J.J. College of Arts and Science(Autonomous)

J.J.Nagar, Sivapuram Post, Pudukkottai - 622 422

NAAC Accredited with 'A' Grade

PG - Programme - **M.Sc. MATHEMATICS - Under Choice Based Credit System**

For the candidates admitted from the academic year 2019-2020 onwards

Sem	Course Code	Course Title	Hours/ Week	Credit	Exam Hours	MARKS
I	P1R1MTCC1	Algebra – I	6	5	3	100
	P1R1MTCC2	**Real Analysis – I**				
	P1R1MTCC3	Ordinary Differential Equations	6	5	3	100
	P1R1MTCC4	Classical Mechanics	6	5	3	100
	P1R1MTEC1	Elective Course-I (Any one from the choice given below)	6	3	3	100
		TOTAL	**30**	**23**		**500**
II	P2R1MTCC5	Algebra – II	6	5	3	100
	P2R1MTCC6	**Real Analysis – II**	6	5	3	100
	P2R1MTCC7	Partial Differential Equations	6	5	3	100
	P2R1MTCC8	Topology	6	5	3	100
	P2R1MTEC2	Elective Course-II (Any one from the choice given below)	6	3	3	100
		TOTAL	**30**	**23**		**500**
III	P3R1MTCC9	Fluid Dynamics	6	5	3	100
	P3R1MTCC10	Functional Analysis	6	5	3	100
	P3R1MTCC11	Complex analysis	6	5	3	100
	P3R1MTCC12	Measure Theory and Integration	6	5	3	100
	P3R1MTEC3	Elective Course-III (Any one from the choice given below)	6	3	3	100
		TOTAL	**30**	**23**		**500**
IV	P4R1MTCC13	Stochastic Processes	6	5	3	100
	P4R1MTCC14	Optimization Techniques	6	5	3	100
	P4R1MTCC15PW	Project	12	8	*	100
	P4R1MTEC4P	Elective Course-IV (Any one from the choice given below)	6	3	3	100
		TOTAL	**30**	**21**		**400**
		GRAND TOTAL		**90**		**1900**

ELECTIVE PAPERS:

Any **Four** to be chosen as EC1, EC2, EC3 and EC4

I Semester

- Calculus of Variation and Integral Equations
- Advanced Number Theory
- Fuzzy Mathematics and its Applications

II Semester

- Numerical Analysis
- Automata Theory
- Combinatorial Mathematics

III Semester

- Applied Mathematical Statistics
- Design Theory
- Advanced Graph Theory

IV Semester

- Advanced MATLAB
- Graph Algorithm

SEM – I	**M.Sc. MATHEMATICS**	**CORE COURSE:1**
Hours/Week: 6	**ALGEBRA- I**	**Int. Marks: 25**
Credit : 5	**CODE:P1R1MTCC1**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To educate the advanced level of Groups*
- *To understand the sequential development of Abelian group concepts and skills by using materials for making the transition from the arithmetic to the symbolic.*
- To understand the concepts of Ring, Euclidean Ring.
- To have a brief study of polynomial Rings
- *To study the algebraic structure of finite fields.*

Unit I: Group Theory (16 Hours)

Introduction to Group Theory: Basic Definitions in Groups – Permutation Groups – Problems in Permutation Groups – Another counting Principle – Conjugate – Normalizer – Applications – Sylow's theorem .

Unit II: Abelian Group (14 Hours)

Direct Product: Internal Direct Product and External direct Product – Normal Group – Center of Groups – Introduction to Abelian Groups: Finite abelian groups – Invariants – Partition –Orders - Properties of Isomorphism in Abelian Groups.

Unit III: Ring Theory (14 Hours)

Introduction: Ring and Field – Integral Domain – The field of Quotients of an Integral domain – Euclidean Rings – Greatest common divisor – Unit – Associates – A Particular Euclidean Rings – Fermat's Theorem.

Unit IV: Polynomial Rings (14 Hours)

Definition for Ring of Polynomials – Properties of Polynomial Rings – Degree – irreducible – Polynomials over the Rational Field: Primitive Polynomials – Content – Integer Monic – Polynomial Rings over commutative rings: Unique Factorization domain.

Unit V: Finite Field (12 Hours)

Finite fields – Wedderburn's theorem on finite division rings – A theorem of Frobenius .

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book :

[1] I.N.Herstein, 'Topics in Algebra', Second Edition, Wiley Eastern Limited 2014.

Unit I - Chapter 2 (Section 2.10 – 2.12)
Unit II - Chapter 2 (Section 2.13 – 2.14)
Unit III- Chapter 3 (Section 3.6 – 3.8)
Unit IV- Chapter 3 (Section 3.9 – 3.11)
Unit V - Chapter 7 (Section 7.1 – 7.3)

Reference Books:

1. Surjeet Singh, Quazizameeudui, 'Moderrn Algebra', Vikas Publi shing House Pvt. Ltd.
2. J. Gallian, 'Contemporary Abstract Algebra', Narosa Publishing House, Fourth Edition.

Outcomes:

The learners would have the ability to

- Acquire knowledge on the metric spaces.
- Apply the mean value theorems in a correct mathematical way.
- Study Cauchy sequence, upper and lower limits of number sequence.
- Learn series , power series, absolute convergence and rearrangements.
- Understand continuity, compactness and monotonic functions.

SEM – I	**M.Sc. MATHEMATICS**	**CORE COURSE:2**
Hours/Week: 6	**REAL ANALYSIS- I**	**Int. Marks: 25**
Credit : 5	**CODE:P1R1MTCC2**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To deal primarily with sequences and series of complex numbers.*
- *To discuss vector valued functions (i.e. functions with values in RK) and functions with values in an arbitrary metric space.*
- *To confine our attention to real functions defined on intervals or segments.*
- *To understand numerical series and power series.*
- *To focus on continuity and connectedness.*

Unit I: Metric Spaces (14 Hours)

Examples of Metric Spaces - Open sets, Closed sets and Convergent sequences - Continuous mappings between metric spaces - Complete metric spaces – Compact metric spaces.

Unit II: Basic Topology (14 Hours)

Finite, Countable and Uncountable Sets – Metric Spaces –Compact Sets, Weirstrass Theorem – Perfect Sets, The Cantor Set – Connected Sets.

Unit III: Numerical Sequences (12 Hours)

Convergent Sequences – Subsequences – Cauchy Sequences – Upper and Lower Limits – Some Special Sequences.

Unit IV: Numerical Series (16 Hours)

Series – Series of Nonnegative Terms - The Number e – The Root and Ratio Tests – Power Series – Summation by Parts – Absolute Convergence – Addition and Multiplication of Series – Rearrangements.

Unit V: Continuity (14 Hours)

Limits of Functions – Continuous Functions – Continuity and Compactness – Continuity and Connectedness – Discontinuities – Monotonic functions – Infinite Limits and Limits at Infinity.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Books:

[1] "Principles of Mathematical Analysis", Walter Rudin - McGraw Hill Education, 3rd Edition, 2013.

[2] " Real Analysis", H.L. Royden, P.M. Fitzpatrick, PHI Learning Pvt. Ltd, 2010.

Unit I : Chapter 9 – 9.1 to 9.5 [2]

Unit II: Chapter 2 [1]

Unit III: Chapter 3(Page No. 47 - 58)[1]

Unit IV: Chapter 3(Page No. 58 - 77) [1]

Unit V: Chapter 4 [1]

Reference Books:

[1] T.M. Apostol, Mathematical Analysis, Narosa Publ. House, New Delhi, 1985.

[2] H.L. Royden, Real Analysis, Macmillan Publ. Co. Inc. 4th edition, New York, 1993.

[3] V. GanapathyIyer, Mathematical Analysis, Tata McGraw Hill, New Delhi, 1970.

Outcomes:

The learners would have the ability to

- *Acquire knowledge on the metric spaces.*
- *Apply the Mean value theorems in a correct Mathematical way.*
- *Study cauchy's sequence ,upper and lower limits of numerical sequences.*
- *Learn series, power series Absolute convergent and rearrangement.*
- *Understand continuity compactness and monotonic functions.*

SEM – I	**M.Sc. MATHEMATICS**	**CORE COURSE:3**
Hours/Week: 6	**ORDINARY DIFFERENTIAL EQUATIONS**	**Int. Marks: 25**
Credit : 5	**CODE:P1R1MTCC3**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives

- To identify an ordinary differential equation and its order.
- To find solutions of separable differential equations.
- To find the general solution of second order linear homogeneous equations with constant coefficients .
- To find solution of DE using Laplace Transforms.
- To use successive approximations.

Unit I: Second Order Linear Equations (16 Hours)

Introduction - The General Solution of Homogeneous Equation - The use of a Known Solution to find another - Homogeneous equation with constant coefficients – The Method of Undetermined Co-efficients - The method of Variation of parameters.

Unit II: Power Series Solutions and Special Functions (14 Hours)

Introduction-Series solutions of First order equations-Second order Linear equations - Ordinary points - Regular singular points - Regular singular points (continued).

Unit III: Some Special Functions (12 Hours)

Legendre Polynomials - Properties of Legendre polynomials - Bessel Function, The Gamma Function - Properties of Bessel Functions.

Unit IV: Laplace Transforms (14 Hours)

Introduction- A few remarks on the theory – Applications to Differential Equations - Derivatives and Integrals of Laplace Transforms – Convolutions and Abels Mechanical Problem.

Unit V:The Existence And Uniqueness Of Solutions (14 Hours)

The method of successive Approximations – Picard's Theorem – the second order linear Equations.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "**Differential Equations with Applications and Historical notes**" by George Simmons, Tata Mc GrawHill, Second Edition 2003, 22nd Reprint 2012.

Unit I: Chapter 3 - Sec 14 to 19
Unit II : Chapter 5-Sec 26 to 30
Unit III: Chapter 8-Sec 44 to 47
Unit IV: Chapter 9 - Sec 48 to 52
Unit V : Chapter 13 - Sec 68 to 70

Reference Books:

[1] W.T. Reid, "Ordinary Differential Equations**"**, John Wiley & Sons, New York,1971.
[2] E.A. Coddington and N. Levinson, "Theory of Ordinary Differential Equaitons", McGraw Hill Publishing Company, New York, 1955.

Outcomes :

The learners would have the ability to

- Use the method of variation of parameters to find particular solutions of second order, linear homogeneous equations.
- Use the method of undetermined co-efficient to solve 2nd order linear homogeneous equations.
- Learn about Legendre Polynomials, Bessels function and Gamma functions
- Acquire the knowledge of apply the Laplace transform to solve the simultaneous linear equations.
- Use the method of successive approximation Picards theorem.

SEM – I	**M.Sc. MATHEMATICS**	**CORE COURSE:4**
Hours/Week: 6	**CLASSICAL MECHANICS**	**Int. Marks: 25**
Credit : 5	**CODE:P1R1MTCC4**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives

- To understand and deals with some of the key ideas of classical mechanics.
- To understand the concepts covered in the course include generalized coordinates, Lagrange's equations, Hamilton's equations and Hamilton - Jacobi theory.
- To develop skills in formulating and solving physics problems.
- To represent the equations of motion for complicated mechanical systems using the Lagrangian.
- To study Hamiltonian formulations of classical mechanics.

Unit I: ELEMENTRARY PRINCIPLES (14 Hours)

Mechanics of a Particle - Mechanics of a system of particles – Constraints – D'Alembert's principle and Lagrange's equation – Velocity – Dependent potentials and the dissipation function – Simple Application of the Lagrangian formulation.

Unit II: CENTRAL FORCE PROBLEM (16 Hours)

Reduction to the equivalent one - Body problem – The equation of motion and first integrals –The equivalent one - Dimensional problem and Classification of Orbits – The Virial theorem – The Differential equation for the Orbit and Integrable power- Law Potentials.

Unit III: The Kepler Problem (12 Hours)

Inverse square law of force – The motion in time in the Kepler Problem – The Laplace-Runge-Lenz vector – Scattering in a Central Force Field.

Unit IV: The Kinematics of Rigid Body Motion (14 Hours)

The independent coordinates of a rigid body – Orthogonal Transformation – Formal Properties of the transformation Matrix – The Euler Angles – The cayley –klein parameters and related quantities – Euler's theorem on the motion of a rigid body.

Unit V: The Hamilton Equation of Motion (15 Hours)

Legendre Transformation and the Hamilton equations of motion – Cyclic Coordinates and conservation Theorems – Routh Procedure – The Hamiltonian Formulation of Relativistic Mechanics – Derivation of Hamilton's Equations from a Variational Principle.

Unit –VI: (01 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Classical Mechanics", by Herbert Goldstein and others, Pearson Publiction, Third Edition 2013, New Delhi.

Unit I: Chapter 1 –Sec 1.1 to 1.6
Unit II: Chapter 3 –Sec 3.1 to 3.5
Unit III: Chapter 3 –Sec 3.7 to 3.10
Unit IV: Chapter 4 –Sec 4.1 to 4.6
Unit V: Chapter 8 – Sec 8.1 to 8.5

Reference Books:

[1] "Classical Dynamics" by Donald T.Greenwood, PHI Pvt. Ltd., New Delhi-1985.
[2]"Classical Mechanics" by Narayanan Chandra Rana and PromodJoag, Tata McGraw Hill.1990.

Outcomes:

The learners would have the ability to

- *Have a deep understanding of Menchanics of a system of practical and D'Alembert's principle.*
- *Be able to solve the DE for the orbit.*
- *Be familiar with Kepler problem used in physics.*
- *Know about Euler's Equation on the notation of rigid body.*
- *Study about Routh procedure to derive Hamiltons Equations..*

SEM – II **M.Sc. MATHEMATICS** **CORE COURSE:5**
Hours/Week: 6 **ALGEBRA – II** **Int. Marks: 25**
Credit : 5 **CODE: P2R1MTCC5** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To develop mathematical maturity and ability on fields.*
- *To study algebraic structure of a linear transformation.*
- *To study Canonical forms.*
- *To educate advanced level of finite fields.*
- *To be better equipped in Canonical forms of various transformations.*

UNIT I: Vector Spaces **(14 Hours)**

Linear Functional and the Dual space - Linear functional and its examples - Dual basis, Reflexivity, Annihilator, Transpose of a linear map - Reflexivity Theorem and solved examples

UNIT II: Extension Fields **(16 Hours)**

Extension - Finite extension – Algebraic extension - splitting field, Algebraic closure – Root field – Root of a polynomial of multiplicity m - Degree of an algebraic number – Derivative of a polynomial, Separable. (Theorems & Problems)

UNIT III: Galois Theory **(14 Hours)**

Automorphism of a field – Normal extension, Fixed field – Elementary symmetric functions – Galois group for a polynomial – Conjugate elements (Theorems and Problems).

UNIT IV: Modules **(12 Hours)**

Definition – Types of modules – algebra of modules – Direct sum of sub modules (Theorems & Problems)

UNIT V: Canonical Forms and Nil Potent Operators **(14 Hours)**

Similarity of matrices and linear maps invariant subspaces – Normal form, Triangular form– Invariant direct sum decomposition – Nil potent transformations.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

TEXT BOOK:

[1] "Advanced Course in Modern Algebra", Goyal Gupta, A Pragati Edition, 8thedition2015.

Unit I **:** Chapter 12 – Part 5 (Page No. 546-565)
Unit II **:** Chapter 13 – (Sec 1,2,3 & 4 Only) (Page No. 566- 596)
Unit III **:** Chapter 14 – (Sec 1 -3) (Page No. 609- 631)
Unit IV **:**Chapter 16 – (All Sections) (Page No. 656- 680)
Unit V **:** Chapter 19 – (All Sections) (Page No. 703- 727)

Reference Books:

[1] 'Abstract Algebra', David S.Dummit and Richard M.Foote, Wiley and sons, Third edition, 2004.
[2] 'Algebra', Serge Lang, Revised Third Edition, Springer – 2002.

Outcomes :

The learners would have the ability to

- *Have a deep understanding of vector spaces.*
- *Understand the concept of Extension field, Splitting field and Root field.*
- *Explain the notion of Galois Theory.*
- *Describe the structure of modules.*
- *Apply the concept of the Decomposition and Nilpotent transformations.*

SEM – II	**M.Sc. MATHEMATICS**	**CORECOURSE:6**
Hrs/Week: 6	**REAL ANALYSIS - II**	**Int.Marks: 25**
Credit : 5	**Code: P2R1MTCC6**	**Ext.Marks: 75**
Total Hrs: 72		**Max.Marks:100**

Objectives:

- *To be familiar with the advanced concepts of Real Analysis.*
- *To give a systematic study of Riemann stieltjes integral and calculus on R^n.*
- *To have a brief study of convergence of sequences and series, Functions of several variables.*
- *To study Fourier Series and Gamma Function.*
- *To apply the contraction principle.*

Unit I: Differentiation (15 Hours)

The derivative of a Real function – Mean value theorems – The Continuity of the derivatives – L' Hospital's rule – Derivatives of higher order – Taylor's theorem – Differentiation of vectors valued functions.

Unit II: Reimann- Stieltjes integral (13Hours)

Definition and existence of the Integral – Properties of the Integral – Integration and Differentiation- Integration of vector – valued Functions.

Unit III: Sequences and Series of functions (14 Hours)

Discussion of main problem – Uniform convergence – Uniform convergence and Continuity – Uniform convergence and Integration – Uniform convergence and Differentiation - Equi-continuous families of functions – The Stone-Wierstrass theorem.

Unit IV: Some Special Functions (14 Hours)

Power series – The Exponential and Logarithmic Functions – The Trigonometric Functions – The Algebraic Completeness of the Complex Field – Fourier Series – The Gamma Function.

Unit V: Functions of Several variables (12 Hours)

Linear Transformations – Differentiations – The contraction Principle- The inverse function theorem – The Implicit Function Theorem.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Books:

[1] " Principles of Mathematical Analysis", Walter Rudin, McGraw Hill, Third Edition, 1976.

Unit I : Chapter 5- Sec 5.1 to 5.19
Unit II: Chapter 6- Sec 6.1 to 6.25
Unit III: Chapter 7 - Sec 7.1 to 7.27
Unit IV: Chapter 8 - Sec 8.1 to 8.22
Unit V: Chapter 9 - Sec 9.1 to 9.29

Reference Books:

[1] "Mathematical Analysis", Tom P. Apostal, Narosa Publishing House, Delhi.
[2] "Analysis I and II", Serge Lang, Addison – Wesley Publishing Company, 1969.

Outcomes:

The learners would have the ability to

- *Study in detail the Mean value theorem and Taylor's theorem.*
- *Acquire knowledge on Differentiations and Integrations.*
- *Learn Cauchy's sequences, Limit superior and Limit inferior.*
- *Understand the concepts of power series –Fourier series.*
- *Study inverse function theorem and implicit function theorem.*

SEM – II	**M.Sc. MATHEMATICS**	**CORECOURSE:7**
Hrs/Week: 6	**Partial Differential Equations**	**Int.Marks: 25**
Credit : 5	**Code: P2R1MTCC7**	**Ext.Marks: 75**
Total Hrs: 72		**Max.Marks:100**

Objectives:

- *To classify Partial differential equations into linear and nonlinear equation.*
- *To understand the notion of linear independence and the notion of a fundamental set of solutions.*
- *To use the Laplace transform to compute solutions of equations involving impulse functions.*
- *To find solutions of the heat equation, wave equation, and the Laplace equation*
- *subject to boundary conditions.*

Unit I: First Order PDE **(14 Hours)**

First order PDE - Curves and surface - Genesis of first order PDE - Classification of Integrals - Linear equation of the first order - Pfaffian Differential equations - Compatible systems - Charpits method – Jacobi's method.

Unit II: cntd. of First Order PDE **(12 Hours)**

Integral surfaces through a given curve - Quasi - Linear equations - Non linear First order PDE.

Unit III: Second Order PDE **(14 Hours)**

Genesis of second order PDE - Classification of Second order PDE: One - Dimensional wave equation - Vibrations of an Infinite string - Vibrations of semi - infinite string – Vibrations of a string of finite length(Method of separation of variables).

Unit IV: Laplace's Equation **(16 Hours)**

Boundary value problems - Maximum and Minimum Principles - The Cauchy problem - The Dirichlet problem for the upper half plane - The Neumann problem for the upper half plane - The Dirichlet problem for a circle - The Dirichlet exterior problem for a circle - The Neumann problem for a circle - The Dirichlet problem for a Rectangle - Harnack's theorem - Laplace's equation - Green's function.

Unit V: Heat Conduction **(14 Hours)**

Heat Conduction problem – Heat conduction - Infinite Rod case - Heat conduction finite rod case - Duhamel's principle - Wave equation - Heat conduction equation.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

TEXT BOOK:

[1] **"**An Elementary Course in Partial Differential equations**"** by T.Amarnath, Narosa, 1997.

Unit I : Chapter 1-Sec 1.1 to 1.8
Unit II : Chapter 1-Sec 1.9 to 1.11
Unit III : Chapter 2- Sec 2.1 to 2.3.5(except 2.3.4)
Unit IV : Chapter 2- Sec 2.4.1 to 2.4.11
Unit V**:**Chapter 2-Sec 2.5.1, 2.5.2, 2.6.1 and 2.6.2

Reference Books:

[1]"Elements of Partial Differential Equations",Sneddon, McGraw Hill, New York.
[2] "Partial Differential Equations", P. Prasad and R. Ravindran, Wiley Eastern, New Delhi.

Outcomes:

The learners would have the ability to

- *Able to solve first order linear differential equations using charpit's method & Jacobi's Method*
- *Understand the quasi linear equations and non linear first order PDE.*
- *Acquire knolewdge to solve second order PDE.*
- *Understand the Laplace transform to compute solutions of equations involving impulse functions.*
- *Learn about Duhamel's principle and wave and heat conduction equation.*

SEM – II **M.Sc. MATHEMATICS** **CORE COURSE:8**
Hours/Week: 6 **TOPOLOGY** **Int. Marks: 25**
Credit : 5 **CODE:P2R1MTCC8** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To develop and understand Topological spaces including connectedness and compactness.*
- *To study the continuous functions on the topological spaces and study their homeomorphisms.*
- *To study regular second countable spaces which are metrizable.*
- *To be familiar with compactness.*
- *To understand countability axioms and normal spaces.*

Unit I: Topological Spaces **(14 Hours)**

Topological Spaces – Basis for a Topology – The Order Topology – The Product Topology on X x Y – The Subspace topology – Closed sets and Limit points.

Unit II: Continuous Functions **(13 Hours)**

Continuous functions – The Product topology – The metric Topology – The metric Topology (continued).

Unit III: Connectedness **(14 Hours)**

Connected Spaces – Connected subspaces of the Real line, Linear Continuum, Intermediate Theorem – Components and Local connectedness.

Unit IV: Compactness **(15 Hours)**

Compact spaces – The Tube Lemma – Compact Subspaces of the Real line – Extreme Value Theorem, Uniform Continuity Theorem – Limit Point Compactness- Local compactness.

Unit V: Countability and Separation Axioms **(14 Hours)**

The Countability axioms – The Separation axioms – Normal Spaces – The Uryshon lemma- The Uryshon Metrization theorem- The Tietz Extension theorem.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Topology", James R. Munkres, Pearson Education Pvt. Ltd. II Edition. (2002)
Unit I: Chapter 2, Sec 12 to 17
Unit II: Chapter 2, Sec 18 to 21
Unit III: Chapter 3, Sec 23 to 25
Unit IV: Chapter 3, Sec 26 to 29
Unit V: Chapter 4, Sec 30 to 35.

Reference Books:

[1] "Topology", J. Dugunji, Prentice Hall of India, 1966.
[2] "Introduction to Topology and Modern Analysis", George F. Simmons, McGraw Hill Book co.,1963.
[3] "General Topology" J. C. Kelly, Van Nostrand, Reinhold Co., Newyork, 1955.

Outcomes:

The learners would have the ability to

- *Obtain the knowledge of fundamental concepts and methods in general topology.*
- *Acquire knowledge about product topology and metric topology .*
- *Know about connectedness and intermediate theorem.*
- *Study about compactness-extreme value theorem and uniform continuity theorem.*
- *Learn about normal spaces and Tietz extension theorem.*

SEM – III	**M.Sc. MATHEMATICS**	**CORE COURSE:9**
Hours/Week: 6	**FLUID DYNAMICS**	**Int. Marks: 25**
Credit : 5	**CODE:P3R1MTCC9**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To introduce the fundamentals of fluid Dynamics such as kinematics of fluid, incompressible flow and boundary layer flows*
- *To discuss of the case of steady motion under conservative body forces and Some Potential Theorems*
- *To develop skills in formulating and solving physics problems.*
- *To study two- dimensional flows.*
- *To introduce viscosity and show what are Newtonian and non-Newtonian fluids*

Unit I: Kinematics of Fluids in Motion (13 Hours)

Real fluids and Ideal Fluids – Velocity of a fluid at a point – Streamlines and Path lines; Steady and Unsteady flows - Velocity Potential – Vorticity Vector – Local and Particle rates of change –The Equations of Continuity – Worked Examples.

Unit II: Equations of Motions of a Fluid (15 Hours)

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary at Two in viscid immiscible fluids – Euler's Equation of a Motion – Bernoulli's Equation – Worked Examples – Discussion of the case of steady motion under conservative body forces – Some Potential Theorems – Some flows involving Axial Symmetry.

Unit III: Some Three Dimensional Flows (14 Hours)

Introduction – Source, Sinks and Doublets, Images in a rigid infinite plane – Images in Solid spheres – Axi-Symmetric Flows: Stoke's stream function – Some special forms of the stream function for Axi-Symmetric irrotational motion.

Unit IV: Some Two Dimensional Flows (15 Hours)

Complex Velocity Potentials For Standard Two – Dimensional Flows – Uniform Stream – Line Sources and Line Sinks – Line Doublets – Line Vortices – Some Worked Examples – Two Dimensional Image System – Milne-Thomson Circle Theorem – Theorem of Blasius.

Unit V: Viscous Flow (13 Hours)

Viscous flow – Some solvable problems in viscous flow – Steady viscous flow in Tubes – Steady viscous flow in Tubes of Uniform cross-section.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Text Book of fluid Dynamics", by Charlton, CBS Publications, New Delhi.,1985.

Unit I : Chapter 2 Sec 2.1 to 2.8
Unit II : Chapter3 Sec 3.1 to 3.9
Unit III : Chapter 4 Sec 4.1 to 4.5
Unit IV **:**Chapter 5 Sec 5.5 to 5.9
Unit V : Chapter 8 Sec 8.10 and 8.11

Reference Books:

[1] "Introduction to Fluid Mechanics",R.W.Fox and A.T.McDonald. Wiley, 1985.
[2] "Fluid Mechanics with Problems and Solutions",E.Krause, Springer,2005.
[3] "Mechanics of Fluids", B.S.Massey,J.W.Smith and A.J.W.Smith,Taylor and Francis, Newyork.

Outcomes:

The learners would have the ability to

- *Recognize the principles written in form of mathematical equations in fluid dynamics.*
- *Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics using potential theorems.*
- *Understand Stoke's stream function.*
- *Study Milne-Thomson circle theorem and theorem of Blasius.*
- *Acquire knowledge of steady of viscous flows.*

SEM – III	**M.Sc. MATHEMATICS**	**CORE COURSE:10**
Hours/Week: 6	**FUNCTIONAL ANALYSIS**	**Int. Marks: 25**
Credit : 5	**Code:P3R1MTCC10**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To understand the definition and fundamental properties of metric spaces, including the ideas of convergence, continuity, completeness, compactness and connectedness*
- *To understand the definition and fundamental properties of Hilbert spaces, and bounded linear maps between them*
- *To generalize the basic concepts of geometry and linear algebra can be generalized to infinite dimensional spaces*
- *To study Banch Algebras.*
- *To study picard's theorem and stone's theorem.*

Unit I : Banach Spaces **(16 Hours)**

The definition and some examples – continuation linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N** – The open mapping theorem – The conjugate of an operator.

Unit II: Hilbert Spaces **(15 Hours)**

The definition and some simples properties – orthogonal complements – orthonormal sets – the conjugate space H* – The adjoint of an operator – self-adjoint operators – normal and unitary operators – projections.

Unit III: Finite Dimensional Spectral Theory **(12 Hours)**

Matrices – Determinants and the spectrum of an operator – The spectral Theorem – A survey of the situation.

Unit IV:General Preliminaries on Banach Algebras **(13 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.

Unit V: The Fixed Point Theorems and Boolean Algebras(Appendices) **(14 Hours)**

Fixed point theorem – Brouwer's fixed point theorem, schauder's fixed point theorem – Picard's theorem – Boolean algebra – Boolean rings – stone's theorem.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Introduction to topology and Modern Analysis " by G.F. simmons , McGraw Hill Education (India) Edition 2004.

Unit I : Chapter 9 Fully (page No. 211-242)
Unit II : Chapter 10 Fully(Page No. 243-277)
Unit III : Chapter 11 Fully(Page No. 278-297)
Unit IV : Chapter 12 Fully (Page No. 301-317)
Unit V : Apendices 1 and 3 (Page No. 337-340 & 344-353)

Reference Books:

[1] "Functional Analysis ",Walter Rudin, TMH Edition 1974.
[2] "Functional Analysis", B.V Linaye, Functional Analysis, Wiley Eastern limited, Bombay, second Edition 1985

Outcomes: The learners would have the ability to

- *Understand the concept of Banach spaces & Hilbert spaces.*
- *Acquire knowledge about Hilbert spaces.*
- *Describe the structure of finite dimensional spectral theory.*
- *Study about Regular, singular elements and the spectrum.*
- *Learn about fixed point theorem, picard's theorem and stone's theorem.*

SEM – III	**M.Sc. MATHEMATICS**	**CORE COURSE:11**
Hours/Week: 6	**COMPLEX ANALYSIS**	**Int. Marks: 25**
Credit : 5	**Code:P3R1MTCC11**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To understand the concepts of Analytical function.*
- *Apply cauchy's integral formula to evaluate complex line integrals.*
- *Expand functions in taylor's and Weirstrass theorems.*
- *Apply the Residue theorem to evaluate real integrals.*
- *To use the two dimension Laplace's equation in Cartesian or polar co-ordinates to determine whether a real valued is harmonic or not.*

Unit I: Complex functions (14 Hours)

Introduction to the concept of Analytical function – Elementary theory of Power series – The exponential and Trigonometric Functions.

Unit II: Fundamental Theorems and Cauchy's Integral Formula (16 Hours)

Line Integrals - Rectifiable Arc's – Line Integrals as Functions of Arcs - Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk – The Index of a point with respect to a closed curve – The Integral Formula –Higher Derivatives.

Unit III: Local Properties of Analytic Functions (12 Hours)

Removable singularities, Taylor's Theorem – Zeros and Poles – Weirstrass Theorem – The Local Mapping-The Maximum Principle – Schwartz Lemma.

Unit IV: General Form of Cauchy's Theorem and the Calculus of Residues (14 Hours)

Chains and Cycles – Simple Connectivity – Locally Exact Differentials-Multiply Connected Regions – The Residue Theorems – The Argument Principle – Evaluation of Definite Integrals.

Unit V: Harmonic Function (14 Hours)

Definition and Basic Properties – Interpretation – The Mean Value Property – Maximum Principle – Poisson's Formula-Schwarz's Theorem – The Reflection Principle.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1]"Complex Analysis", Lars V.Ahlfors, III edition McGraw Hills Education(India) 2013.

Unit I : Chapter 2 – All sections

Unit II : Chapter 4- Sec 1(1.1 to 1.5),Sec2 (2.1 to 2.3)

Unit III : Chapter 4- Sec 3(3.1 to 3.4)

Unit IV : Chapter 4- Sec 4(4.1,4.2,4.6 and 4.7) and Sec 5(5.1 to 5.3)

Unit V : Chapter 4- Sec 6(6.1 to 6.5)

Reference Books:

[1] "Complex Analysis",Sarge Lang, AddisionWeslay, 1977.

[2] "Foundations of Complex Analysis", S.Ponnusamy, ,Narosa Publishing House,New Delhi.

[3] "Complex Analysis", V.Karunakaran,.

Outcomes :

The learners would have the ability to

- *Recognize the concept of Analytical function.*
- *Study cauchy's theorem for a rectangle in a disk.*
- *Use Taylor's theorem and the maximum principle.*
- *Have a deep understanding of Residues to evaluate definite integrals.*
- *Know about Schwarz's theorem and reflection principle.*

SEM – III	**M.Sc. MATHEMATICS**	**CORE COURSE:12**
Hours/Week: 6	**MEASURE THEORYAND INTEGRATION**	**Int. Marks: 25**
Credit : 5	**Code:P3R1MTCC12**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To understand the concept of Measure Theory, Definitions and Main Properties of the Integral.*
- *To construct Lebegsue's Measure on a Real line and in n – dimension Euclidean Space.*
- *To overcome the limitation using more abstract space.*
- *To provide a concise introduction to Measure Theory in the context of Abstract Algebra.*
- *To Focus on the Development of Measure and Integration Theory.*

Unit I : Measure on Real Line **(14 Hours)**

Lebesgue outer measure – Measurable sets – Regularity – Measurable Functions – Borel and Lebesgue Measurability.

Unit II : Integration of Functions of a Real Variable **(14 Hours)**

Integration of non-negative functions – The General Integral - Integration of Series – Riemann and Lebesgue Integrals.

Unit III : Convergence **(14 Hours)**

Meaures and Outer Measures – Extension of a Convergence in Measure – Almost Uniform Convergence – Measure – Uniqueness of the Extension.

Unit IV : Signed Measures and their Derivatives **(14 Hours)**

Hahn Decomposition Theorem – The Jordan Decomposition – The Radon Nikodym Theorem.

Unit V : Measure & Integration in a Product Space **(14 Hours)**

Measurability in a product space – The Product Measure and Fubini's Theorem.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Measure Theory and Integration" by G. De. Barra – New Age International Private Ltd.

Unit I : Chapter 2, Sec 2.1 – 2.5
Unit II : Chapter 3, Sec 3.1 – 3.4
Unit III : Chapter 5, Sec 5.1 – 5.3 and
Chapter 7, Sec 7.1 – 7.2
Unit IV : Chapter 8, Sec 8.1 – 8.3
Unit V : Chapter 10, Sec 10.1 – 10.2

Reference Books:

[1] "An Introduction to Measure and Integration" – Inder, K. Ranna, Narosa Publishing House – New Delhi - 1997.
[2] "Lebesgue Measure and Integration" – P.K.Jain, V.P.Gupta – New Age International Pvt. Ltd – 2000

Outcomes:

The learners would have the ability to

- *Understand basis of measure theory*
- *Study about Riemann and Lebesgue integrals.*
- *Acquire the knowledge of convergence in measure.*
- *Understand the Hahn decomposition theorem & Jordan decomposition theorem.*
- *Learn about measurability and Fubini's theorem.*

SEM – IV	**M.Sc. MATHEMATICS**	**CORE COURSE:13**
Hours/Week: 6	**STOCHASTIC PROCESSES**	**Int. Marks: 25**
Credit : 5	**CODE:P4R1MTCC13**	**Ext. Marks: 75**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To understand the notion of a Markov chain.*
- *To understand how simple ideas of conditional probability can be used to give a thorough and effective account of discrete-time Markov chains.*
- *To apply these ideas to answer basic questions in several applied situations including genetics, branching processes and random walks.*
- *To develop skills in analysing and interpreting the results.*
- *To discuss steady state Transient behaviour of M/M/1 model.*

Unit I: Stochastic Processes (14 Hours)

Introduction – Specification of Stochastic processes – Stationary Processes – stationary – Gaussian processes - Markov Chains – Definitions and Examples – Higher Transition Probabilities – Generalization of Independent Bernoulli trails – Sequence of Chain – Dependent trails.

Unit II : Classification of states and chains (14 Hours)

Communication relations – class property – classification of chains – transient and Persistent (recurrent) states – related theorems - Determination of Higher Transition Probabilities – Stability of a Markov system – Stationary distribution – Theorem and problems.

Unit III : Markov Processes with Discrete State space (14 Hours)

Poisson Process – Postulates for poison process – Theorems and problems – Properties of poisson process – Poisson processes and related distributions – Generalisation of poisson process – Time dependent poisson processes – Birth and death process.

Unit IV: Renewal Processes and Theory (12 Hours)

Renewal Process in discrete time – Relation between F(s) and P(s) - Renewal Processes in continuous time – Renewal equation – Stopping time – Wald's equation – Renewal theorems.

Unit V**: Stochastic Processes in Queuing (16 Hours)**

Queuing systems: General concepts – Queueing processes – steady state distribution – Little's formula – The Queueing model M/M/1: study state behavior – steady state solution – waiting time distributions – Transient behavior of M/M/1 model.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] J.Medhi, "Stochastic Processes", Second edition, 1994 - Wiley Eastern limited, Chennai.

Unit I: Chapter 2 –Sec 2.1to2.3(Pg.No.56-63),
Chapter 3-Sec3.1 and 3.2(Pg no.69-83)

Unit II : Chapter 3 – Sec 3.4 to 3.6 (Page No.88-112)

Unit III : Chapter 4 – Sec 4.1 to 4.4 (Page No.157-192)

Unit IV : Chapter 6 - Sec 6.1 to 6.5.1 (Page No.242-264)

Unit V :Chapter 10 - Sec10.1 to 10.2.2, 10.3.1(Page No.407-417,421-424)

Reference Books:

[1] "A First course in Stochastic Processes**",** Samuel Kolri ,Howard M.Taylor ,2nd Edition.

[2] "Stochastic Processes**"**, Srinivasan and Medha, N.V Prabhu , Macmillan(NY),

Outcomes: The learners would have the ability to

- *Acquire the knowledge of stochastic process, transition probabilities.*
- *Understand transient and persistent state , stability of a Markov system.*
- *Be familiar with Poisson process – Birth and death process.*
- *Know about renewal process and renewal theorem.*
- *Study about Queuing system – M/M/1: steady state behavior.*

SEM – IV **M.Sc. MATHEMATICS** **CORE COURSE:14**
Hours/Week: 6 **OPTIMIZATION TECHNIQUES** **Int. Marks: 25**
Credit : 5 **Code:P4R1MTCC14** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**
Objectives:

- *To describe the need and importance of Operations Research.*
- *To discuss the basic concepts and techniques for solving particular Operations Research problem.*
- *To develop a research proposal using the general approach for Operations Research.*
- *To maximize the utility of limited resources*.
- *To use simulation in investment and budgeting*.

UNIT I: Integer Programming (14 Hours)

Introduction – Pure and Mixed Integer programming problems – Gomory's All – I.P.P. Method – Construction of Gomory's Constraints – Fractional Cut Method – All Integer LPP – Fractional Cut method – Mixed Integer LPP – Branch and Bound method.

UNIT II: Dynamic Programming (13 Hours)

Introduction – The Recursive equation approach – Characteristics of Dynamic programming – Dynamic programming Algorithm – Solution of Discrete D.P.P – Some applications – Solution of LPP by Dynamic programming.

UNIT III: Non-Linear Programming (12 Hours)

Introduction – Graphical Solution – Kuhn-Tucker conditions with non-negative constraints – Quadratic Programming – Wolfe's Modified Simplex Method – Beale's Method – Separable Convex Programming – Separable Programming Algorithm.

UNIT IV: Queueing Theory (15 Hours)

Introduction – Queueing system – Elements of a Queueing system – Operating characteristics of a Queueing system – Deterministic Queueing system – Probability Distributions in Queueing systems – Classifications of Queueing models – Definition of Transient and steady states – Poisson Queueing system.

UNIT V: Simulation (16 Hours)

Introduction – Why Simulation? – Process of Simulation – Simulation models – Event – Type Simulation – Generation of random numbers – Monte – Carlo Simulation – Simulation of Inventory problems – Simulation of a queueing systems – Simulation of maintenance problems – Simulation in Investment and budgeting.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Operations Research", by Kanti Swarup, P.K. Gupta, Manmohan, Sultan Chand & sons, Educational Publishers, New Delhi, 7th Edition – 2014.

Unit: I Chapter 7 sec 7.1 to 7.7
Unit: II Chapter 13 sec 13.1 to 13.7
Unit: III Chapter 28 sec 28.1 to 28.8
Unit: IV Chapter 21 sec 21.1 to 21.9
Unit: V Chapter 22 sec 22.1 to 22.11

Reference Book:

[1] "Operations Research" by Hamdy A. Taha, Prentice Hall of India Private Limited, New Delhi, Sixth Edition – 1998.

Outcomes:

The learners would have the ability to

- *Understand the different methods of I.P.P method and mixed integer LPP.*
- *Acquire knowledge about Dynamic programming.*
- *Study about Kuhn Tucker conditions and Quadratic programming.*
- *Understand the concepts of Queuing system – Poisson Queuing system.*
- *Discuss simulation method and select the suitable technique and the problem.*

SEM – I | **M.Sc. MATHEMATICS** | **ELECTIVE COURSE:1**

Hours/Week:6 | **CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS** | **Int. Marks: 25**

Credit : 3 | **Code: P1R1MTEC1** | **Ext. Marks: 75**

Total Hours: 72 | **Max. Marks: 100**

Objectives:

- *To find the external functions that make the functional attain a maximum or minimum value*
- *To understand boundary value problems involving certain types of differential equation like Lagrange's equations.*
- *To study Green's function and its uses.*
- *To study the influence function.*
- *To use interative method for solving equations of the second kind.*

Unit I: Calculus of Variations **(15 Hours)**

Maxima and Minima - The Simplest Case - Illustrative Examples – Natural boundary conditions and Transition conditions – The Variational notation – The more general case.

Unit II: Applications of Calculus of Variations **(14 Hours)**

Constraints and Lagrange multipliers – Variable end points – Sturm-Liouville problems – Hamilton's principle – Lagrange's equations.

Unit III: Integral Equations **(14 Hours)**

Introduction – Relations between Differential and Integral Equations – The Green's function – Alternative definition of the Green's function.

Unit IV: Linear Equation in Cause and Effect **(13 Hours)**

The influence function – Fredholm equations with seperable kernels – Illustrative examples.

Unit V: Applications of Integral Equations **(14 Hours)**

Hilbert – Schmidt theory – Iterative methods for solving equations of the second kind – The Fredholm theory – Neumann series.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Methods of Applied Mathematics" – Francis B.Hilderbrand , second edition – Prentice - Hall of India pvt, New Delhi, 1968.

Unit – I: Chapter 2, Sec: 2.1 – 2.6
Unit – II: Chapter 2, Sec: 2.7 – 2.11
Unit – III: Chapter 3, Sec: 3.1 – 3.4
Unit – IV: Chapter 3, Sec: 3.5 – 3.7
Unit – V: Chapter 3, Sec: 3.8 – 3.10

Reference Book:

[1] "Linear integral Equations, Theory and Techniques" – R.P.Kanwal, Academic press, New York, 1971.

Outcomes :

The learners would have the ability to

- *Acquire the knowledge of natural boundary conditions and transition condition.*
- *Understand and apply the application of calculus of variations, using Hamilton's principle.*
- *Know about the applications of Green's function to solve the integral equations.*
- *Study Fredholm equations with seperable kernels.*
- *Apply iterative methods for solving equations of the second kind, using Fredholm theory.*

SEM – I **M.Sc. MATHEMATICS** **ELECTIVE COURSE:1**
Hours/Week: 6 **ADVANCED NUMBER THEORY** **Int. Marks: 25**
Credit : 3 **Code: P1R1MTEC1** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**
Objectives:

- *To prove results involving divisibility and greatest common divisors.*
- *To apply Euler – Fermat's Theorem to prove relations involving prime numbers*.
- *To apply primitive roots for primes – composite numbers.*
- *To study perfect and Amicable numbers.*
- *To find the use a Fibonacci sequence in pell's equations*.

UNIT I: Number Theoretic Functions **(14 Hours)**

The sum and number of divisors-The Mobius Inversion formula – The Greatest Integer Function – An Application to the calender.

UNIT II: Euler's Generalization of Fermat's Theorem **(14 Hours)**

Leonhard Euler – Euler's Phi-Function – Euler's Theorem – Some properties of the Phi-Function.

UNIT III: Primitive Roots and Indices **(14 Hours)**

The order of an Integer Modulo n – Primitive Roots for primes – composite Numbers having primitive Roots – The Theory of Indices.

UNIT IV: Number of Special Form **(13 Hours)**

Marin Mersenne – Perfect Numbers – Mersenne Primes and Amicable Numbers – Fermat Numbers.

UNIT V: Fibonacci Number and Continued Fraction **(15 Hours)**

Fibonacci – The Fibonacci Sequence – Certain Identities – Involving Fibonacci Numbers - Srinivasa Ramanujan – Finite Continued Fractions – Infinite continued Fractions – Farey Fractions – Pell's Equation.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Elementary Number Theory" by David M. Burton, Tata McGraw – Hill Edition. 2012.
UNIT I: Chapter 6
UNIT II: Chapter 7
UNIT III: Chapter 8
UNIT IV: Chapter 11
UNIT V: Chapter 14 and 15

Reference Books:

[1] "Basic Number Theory" by S.B. Malik, Second Revised Edition 1998.
[2] "Number Theory" by Hari Krishnan, Twelfth Edition- 2017.

Outcomes:
The learners would have the ability to

- *To study the Mobius Inverssion formula.*
- *Acquire the knowledge of phi – function.*
- *Learn about primitive roots and indices.*
- *Acquire the knowledge of number of special form.*
- *Demonstrate an in – depth understanding of Fibonacci sequences and Srinivasa Ramanujan finite continued frsactipons.*

SEM – I	**M.Sc. MATHEMATICS**	**ELECTIVE COURSE:1**
Hrs/Week: 6	**FUZZY MATHEMATICS AND ITS APPLICATION**	**Int.Marks: 25**
Credit : 3	**Code: P1R1MTEC1**	**Ext.Marks: 75**
Total Hrs: 72		**Max.Marks:100**

Objectives:

- *To provide the knowledge of operations on fuzzy sets.*
- *To introduce the mathematical field on the concept of a fuzzy numbers.*
- *To enable the students to develop fuzzy relations.*
- *To use direct methods with one expert and multiple experts.*
- *To know the applications of fuzzy methodology.*

UNIT I: Operations on Fuzzy Sets (14 Hours)

Fuzzy Intersections: t-norms – Fuzzy Unions: t-conorms – Combinations of Operations – Aggregate Operations.

UNIT II: Fuzzy Arithmetic (14 Hours)

Fuzzy Numbers – Linguistic Variables – Arithmetic Operations on Intervals – Arithmetic Operations on Fuzzy Numbers – Lattice of Fuzzy Numbers – Fuzzy Equations.

UNIT III: Fuzzy Relations (14 Hours)

Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Ordering Relations – Fuzzy Morphisms – sup-i Compositions of Fuzzy Relations – Inf-ω_I Compositions of Fuzzy Relations.

UNIT IV: Constructing Fuzzy Sets and Operations on Fuzzy Sets (15 Hours)

General Discussion – Methods of Construction: An Overview – Direct Methods with One Expert – Direct Methods with Multiple Experts – Indirect Methods with one Expert – Indirect Methods with Multiple Experts - Constructions from Sample Data.

UNIT V: Applications (13 Hours)

Introduction – Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Fuzzy sets and Fuzzy logic", George J.Klir and Bo Yuan, Prentice Hall of India, New Delhi, 1995.

UNIT I : Chapter 3 (Section 3.3 – 3.6)
UNIT II : Chapter 4 Fully
UNIT III : Chapter 5 (Section 5.5 – 5.10)
UNIT IV : Chapter 10 Fully
UNIT V : Chapter 17 Fully

Reference Books:

[1] 'Fuzzy set theory and its applications', Second Edition – H.J.Zimmerman 2013.
[2]'Fuzzy Logic with Engineering Applications' Timothy J. Ross, McGraw Hill International Editions-1997.

Outcomes:

The learners would have the ability to

- *Discuss the types of operations on fuzzy sets, t- norms and fuzzy arithmetic.*
- *Study knowledge of fuzzy equivalnce relations.*
- *Identify fuzzy relations, binary fuzzy relations and fuzzy equivalence relations.*
- *Gain the knowledge of condtructing fuzzy sets and operations on fuzzy sets.*
- *Apply the fuzzy models to natural science and technical fields.*

SEM – II **M.Sc. MATHEMATICS** **ELECTIVE COURSE:2**
Hours/Week: 6 **NUMERICAL ANALYSIS** **Int. Marks: 25**
Credit : 3 **Code:P2R1MTEC2** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**
Objectives:

- *To understand the concept of transcendental and polynomial equations.*
- *To know the eigen values and eigen vectors and matrices.*
- *To know the techniques of Numerical Differentiation and Numerical Integration.*
- *To know how to use iterative methods to solve systems of linear equations.*
- *To develop skills in using shooting method and finite elements methods.*

Unit I: Transcendental and Polynomial Equations (14 Hours)

Iteration Methods Based on Second degree equation - Rate of convergence - General Iteration Methods-System of non-linear equations - Methods for Complex Roots-Polynomial equations.

Unit II: Eigen Values and Eigen Vectors (16Hours)

Eigen values and Eigen vectors-Jacobi Method for Symmetric Matrices - Givens Method for Symmetric Matrices – Householder's method for symmetric matrices - Rutishauser Method for Arbitrary Matrices - Power Method - Inverse Power Method.

Unit III: Interpolation and Approximation (14 Hours)

Interpolating Polynomials using Finite Differences - Hermite Interpolations - Piecewise and Spline Interpolation - Bivariate Interpolation-Approximation- Least Square Approximation.

Unit IV:Differentiation and Integration (14 Hours)

Numerical Differentiation - Optimum Choice of Step-Length-Extrapolation methods-Numerical Integration - Methods based on interpolation - Methods based on undetermined coefficients- Composite Integration Methods-Romberg Integration.

Unit V: ODE - Boundary Valve Problems:- (12Hours)

Introduction – Initial Value Problem - Shooting Method - Finite Difference Methods – Finite Element Methods.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "NumericalMethods Scientific and Engineering Computation", sixth edition by M.K.Jain, Iyengar and R.K.Jain, New Age International (P) Ltd. Reprint- 2012.

Unit I : Chapter 2 Sec 2.4 to 2.9 (page No. 29-99)
Unit II : Chapter 3 Sec 3.5 to 3.12 except 3.6 (Page No. 170-173 & 179-200)
Unit III : Chapter 4 Sec 4.4 to 4.9 (Page No. 235-301)
Unit IV : Chapter 5 Sec 5.2 to 5.4 and 5.6 to 5.10 (Page No. 320-342)
Unit V : Chapter 7 Sec 7.1 to 7.4 (Page No. 550-630)

Reference Books:

[1] S.S.Sastry, "Introduction methods of Numerical Analysis**"**, Prentice Hall of India, New Delhi,(1998).

[2] R.L.Burden and J.DouglasFairis, **"**Numerical Analysis**"**, P.W.S.Kent Publishing company, Bostan(1989), Fourth Edition.

Outcomes:

The learners would have the ability to

- *Understand the fundamentals of solutions of Algebraic and transcendental equations.*
- *Understand howuse Householder's method, power method.*
- *Acquire knowledge to use hermite interpolation and least square approximation.*
- *B familiar with interp[olation and extrapolation method.*
- *Use shooting method, to solve initial value problem.*

SEM – II **M.Sc. MATHEMATICS** **ELECTIVE COURSE:2**
Hours/Week: 6 **AUTOMATA THEORY** **Int. Marks: 25**
Credit : 3 **Code:P2R1MTEC2** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**
Objectives:

- *To construct finite state machines and the equivalent regular expressions.*
- *To provide the equivalence of languages described by finite state machines and regular expressions.*
- *To construct pushdown automata and the equivalent content tree grammars.*
- *To construct model for regular languages*
- *To study finite automata and regular expressions.*

Unit I: Mathematical Background and Languages **(14 Hours)**

Sets – Relations – Graphs – proofs – Formalization of languages – Expressions and grammars: Expressions – grammars.

Unit II: Automata **(12Hours)**

Conceptualization of automata – Transducers – computability – Exercise.

Unit III: Regular Languages **(16Hours)**

Regular Expressions – Finite Automata: Basic Definitions – Elimination of $\in$-moves.

Unit IV: Models for Regular Languages **(14Hours)**

Determinism – simplification- Minimization.

Unit V: Finite Automata and regular expressions **(14Hours)**

From regular expressions to finite automata: Conversion of regular expressions to finite automata – Scanning.

Unit –VI: **(02Hours)**

Latest development related to the course during the semester concerned[For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Automata and Languages – Theory and Applications", Alexander Meduna, Springer international Edition, 2005.

Unit I : Part I sec 0.1 to 0.4 and Chapter 1 sec 1.1, 1.2: 1.2.1 and 1.2.2 only
Unit II : Chapter 2 sec 2.1 to 2.3
Unit III : Chapter 3 sec 3.1, 3.2: 3.2.1 and 3.2.2 only
Unit IV : Chapter 3 sec 3.2: 3.2.3 to 3.2.5
Unit V : Chapter 3 sec 3.3: 3.3.1 – 3.3.1.1 and 3.3.1.2

Reference Book:

[1] "Introduction to Automata Theory, Languages and Computation", John E. Hopcroft, Rajeev Motwani and Jeffrey D. Uiiman, Pearson publications, 3rd Edition.

Outcomes:

The learners would have the ability to

- *Apply Automata concepts and techniques in designing systems that address real world problems.*
- *Understand the connection between language and computation.*
- *Analyze the computational strengths and weakness of these machines.*
- *Demonstrate an in-depth understanding of theories, concepts and techniques in automata and their link to computation.*
- *The conversion opf regular expression to finite automata – scanning.*

SEM – II **M.Sc. MATHEMATICS** **ELECTIVE COURSE:2**
Hours/Week: 6 **COMBINATORIAL MATHEMATICS** **Int. Marks: 25**
Credit : 3 **CODE:P2R1MTEC2** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**
Objectives:

- *To learn core ideas in combinatorial mathematics.*
- *To learn about countable sets combinations.*
- *To become familiar with fundamental combinatorial structures.*
- *To be familiar with convolution and couting technique.*
- *To find n^{th} order relations.*

Unit I: Principles of Counting – I **(13Hours)**

The Rules of sum and product- The sum Rule, The product rule- Permutations- Combinations- Binomial and Multinomial Theorems- Combinations with Repetitions.

Unit II: Principle of Counting - II **(15 Hours)**

Catalan Numbers, Problem of Catalan Numbers - Ramsey Numbers; Introduction , theorem on Ramsey Number with Examples- Strilling Numbers; Introduction- Strilling Numbers of First kind and second kind- Bell Numbers.

Unit III: Principles of Counting - III **(13 Hours)**

The Pigeonhole principle; Generalization theorem –Principle of inclusion- Exclusion: Principle of inclusion for n sets; Generalization theorem- Problems.

Unit IV: Generating Functions **(15 Hours)**

Ordinary generation function; Generating functions, Properties and Problems of ordinary generating function- Convolution of sequences-summation using convolution, problems of convolution of sequences- A counting Technique: Problems of a counting Technique- Partitions of integer.

Unit V: Recurrence Relations **(14Hours)**

First- order Relations: Problems of first order Relations- Second –order linear Homogeneous Relations - Problems of Second-order Linear Homogenous Relations - Third and higher-order Linear Homogeneous Relations and Problems.

Unit –VI: **(02Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Books:

[1] "Graph Theory and Combinatorics" by Dr.D.S.Chandrasekharaiah – Bangalore prism books, 2005.

Unit I: Chapter 5 – sec 5.1,5.2,5.3(5.3.1,5.3.2)
Unit II: Chapter 5– sec 5.4-5.6
Unit III: Chapter 6 – sec 6.1,6.2
Unit IV: Chapter 7 – sec 7.1(7.1.1,7.1.2,7.1.3)
Unit V: Chapter 8 – sec 8.1-8.3

Reference Books:

[1] "Graph Theory " – Harray . F – Addison - Wesley - 1969.
[2]"Graph Theory with Applications to Engineering and Computer" – NarasingaDeo – Prientice Hall of India Pvt. Ltd. – New Delhi - 2000.

Outcomes :

The learners would have the ability to

- *Understand the ideas of Combinatorics.*
- *Study Ramsey numbers and strilling numbers.*
- *Study about pigeonhole principle.*
- *Auquire the knowledge generating function and counting technique.*
- *Use recurrence relations to solve problems of first, second and higher order linear homogeneous relations.*

SEM – III **M.Sc. MATHEMATICS** **ELECTIVE COURSE:3**
Hours/Week: 6 **APPLIED MATHEMATICAL STATISTICS** **Int. Marks: 25**
Credit : 3 **Code:P3R1MTEC3** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To Compute and interpret a correlation coefficient and linear regression analysis*
- *To understand the relationship between point estimate and interval estimation*
- *To understand the purpose of analysis of variance*
- *To compute analysis data generated by functional experiments by using analysis of variance.*
- *To study statistical analysis with 2^n Factorial experiment.*

Unit I: Correlation and Regression **(14 Hours)**

Multiple and partial correlation – Yule's Notation – Plane of Regression – Generalization – Properties of residuals – Coefficient of multiple correlation – Properties of multiple correlation-coefficient of partial correlation.

Unit II: Theory of Estimation **(14 Hours)**

Method of estimation – Method of maximum likelihood Estimation - Method of minimum variance – Method of moments – Confidence intervals and confidence limits – confidence intervals of large sample.

Unit III: Non-Parametric Methods **(16 Hours)**

Introductions - Advantages and Drawbacks of Non-parametric methods over parametric methods – Basic distribution – Wald - Wolfowitz Run test – test for randomness – median test – sign test – Mann-Whitney – Wilcoxon U Test.(Related simple problems)

Unit IV: Analysis of Variance **(12Hours)**

Introduction – One way classification – Statistical Analysis of the model – Two Way classification – Statistical Analysis of the Model – Analysis of Two-Way classified data with K-Observation per cell.(Related simple problems)

Unit V: Factorial Experiments **(14 Hours)**

Factorial experiments – 2^2-Design – Statistical Analysis of 2^2 design – Yate's Method of Computing factorial effect totals - 2^3 Factorial Experiment – Statistical Analysis - 2^n Factorial experiment.(Related simple problems).

Unit –VI: **(02Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Books:

[1] " Fundamentals of Mathematical Statistics" by S.C Gupta and V.K Kapoor. Sultan Chand & Sons, New Delhi (2002).

[2]"Fundamentals of Applied Statistics" by S.C. Gupta and V.K. Kapoor. Sultan Chand & Sons, New Delhi (2007).

Unit I : Chapter : 12sec:12.4 to 12.11 [1]
Unit II : Chapter: 17 sec: 17.6 to 17.7.1 [1]
Unit III: Chapter:18 sec: 18.7 to 18.7.7 [1]
Unit IV: Chapter: 5 sec: 5.1 to 5.4[2]
Unit V: Chapter: 6 sec: 6.8 – 6.8.4 [2]

Reference Books:

[1] "Statistics for Management "K.Subramani and A. Santha, Scitech Publications Pvt. Ltd., 2nd Edition.

[2] "Mathematical Statistics" J. N. Kapur, H .C. Saxena, Chand and Co. Publication Ltd.

Outcomes:

The learners would have the ability to

- *Acquire the knowledge of multiple and partial correlation.*
- *Acquire knowledge on Theory of Estimation and methods of estimating a parameter through sampling and test their Goodness.*
- *Study the advantages and drawbacks of Non – parametric method and test for randomness.*
- *Know about analysis of one way and two way classifications.*
- *Understand the concept of Factorial experiment – 2^2, 2^3, 2^n.*

SEM – III **M.Sc. MATHEMATICS** **ELECTIVE COURSE:3**
Hours/Week: 6 **ADVANCED GRAPH THEORY** **Int. Marks: 25**
Credit : 3 **CODE:P3R1MTEC3** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To understand some applications of Graph Theory to Practical Problems and Branches of Mathematics.*
- *To practice creative problem solving and improve skills in this area.*
- *To see the simplicity of Graph Theory and combinactorics at make them ubiquitous.*
- *To make Graph Theory easier and to be creative in Research fields .*
- *To study domination in graphs.*

Unit I :Matchings **(14 Hours)**

Matchings – Definitions – examples - Matchings and Coverings in Bipartite Graphs – Perfect Matchings.

Unit II : Edge Colourings, Independent Sets and Cliques **(14 Hours)**

Edge Chromatic Number – Vizing's Theorem – Independent sets – Ramsey's Theorem.

Unit III : Vertex Colourings **(13Hours)**

Chromatic Number – Brook's Theorem – Hajo's Conjecture – Chromatic Polynomials.

Unit IV : Planar Graphs **(15 Hours)**

Plane and Planar Grpahs – Dual Graphs – Euler's Formulae – Bridges – Kuratowski's Theorem – The Five - Colour Theorem – The Four - Colour conjuncture.

Unit V : Domination in Graphs **(14 Hours)**

Dominating sets in Graphs – Sets of Representatives - Applications of Domination Numbers.

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Graph Theory with Applications" – J.A. Bondy –U.S.R Murty – The Macmillan Press Ltd.

[2] "Fundamentals of Domination in Graphs", T.W.Haynes, S.Hedetniemi and P. J. Slater, 1998, CRC Press.

Unit – I: Chapter 5, Sec: 5.1 – 5.3 [1]
Unit – II: Chapter 6, Sec: 6.1 – 6.2 and Chapter 7, Sec: 7.1 – 7.2[1]
Unit – III: Chapter 8, Sec: 8.1 – 8.4[1]
Unit – IV: Chapter 9, Sec: 9.1 – 9.6 [1]
Unit – V: Chapter 1, Sec: 1.1 – 1.13 [2]

Reference Books:

[1] "Graph Theory" – Harray. F – Addison - Wesley - 1969.

[2] "Graph Theory with Applications to Engineering and Computer" – Narasingh Deo – Prientice Hall of India Pvt. Ltd. – New Delhi - 2000.

Outcomes :**The learners would have the ability to**

- *Understand matching and coverings*
- *Acquire the knowledge of edge coloring and Ramsey's Theorem.*
- *Know about chromatic number and chromatic polynomials*
- *Characterize planar graphs and solve problems related to trees.*
- *Have a deep knowledge of Doinating and its applications.*

SEM – III **M.Sc. MATHEMATICS** **ELECTIVE COURSE:3**
Hours/Week: 6 **INTEGRALS OF SPECIAL FUNCTIONS** **Int. Marks: 25**
Credit : 3 **Code:P3R1MTEC3** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To study about classical polynomials, special functions and their properties*
- *To learn the* Orthogonal Properties of $T_n(x)$ and $U_n(x)$.
- *To study Rodriques formula*
- *To study Elliptic function*
- *To study Orthogonalsets of function*

Unit I: Hermite polynomials (14 Hours)

Introduction - Solution of Hermite's differential equation - Hermite polynomials - Generating functions - value of H_n (x) and its derivative at x=0 - Rodrigues formula for $H_n(x)$ - Other form of Hermite polynomials - First few Hermite Polynomials – Recurrence Relations for $H_n(x)$ - Hermite's differential equation.

Unit II: Laguerre polynomials and Chebyshev Polynomials (15 Hours)

Introduction – solution of Laguerre's Differential Equation – Generating Function – Rodrigue's Formula – Recurrence Relations – Laguerre Polynomials for Particular Value of n and x – Differential Equation of $L_n(x)$ – Orthogonal Property of $L_n(x)$– Other Integral Relation – Independent solution of Chebyshev's Equation – Expansion of $T_n(x)$ and $U_n(x)$ – Generating Functions – Recurrence Relations – To determine$T_n(x)$ and $U_n(x)$ for given value of n – Orthogonal Properties of $T_n(x)$ and $U_n(x)$.

Unit III: Jacobi Polynomials (14 Hours)

Introduction – Generating Function – Rodrigues Formula – Orthogonal Properties - Some implications of orthogonality – Recurrence Relations - Relations in which Shift of n is involved - Relations in which Shifts in α, β and n are involved – Expansions – More Generating Relations – Some properties of Tchebycheff Polynomials.

Unit IV: Elliptic Functions (13 Hours)

Introduction – Weistrass' Elliptic Function $P(z)$– Differential Equation Satisfied by $P(z)$ – Jacobian Theta Function – Zeros of Theta Functions – Some Important Relations – Differential Equation Satisfied by Theta Functions – Jacobian Elliptic Function $S_n(u)$ – Jacobian Elliptic Functions $c_n(u)$ and $d_n(u)$.

Unit V: Orthogonal sets of Functions (14 Hours)

Introduction – Definitions – Orthogonal set of Functions – Gram-Schmidt Process of Orthogonalization – Orthogonality with respect to Weight Function - Orthogonal set of functions with respect to weight function - Orthonormal set of functions with respect to weight function – Complete Set – Generalised Fourier Series and Fourier constants (Application of Orthogonality) – Strum-Lioville Problem – Eigen (or Characteristic) Functions – Properties of Eigen Functions and Eigen Values.

Unit –VI: (02 Hours)

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text book:

[1] **"**Special Functions**"**- Saran, Sharma, Trivedi – PragatiPrakashan Educational Publishers.
Unit I: Chapter 7 – sec 7.1,7.2
Unit II: Chapter 8 – sec 8.1-8.9 & Chapter 9 – sec 9.1-9.7
Unit III: Chapter 10 – sec 10.1-10.8
Unit IV: Chapter 11 – sec 11.1-11.9
Unit V: Chapter 12 – sec 12.1-12.10

Reference books:

[1] "Special Functions and their Applications" – R. Simmon, Dover books.

Outcomes: The learners would have the ability to

- *Be familiar with Hermite polunomials and Hermite differential equations*
- *Study about Laguerre polynomials and Chebyshev polynomials*
- *Acquire knowledge of Rodrigues formula – Recurrence relations and Propertties of Tchbycheff polynomials*
- *Have adeep knowledge of Elliptic Functions and Jacobian elliptic functions*
- *Know about orthonality with respect ot Weight functiona dn Storm- Liovillle's pr*

SEM – IV	**M.Sc. MATHEMATICS**	**ELECTIVE COURSE:4**
Hours/Week: 6	**ADVANCED MATLAB**	**Int. Marks: 40**
Credit : 3	**Code:P4R1MTEC4**	**Ext. Marks: 60**
Total Hours: 72		**Max. Marks: 100**

Objectives:

- *To apply Computer theory and algorithmic aspects in various situations.*
- *To design and debug the programs.*
- *To develop program skills independently themselves.*

LIST OF PRACTICALS

1. MATLAB program involving matrix manipulation.

   Sec: 3.7 - 3.10.3 [1], Page: 48 – 68
2. MATLAB program to find Eigen Values and Eigen Vectors

   Sec: 8.1 [2], Page: 371 – 373
3. MATLAB program to solve a system of linear equations using matrix method.

   Sec: 2.3 [2], Page: 92
4. MATLAB program to solve polynomial equation.

   Sec: 4.1 – 4.11 [1], Page: 81 – 89.
5. MATLAB program to draw two-dimensional plots.

   Sec: 6.1 and 6.2[1], Page: 120 – 129.
6. MATLAB program to draw multiple plots.

   Sec: 6.3[1] Page: 129 – 131
7. MATLAB program to draw style options, legend command and sub plots.

   Sec: 6.4 – 6.6, Page: 132 – 135
8. MATLAB program to draw Three Dimensional plots.

   Sec: 6.8.1 – 6.8.8, Page: 146 – 151
9. MATLAB program to solve constrained optimization.

   Sec: 7.3.2[2], Page: 352 – 355
10. MATLAB program to solve Graphical LPP.

    Sec: 7.3.3[2], Page: 355 – 357
11. MATLAB program to solve Laplace Transform and Inverse Laplace Transform.

    Sec: 11.2[1] Page: 265 – 266
12. MATLAB program to solve partial Fractions expansion.

    Sec: 11.4[1], Page: 267 – 269
13. MATLAB program to solve transfer function representation

    Sec: 11.5[1], Page: 270 – 271
14. MATLAB program to solve Zeros, Poles and Pole – Zero map of a transfer function

    Sec: 11.6[1], Page: 272

Unit –VI:

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

TEXT BOOKS:

[1] **"**MATLAB and Its Applications in Engineering**"** By Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma - Dorling Kindersely (India) Pvt. Ltd.,

[2] **"**Applied Numerical Methods using MATLAB**"** By Won Young Yang, Wenwu Cao, Tae – Sang Chung, John Morris, A John Wiley and sons Inc Publications

Outcomes:

The learners would have the ability to

- *Express programming and simulation for engineering problems.*
- *Find importance of this software for lab experimentation.*
- *Perform and evaluate the relational and logical operations.*

SEM – IV **M.Sc. MATHEMATICS** **ELECTIVE COURSE:4**
Hours/Week: 6 **GRAPH ALGORITHMS** **Int. Marks: 25**
Credit : 3 **CODE:P4R1MTEC4** **Ext. Marks: 75**
Total Hours: 72 **Max. Marks: 100**

Objectives:

- *To identify a connected graph that is a spanning tree.*
- *To identify whether a graph has a Hamiltonian circuit or path, Eulerian circuit.*
- *To find a shortest path spanning tree in a graph or digraph.*
- *To find the components of a graph and the strongly connected components of a digraph.*
- *To study Hamiltonian algorithm for Maximun matching*

UNIT I: An Introduction to Graphs **(15 Hours)**

Definitions and basic concepts – Distance, Radius, Diameter and Girth – Sub graphs and Isometric sub graphs – Operations on Graphs – The Adjacency, Incidence and Path matrices – Algorithms: Introduction to Algorithms – Breadth-first search Algorithm – Dijkstra's Algorithm – Ford's Algorithm

UNIT II: Graphic Sequences **(14 Hours)**

Degree sequences – Graphic sequences – Wang and Kleitman's Theorem – Algorithms: Algorithm 1 – Algorithm 2

UNIT III: Eulerian Graphs **(12 Hours)**

Characterisations of Eulerian Graphs – Degree sets – Randomly Eulerian Graphs – Application – Algorithm – Fleury's Algorithm

UNIT IV: Hamiltonian Graphs **(15 Hours)**

Hamiltonian Graphs – Hamilton Cycle in Power Graphs and Line Graphs – Hamiltonian sequences – Application – Algorithms: Two Optimal Algorithm – The Closest Iteration Algorithm – Albertson's Algorithm – Related parameters

UNIT V: Matchings **(14 Hours)**

Matching – System of Distinct Representatives and marriage problem – Covering -1-Factor – Stable Machings – Application – Algorithm: The Hungarian Algorithm – Algorithm for Maximum matching

Unit –VI: **(02 Hours)**

Latest development related to the course during the semester concerned. [For purpose of Continuous Internal Assessment only]

Text Book:

[1] "Topics in Graph Theory and Algorithms", Dr. M. Murugan, First Edition, Muthali Publishing House.

Unit I: Chapter 1: Sections 1.1, 1.8 to 1.12
Unit II: Chapter 2: Sections 4.1 to 4.4
Unit III: Chapter 5: Sections 5.1 to 5.5
Unit IV: Chapter 5: Sections 5.7 to 5.12
Unit V: Chapter 6: Sections 6.1 to 6.7

Reference Books:

1) "Graph Theory", Suresh Singh. G, - 2013, New Delhi, PHI Learning Pvt., Ltd.
2) "Graph and Combinatorics", Chandrasehaariah. D.S – 2005, Bangalore Prism Books.

Outcomes:

The students will be able to

- *Understand some applications of graph theory to practical problems and other branches of Mathematics.*
- *Learn about how graph theory and combinatorics developed via a creative organic historical process.*
- *Use Kruskal's algorithm to form a spanning tree and a minimum cost spanning tree.*