand the socio-economic issues.

PROGRAMME SPECIFIC OUTCOMES: (PSOs)

Upon completion of Master of Mathematics Degree, STUDENTS are able to achieve the following outcomes.

PSO1	Mould the students for prominent career as Computational Fluid Dynamics Analyst, Data scientist, Quality control, Big data Analyst, Meteorologist, Cosmologist, Cryptologists and Astronomers.
PSO2	To inculcate the concepts of Algebra, Analysis, Differential equations, Mechanics, Operations Research, Numerical methods, Topology, Fluid Dynamics and Control Theory.
PSO3	Impart the knowledge conceptual facts, skills in problem solving in the areas Discrete structure, Fuzzy Mathematics, Mathematical Methods and Graph Theory.
PSO4	To understand and realize the principle algebraic Structures in Algebra, Analysis, Number Theory, Differential Geometry, Functional Analysis to develop higher order thinking to do Research etc.

RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS AND SCIENCE

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SCHEME OF EXAMINATIONS

M. Sc., MATHEMATICS 2021 - 2023 BATCH

Semester	Type	TITLE OF THE PAPER	Hours of instructions/week			Credits	Duration of examination in Hours	MARKS		
			Lecture Hours	Tutorial Hours	Practical Hours			CIA	EOS	TOTAL
I	M-I	ALGEBRA	5	1	-	4	3	25	75	100
	M-II	REAL ANALYSIS	5	1	-	4	3	25	75	100
	M-III	ORDINARY DIFFERENTIAL EQUATIONS	5	1	-	4	3	25	75	100
	M-IV	NUMERICAL METHODS	5	1	-	4	3	25	75	100
	M-V	LATEX AND MATHEMATICA - THEORY	4	-	-	4	3	25	75	100
	M-P	LATEX AND MATHEMATICA - PRACTICAL	-	-	2	2	3	40	60	100
II	M-VI	COMPLEX ANALYSIS	5	1	-	4	3	25	75	100
	M-VII	PARTIAL DIFFERENTIAL EQUATIONS	5	1	-	4	3	25	75	100
	M-VIII	MECHANICS	5	1	-	4	3	25	75	100
	M-IX	OPTIMIZATION TECHNIQUES	5	1	-	4	3	25	75	100
	EL-I	***ELECTIVE-I*** DIFFERENTIAL GEOMETRY	5	1	-	4	3	25	75	100
III	M-X	TOPOLOGY	5	1	-	4	3	25	75	100
	M-XI	MULTIVARIABLE CALCULUS	4	1	-	4	3	25	75	100
	M-XII	PROBABILTY THEORY	4	1	-	4	3	25	75	100
	M-XIII	FLUID DYNAMICS	4	1	-	4	3	25	75	100
	EL-II	***ELECTIVE-II*** CONTROL THEORY	4	1	-	4	3	25	75	100
	EL-III	***ELECTIVE-III-*** EDC	4		-	4	3	25	75	100
IV	M-XIV	FUNCTIONAL ANALYSIS	5	1	-	5	3	25	75	100
	M-XV	MATHEMATICAL METHODS	5	1	-	5	3	25	75	100
	M-XVI	GRAPH THEORY	5	1	-	5	3	25	75	100
	M-XVII	MATLAB	5	1	-	5	3	25	75	100
	PV	**PROJECT VIVA-VOCE****	6		-	4		40	60	100
		TOTAL				90				2200
I-III	ES	**EMPLOYABILITY SKILLS ***	-		2	-		-	-	Grade

LIST OF ELECTIVES

EL-I : ELECTIVE-I (SEMESTER-II)

1. DIFFERENTIAL GEOMETRY 2. FUZZY MATHEMATICS

EL-II : ELECTIVE-II (SEMESTER-III)

1. CONTROL THEORY 2. DISCRETE STRUCTURE

EL-III : ELECTIVE-III (SEMESTER-III)

EDC- EXTRA DECIPLINARY COURSE
EDC-QUANTITATIVE APTITUDE

M- MAJOR PAPER **,** ***MP***- MAJOR PRACTICAL**,** ***EL****-ELECTIVE PAPERS **,** ***EDC***- EXTRA DECIPLINARY COURSE.

ES*-EMPLOYABILITY SKILLS classes are held in first three semesters .Exam will be conducted in their II and III semesters .Two Extra Credits will be given. This is 'Mandatory' to get a degree.

SEMESTER-I

Course Title	: **ALGEBRA (T)**	Course Code	: 13A
Semester	: **I**	Course Group	: **M-I**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**		Credits	: **4**
Map Code : **F(PROBLEM – ANALYSIS)**		Total Contact Hours	: **90**
CIA : **25 Marks**		SEE #	: **75 Marks**
Programme : **M. Sc MATHEMATICS**		**# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl. Ses	CL
CO1	Remember the Group Theory.	PSO2	16	R
CO2	Analyze the Ring Theory.	PSO2	18	AN
CO3	Analyze the Fields.	PSO2	18	AN
CO4	Gain the knowledge of Fields.	PSO2	18	U
CO5	Analyze the Linear Transformation.	PSO2	10	AN
CO6	Apply the derivative concepts to determine the Hermitian, Unitary and Normal transformations.	PSO2	10	AP

UNIT-I **Lecture hour:16**

GROUP THEORY: Another Counting Principle (Explaination of another counting principle)- Conjugacy (Definition and Lemma)– Normalize (Definitions, lemma and theorems)- Cauchy's theorem (Theorems, lemma and corollary) – Sylow's theorem(theorem and corollary – Direct products(Definitions, lemma and theorems).

UNIT-II **Lecture hour:18**

RING THEORY : Euclidean Rings(Definitions, theorems and corollary) – Unique Factorization theorem (Theorem)- A particular Euclidean Ring (Lemmas and theorems)– Fermat's Theorem(Definitions, lemma and theorems)- Polynomial Rings(Definitions, theorems and corollary) – Polynomials over the rational field (Definitions, theorems and corollary) – Gauss lemma(Definitions, theorems and corollary) – The Eisentein Criterion(Theorem).

UNIT-III **Lecture hour:18**

FIELDS: Extension Fields (Definitions, theorems and corollary) – Algebraic Extension Fields (Definitions, theorems and corollary) - Roots of Polynomial(Definitions, theorems and corollary) s –

Remainder theorem(Definitions, theorems and corollary) - Splitting Fields(Definitions, theorems and corollary).

UNIT-IV **Lecture hour:18**

FIELDS: More about roots(Definitions, theorems and corollary) - Simple Extension (Definitions, theorems and corollary) – The Elements of Galois theory(Definitions, lemma and theorems) – Fixed field of a Group(Definitions, lemma and theorems) –Normal extensions(Definitions, lemma and theorems) – The Galois group of polynomial(Definitions, lemma and theorems) – Fundamental theorem of Galois theory. (Definitions, lemma and theorems)

UNIT-V **Lecture hour:20**

LINEAR TRANSFORMATION: Canonical forms (Definitions, theorems and corollary) – Similar Transformations (Definitions, lemma and theorems)– Triangular form(Definitions, lemma and theorems) – Trace and Transpose(Definitions, lemma and theorems) – Symmetric matrix(Definitions, lemma and theorems) – Skew Symmetric matrix (Definitions, lemma and theorems)– Hermitian ,unitary and normal transformations(Definitions, lemma and theorems)-Real Quadratic Forms(Definitions, lemma and theorems).

TEXT BOOK:

"TOPIC IN ALGEBRA" I.N.HERSTEIN (II-EDITION)

UNIT-I : Chapter-2 2.11 to 2.14
UNIT-II : Chapter-3 3.7 to 3.10
UNIT-III : Chapter-5 5.19 to 5.3
UNIT-IV: Chapter-5 5.5 to 5.6
UNIT-V : Chapter-6 6.4, 6.8 and 6.10,6.11

REFERENCE BOOK:

J.B.Fraleigh**, A First course in Abstract Algebra ,** Narosa Publishing House, New Delhi, 1988.

Course Title : **REAL ANALYSIS**	Course Code : 13B
Semester : **I**	Course Group : **M-II**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code : **F(PROBLEM – ANALYSIS)**	Total Contact Hours : **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl. Ses	CL
CO1	Remember the integration and differentiation.	PSO2	18	R
CO2	Remember the uniform convergence.	PSO2	18	R
CO3	Gain more knowledge of trigonometric function and Fourier series.	PSO2	9	U
CO4	Analyze the Lebesgue theorem.	PSO2	18	AN
CO5	Analyze the function of several variables.	PSO2	9	AN
CO6	Apply the Integration of complex functions	PSO2	18	AP

UNIT – I **Lecture hour: 18**

THE RIEMANN – STIELTJES INTEGRAL : Definition and existence of the integral(Definition, theorems and properties) – Properties of the Integral (Theorems) – Integration and Differentiation (theorems) – Integration of vector valued function (Definitions and theorems) – Rectifiable curves(definitions and theorems).

UNIT – II **Lecture hour:18**

SEQUENCES AND SERIES OF FUNCTIONS : Discussion of main problem (Definitions and examples)– Uniform convergence (Definitions and theorems)– Uniform convergence and continuity (theorems)– Uniform convergence and Integration uniform convergence and Differentiation(theorems) – Equicontinuous families of functions (definitions, theorems and examples)– The Stone - Weierstrass theorem (Definitions and theorems).

UNIT – III **Lecture hour:18**

FUNCTIONS OF SEVERAL VARIABLES: Linear transformations(Definitions and theorems)- Differentiation(definitions, theorems and examples)- The contraction principle(theorems)- The inverse function theorem(theorems)- The implicit function theorem(theorems).

UNIT – IV **Lecture hour:18**

LEBESGUE MEASURE : Outer measure (Definitions and theorems)- Measurable sets and Lebesgue measure(definitions, theorems and examples)- Non measurable set(theorems)- Measurable fuctions(theorems)- Little wood;s three principles(theorems).

UNIT – V **Lecture hour:18**

THE LEBESGUE INTEGRAL: The Lebesgue integral of a bounded function over a set of finite measure(Definitions and theorems)-The integral of a non-negative function-(theorems) The general Lebesgue integral(theorems)-Convergence in measure(theorems).

TEXT BOOK:

T1 : Principle of Mathematical Analysis by Walter Rudin (1985), Edition-13, MACGRAW-HILL, International Book Company.

T2 : Real Analysis, H.L. Royden, edition :3, Machillan Publisher, (1988).

REFERENCES BOOK:

1. R.G.Bartle, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York, 1976.
2. W.Rudin, Real and Complex Analysis, 3rd Edition, McGraw-Hill, New York, 1986.

Course Title : **ORDINARY DIFFERENTIAL EQUATIONS**	Course Code : 13C
Semester : **I**	Course Group : **M-III**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code : **F(PROBLEM – ANALYSIS)**	Total Contact Hours : **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	# - **Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Apply the method of power series to solve the second order differential equations.	PSO2	18	R
CO2	Outline the proof of existence and uniqueness of solutions of system of first order differential equations.	PSO2	18	AN
CO3	Analyze the solutions of non-homogeneous linear system.	PSO2	18	AN
CO4	Formulate the proof of Picard's theorem.	PSO2	10	U
CO5	Develop the non-uniqueness of solutions, continuation and dependence on initial conditions of differential equations.	PSO2	10	AN
CO6	Describe oscillatory properties of second order differential equations by applying sturm's comparison and Hille wintner theorem.	PSO2	16	AP

UNIT I: **Lecture hour:18**

SOLUTION OF POWER THEORY:

Second order linear equations with ordinary points (Definitions, Examples and Theorems) – Legendre equation and Legendre polynomials (Definitions and Theorems) – Second order equations with regular singular points (Definition, Examples and theorems) –Properties of Bessel functions (Definitions and Properties).

UNIT II: **Lecture hour:18**

SYSTEM OF LINEAR EQUATIONS

Systems of first order equations (Definitions and Examples) – existence and uniqueness theorem (Examples and theorems)– Fundamental matrix (Examples and Theorems).

UNIT III: **Lecture hour:18**

SYSTEM OF LINEAR EQUATIONS

Non- homogeneous linear systems (Definitions and Examples) – linear systems with constant coefficients(Examples and Theorems) – linear systems with periodic coefficients (Theorems).

UNIT IV: **Lecture hour: 20**

EXISTENCE AND UNIQUENESS OF SOLUTIONS

Successive approximation (Lemma and Examples)– Picard's theorem (Lemmas and theorems)- Non-uniqueness of solution (Theorems) –Continuation and dependence on initial conditions (Definitions, Examples and Theorems), Existence of solutions in the large(Examples) –Existence and uniqueness of solutions of systems(examples)-Fixed Method(Theorems).

UNIT V: **Lecture hour: 16**

OSCILLATIONS OF SECOND ORDER EQUATIONS

Oscillations of Second order equations: Fundamental results(Definitions, Examples and Theorems) – Sturm's comparison theorem (Examples and Theorems)– Elementary linear oscillations(Examples and Theorems). Comparison theorem of Hille -Winter(Lemma and theorems).

TEXT BOOK:

Ordinary Differential Equations and Stability Theory by S.G.Deo , V.Raghavendra and V. Lakshmi Kantham(1997).

Unit I - Chapter – 3 - Section 3.2 – 3.5
Unit II - Chapter – 4 - Section 4.2 – 4.4
Unit III - Chapter – 4 - Section 4.5 – 4.8
Unit IV - Chapter – 5 - Section 5.3 – 5.9
Unit V - Chapter – 8 - Section 8.1 – 8.4

REFERENCES BOOK:

E.A.Coddington and N.Levinson **, Theory of Ordinary Differential Equations,** McGraw Hill, New York, 1955.

Course Title : **NUMERICAL METHODS**	Course Code : 13D
Semester : **I**	Course Group : **M-IV**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code: F**(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **Msc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Apply the numerical methods (such as Muller method, Chebyshev method, Brige vieta method) to solve Transcendental and polynomial equations.	PSO2	18	AN
CO2	Compute the Numerical solution of ordinary differential equations	PSO2	9	AP
CO3	Recognize Iteration methods	PSO2	9	AP
CO4	Analyze the Interpolation, Numerical integration.	PSO2	18	AN
CO5	Apply the Iterative method for eigen values, Numerical method of double integrals for solving the problems numerically.	PSO2	18	AN
CO6	Construct Numerical solution of partial differential equations.	PSO2	18	AP

UNIT – I **Lecture hour:18**

TRANSCENDENTAL AND POLYNOMIAL EQUATIONS: Muller method (Expansions and related problems) – Chebyshev method (Expansions and related problems) – Multipoint method (Expansions and related problems) Polynomial Equations(Expansions and related problems) : Iterative Methods: Bridge Vieta method (Related problems)– Bairstow method (Related problems) .

UNIT – II **Lecture hour:18**

SYSTEM OF LINEAR ALGEBRAIC EQUATIONS: Direct Methods: Cholesley method. Iteration Methods (Related problems): Successive over relaxation (SoR) method(Related problems).

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Rungekutta methods (Related problems) – Predictor-Corrector Methods (Related problems): Milne's method (Related problems) – Adam's method (Related problems).

UNIT – III **Lecture hour:18**

INTERPOLATION: Hermite Interpolation (Related problems) – Bivariate Interpolation (Related problems)

NUMERICAL INTEGRATION: Trapezoidal Rule- Romberg's Method (Related problems)- Simpson's one third Rule-Simpson's three eight Rule(Related problems).

UNIT – IV **Lecture hour:18**

ITERATIVE METHOD FOR EIGEN VALUES: Power Method (Related problems)

NUMERICAL METHOD OF DOUBLE INTEGRALS: Gaussian Quadrature (Related problems) – Two points and three points Formulae (Related problems)-Numerical solution of Ordinary Differential equation by Finite Difference Method (Related problems).

UNIT – V **Lecture hour:18**

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: -

Classification of Partial Differential equations of the second order (Related problems)-Elliptic Equations –Solution of Laplace's equation (Related problems)-The Poisson equations (Related problems) –Parabolic Equations (Related problems): Bender Schmidt Methods-The Crank Nicolson method (Related problems) –Hyperbolic Equations (Related problems).

TEXT BOOKS:

T_1 : Numerical methods for scientific and engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K Jain.

T_2 : Numerical Methods by Kandhasamy, Thilagavathi, Gunavathy.

Unit I : T_1

Unit II : T_1 and T_2

Unit III : T_1 and T_2

Unit-IV and Unit-V : T_2

REFERENCE BOOKS:

1. S.C. Chapra and P.C. Raymond: Numerical Methods for Engineers, tata McGraw Hill, New Delhi,
2. R.L. Burden and J. Douglas Faires: Numerical Analysis, P.W.S.Kent Publishing Company, Boston (1989), Fourth Edition.
3. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998)

Course Title : **LATEX AND MATHEMATICA -THEORY**	Course Code : 13E
Semester : **I**	Course Group : **M-V**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code: : **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **60**
CIA: **25 Marks**	SEE #: **75 Marks**
Programme: **M.Sc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Be able to typeset and control key LaTeX environments.	PSO3	10	U
CO2	Understand the use of packages to control document style elements.	PSO3	10	U
CO3	Know how to use style files to typeset to specific thesis and journal styles.	PSO3	10	AP
CO4	Be familiar with good practice and proper LaTeX work-flow for efficient best practice.	PSO3	8	AP
CO5	Be aware of a range of online resources to support your use of LaTeX.	PSO3	7	U
CO6	Be able to write a journal article or PhD thesis using LaTeX.	PSO3	8	U
CO7	Use LaTeX to produce high-quality documents and to write a thesis that follows the University of Bath style guidelines	PSO3	7	AP

UNIT – I **Lecture hour: 10**

Basics: Introduction. Just what is LATEX (Definition and Explanation), TEX and its offspring Basics of a LATEX file.

Text, Symbols, and Commands: Command names (Definition and Explanation), Arguments. Environments (Definition and Explanation)

UNIT – II **Lecture hour: 10**

Text, Symbols, and Commands: Declarations (Definition and Explanation), Length (Definition and Explanation)s, Special Characters(Definition and Explanation), Fine-tuning text. Word division

(Definition and Explanation)**,** Document Layout and Organization: Document class (Definition and Explanation).

UNIT – III **Lecture hour:10**

Document layout and organization – Page style, Parts of the document(Definition and Explanation), Table of Contents(Definition and Explanation).

Displayed text - Changing font(Definition and Explanation), Centering and indenting(Definition and Explanation), Lists, Generalized lists(Definition and Explanation), Theorem–like declarations, Tabulator stops(Definition and Explanation), Boxes.

UNIT – IV **Lecture hour:15**

Displayed text - Tables, Printing literal text, Footnotes and marginal notes(Definition and Explanation). Drawing pictures with LATEX(Definition and Explain and Drawing).

Mathematical formulas: Mathematical symbols(Definition and Explanation)

UNIT – V **Lecture hour:15**

Introduction to Mathematica : Running Mathematica(Definition and Explanation) - Numerical calculations, Building up calculations (Definition and Explanation)– Using the Mathematica system(Definition and Explanation), Algebraic calculations(Definition and Explanation) - Symbolic mathematics (Definition and Explanation)- Numerical mathematics(Definition and Explanation).

TEXT BOOKS:

1. A Guide to LATEX"by H. Kopka and P.W. Daly, Fourth Edition, Addison – Wesley, London, May 12, 2003
2. The Mathematica Book by S. Wolfram, Fifth Edition, Cambridge University Press, Cambridge, 1999

Unit I : Chapter 1: Sections: 1.1 ,1.3, 1.5.
Unit II : Chapter 2: Sections: 2.1 - 2.7.
Unit III : Chapter 3: Sections: 3.1 - 3.6, 4.1 - 4.7
Unit IV : Chapter 4: Sections: 4.8 - 4.10, 5.3, 6.1.
Unit V : Chapter 5: Sections: 1.0 - 1.6.

REFERENCE BOOKS:

1. A Guide to LATEX"by H. Kopka and P.W. Daly, Third Edition, Addison – Wesley, London, 1999.
2. The Mathematica Book" by S. Wolfram, Fourth Edition, Cambridge University Press, Cambridge, 1999.

Course Title : **LATEX AND MATHEMATICA - PRACTICAL**	Course Code : 13E
Semester : **I**	Course Group : **M-P**
Teaching Scheme in Hrs (L:T:P) : **0:0:2**	Credits : **2**
Map Code: **G (PRACTICAL PROGRAMMING)**	Total Contact Hours: **30**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **M.Sc-MATHEMATICS**	# - **Semester End Exam**

LIST OF EXPERIMENTS:

UNIT-I

1. Program for Title with author name and date, Special characters , Commenting in Tex documents , insert comments, Font attributes , Font sizes in a LaTeX document.

2. Program for Line-spacing, Program for Text justification, Program for column spacing, Program for Itemization, Program for margins, Program for Header in a LaTeX.

3. Program for Structured document, Math text inclusion with equation, Inline equations, Math equations, Multiline equations, Matrices in a LATEX.

4. The Latex code for columns spanning multiple rows, Table creation, Types of tables, sideways table.

5. Write an algorithm for find the minimization of cost function

6. Write an algorithm to find the digraph is connected or not

7. Program for Creating bibiliogrpahy, Iindex and Nomenclature.

TEXT BOOK:

T1. A Guide to LATEX, H. Kopka and P.W. Daly, Fourth Edition, Addison – Wesley, London, 2003.

SEMESTER-II

Course Title : COMPLEX ANALYSIS	**Course Code : 23A**
Semester: II	**Course Group : M-VI**
Teaching Scheme in Hrs (L:T:P):5:1:0	**Credits : 4**
Map Code : F(PROBLEM – ANALYSIS)	**Total Contact Hours : 90**
CIA: 25 Marks	**SEE # : 75 Marks**
Programme : M.Sc Mathematics	**# - Semester End Exam**

No	Course Outcome (Cos):After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Explain analytic function, limit and continuity, polynomials, rational functions, elementary theory of power series and and also conformal mapping, Length and area linear transformations, linear group, Cross ratio. Construct the proof of Abel's limit theorem.	PSO4	18	U
CO2	Outline the proof of Cauchy's theorem for a rectangle, Cauchy's theorem in a disc, Cauchy's integral formal. General form of Cauchy's theorem and explain chain, cycles, simple connectivity, multiple connected regions, Locally exact differentials.	PSO4	18	U
CO3	Evaluating definite integrals using residues and explain harmonic functions and its basic properties, Mean value property, the reflection principle. Construct the proof of Schwart's theorem, Poisson's formula.	PSO4	18	EV
CO4	Develop the proof of Stirling's formula, Jenson's Formula	PSO4	18	AP
CO5	Examine the proof of the Riemann mapping theorem, The schwart's chirstoffel formula.	PSO4	9	AN
CO6	Examine the mapping on a Rectangle, The triangle functions of Schwarz.	PSO4	9	AN

UNIT – I **Lecture hour:18**

COMPLEX FUNCTIONS: Introduction to the concept of analytic function: Limits and continuity (Definition & Expansion)– Analytic function(Expansion) – Polynomials (Expansion & Theorem)– Rational functions(Expansion). Elementary theory of power series: Power series (Expansion & Theorem)– Abel's limit theorem (Thereom).

ANALYTIC FUNCTIONS AS MAPPINGS: Conformality: Arcs and closed curves (Expansion)– Analytic function in regions (Definition & Theorem)– Conformal mapping (Expansion)– length and area

(Expansion)– Linear Transformations: The Linear Group (Expansion)- The Cross Ratio-Symmetry((Expansion & Theorem).

UNIT – II **Lecture hour:18**

COMPLEX INTEGRATION: Fundamental Theorems: Line Integrals- Rectifiable Arcs (Expansion)– Line Integrals as Functions of Arcs(Expansion) – Cauchy's theorem for a Rectangle (Definition & Theorem)– Cauchy's theorem in a Disk(Expansion & Theorem). Cauchy's Integral formula: The index of a point with respect to a closed curve (Expansion & Theorem)– the Integral formula(lemma) – Higher derivatives (theorem). General form of Cauchy's theorem: Chain and Cycles- Simple connectivity (Definition & Theorem) – Homology (Definition) – Locally exact Differentials(theorem) – Multiple connected Regions(Expansion).

UNIT – III **Lecture hour:18**

COMPLEX INTEGRATION :The calculus of Residues : The Residue theorem(Expansion, Definition & Theorem) – The argument principle (theorem & corollary)– Evaluation of definite Integrals(theorem). Harmonic functions: Definitions and Basic properties (Definition, properties & theorem)– The mean value property(theorem) – Poisson's formula (Expansion & Theorem)– Schwarz's theorem(theorem) – The Reflection principle(Expansion & Theorem).

UNIT - IV **Lecture hour:18**

SERIES AND PRODUCT DEVELOPMENTS: Partial fraction and factorization: Partial fraction (Expansion & Theorem)– Infinite production (Expansion & Theorem)– canonical products (Expansion & Theorem)– The Gamma function (Expansion & Theorem)– Stirling's formula (Expansion & Theorem)– Entire Function :Jensen's formula(Expansion & Theorem).

UNIT - V **Lecture hour:18**

CONFORMAL MAPPING: The Riemann mapping theorem: Statement and proof – Boundary behavior (Expansion)– use of the reflection principle(Expansion & Theorem) – Analytic Arc(Expansion & Theorem). Conformal mapping of polygons: The Behavior at an angle (Expansion) – The Schwarz – Chirstoffel formula(theorem) – Mapping on a Rectangle(Expansion) – The triangle functions of Schwarz(Expansion).

TEXT BOOK:

COMPLEX ANALYSIS by L.V. Ahlfors, MC Graw Hill, New York, 1979

UNIT – I	Chapter 2	Section 1.1 – 1.4, 2.4, 2.5
	Chapter 3	Section 2.1 – 2.4, 3.1 -3.3
UNIT – II	Chapter 4	Section 1.1 – 1.5, 2.1 – 2.3, 4.1,4.2, 4.3, 4.6, 4.7
UNIT – III	Chapter 4	Section 5.1 – 5.3, 6.1 – 6.5
UNIT – IV	Chapter 5	Section 2.1 -2.5, 3.1
UNIT – V	Chapter 6	Section 1.1 – 1.4, 2.1 – 2.4.

REFERENCE BOOK:

COMPLEX ANALYSIS by George Cain, George Cain Publisher, Edition 2, 2001.

Course Title : PARTIAL DIFFERENTIAL EQUATIONS	**Course Code : 23 B**
Semester: II	**Course Group : M-VII**
Teaching Scheme in Hrs (L:T:P):5:1:0	**Credits : 4 Credits**
Map Code : F(PROBLEM – ANALYSIS)	**Total Contact Hours : 90**
CIA: 25 Marks	**SEE # : 75 Marks**
Programme : M.Sc Mathematics	**# - Semester End Exam**

No	Course Outcome (Cos):After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Illustrate Cauchy method of characteristics, compatible system charpit's method, special types of first order equations, Jacobi method and also solve first order equations.	PSO2	18	U
CO2	Identify the origin of second order equations, solve linear partial differential equations with constant coefficients, Equations with variable coefficients after classifications.	PSO2	18	AP
CO3	Construct the solution of linear hyperbolic equations and also solve by using the method of separation of variables.	PSO2	18	AP
CO4	Develop elementary solution of Laplace's equations and solve by using the method of separation of variables including problems with axial symmetry.	PSO2	18	AP
CO5	Discover elementary solutions of one dimensional wave equations. Analyse the solutions of Problems in vibrating membrances and also solve three dimensional problems by using the method of separation of variables.	PSO2	9	AN
CO6	Determine elementary solution of diffusion equation and also solve diffusion equation by applying the method of separation of variables.	PSO2	9	EV

UNIT I **Lecture hour: 18**

Non-linear Partial Differential Equations of the first Order: Cauchy's Method of Characteristics (Theorems & Related Problems)-Compatible systems of First Order Equations (Derivation & Related Problems)-Charpits Method(Derivation & Related Problems)-Special types of First Order Equations(Derivation & Related Problems) –Solutions Satisfying Given Conditions(Derivation & Related Problems)-Jacobi's Method (Derivation & Related Problems).

UNIT II: **Lecture hour: 18**

Partial differential equations of the second order: The origin of Second order equations (Derivation & Related Problems)-linear partial differential equations with constant coefficients (Derivation & Related Problems)- Equations with variable coefficients(Derivation & Related Problems).

UNIT III: **Lecture hour: 18**

The solution of linear hyperbolic equations (Derivation & Related Problems)-separation of variables (Derivation & Related Problems)-the method of integral transforms (Derivation & Related Problems)-non linear equations of second order(Derivation & Related Problems).

UNIT IV: **Lecture hour: 18**

Laplace's Equation: Elementary Solution of Laplace's Equation(Derivation & Related Problems)-Families of Equipotential surfaces(Derivation & Related Problems)-Boundary value problems(Derivation & Related Problems)-separation of variables and problems with Axial symmetry(Derivation & Related Problems).

UNIT V: **Lecture hour: 18**

The Wave Equation: Elementary Solutions of one dimensional wave Equation (Derivation & Related Problems)-vibrating membrances(Derivation & Related Problems)-application of the calculus of variations(Derivation & Related Problems)-Three dimensional problems(Derivation & Related Problems)-Elementary solution of Diffusion Equation-separation of variables(Derivation & Related Problems).

TEXT BOOK: Elements Of Partial Differential Equations " Ian N.Sneddon " International Student Edition. Mc Graw Hill International Book Company.

Unit	Chapter	Sections
1	2	7 - 13
2	3	1 &4 -5
3	3	8-11
4	4	2-6
5	5	2&4-5
5	6	3&4

REFERENCE BOOK: Partial Differential Equations for Scientists and Engineers, "Shanthi Narayanan & J.N Kapoor, Mcgraw Hill, Edition-3.

Course Title : **MECHANICS**	Course Code : **23C**
Semester : **II**	Course Group : M-VIII
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Characterize the generalized coordinates and constraints.	PSO3	18	U
CO2	Derive the Lagrange's equations.	PSO3	18	AP
CO3	Determine the Hamilton's equations.	PSO3	18	U
CO4	Construct the Hamilton's Principal Function.	PSO3	18	AP
CO5	Explain Separability.	PSO3	9	U
CO6	Construct the Special Transformations.	PSO3	9	AP

UNIT – I **Lecture hour:18**

Generalized co-ordinates

Generalized co-ordinates (Theorem)– Constraints(Theorem) – Virtual work(Theorems & Related Problems)-D'Alemberts Principle(Theorems & Related Problems)-Energy and Momentum(Theorems & Related Problems).

UNIT – II **Lecture hour:18**

Derivation of Lagrange's Equation

Derivation of Lagrange's Equation(Theorems & Related Problems) – Examples(Related Problems) – Integrals of the motion (Theorems & Related Problems)– Velocity Dependent potentials(Theorems & Related Problems).

UNIT – III **Lecture hour:18**

Hamilton's principle

Hamilton's principle (Theorems & Related Problems)– Hamilton's Equations(Theorems & Related Problems) – other variation principles(Theorems & Related Problems)

UNIT – IV **Lecture hour:18**

Hamilton's Principal Function

Hamilton's Principal Function (Theorems & Related Problems)– The Hamilton(Theorems & Related Problems)– Jacobi Equation (Theorems & Related Problems)– Separability(Theorems & Related Problems).

UNIT – V **Lecture hour:18**

Differential Forms and Generating Functions

Differential Forms and Generating Functions (Theorems & Related Problems) –Special Transformations (Theorems & Related Problems) – Lagrange and Poisson Brackets (Theorems & Related Problems).

Text Book:

"CLASSICAL DYNAMICS" by Donald T. Greenwood

Reference Book:

1. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
2. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
3. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979.

Course Title : **OPTIMIZATION TECHNIQUES**	Course Code : **23D**
Semester : **II**	Course Group : M-IX
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	**Course Outcome (Cos): After completion of this course, the students will be able to**	**PSOs**	**Cl. Ses**	**CL**
CO1	Define the decision variables, Constraints and Solve the linear equations by using Dual Simplex Method and Revised Simplex Method.	PSO2	18	AP
CO2	Explain the characteristics of different types of decision-making environments and the appropriate decision making approaches and tool to be used in each type.	PSO2	9	AP
CO3	Solve Game theory by using some Strategies.	PSO2	9	AP
CO4	Apply the process of Stock Items in all Inventory Models.	PSO2	18	AP
CO5	To appropriately formulate Queuing models for service and manufacturing systems, and apply Operations Research techniques and algorithms to solve these Queuing problems.	PSO2	18	AP
CO6	Solve various constrained and unconstrained problems in single variable as well as multivariable.	PSO2	18	AP

UNIT- I: **Lecture hour:18**

LINEAR PROGRAMMING PROBLEM: Dual simplex Algorithm (Algorithm)- Dual Simplex Method(Related Problems)- Revised Simplex Algorithm (Algorithm)- Development of the optimality and Feasibility conditions (Related Problems)-Revised Simplex Method(Related Problems)-Illustrative Applications(Related Problems)-Capital Budgeting-Set covering Problem(Related Problems)-Fixed change Problem(Related Problems)-Either or and if then constraints(Related Problems)-Integer Programming Algorithm(Algorithm)-Branch and bound Algorithm(Algorithm)-Cutting plane Algorithm(Algorithm)-Computational considerations in ILP(Related Problems).

UNIT-II **Lecture hour:18**

DECISION ANALYSIS AND GAMES: Decision Making under Certainty(Related Problems)-Analytic Hierarchy Process (AHP) (Related Problems)-Decision Making under Risk(Related Problems)-Decision

Tree(Related Problems)-Based Expected Value Criterion(Related Problems)-Variations of the Expected Value Criterion(Related Problems)-Decision under Uncertainty(Related Problems)-Game Theory(Related Problems)-Optimal Solution of Two-Person Zero sum Games(Related Problems)-Solution of Mixed Strategy Games(Related Problems).

UNIT-III **Lecture hour:18**

INVENTORY MODELS: Deterministic Inventory Models(Related Problems)-General Inventory Model(Related Problems)-Role of demand in the Development of Inventory Models(Related Problems)-Static Economic Order Quantity (EOQ) Models(Related Problems)-Classic EOQ model(Related Problems)-EOQ Problems with Price Breaks-Multi item EOQ with Storage limitation(Related Problems)-Probabilistic Inventory Models(Related Problems)-Continuous Review Models(Related Problems)-"Probabilitized" EOQ Model(Related Problems)-Probabilistic EOQ Model(Related Problems).

UNIT-IV **Lecture hour:18**

QUEUING THEORY: Elements of a Queuing Model(Related Problems)-Role of Exponential Distribution(Related Problems)-Pure Birth and Death Models (Relationship Between the Exponential and Poission Distributions) (Related Problems)-Generalized Poisson Queuing Model(Related Problems)-Specialized Poisson Queues(Related Problems)-Steady-State Measure of Performance(Related Problems)-Single-Server Models(Related Problems)-Multiple-Server Models-(M/G/1):(GD/∞/∞) Pollaczek-Khint Chine(P-K) Formula(Related Problems).

UNIT-V **Lecture hour:18**

OPTIMIZATION THEORY: Classical Optimization Theory (Related Problems)-Unconstrained Problems(Related Problems)-Necessary and Sufficient Conditions(Related Problems)-The Newton-Raphson Method(Related Problems)-Constrained Problems(Related Problems)-Equality Constraints(Related Problems)-Inequality Constraints(Related Problems)-Karush-Kuhn-Tucker (KKT) Conditions(Related Problems).

Text Book:

Hamdy A Taha, Operations Research: An Introduction, Eighth Edition, Prentice-Hall of India, New Delhi, 2007.

Reference Book:

1. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 4th Edition, Mc Graw Hill Book Company, New York, 1989.

2. D.T. Philips, A. Ravindra and J. Solberg, Operations Research, Principles and Practice, John Wiley and Sons, New York, 1991.

3.B.E. Gillett, Operations Research- A Computer Oriented Algorithmic Approach, TMH Edition, New Delhi, 1976.

Course Title : **DIFFERENTIAL GEOMETRY**	Course Code : 23E
Semester : **II**	Course Group : **EL-I-1**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code: **F (PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Define tangent, osculating plane, principal normal, bi normal, curvature and torsion.	PSO4	18	R
CO2	Construct the equations of tangent, osculating plane, principal normal, bi normal, curvature and torsion.	PSO4	18	AP
CO3	Explain contact between curves and surfaces and to apply the osculating circle and osculating sphere	PSO4	18	AP
CO4	Explain tangent surfaces, involutes and evolutes, helices and to apply the different curves	PSO4	18	AP
CO5	Define surfaces, tangent plane and surface normal, helicoids, metric on a surface and construct the first fundamental form	PSO4	9	AP
CO6	Explain the geodesic on a surface and their differential equations	PSO4	9	U

UNIT-I **Lecture hour:18**

THEORY OF SPACE CURVES: Arc length (Definition, theorems and Example) - Tangent and Osculating plane(Definition, theorems and Example) - Principal normal and Binormal (Definition, Example)- Curvature and torsion (Definition, theorems and Example).

UNIT-II **Lecture hour:18**

THEORY OF SPACE CURVES: Behaviour of near one of its points(Definition, theorems and Example)-The Curvature and torsion of a curve as the intersection of two surfaces(Definition, theorems and Example)-Contact between curves and Surfaces(Definition, theorems and Example) - Osculating Circle and Osculating Sphere -Locus of centres of spherical curvature(Definition, theorems and Example).

UNIT-III **Lecture hour:18**

THEORY OF SPACE CURVES: Tangent surfaces (Definition, theorems) - Involutes and Evolutes (Definition, theorems and Example)– Intrinsic equations of space curves (Definition, theorems and Example)-Fundamental existence theorem for space curves(Definition, theorems and Example) – Helices(Definition and theorems).

UNIT-IV **Lecture hour:18**

THE FIRST FUNDAMENTAL FORM AND LOCAL INTRINSIC PROPERTIES OF A SURFACE: Definition of a surface – Nature of points on a surface (Definition)– Representation of a surface (Definition, theorems and Example) – curves on surfaces(Definition and Example)-Tangent plane and surface normal(Definition, theorems and Example) – The general surfaces of revolution (Definition and Theorems)– Helicoids (Definition, theorems and Example)– Metric on a surface (Definition, theorems and Example)–First fundamental form (Definition, theorems and Example)- Direction co-efficient on a surfaces(Definition, theorems and Example).

UNIT-V **Lecture hour:18**

THE FIRST FUNDAMENTAL FORM AND LOCAL INTRINSIC PROPERTIES OF A SURFACE: Families of curves – Orthogonal trajectories (Definition and Theorems) –Double families of curves (Definition and Theorems) – Isometric correspondence (Definition and Theorems) -Geodesics and their differential equations (Definition, theorems and Example) – Canonical geodesics equations (Definition and Theorems) – Geodesics on surface of revolution (Definition and Theorems).

Text Book:

D. Somasundaram **"Differential Geometry A First Course"** Narosa Publishing House P v t. Ltd 2005…

UNIT	CHAPTER	SECTIONS
I	1	1.2 to 1.9
II	1	1.10 to1.13 & 1.16 to 1.18
III	2	2.2 to 2.10
IV	2 &3	2.11 to 2.15 & 3.2 to 3.4
V	3	3.5 to 3.8 & 3.10

Reference Book: D.struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing company, 1961.

Course Title : FUZZY MATHEMATICS	**Course Code : 23E**
Semester : II	**Course Group : EL-I-2**
Teaching Scheme in Hrs (L:T:P) : 5:1:0	**Credits : 4**
Map Code: F(PROBLEM – ANALYSIS)	**Total Contact Hours: 90**
CIA: 25 Marks	**SEE # :75 Marks**
Programme: M.Sc MATHEMATICS	**# -- Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Remembering the Crisp sets & Fuzzy Sets	PSO1 & PSO3	18	R
CO2	Gain more Knowledge of Operations of Fuzzy Sets	PSO1 & PSO3	9	R
CO3	Analyze the Fuzzy Arithmetic	PSO1 & PSO3	18	AN
CO4	Analyze Fuzzy Complements	PSO1 & PSO3	9	AN
CO5	Analyze Fuzzy Relations	PSO1 & PSO3	18	AN
CO6	Analyze Fuzzy Relations Equations	PSO1 & PSO3	18	AN

UNIT-I **Lecture hour:18**

Crisp sets : An over view (Definition and Examples): Fuzzy Sets –Basic Types (Theorems and Examples)– Basic Concepts – α-cuts (Theorems) - Additional properties of α-cuts (Theorems) - Representation of Fuzzy Sets(Definitions & theorems)- Extension Principle for Fuzzy Sets(Definitions & theorems).

UNIT-II **Lecture hour:18**

Operations of fuzzy sets- Types of Operations (Axioms and Theorems)– Fuzzy Complements(Axioms and Theorems)–Fuzzy Intersections:t-norms (Axioms and Theorems)– Fuzzy Unions:t-conorms(Axioms and Theorems) – Combinations of Operations(Axioms and Theorems) – Aggregation Operations. (Definitions & theorems)

UNIT-III **Lecture hour:18**

Fuzzy Arithmetic- Fuzzy numbers (Definitions & theorems) – Arithmetic operations on intervals (Properties)– Arithmetic operations on fuzzy numbers(Theorems and Examples).

UNIT-IV **Lecture hour:18**

Fuzzy Relations –Crisp versus Fuzzy relations (Definition and Examples)- Projections and Cylindrical Extensions(Definition and Examples) - Binary Fuzzy Relation(Definition and Examples) –Binary Relation on a single set(Definition and Examples)-Fuzzy Equivalence Relation(Definition and Examples) – Fuzzy Compatibility Relations(Definition and Examples)- Fuzzy Ordering Relations(Definition and Examples) – Fuzzy Morphisms(Definition and Examples).

UNIT-V **Lecture hour:18**

Fuzzy Relation Equations – General Discussion (Definition concept of composition of binary relation) – Problem Partitioning (Basic procedure, examples, definition and diagram)– Solution Method (Definition and Theorems)– Fuzzy Relation Equations based on sup-i compositions (Definition and Theorems)– Fuzzy Relation Equations based on inf –w_i compositions(Definition and Theorems).

Text Book:

George J. Klir / Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice -Hall of India Private L.t.d New Delhi 2009.

Reference Book: George J. Klir and Tina A.Folger , Fuzzy Sets ,Uncertainty and Information ,Prentice-Hall of India Private Limited-Fourth printing –June 1995.

SEMESTER-III

Course Title : **TOPOLOGY**	Course Code : **33A**
Semester : **III**	Course Group : **M-X**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	# - **Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Remember the topological spaces.	PSO4	18	R
CO2	Analyze the concept of connected and local connectedness	PSO4	18	AN
CO3	Point out the varies types of compact spaces	PSO4	18	AN
CO4	Analyze the concept of axioms	PSO4	18	AN
CO5	Remember the types of spaces	PSO4	9	R
CO6	Analyze the concept of complete and compact in metric spaces	PSO4	9	AN

UNIT I: **Lecture hour:18**

Topological spaces

Topological spaces (Definition and Examples)– Basis for a Topology(Definition, Examples and Lemma) – The Order Topology (Definition and Examples)– Product Topology on $X \times Y$ (Definition and Theorems)–The subspace topology (Definition, Examples, Lemma and Theorems)-Closed sets and Limit Points (Definition, Examples and Theorems)– Continuous Functions (Definition, Examples and Theorems)–Product topology(Definition and Theorems)- Metric Topology(Definition and Theorems).

UNIT II: **Lecture hour:18**

Connectedness

Connectedness: Connected Spaces (Definition, Examples, Lemma and Theorems)-Connected subspaces of the real line (Definition, Examples and Theorems) -Components and Local connectedness (Definition, Examples and Theorems).

UNIT III: **Lecture hour:18**

Compact Spaces

Compact Spaces (Definition, Examples, Lemma and Theorems) – Compact subspaces of real line Definition, Examples, Lemma and Theorems)-Limit Point Compactness (Definition, Examples and Theorems).

UNIT IV: **Lecture hour:18**

Count ability and Separation Axioms:

Count ability and Separation Axioms: Count ability Axioms (Examples and Theorems)– Separation Axioms(Definition, Examples, Lemma and Theorems)-Normal spaces(Examples and Theorems)-Urysohn's Lemma(Definition and Theorems) – Urysohn Metrization Theorem (Theorem)-The Tietze Extension Theorem(Theorem).

UNIT V: **Lecture hour:18**

Complete Metric Spaces:

The Tychonoff Theorem (Introduction, Lemma and Theorem)–The stone Cech compactification. (Definition, Examples, Lemma and Theorems)-Complete Metric Spaces (Definition, Examples, Lemma and Theorems) – Compactness in Metric Spaces (Definition, Examples, Lemma and Theorems)–Baire Spaces (Definition, Examples, Lemma and Theorems).

TEXT BOOK:

Topology, James R. Munkers Second Edition Pearson Education (singapore) pvt ltd .

REFERENCE BOOK:

George F. Simmons , **Introduction to Topology and Modern Analysis** , Mcgraw hill Book Company , 1963.

Course Title : **MULTIVARIABLE CALCULUS**	Course Code : **33B**
Semester : **III**	Course Group : **M-XI**
Teaching Scheme in Hrs (L:T:P) : **4:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours : **75**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Define Sequences in R^2 and Continuity	PSO2	15	R
CO2	Recall Partial and Total Differentiation, partial and Directional derivatives	PSO2	15	R
CO3	Demonstrate Implicit differentiation, Taylor's theorem and classify partial and Directional derivatives	PSO2	8	U
CO4	Apply Chain rule of Differentiability and directives	PSO2	7	U
CO5	Illustrate Absolute extrema, Constrained extrema, Local extrema, saddle points and Compare Linear and quadratic approximations	PSO2	15	AP
CO6	Analyze Double integrals on rectangles, Basic inequality , criterion for integrability, Domain additivity on rectangles, Integrability of monotonic, continuous functions and explain Fundamental theorem of calculus the Lebesgue integral	PSO2	15	AP

UNIT – I **Lecture hour:15**

SEQUENCES AND CONTINUITY

Sequences in R^2 – Subsequences and Cauchy sequences (Definitions and Theorems) – Closure, boundary and interior (Definitions and Theorems).

Continuity – Composition of continuous functions (Definitions and Theorems) – Characterizations of continuity(Theorems) – Continuity and boundedness (Definitions and Theorems) –Continuity and convexity (Definitions and Theorems) – Continuity and Intermediate value property (Definitions and Theorems) - Uniform continuity (Definitions and Theorems)

UNIT – II **Lecture hour:15**

PARTIAL AND TOTAL DIFFERENTIATION

Partial and Directional Derivatives (Definitions and Theorems) – Partial derivatives (Definitions and Theorems) – Directional derivatives (Definitions and Theorems) – Higher-order partial derivatives (Definitions and Theorems, problems) – Problems

UNIT – III **Lecture hour:15**

PARTIAL AND TOTAL DIFFERENTIATION (Contd…)

Differentiability (Definitions and Theorems) – Differentiability and directives (Definitions and Theorems, problems) – Implicit differentiation(Definitions and Theorems) – Taylor's theorems and Chain rule(Definitions and Theorems, problems) – Problems

UNIT IV **Lecture hour:15**

APPLICATIONS OF PARTIAL DIFFERENTIATION

Absolute extrema (Definitions and Theorems) – Constrained extrema (Definitions and Theorems) – Local extrema and saddle points (Definitions and Theorems, problems) – Linear and quadratic approximations (Definitions and Theorems)

UNIT – V **Lecture hour:15**

MULTIPLE INTEGRATION

Double integrals on rectangles (Definitions and Theorems) – Basic inequality and criterion for integrability (Definitions and Theorems) – Domain additivity on rectangles(Definitions and Theorems) - Integrability of monotonic and continuous functions(Definitions and Theorems) – Algebraic and order properties(Properties) – Fundamental theorem of calculus(Definitions and Theorems) .

TEXT BOOK:

S.R. Ghorpade and B. V. Limaye, "A Course in Multivariable Calculus and Analysis" Springer, 2017.

REFERENCE BOOKS:

1. Spivak, Calculus on Manifolds, 5th Edition, CRC Press, 1965.
2. J. L. Taylor, Foundations of Analysis, American Mathematical Society, 2012.
3. W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw Hill Book Co., Kogaskusha, 1976.

Course Title : **PROBABILITY THEORY**	Course Code : **33C**
Semester : **III**	Course Group : **M-XII**
Teaching Scheme in Hrs (L:T:P) : **4:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **75**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	# - **Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Define probability and explain sample space, axioms, theorems of probability and solve them.	PSO3	**15**	AP
CO2	Explain the discrete, continuous, functions of random variables and solve probability distributions.	PSO3	**15**	AP
CO3	Apply moments of a distribution function and its generating function.	PSO3	**15**	AP
CO4	Apply the multiple random variables, independent random variables and solve them.	PSO3	**15**	AP
CO5	Define the large sample theory and apply weak, strong law of large numbers.	PSO3	**8**	AP
CO6	Define large sample theory and apply central limit theorem.	PSO3	**7**	AP

UNIT I: **Lecture hour: 15**

PROBABILITY: Introduction-sample space (definition, theorems, examples)-probability axioms (definition, theorems, examples)-combinatorics: Probability on finite sample spaces (theorems, examples)-conditional probability and Bayes theorem (theorems, examples)-Independent events (theorems, examples).

UNIT II: **Lecture hour: 15**

RANDOM VARIABLE AND THEIR PROBABILITY DISTRIBUTIONS: Introduction-Random variables (definition, examples)-probability distribution of a random variable

(definition, properties, examples)-Discrete and continuous random variables (definition, properties, examples)-Functions of random variable (definition, properties, examples).

UNIT III: **Lecture hour:15**

MOMENTS AND GENERATING FUNCTIONS: Introduction-Moments of a distribution function (definition, properties, theorems, examples)-Generating functions (definition, examples)-some moment inequalities (definition, theorems, examples).

UNIT IV: **Lecture hour:15**

MULTIPLE RANDOM VARIABLES: Introduction-Multiple Random variables (definition, examples)-covariance (definition, examples)-correlation and moments (definition, theorems, examples)-conditional expectation (definition, theorems, examples)-Independent random variables (definition, examples)-Functions of several random variables (definition, examples).

UNIT V: **Lecture hour:15**

BASIC ASYMPTOTICS: LARGE SAMPLE THEORY: Introduction-Modes of convergence (definition, examples)-weak law of large numbers (definition, theorems, examples)-strong law of large numbers (theorems, examples)-limiting moment generating functions (definition, theorems, examples)-central limit theorem (theorems).

Text Book:

T_1 Statistical Methods by S. P. Gupta, Sultan Chand & Sons, New Delhi 2007.
T_2 Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, New Delhi 2002.
T_3 Mathematical Statistics by P.R. Vittal, Margham Publications, Chennai, 2002.

Unit I : T_1
Unit II : T_2 and T_3
Unit III : T_2 and T_3
Unit-IV : T_2 and T_3
Unit-V : T_1

Reference Book:

An Introduction to Probability and Statistics by Vijay K. Rohatgi and A. K. Md. Ehsanes saleh, John wiley and sons, New jersey, 2015.

Course Title : **FLUID DYNAMICS**	Course Code : **33D**
Semester : **III**	Course Group : M-XIII
Teaching Scheme in Hrs (L:T:P) : **4:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **75**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	# - **Semester End Exam**

No	**Course Outcome (Cos): After completion of this course, the students will be able to**	**PSOs**	**Cl.Ses**	**CL**
CO1	Define Elasticity, Plasticity, Flow Fluid, Inviscid, Viscous Fluid, Velocity and Stream Lines and Paths of the Particles, Stream Tubes and explain Filaments, Fluid Body, Density and Pressure of the fluid.	PSO1,PSO2	8	AP
CO2	Explain differentiation with respect to the Time, Equation of Continuity, boundary Conditions and also Evaluate rate of change of Linear Momentum and Equation of Motion of an Inviscid Fluid.	PSO1,PSO2	7	AP
CO3	Analyze the conservative forces and evaluate the rate of change of circulation.	PSO1,PSO2	15	AN
CO4	Describe the Basic singularities and explain the Blasius ‘s theorem, lift force.	PSO1,PSO2	15	AP
CO5	Define viscosity, Reynolds number and analyze the dynamic of real fluids.	PSO1,PSO2	15	AP
CO6	Formulate the concept of the Boundary layers in the Laminar boundary layer in incompressible flow.	PSO1,PSO2	15	AP

UNIT I: **Lecture hour:15**

INTRODUCTORY NOTIONS –Elasticity, Plasticity (Definition and Theorems) –Flow fluid, Inviscid, Viscous Fluid (Definitions and theorems) – Stream Lines and Path Lines (Definitions and theorems) –

Stream Tubes and Filaments (Theorem and Derivatives) – Fluid Body (Definition)– Density(Definition) – Pressure(Theorem and Derivatives).

EQUATIONS OF MOTION - Differentiation following the Fluid (Theorem and Derivatives) – Equation of continuity (Theorem and Derivatives) – Boundary conditions (Theorem and Derivatives) – Kinematical and Physical (Theorem) – Rate of change of linear momentum (Theorem and Derivatives) – Equation of motion of an inviscid fluid(Definitions and theorem).

UNIT II: **Lecture hour: 15**

EQUATIONS OF MOTIONS: Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady motion – energy equation for inviscid fluid – circulation – Kelvin's theorem – vortex motion –Helmholtz equation.

UNIT III: **Lecture hour: 15**

TWO DIMENSIONAL MOTION – Two Dimensional Functions (Definitions, Theorems and Derivatives) – Complex Potential (Definitions, Theorem and Derivatives) – basic singularities (Definitions, Theorem and Derivatives) – source (Definitions, Theorem and Derivatives) – sink (Definitions and theorems) – Vortex(Definitions and theorems) – doublet (Theorem and Derivatives) – Circle theorem(Theorem and Derivatives). Flow past a circular cylinder with circulation (Definitions and theorems) – Blasius Theorem (Theorem and Derivatives) – Lift force (Theorem and Derivatives).

UNIT IV: **Lecture hour: 15**

DYNAMICS OF REAL FLUIDS: Viscous flows (Definitions, Theorem and Derivatives) – Navier-Stokes equations(Definitions, Theorem and Derivatives) – Vorticity and circulation in a viscous fluid (Definitions, Theorem and Derivatives) –Steady flow through an arbitrary cylinder under pressure (Definitions, Theorem and Derivatives) – Staedy Couettc flow between cylinders in relative motion(Definitions, Theorem and Derivatives) – Steady flow between parallel planes (Definitions, Theorem and Derivatives).

UNIT V: **Lecture hour: 15**

LAMINAR BOUNDARY LAYER IN INCOMPRESSIBLE FLOW: Boundary Layer concept (Theorem and Derivatives) – Boundary Layer equations(Theorem and Derivatives) – Displacement thickness, Momentum thickness(Theorem and Derivatives) – Kinetic energy thickness(Theorem and Derivatives) – integral equation of boundary layer (Theorem and Derivatives) – flow parallel to semi infinite flat plate (Theorem and Derivatives) – Blasius equation and its solution in series(Theorem and Derivatives).

Text Book:

For **Units I and II:**

Theoretical Hydro Dynamics by L.M. Milne Thomson, McMillan
Company, 5th Edition (1968).
Chapter I : Sections 1.0 – 1.3., 3.10-3.41 (omit 3.32)
Chapter III : Sections 3.42 – 3.53 (omit 3.44)

For **Units III, IV and V:**

Modern Fluid Dynamics – (Volume I) by N. Curle aand H.J. Davies, D
Van Nostrand Company Limited., London (1968).
Chapter III : Sections 3.1 – 3.7.5 (omit 3.3.4, 3.4, 3.5.2,3.6)
Chapter V : Sections 5.1 – 5.3.3 ;Chapter VI : Sections 6.1 – 6.3.1 (omit 6.2.2., 6.2.5

Reference Book: Advanced Fluid Dynamics by Hyoung Woo oh, Janeza Trdinea, Croatia.

Course Title : **CONTROL THEORY**	Course Code : **33E**
Semester : **III**	Course Group : **EL-II-1**
Teaching Scheme in Hrs (L:T:P) : **4:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **75**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos):After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Explain observability and estimate the observability of constant coefficient system, linear, nonlinear system, and discuss reconstruction kernel.	PSO2	15	U
CO2	Apply controllability criteria to constant coefficient system, linear, nonlinear system, and explain steering function.	PSO2	15	AP
CO3	Analyze the stability of linear system, linear time varying system, perturbed linear system and nonlinear system.	PSO2	15	AN
CO4	Illustrate stabilizabilization via linear feedback control, Bass method and analyze control subspace.	PSO2	15	AN
CO5	Develop optimal control of linear time varying systems with quadratic performance criteria, construct Matrix Riccati equation.	PSO2	8	EV
CO6	Formulate the existence of optimal control of nonlinear systems.	PSO2	7	EV

UNIT I: **Lecture hour:15**

OBSERVABILITY: Linear Systems (Definition and Proposition) – Observability Grammian (Theorem)– Constant coefficient systems (Proposition and Related problems)–Reconstruction kernel (Related problems)– Nonlinear Systems(Definition and proposition).

UNIT II: **Lecture hour:15**

CONTROLLABILITY: Linear systems (Definition, Proposition and Theorem)–

Controllability Grammian matrix (Theorem) – Adjoint systems(Theorem) – Constant coefficient systems (Proposition and Theorem)– steering function (Definition and Related Problems)– Nonlinear systems(Lemma, Theorem and Related Problems).

UNIT III: **Lecture hour:15**

STABILITY: Stability (Definition, Theorem and Related Problems)– Uniform Stability (Theorem and Related Problems)– Asymptotic Stability of Linear Systems(Theorem and Related Problems) - Linear time varying systems (Theorem and Related Problems)– Perturbed linear systems(Theorem and Related Problems)– Nonlinear systems(Theorem and Related Problems).

UNIT IV: **Lecture hour:15**

STABILIZABILITY: Stabilization via linear feedback control (Definition, Theorem, Lemma and Related Problems) – Bass method (Related Problems)– Controllable subspace (Definition, Theorem, Lemma and Related Problems).

UNIT V: **Lecture hour:15**

OPTIMAL CONTROL: Linear time varying systems with quadratic performance criteria (Definition, Theorem, Lemma and Related Problems) – Matrix Riccati equation (Definition, Theorem, Lemma and Related Problems) – Nonlinear Systems (Theorem, Lemma and Related Problems).

Text Book:

Elements of Control Theory by K.Balachandran and J.P.Dauer, Narosa,Second Edition New Delhi, 2012.

Reference Book:

1. Linear Differential Equations and Control by R.Conti, Academic Press, London, 1976.

2. Functional Analysis and Modern Applied Mathematics by R.F.Curtain and A.J.Pritchard, Academic Press, New York, 1977.

3. Controllability of Dynamical Systems by J.Klamka, Kluwer Academic Publisher, Dordrecht, 1991.

4. Mathematics of Finite Dimensional Control Systems by D.L.Russell, Marcel Dekker, New York, 1979.

5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley, New York, 1967

Course Title : **DISCRETE STRUCTURES**	Course Code : **33E**
Semester : **III**	Course Group : **EL-II-2**
Teaching Scheme in Hrs (L:T:P) : **4:1:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **75**
CIA: **25 Marks**	SEE #: **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos):After completion of this course, the students will be able to	PSOs	Cl. Ses	CL
CO1	Define the basic concept of relations and functions.	PSO3	15	AP
CO2	Apply the types of lattices and Boolean algebra	PSO3	8	AP
CO3	Construct the Karnaugh map	PSO3	7	AP
CO4	Solve recurrence Relations and generating function	PSO3	15	AP
CO5	Compute languages and Grammer	PSO3	15	AP
CO6	Analyze the finite state automata	PSO3	15	AN

UNIT – I **Lecture hour:15**

RELATIONS

Cartesian products of two sets (Related Problems) – Domain and Range of a relation(Related Problems) – representation of relation (Related Problems) – Operations on Relations (Related Problems) – Composition of Relations (Related Problems) – Equivalence relations(Related Problems).

FUNCTIONS

Functions and Operators(Related Problems) – Range of a function(Related Problems) – One-to-one, onto (Related Problems) – Special types of functions(Related Problems) – Invertible functions (Related Problems) – Composition of function(Related Problems).

UNIT - II **Lecture hour:15**

LATTICES AND BOOLEAN ALGEBRA

Lattice (Related Problems) – Duality(Related Problems) - types of lattices (Related Problems) - join irreducible elements (Related Problems) – Boolean algebra (Related Problems) – basic theorem on Boolean algebra (Related Problems) – applications of Boolean algebra (Related

Problems) – logic gates and circuits (Related Problems) – combinatorial circuits (Related Problems) – Boolean expressions (Related Problems) – Karnaugh map(Related Problems).

UNIT – III **Lecture hour:15**

RECURRENCE RELATIONS AND GENERATING FUNCTION

Recursion and Iteration (Related Problems) – Recurrence relations (Related Problems) – Solution of finite order homogeneous (linear) relations (Related Problems) – Solution of Non-Homogeneous relations (Related Problems) – Generating functions (Related Problems) – Some common Recurrence relations (Related Problems) – Primitive recursive function (Related Problems) – Recursive and partial recursive function(Related Problems).

UNIT - IV **Lecture hour:15**

LANGUAGE AND GRAMMER

Language : The set Theory of Strings (Related Problems) – Languages(Related Problems) – Regular Expressions and Regular Languages (Related Problems) – Grammar (Related Problems) – Finite (Related Problems) –state Machine(Related Problems).

UNIT - V **Lecture hour:15**

AUTOMATA

Finite-state Automata (Related Problems) – Pumping Lemma for Regular Sets(Related Problems) – Finite Automation with Output (Related Problems) – Minimization of Finite Automata (Related Problems) – Turning Machines (Related Problems).

TEXT BOOK:

1. UNIT I & III - "**Discrete Mathematics**" Dr. M. K. Venkataraman, Dr. N. Sridharan N. Chandrasekaran
2. UNIT II, IV & V – "**Discrete Mathematics**" J K. Sharma

REFERENCE BOOK: "**DiscreteStructures"** P. K. Mittal

Course Title : **EDC-QUANTITATIVE APTITUDE**	Course Code : **3EK**
Semester : **III**	Course Group : **EL-III**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos):After completion of this course, the students will be able to	PSOs	Cl. Ses	CL
CO1	Remember the square root and cube root.	PSO3	10	R
CO2	Analyze the concept of problems on numbers and problem on ages.	PSO3	8	AN
CO3	Point out varies types of shortcuts in percentage.	PSO3	8	AN
CO4	Analyze the concept of time and work and time and distance.	PSO3	12	AN
CO5	Remember about simple interest and compound interest.	PSO3	12	R
CO6	Analyze the concept of allegation and mixture.	PSO3	10	AN

UNIT I: **Lecture hour:10**

Decimal Fractions (Basic formulae and Simple Problems)- Simplification (Basic formulae and Simple Problems)– Square Roots & Cube Roots(Basic formulae and Simple Problems).

UNIT II: **Lecture hour:16**

Problems on Numbers (Basic formulae and Simple Problems)– Problems on Ages (Basic formulae and Simple Problems)– Percentage(Basic formulae and Simple Problems).

UNIT III: **Lecture hour:12**

Time and Work(Basic formulae and Simple Problems) – Time and Distance(Basic formulae and Simple Problems) – Problems on trains(Basic formulae and Simple Problems).

UNIT IV: **Lecture hour:12**

Simple Interest (Basic formulae and Simple Problems)– Compound Interest (Basic formulae and Simple Problems)– Logarithms(Basic formulae and Simple Problems).

UNIT V **Lecture hour:10**

Area (Basic formulae and Simple Problems)– Volume and Surface Areas(Basic formulae and Simple Problems) – Races and Games of Skill(Basic formulae and Simple Problems).

Text Book:

"Quantitative Aptitude" by R.S.Agarwal ,S.Chand & company Ltd,New Delhi,7th Edition.

SEMESTER-IV

Course Title : **FUNCTIONAL ANALYSIS**	Course Code : 43A
Semester : **IV**	Course Group : **M-XIV**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **5**
Map Code: **F(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M. Sc MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Outline proof of The Hahn-Banach theorem, The natural imbedding of N in N** and the open mapping problem by defining Banach spaces.	PSO2	**18**	U
CO2	Construct the proof of theorems on Orthonormal sets by defining Hilbert spaces.	PSO2	**16**	AP
CO3	Develop conjugate space and analyze the proof of theorems of ad joint of an operator, self adjoint operators and Normal and unitary operators.	PSO2	**18**	AN
CO4	Construct the proof of theorems on the spectral theorem.	PSO2	**18**	AP
CO5	Examine Banach algebra, Regular and singular elements and related theorems.	PSO2	**10**	AN
CO6	Survey the proof of Topological divisors of zero, the spectrum and the formula for the spectral radius.	PSO2	**10**	AN

UNIT I: **Lecture hour:18**

Banach spaces (Basic concepts)– The definition and some examples (Examples and theorems) – Continuous linear transformations (Theorems)– The Hahn-Banach theorem (Lemma and theorem)– The natural imbedding of N in N** (Theorem)- The open mapping problem (Theorem).

UNIT II: **Lecture hour:16**

The conjugate of an operator (Theorems) – Hilbert spaces (Definition and Theorems) – The definition and some simple properties (Theorem and examples)– Orthogonal complements (Theorems)- Orthonormal sets(Theorem and examples).

UNIT III **Lecture hour:18**

The Conjugate space H*(Theorems) - The adjoint of an operator (Theorems)– Self-adjoint operators(Theorems) – Normal and unitary operators(Theorems) – Projections(Theorems).

UNIT IV: **Lecture hour:18**

Matrices (Theorems)– Determinants and the spectrum of an operator (Theorems)– The spectral theorem(Theorem).

UNIT V: **Lecture hour:20**

The definition and some examples of Banach algebra(Theorems) – Regular and singular elements (Theorems)–Topological divisors of zero(Theorems) – The spectrum (Theorems)– The formula for the spectral radius(Theorems).

Text Book:

G.F. Simmons**, Introduction to Topology and Modern Analysis,** McGraw –Hill Book Company, London, 1963.
Unit I: Sections: 46 – 50. Unit II: Sections: 51 – 54. Unit III: Sections: 55 – 59.
Unit IV: Sections: 60 – 63. Unit V: Sections: 64 – 68.

Reference Book:

C. Goffman and G. Pedrick, **A First Course in Functional Analysis,** Prentice Hall of India, New Deli, 1987.

Course Title : **MATHEMATICAL METHODS**	Course Code : 43B
Semester : **IV**	Course Group : **M-XV**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **5**
Map Code : F **(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	# - **Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Define Fourier transforms and solve the two dimensional diffusion equation.	PSO3	18	AP
CO2	Apply the Hankel transforms and Axi-symmetric Dirichlet Problem.	PSO3	18	AN
CO3	Explain the types of integral equations and theorems.	PSO3	18	U
CO4	Classify the applications of integral equation to ordinary differential equation	PSO3	16	AP
CO5	Define the Euler's equation and solve functional dependent on higher order derivatives	PSO3	10	AP
CO6	Apply variation problems in parametric form and its applications.	PSO3	10	AN

UNIT I: **Lecture hour:18**

FOURIER TRANSFORMS: Fourier sine and cosine transforms (Theorems and Derivatives)– Fourier transforms of derivatives (Theorems and Derivatives)- Fourier transforms of simple functions (Theorems and Derivatives)- convolution integral(Theorems and Derivatives) –

Parseval's Theorem (Theorems and Derivatives)- Solution of PDE by Fourier transform (Theorems and Derivatives)– Laplace equation in half plane in infinite strips; in semi infinite strip. The Linear diffusion equation on a semi-infinite line (Theorems and Derivatives)– the two dimensional diffusion equation(Theorems and Derivatives).

UNIT II: **Lecture hour:18**

HANKEL TRANSFORMS: Properties of Hankel Transforms(Theorems and Derivatives) – Hankel inversion theorem of derivatives of functions (proof deleted) (Theorems and Derivatives)- The Parseval's relation (Theorems and Derivatives)– relation between Fourier and Hankel transforms (Theorems and Derivatives)- Axisymmetric Dirichlet problem for a half space (Theorems and Derivatives)- Axisymmetric Dirichlet problem for a thick plate(Theorems and Derivatives).

UNIT III: **Lecture hour:18**

INTEGRAL EQUATIONS: Types of Integral equations(Derivatives and Examples)– Integral Fredholm Alternative (Theorems and Derivatives)- Approximate method (Theorems and Examples)– Equation with separable Kernel (Theorems and Examples)- Volterra integral equations (Definition and Examples)– Fredholm's theory (Theorems and Derivatives) – Fredholm's first, second, third theorems(Statement only).

UNIT IV: **Lecture hour:16**

Application of Integral equation to ordinary differential equation(Derivatives and Examples) – initial value problems (Derivatives and Examples)– Boundary value problems (Derivatives and Examples)– singular integral equations (Derivatives and Examples)– Abel Integral equation(Derivatives and Examples).

UNIT V: **Lecture hour:20**

CALCULUS OF VARIATIONS: Variation and its properties (Derivatives and Examples)– Euler's equation(Derivatives and Examples) –Functional of the integral forms (Derivatives and Examples)- Functional dependent on higher order derivatives(Derivatives and Examples) – functional dependent on the functions of several independent variables(Derivatives and Examples) – variational problems in parametric form (Derivatives and Examples).

Text Book:

For Units I and II: **The Use of Integral Transforms** by I.N.Sneddon, Tata Mc Graw Hill, New Delhi, 1974.
For Units III and IV: **Linear Integral Equations Theory and Technique** by R.P.Kanwal, Academic Press, New York, 1971.
For Unit V: **Differential Equations and Calculus of Variations** by L.Elsgolts, Mir Publishers, Moscow, 1970.
Unit I : Chapter 2: 2.4 - 2.7, 2.9 – 2.10, 2.16 – 2-(a).(b).(c) 2.16.
Unit II : Chapter 5: 5.2 – 5.4, 5.6 – 5.7, 5.10 – 5.12.
Unit III : Chapter 2: 2.3 - 2.5, Chapter 3: 3.3 - 3.4.
Unit IV : Chapter 5: 5.1 – 5.2, Chapter 8: 8.1 – 8.2.
Unit V : Chapter 6: 6.1 – 6.7.

Course Title : **GRAPH THEORY**	Course Code : 43C
Semester : **IV**	Course Group : **M-XVI**
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **5**
Map Code : F **(PROBLEM – ANALYSIS)**	Total Contact Hours : **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **M.Sc MATHEMATICS**	# - **Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Understand the basic concepts of graphs , Isomorphism and Automorphism of a graph, directed graphs	PSO2	18	R
CO2	Know the various types of graphs, : Sub graphs, decompositions and coverings.	PSO2	18	U
CO3	Identify Euler tours and apply results, Study the properties of trees and non-separable graphs.	PSO2	18	AP
CO4	Understand the concepts Planarity including Euler identity	PSO2	16	U
CO5	Discuss and understand the importance of the concepts Coloring	PSO2	10	U
CO6	Identify the Hamiltonian cycle	PSO2	10	AP

UNIT – I **Lecture hour:18**

GRAPHS: Graphs and their representation (Definitions, Examples and Theorems)– Isomorphism's and Automorphism's (Definitions and Examples)- Graphs arising from other structures(Definitions and Examples) – Constructing graphs from other graphs (Definitions and Examples)– directed graphs (Definitions and Examples)– infinite graphs(Definitions and Examples).

UNIT –II **Lecture hour:18**

SUBGRAPHS : Sub graphs and super graphs (Definitions, Examples and Theorems)– spanning and induced subgraphs (Definitions, Examples and Theorems)– modifying graphs (Definitions

and Examples)– decompositions and coverings(Definition and Theorems) – edge cuts and bonds (Definitions, Examples and Theorems) – even subgraphs (Definitions, Examples and Theorems) – graph reconstruction(Definitions, Examples, Lemma and Theorems)

UNIT – III **Lecture hour:18**

CONNECTED GRAPHS: Walks and connection (Definitions and Examples) – cut edges (Definitions and Examples) – Euler tours (Definitions, Examples, Algorithm and Theorems)– connection in Digraphs (Theorems)**.**

TREES: Forests and trees (Definitions, Examples, Propositions and Theorems) – Spanning trees (Definitions, Examples and Theorems)

NON-SEPARABLE GRAPHS: Cut vertices (Definitions, Examples and Theorems)– separations and blocks (Definitions, Examples and Propositions).

UNIT –IV **Lecture hour:16**

CONNECTIVITY: Vertex connectivity (Definitions, Examples and Theorems) – The fan lemma (Lemma, Propositions and Theorems)– edge connectivity (Definitions and Theorems)– Three connected graphs(Definitions, Examples and Theorems).

PLANAR GRAPHS: Plane and planar graphs – duality(Definitions, Examples, Propositions and Theorems) – Euler's formula (Theorems)– bridges(Definitions, Examples and Theorems) – Kuratowski's theorem(Definitions, Examples, Lemma and Theorems).

UNIT –V **Lecture hour:20**

THE FOUR-COLOUR PROBLEM: Colourings of planar maps(Definitions, Examples and Theorems)– the five colour theorem (Theorem)

HAMILTON CYCLES : Hamiltonian and non-Hamiltonian graphs(Definitions, Examples and Thereoms – Non-Hamiltonian planar graphs (Definitions and Examples) – path and cycle exchanges (Definitions and Examples) – path exchanges and parity (Definitions, Examples and Theorems)– Hamilton cycles in Random graphs(Definitions, Examples and Theorems).

TEXT BOOK

GRAPH THEORY by J.A. Bondy and U.S.R. Murty, Springer international edition – 2013

REFERENCE BOOK

Treatment as in " **GRAPH THEORY**" by Narsingh Deo, Prentice – Hall of India private limited, New Delhi, 1997

Course Title : **MATLAB**	Course Code: **43D**
Semester : **IV**	Course Group : **M-XVII**
Teaching Scheme in Hrs (L:T:P) : 5 **:1: 0**	Credits : **5**
Map Code: F **(PROBLEM – ANALYSIS)**	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl.Ses	CL
CO1	Define the basic concept of starting windows and solve the MATLAB applications.	PSO1&PSO3	10	AP
CO2	Define how to creating arrays and solve them in MATLAB.	PSO1&PSO3	10	AP
CO3	Demonstrate the Mathematical operations with arrays and solve them in MATLAB.	PSO1&PSO3	16	AP
CO4	Explain the two dimensional and three dimensional plots and solve them in MATLAB.	PSO1&PSO3	18	AP
CO5	Explain the Relational and logical operators and solve the programming in MATLAB.	PSO1&PSO3	18	AP
CO6	Demonstrate the polynomials, curve fitting and interpolation and solve them in MATLAB.	PSO1&PSO3	18	AP

UNIT I: **Lecture hour: 20**

STARTING WITH MATLAB: Starting MATLAB, MATLAB Windows (Command, Description and Example)- Working in the Command Window(Command, Description and Example) - Arithmetic Operations with Scalars (Command, Description and Example)- Display Formats - Elementary Math Built-In Functions (Command, Description and Example)- Defining Scalar Variables(Command, Description and Example) - Useful Commands for Managing

Variables -Script Files (Command, Description and Example)- Examples of MATLAB Applications (Examples).

CREATING ARRAYS: Creating a One-Dimensional Array (Vector) - Creating a Two-Dimensional Array (Matrix) - Notes about Variables n MATLAB (Command, Description and Example) - The Transpose Operator(Command, Description and Example) -Array Addressing - Using a Colon: In Addressing Arrays(Command, Description and Example) - Adding Elements to Existing Variables - Deleting Elements (Command, Description and Example)- Built-In Functions for Handling Arrays - Strings and Strings as Variables(Command, Description and Example).

UNIT II **Lecture hour:16**

MATHEMATICAL OPERATIONS WITH ARRAYS: Addition and Subtraction – Array Multiplication - Array Division - Element-By-Element Operations (Command, Description and Example) - Using Arrays In MATLAB Built-In Math Functions(Command, Description and Example)- Built-In Functions For Analyzing Arrays(Command, Description and Example) - Generation Of Random Numbers - Examples Of MATLAB Applications(Examples).

USING SCRIPT FILES AND MANAGING DATA: The MATLAB Workspace and the Workspace Window(Command, Description and Example) - Input To A Script File - Output Commands(Command, Description and Example) - The Save And Load Commands (Command, Description and Example)- Importing And Exporting Data - Examples Of MATLAB Applications(Examples).

UNIT III **Lecture hour:18**

TWO-DIMENSIONAL PLOTS: The plot Command - The fplot Command - Plotting Multiple Graphs in the Same Plot - Formatting a Plot - Plots With Logarithmic Axes(Command, Description and Example) - Plots With Error Bars - Plots With Special Graphics - Histograms - Polar Plots - Putting Multiple Plots on the Same Page(Command, Description and Example) - Multiple Figure Windows - Examples of MATLAB Applications(Examples).

THREE-DIMENSIONAL PLOTS: Line Plots - Mesh and Surface Plots - Plots with Special Graphics - The View Command - Examples Matlab Applications.

UNIT IV **Lecture hour: 18**

PROGRAMMING IN MATLAB: Relational and Logical Operators (Command, Description and Example)- Conditional Statements -The Switch-Case Statement(Command, Description and Example) - Loops - Nested Loops and Nested Conditional Statements(Command, Description and Example) – The Break and Continue Commands(Command, Description and Example) - Examples of MATLAB Applications(Examples).

USER-DEFINED FUNCTIONS AND FUNCTION FILES: Creating A Function File – Structure of a Function File(Command, Description and Example)- Local And Global Variables - Saving A Function File - Using A User-Defined Function - Examples of Simple

User(Command, Description and Example)-Defined Functions - Comparison Between Script Files and Function Files(Command, Description and Example) - Anonymous And Inline Functions - Function Functions – Sub functions(Command, Description and Example)- Nested Functions - Examples Of MATLAB Applications(Examples).

UNIT V **Lecture hour: 18**

POLYNOMIALS, CURVE FITTING, AND INTERPOLATION: Polynomials (Command, Description and Example)- Curve Fitting -Interpolation (Command, Description and Example)- The Basic Fitting Interface - Examples of MATLAB Applications(Examples).

APPLICATIONS IN NUMERICAL ANALYSIS: Solving an Equation with One Variable - Finding a Minimum or a Maximum of a Function(Command, Description and Example) - Numerical Integration - Ordinary Differential Equations (Command, Description and Example)- Examples of MATLAB Applications(Examples).

Text Book:

Treatment as in:MATLAB An Introduction with Applications By AmosGilat. JOHN WILEY & SONS, INC.2011.

Reference Books:

1. Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers By RUDRA PRATAP. Oxford University Press.

2. Introduction to MATLAB 7 for Engineers By William John Palm. McGraw-Hill Professional, 2005.

3. **Introduction to MATLAB 7** By Dolores M. Etter, David C. Kuncicky, Printice Hall, 2004.

Course Title : **PROJECT AND VIVA VOCE**	Course Code : 43R
Semester : I**V**	Course Group : **PV**
Teaching Scheme in Hrs (L:T:P) : 6:0:0	Credits : **4**
Map Code: I **(PROJECT)**	Total Contact Hours : **90**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **MSc-MATHEMATICS**	**# - Semester End Exam**

PROJECT AND VIVA- VOCE

- Students should do the project in any one of the following topic.
- At the end of the semester the students must submit the project Record to the concern Guide.
- Viva Voce Examination will be jointly conducted on the End of Semester.

PROJECT AREAS (BROAD FIELD)

1.Algebra
2.Operations Research
3.Functional Analysis
4.Graph Theory
5.Control Theory
6.Ordinary Differential Equations
7.Fuzzy Logic And Fuzzy Sets
8.Topology
9.Real Analysis
10. Partial Differential Equations
11. Mechanics
12. Discrete Structures
13. Complex Analysis
14. Number Theory