MASTER OF SCIENCE - MATHEMATICS

REGULATIONS

ELIGIBILITY

A candidate who has passed the Degree Examination in B.Sc. (Mathematics) or

B.Sc (Mathematics with Computer Applications) of Bharathiar University and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **Master of Science – Mathematics Degree Examination** of this College after a course of study of two academic years.

OBJECTIVE OF THE COURSE

- To meet the demand for well trained Post Graduates in Mathematics students with Academic excellence.
- To demonstrate an understanding of the theoretical concepts and axiomatic underpinnings of mathematics and an ability to construct proofs at the appropriate level.
- To demonstrate competency in mathematical modeling of complex phenomena, problem solving and decision making.
- To demonstrate a level of proficiency in quantitative and computing skills sufficient to meet the growing demands of society upon modern education.

SCHEME OF EXAMINATION

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
15PMA13A	CORE- I: Algebra	7	3	25	75	100	4
15PMA13B	CORE- II: Real Analysis	7	3	25	75	100	4
15PMA13C	CORE- III: Ordinary Differential Equations	6	3	25	75	100	4
15PMA13D	CORE- IV: Numerical Methods	6	3	25	75	100	4
	ELECTIVE -I	4	3	25	75	100	4
		30				**500**	**20**
Second Semester							
15PMA23A	CORE -V :Complex Analysis	6	3	25	75	100	4
15PMA23B	CORE- VI: Partial Differential Equations	7	3	25	75	100	4
15PMA23C	CORE –VII: Mechanics	6	3	25	75	100	4
15PMA23D	CORE- VIII: Introduction to Mathematical Software	4	3	25	75	100	4
15PMA23P	CORE LAB- I: Introduction to Mathematical Software	3	3	20	30	50	2
	ELECTIVE- II	4	3	25	75	100	4
		30				**550**	**22**
Third Semester							
15PMA33A	CORE- IX: Topology	7	3	25	75	100	4
15PMA33B	CORE- X: Fluid Dynamics	7	3	25	75	100	4
15PMA33C	CORE- XI: Mathematical Statistics	6	3	25	75	100	4

BoS Chairman/HoD
Department of Mathematics
Dr. N. G. P. Arts and Science College
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15PMA33D	CORE- XII: Operations Research	6	3	25	75	100	4
	ELECTIVE- III	4	3	25	75	100	4
		30				**500**	**20**
Fourth Semester							
15PMA43A	CORE –XIII: Functional Analysis	6	3	25	75	100	4
15PMA43B	CORE- XIV: Mathematical Methods	6	3	25	75	100	4
15PMA43C	CORE –XV: Graph theory	6	3	25	75	100	4
15PMA43D	CORE- XVI: Computer Programming in C++	4	3	25	75	100	4
15PMA43P	CORE LAB –II: Computer Programming in C++	2	3	20	30	50	2
15PMA43V	Project Work	2	3	60	90	150	6
	ELECTIVE- IV	4	3	25	75	100	4
		30				**700**	**28**
	TOTAL					**2250**	**90**

ELECTIVE – I

(Student shall select any one of the following subject as Elective in first semester)

S.No	Subject Code	Name of the Subject
1	15PMA1EA	Discrete Mathematics
2	15PMA1EB	Differential Geometry
3	15PMA1EC	Fuzzy Logic and Fuzzy Sets

ELECTIVE - II

(Student shall select any one of the following subject as Elective in second semester)

S.No	Subject Code	Name of the Subject
1.	15PMA2EA	Linear Algebra
2.	15PMA2EB	Mathematical Modeling
3.	15PMA2EC	Integral Equations and Integral Transforms

ELECTIVE - III

(Student shall select any one of the following subject as Elective in third semester)

S.No	Subject Code	Name of the Subject
1.	15PMA3EA	Number Theory
2.	15PMA3EB	Magneto Hydro Dynamics
3.	15PMA3EC	Stochastic Differential Equations

ELECTIVE - IV

(Student shall select any one of the following subject as Elective in fourth semester)

S.No	Subject Code	Name of the Subject
1.	15PMA4EA	Control Theory
2.	15PMA4EB	Neural Networks
3.	15PMA4EC	Cryptography

Total Credit Distribution

Subjects	Credits	Total		Credits	Cumulative Total
Core	4	16 x 100 =	1600	64	74
Core Lab	2	2 x 50 =	100	04	
Project	6	1 x 150 =	150	06	
Elective	4	4 x 100 =	400	16	**16**
Total			**2250**	90	**90**

FOR COURSE COMPLETION

Students has to Complete the following Subjects:

- Core papers in I, II, III and IV Semesters.
- Elective papers in the I, II , III and IV Semesters.
- Core practical's in II and IV Semesters.
- Project and Viva - Voce in IV Semester.

15PMA13A	CORE- I: ALGEBRA	SEMESTER - I

Total Credits: 4
Hours Per Week: 7

OBJECTIVES:

1. To introduce to the students the general concepts in Abstract Algebra.
2. To give a foundation in various algebraic structures

CONTENTS

UNIT-I

Group Theory**:** Another counting principle – Cauchy Theorem - Sylow's theorem – First, second and third proof of Sylow's theorem - Second part of Sylow's Therorm - Direct products- internal direct product.

UNIT-II

Ring Theory**:** Euclidean rings – A particular Euclidean ring – Fermat theorem - Polynomial rings –The Division Algorithm – Polynomials over the rational field – The Eisenstein Criterion Theorem.

UNIT-III

Fields: Extension Fields – Roots of polynomials –Remainder Theorem- More about roots- the derivative of f(x).

UNIT-IV

Fields: The Elements of Galois theory –fixed field- normal extension- galois group – Some theorems – Selected Topics: Finite Fields.

UNIT-V

Linear Transformations: Canonical forms: Triangular form – Trace and Transpose – Jacobson Lemma - Hermitian, unitary and normal Transformations.

TEXT BOOKS:

1. *Herstein, I.N.2002.* **Topics in Algebra** (II Edition)**.** Narosa Publishing House, New Delhi.
2. *Artin, M.*1991.**Algebra**. Prentice-Hall. Englewood Cliff.

REFERENCE BOOKS:

1. *Fraleigh, J.B.* 1988. **A First Course in Abstract Algebra.** Narosa Publishing House, New Delhi.
2. *Hungerfor, T.W.* 1974. **Algebra.** Springer.New York.

15PMA13B	CORE- II: REAL ANALYSIS	SEMESTER - I

Total Credits: 4
Hours Per Week: 7

OBJECTIVES:

1. To give a systematic study of Riemann Stieltjes Integral and the calculus on R^n .
2. A brief study of convergence of sequences and series, Power series, Fouries series and polynomials.

CONTENTS

UNIT - I

RIEMANN STILTJES INTEGRAL: Definition and Existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued function – rectifiable curves.

UNIT - II

Uniform convergence and continuity – uniform convergence and integration – uniform convergence and differentiation – equicontinuous families of functions – The Stone Weirstrass theorem

UNIT - III

FUNCTIONS OF SEVERAL VARIABLES: Linear transformation – Vector Space – Basis - Dimension – Linear Operators – Invertible – Linear Combination – Spans- contraction principle – Inverse function theorem – Implicit function theorem.

UNIT – IV

LEBESGUE MEASURE: Countably Additive measure- Outer measure – Measurable sets and Lebesgue measure – almost everywhere – Characteristic functions – Simple functions - Measurable functions – Littlewood's Theorem

UNIT - V

LEBESGUE INTEGRAL: The Lebesgue integral of bounded functions over a set of finite measure – integral of a non – negative function – General Lebesgue Integral – convergence in measure

TEXT BOOKS:

1. *Rudin,W.* **Principles of Mathematical Analysis**. 1976. McGraw Hill, New York.
2. *Roydon, H.L.* **Real Analysis** .2005.Third Edition. Prentice Hall of India.

REFERENCE BOOKS:

1. *Bartle, R.G.* 2000. **Introduction to Real Analysis**.3rd Edition. John Wiley and Sons Inc. New York.
2. *Rudin,W,* 1986 . **Real and Complex Analysis.** 3rd Edition. McGraw-Hill. New York.

15PMA13C	CORE -III: ORDINARY DIFFEENTIAL EQUATIONS	SEMESTER - I

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. To learn mathematical methods to solve Higher Order Differential Equations
2. Apply to dynamical problems of practical interest

CONTENTS

UNIT - I

Second order linear equations with ordinary points – Legendre equation and Legendre polynomials – Second order equations with regular singular points – Bessel equation.

UNIT - II

Systems of first order equations – existence and uniqueness theorem – Fundamental matrix.

UNIT - III

Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

UNIT - IV

Successive approximation – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large – Existence and uniqueness of solutions of systems.

UNIT - V

Fundamental results – Sturm's comparison theorem – Elementary linear oscillations. Comparison theorem of Hille-Winter – oscillations of $x^{11} + a(t)\, x = 0$ - Elementary non-linear oscillation.

TEXT BOOKS:

1. *Deo, G and Raghavendra,V*. 2003. **Ordinary Differential Equations and Stability Theory.** Tata McGraw-Hill, New York.
2. *Coddington, E.A and Levinson ,N.* 1955 . **Theory of Ordinary Differential Equations**, McGraw Hill, New York**.**

REFERENCE BOOKS:

1. *Sanchez , D.A*. 1968 . **Ordinary Differential Equations and Stability Theory**, Freeman W.H, & Co., San Francisco.

15PMA13D	CORE -IV: NUMERICAL METHODS	SEMESTER - I

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. To expose the students to various tools in solving numerical problems.
2. To enable the students to apply these methods in a computer environment.

CONTENTS

UNIT - I

SOLUTION OF NONLINEAR EQUATIONS: Newton's method – Convergence of Newton's method – Bairstow"s Method for quadratic factors NUMERICAL DIFFERENTIATION AND INTEGRATION: Derivatives from Differences tables – Higher order derivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

UNIT - II

SOLUTION OF SYSTEM OF EQUATIONS: The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal Iteration – Relaxation method – Systems of Nonlinear equations.

UNIT - III

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor series method – Euler and Modified Euler methods – Rungekutta methods – Multistep methods – Milne's method – Adams Moulton method.

UNIT - IV

BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS: The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

UNIT - V

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: (Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences.

TEXT BOOK:

1. *Gerald , C.F and Wheatley, P.O*. 1998. **APPLIED NUMERICAL ANALYSIS**. Fifth Edition. Addison Wesley.
2. *Chapra, S.C and Raymond, P.C.* 2000. **Numerical Methods for Engineers**. Tata McGraw Hill.New Delhi.

REFERENCE BOOKS:

1. *Burden, R.L and Douglas Faires,J* .1989.**Numerical Analysis**. P.W.S.Kent Publishing Company. Boston. Fourth Edition.

15PMA23A	CORE -V : COMPLEX ANALYSIS	SEMESTER – II

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. To lay the foundation for topics in Advanced Complex Analysis.
2. To develop clear thinking and analyzing capacity for research.

CONTENTS

UNIT - I

Introduction to the concept of analytic function: Limits and continuity – Analytic functions – Polynomials – Rational functions – Conformality: Arcs and closed curves – Analytic functions in regions – Conformal Mapping – Length and Area – Linear Transformations: The Linear group – The Cross ratio – Elementary Riemann Surfaces.

UNIT - II

Complex Integration: Line Integrals Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk, Cauchy's Integral formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives Removable singularities, Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum principle – chains and cycles.

UNIT - III

The Calculus of Residues: The Residue theorem – The Argument principle – Evaluation of definite integrals. Harmonic functions: The Definitions and basic Properties – Mean value property – Poisson's Formula.

UNIT - IV

Series and Product Developments: Weierstrass Theorem – The Taylor Series – The Laurent Series – Partial fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products.

UNIT - V

The Riemann Mapping Theorem – Statement and Proof – Boundary Behaviour – Use of the reflection principle – Analytic arcs – Conformal mapping of Polygons: The Behaviour at an angle – The Schwarz – Christoffel Formula – Mapping on a rectangle.

TEXT BOOK:

1. *Ahlfors, L.V.* 1979. **Complex Analysis.** Mc Graw Hill. New York.
2. *Tom. M. APOSTOL.*1990. **Mathematical Analysis.** 2nd edition. Addison-Wisely. Narosa Publishing Company, Chennai.

15PMA23B	CORE- VI : PARTIAL DIFFERENTIAL EQUATIONS	SEMESTER - II

Total Credits: 4
Hours Per Week: 7

OBJECTIVES:

1. To give an introduction to Mathematical techniques in analysis of Partial Differential Equations.
2. To know about the Boundary value problems

CONTENTS

UNIT - I

Mathematical Models: The Classical equation – The vibrating string – The vibrating membrane – Conduction of Heat in solids. Classification of second order equations: Second order equations in two independent variables – Cannonical forms – equations with constant coefficients – general solution.

UNIT - II

The Cauchy problem: The Cauchy problem – Cauchy – Kowlalewsky theorem – Homogeneous wave equation – Initial – Boundary value problems – Non-homogeneous boundary conditions – Non-homogeneous wave equation, Riemann Method.

UNIT - III

Methods of separation of variables: Seperation of variables – The vibrating string problem – Existence and Uniqueness of solution of the vibrating string problem. The heat conduction problem – existence and uniqueness of solution of the heat conduction problem – The laplace and beam equations.

UNIT - IV

Boundary value problems: Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorems – Dirichlet problems for a circle – Dirichlet problems for a circular annulus – Neumann problem for a circle Drirchlet problem for a rectangle – Neumann problem for a rectangle.

UNIT - V

Green's function: The delta function – Green's function – method of Green's function – Dirichlet problem for the Laplace operator – method of images – method of eigen functions.

TEXT BOOKS:

1. *Tyn Myin,U and Lokenath Debnath.2003.* **Partial Differential Equations for Scientists and Engineers,** 3rd Edition. Elsevier Academic Press, London.
2. *Sneddon, I.N.* 2003.**Elements of Partial Differential Equations**, McGraw Hill, London.

REFERENCE BOOKS:

1. *Evans, L.C.* 2003. **Partial Differential Equations**, AMS, Providence, R I.

15PMA23C	CORE- VII: MECHANICS	SEMESTER – II

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. The students should have understood the concepts of: Lagrange's Equations,
2. The students should have understood the concepts of: Hamilton's Equations.

CONTENTS

UNIT-I

INTRODUCTORY CONCEPTS: The Mechanical system – Equations of motion - Generalized Coordinates – Constraints – Virtual Work – Principle of virtual work – Generalized force - Energy and Momentum – Potential energy – Work and Kinetic Energy – Conservation of energy – Equilibrium and Stability - Problems.

UNIT-II

LAGRANGE'S EQUATIONS: Derivations of Lagrange's Equations - A nonholonomic rheonomic system - Derivations of Lagrange's Equations – Conservative Systems – Natural Systems – holonomic conservative systems - Examples – Integrals of Motion.

UNIT-III

HAMILTON'S EQUATIONS: Hamilton's Principle – Invariance of the equation of motion – Remarks on the order of the equations of motion – Lagrangian for a free particle - Hamilton's Equations.

UNIT-IV

HAMILTON – JACOBI THEORY: Hamilton's Principle functions – The action as a function of coordinates and time – Hamilton Jacobi Equation – Time and independent and Hamiltonians - One dimensional motion - Separability.

UNIT-V

CANONICAL TRANSFORMATIONS: Canonical Transformations and perturbation theory – Canonical perturbation Theory – Non linear Oscillator - Differential forms and Generating Functions – Lagrange and Poisson Brackets - .

TEXT BOOKS:

1. *Greenwood, D.T.* 1977. **Classical Dynamics.** Dover Publication, New York.
2. *Gelfand, I.M and Fomin, S.V.* 1975.**Calculus of Variations.** Prentice Hall.

REFERENCE BOOKS:

1. *Gantmacher, F. 1975.* **Lectures in Analytic Mechanics.** MIR Publishers, Moscow.
2. *Loney, S.L. 1979.* **An Elementary Treatise on Statics.** Kalyani Publishers. New Delhi.

15PMA23D	CORE –VIII: INTRODUCTION TO MATHEMATICAL SOFTWARE	SEMESTER – II

Total Credits: 4
Hours Per Week:4

OBJECTIVES:

1. To give an insight into Theoretical Computer Science.
2. To understand the structures of various interconnection networks.

CONTENTS

UNIT - I

LATEX: Text formatting – TEX and its offspring – Whats different in LATEX 2ε - Distinguishing LATEX 2ε - Basics of a LATEX file. Commands and Environments – Command names and arguments – Environments – Declarations – Lengths – Special Characters – Fragile Commands.

UNIT - II

Tables – Printing literal text – Footnotes and marginal notes. Drawing pictures with LATEX. Mathematical formulas – Mathematical environments – Main elements of math mode – Mathematical symbols – Additional Elements – Finetuning mathematics.

UNIT - III

MATLAB: Introduction – Basics of MATLAB – Input – Output – File types – Platform dependence – General commands – Creating a script file – Creating and Executing a function file – Working with files and directories.

UNIT - IV

Interactive Computation : Matrices and Vectors Matrix and Array operations Using Built-in Functions and ON-line Help – Command line functions – Saving and loading data – Ploting simple graphs.

UNIT - V

MATHEMATICA : Running Mathematica – Numerical Calculations – Building Up calculations – Using the Mathematica system – Algebraic Calculations – Symbolic Mathematics – Numerical Mathematics.

TEXT BOOKS:

1. *Kopka ,H and Daly ,P.W.* 1999. **A Guide to LATEX**. Thrid Edition. Addison Wesley, London.
2. *Rudra Pratap.* 2003. **Getting started with MATLAB A Quick Introduction for Scientists and Engineers.** Oxford University Press.
3. *Stephen Wolfram.* 2003. **The Mathematical Book.** Fifth Edition. Cambridge University Press.

REFERENCE BOOKS:

1. *Delores M.Etter and David C Kunciciky with Hally Moore*. 2009. **Introduction to MATLAB 7**. Dorling Kindersley Pvt Ltd.
2. *Brian R Hunt, Ronald L Lipsman, Jonathan M Rosenberg with Kevin ,R Coombes, John, E, Osborn and Garrett J Stuck. 2006.* ***A Guide to MATLAB.*** Replika Press Pvt Ltd.

15PMA23P	CORE LAB -I : INTRODUCTION TO MATHEMATICAL SOFTWARE	SEMESTER – II

Total Credits: 2
Hours Per Week: 3

CONTENTS

LATEX

1. Creating a document with paragraph alignment.
2. Creating a document using tables.
3. Inserting a graph or picture in a document.
4. Creating a document and type mathematical formulas.
5. Generating a document structures.

MATLAB

1. Generating Fibonacci numbers.
2. Solving a first/second order nonlinear ODE.
3. Finding Addition, Multiplication and determinant of matrices.
4. Designing a Simple Plot.
5. Solving nonlinear algebraic equations.

MATHEMATICA

1. Performing Matrix Operations.
2. Solving Quadratic Equations.
3. Solving a First / Second order Differential Equations.

15PMA33A	CORE- IX: TOPOLOGY	SEMESTER–III

Total Credits: 4
Hours Per Week: 7

OBJECTIVES:

1. To give an insight into Topological space.
2. To understand the concept of countability.

CONTENTS

UNIT - I

Topological spaces – Basis for a Topology – The Order Topology – The Product Topology X x Y- The Subspace Topology – Closed sets and Limit Points – Continuous Functions –The Product Topology - Metric Topology.

UNIT - II

Connectedness and Compactness: Connected Spaces – Connected subspace of the real line R – Components – Local connectedness – Compact Spaces – Compact subspaces of the real line R- Limit Point Compactness.

UNIT - III

Countability and Separation Axioms: Countability Axioms – Separation Axioms Normal spaces - Urysohn's Lemma – Urysohn Metrization Theorem.

UNIT - IV

The Tychonoff Theorem: Compactification – Equivalent Compactification – Finite Intersection Property - The stone-Cech Compactification - Definitions and Theorem.

UNIT - V

Complete Metric Spaces -Equicontinuous– Compactness in Metric Spaces – Pointwise and Compact Convergences –Completely generated – Compact Open Topology – Evaluation map – Ascoil's Theorem.

TEXT BOOKS:

1. *James R.Munkres*. 2007 . **Topology**. Prentice Hall of India Private Limited, New Delhi.
2. *George F. Simmons.* 2006. **Introduction to Topology and Modern Analysis**, McGraw Hill Book Company.

REFERENCE BOOKS:

1. *Joshi,K.D.* 2006. **Introduction to General Topology**. New age International Private Limited.
2. *Kelley, J.L.*1955. **General Topology.** Springer International Edition.

15PMA33B	CORE- X: FLUID DYNAMICS	SEMESTER–III

Total Credits: 4
Hours Per Week: 7

OBJECTIVES:

1. To understand the concepts of the fluid.
2. To give an insight into viscous flows

CONTENTS

UNIT - I

Introductory Notions – Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation following the Fluid – Equation of continuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

UNIT – II

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

Two Dimensional Motion – Two Dimensional Functions – Complex Potential – basic singularities – source – sink – Vortex – doublet – Circle theorem. Flow past a circular cylinder with circulation – Blasius Theorem – Lift force. (Magnus effect)

UNIT - IV

Viscous flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – Staedy Couettc flow between cylinders in relative motion – Steady flow between parallel planes.

UNIT - V

Laminar Boundary Layer in incompressible flow: Boundary Layer concept – Boundary Layer equations – Displacement thickness, Momentum thickness – Kinetic energy thickness – integral equation of boundary layer – flow parallel to semi infinite flat plate – Blasius equation and its solution in series.

TEXT BOOKS:

1. *Milne Thomson, L.M. 1968.* **Theoretical Hydro Dynamics** by McMillan Company. 5th Edition.

2. *Curle , N and Davies, H.J.* 1968. **Modern Fluid Dynamics (Volume I).** D Van Nostrand Company Limited., London .

15PMA33C	CORE - XI: MATHEMATICAL STATISTICS	SEMESTER–III

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. On successful completion of this course the students should gain knowledge about the Probability and moment generating functions.
2. To understand the concept of Test of significance.

CONTENTS

UNIT - I

Probability : Basic terminology-Some theorems on probability- addition and multiplication theorems on probability- Boole's Inequality- Conditional probability – Independent Events – Pair wise independent events- Bayes theorem –Geometric probability-Random variables – Distribution function – random variables of the discrete and continuous – Independent random variables –Two dimensional random variables: Marginal distribution functions-Joint density functions distributions- Conditional distributions function and Conditional probability density functions– Stochastic independence.

UNIT - II

Moment Generating Functions - Characteristic functions and their Properties – Multivariate Moment generating functions and Characteristic function. Some important theorems: Levy theorem –Uniqueness theorems of characteristic function-Hall- Bray theorem-Chebycbev's Inequality-Convergence in Probability- Bernoulli law of large numbers- The DeMoivre Laplace theorem – the Lindeberg-Levy theorem.

UNIT - III

Discrete Probability distribution: Binomial distribution – Probability generating functions of Binomial distribution. Poisson distribution – Probability generating functions of Poisson distribution -Geometric distribution-Power series Distribution and their properties.

UNIT - IV

Continuous probability distributions: Normal distribution –Gamma distribution –Rectangular distribution- Exponential distribution. Exact sampling distributions: Chi-square distribution- Students t- distribution- F-distribution –Fiszer's Z-distribution-Fisher's Z-Transformation-Applications of Z-Transformation.

UNIT - V

Test of significance – Procedure for Testing of hypothesis – Test of significance for large samples and small samples test - simple problems. Non-parametric methods: Wald-Wolfowitz Run Test- Test for randomness-Median Test-Sign test – Mann-Whitney-Wilcoxon U –test- Simple problems.

TEXT BOOKS:

1. *Gupta, S.C. Kapoor, V.K.*2007. **Fundamentals of Mathematical Statistics.** S.**C**hand and Co New Delhi.
2. *Gupta, S.P.* 2007.**Statistical Methods.** S.Chand and Co. New Delhi.
3. *Marek Fisz.* 1963.**Probability Theory and Mathematical Statistics,** John Wiley

REFERENCE BOOKS :

1. *Vittal, P.R.* 2015. **Mathematical Statistics.** Margham Publications, Chennai
2. *Kapur, J.*M and Saxena, H.C. 2001 . **Mathematical Statistics.** S.Chand & Co, New Delhi

15PMA33D	CORE- XII: OPERATIONS RESEARCH	SEMESTER–III

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. The students should gain knowledge about the Simplex and Dual Simplex method.
2. To understand the concept of CPM / PERT.

CONTENTS

UNIT - I

Introduction to Operations Research – Operations Research Techniques– Simulation Modeling – Art of Modeling the Simplex method- Standard LPP form – and its basic solutions –Artificial starting solution – Special cases in the Simplex method - Applications.

UNIT - II

Duality – Definition – Primal –Dual relationship – Dual simplex method – Transportation model – Transportation Algorithm – The North West Corner Rule – Least Cost Method – Vogel's Approximation Method – Modi Method - Assignment model – Hungarian Method.

UNIT - III

Network models – A Scope of network applications – Definitions – Network representations - Minimal spanning tree algorithm – Shortest root algorithm (Dijkstra's algorithm only) – CPM and PERT.

UNIT - IV

Advanced linear programming – Introduction – Vector and bases– Standard LPP in Matrix Form – Vector Representation – Basic Solution - Simplex method – Fundamentals – Revised simplex method – Bounded Variables Algorithm – Decomposition Algorithm.

UNIT - V

Simulation modeling – Introduction - Monte Carlo simulation – Types of simulation – Elements of discrete event simulation – Generic Definitions of events - Generation of random numbers.

TEXT BOOKS:

1. *Taha, H.A.* 2006. **Operations Research: An Introduction.** Eighth Edition. Prentice Hall of India Private Limited, New Delhi.

2. *Kandiswarup, P. K. Gupta. Man Mohan*.1998.**Operations Research** . S. Chand & Sons Education Publications, New Delhi.

REFERENCE BOOKS:

1. *Dantzig, G.*1963.**Linear Programming and Extension.** Princeton University Press. Princeton.
2. *Ross, S*.1990. **A Course in Simulation.** Macmillion, New York.

15PMA43A	CORE –XIII: FUNCTIONAL ANALYSIS	SEMESTER–IV

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. The students should gain knowledge about the Banach Spaces.
2. To understand the concept operators.

CONTENTS

UNIT - I

Banach spaces – The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N** - The open mapping problem.

UNIT - II

The conjugate of an operator – Hilbert spaces – The definition and some simple properties – Orthogonal complements - Orthonormal sets.

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

1. *Simmons, G.F.* 1963. **Introduction to Topology and Modern Analysis.** McGraw – Hill Book Company, London.
2. *Bachman G. and Narici*, L.1966. **Functional Analysis.** Academic Press, New York.

REFERENCE BOOK:

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

15PMA43B	CORE –XIV: MATHEMATICAL METHODS	SEMESTER–IV

Total Credits: 4
Hours Per Week: 6

OBJECTIVES:

1. The students should gain knowledge about the Fourier Transforms.
2. To understand the concept of application of Integral equation.

CONTENTS

UNIT - I

FOURIER TRANSFORMS: Fourier sine and cosine transforms – Fourier transforms of derivatives - Fourier transforms of simple functions - convolution integral – Parseval's Theorem - Solution of PDE by Fourier transform – Laplace equation in half plane in infinite strips; in semi infinite strip. The Linear diffusion equation on a semi infinite line – the two dimensional diffusion equation.

UNIT - II

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

UNIT- III

INTEGRAL EQUATIONS: Types of Integral equations – Integral Fredholm Alternative - Approximate method – Equation with separable Kernel - Volterra integral equations.

UNIT - IV

Application of Integral equation to ordinary differential equation – initial value problems – Boundary value problems – singular integral equations – Abel Integral equation.

UNIT - V

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

TEXT BOOKS:

1. *Sneddon, I.N.* 1974.**The Use of Integral Transforms.** Tata Mc Graw Hill, New Delhi.
2. *Kanwal, R.P.* 1971.**Linear Integral Equations Theory and Technique,** Academic Press, New York.
3. *Elsgolts, L.*1970.**Differential Equations and Calculus of Variations,** Mir Publishers, Moscow.

15PMA43C	CORE – XV: GRAPH THEORY	SEMESTER–IV

Total Credits: 4
Hours Per Week: 6

Note: Simple problems in the exercise of all units can also be included.

OBJECTIVES:

1. To give an insight into Graphs and connectivity.
2. To understand the concept of matching and edge colourings.

CONTENTS

UNIT - I

Graphs, Sub graphs and Trees: Graphs and Sub graphs: Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency matrices – Sub graphs – Vertex Degrees – paths and Connection – Cycles. Trees: Trees – Cut edges and Bonds – cut vertices – Cayley's formula

UNIT – II

Connectivity, Euler tours and Hamilton Cycles: Connectivity: Connectivity – Blocks. Euler tours and Hamilton Cycles: Euler tours - Hamilton Cycle.

UNIT - III

Matchings and Edge colourings: Matchings: Matchings coverings in Bipartite Graphs – Perfect Matchings. Edge colourings: Edge chromatic number – Vizing's theorem.

UNIT - IV

Independent sets, Cliques and Vertex Colourings: Independent sets, Cliques: Independent sets – Ramsey's theorem. Vertex Colourings: Chromatic Number – Brook's Theorem – Hajos Conjecture – Chromatic Polynomials – Girth and Chromatic number.

UNIT - V

Planar Graphs and Directed Graphs: Planar Graphs: Plane and planar Graphs – Dual Graphs – Euler's formula – Bridges – Kuratowski's theorem (Proof omitted) – The Five Colour Theorem and the Four Colour Conjecture – Nonhamiltonian planar Graphs.

TEXT BOOKS:

1. *Bondy, J.A and Murty, U.S.R.* 1976.**Graph Theory with Applications.** American Elsevier Publishing Company Inc., New York.
2. *Chandran, A.*1993. **A First Course in Graph Theory.**Macmillan.

15PMA43D	CORE-XVI: COMPUTER PROGRAMMING IN C++	SEMESTER–IV

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the OOPS.
2. To understand the concept of functions, operator overloading, classes and objects.

CONTENTS

UNIT - I

Principles of object-Oriented Programming: Software crisis – Software evolution – A look at procedure-oriented Programming – Object-oriented Programming Paradigm – Basic Concept of Object-Oriented Programming – Benefits of OOP – Object-Oriented languages – Applications of OOP.

UNIT – I

Tokens, Expressions and Control structure: Introduction – Tokens – Keywords – Identifiers and constants – basic data types – User defined data types - Derived data types – Symbolic constants – type compactability – Declaration of variables – Dynamic insulation of variables – Reference variables – operations in C++ - Scope resolution operator – member Dereferencing operators – memory management operators – Manipulators – typr cast operator – expressions and their types – Special assignment expressions – implicit conversions – operator over loading – operator precedence – Control structures.

UNIT – III

Functions in C++: Introduction – The main function – Function prototyping – call by reference – return by reference inline functions – default arguments – constant arguments – function over loading – friend and virtual functions – Math library functions – Managing Console I/O operations: Introduction – C++ streams – C++ stream classes – Unformatted I/O operations - Formatted I/O operations – Managing output with manipulators.

UNIT - IV

Classes and Objects: Introduction – C Structures Revisited – Specifying a class – Defining Member Functions – A C++ Program with class – Making an outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a class – Memory Allocation for Objects – Static Data Members – Static Member Functions – Arrays of Objects – Objects as Function Arguments – Friendly functions – Returning Objects – Constant Member Functions. Constructors and Destructors: Introduction – Constructors – Parameterized Constructors – Multiple Constructors in a class – Constructors with Default Arguments – Dynamic Initializations of Objects – Copy Constructor – Constructing Two dimensional arrays – Constant Objects – Destructors.

UNIT - V

Operators overloading and Type Conversions: Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators Using Friends – manipulating of strings Using Operators – Rules of Overloading Operators.
Inheritance: Extending Classes: Introduction – Defining Derived Classes – Single inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierachial Inheritance – Hybrid Inheritance – Virtual Base Classes – Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

TEXT BOOK:

1. *Balaguruswamy, E.*1999. **Object Oriented Programming with C++** . Tata McGraw- Hill Publishing Company limited.

REFERENCE BOOKS:

1. *Alam ,S.S. and Sen, S.K.* 1988. **Computer and Computing with Fortran 77**. Oxford and IBH Publishing Pvt. Ltd., New Delhi .
2. *Krishnamurthy ,E.V. and Sen, S.K.*1986.**Numerical Algorithms – Computations in Science and Engineering**. Affiliated East-West Press Pvt.Ltd.
3. *Gerald , C.F. and Wheatley, P.O.*1998.**Applied Numerical Analysis**, Fifth Edition, Addison-Wesley Publishing Co.

15PMA43P	CORE LAB- II: COMPUTER PROGRAMMING IN C++	SEMESTER–IV

Total Credits: 2
Hours Per Week: 2

CONTENTS

1. DISTANCE CONVERSION PROBLEM:

Creating two classes DM and DB which store the value of distances. The display may be in the order of meter and centimeter and feet or inches depending on the order of display.

2. OVERLOADING OBJECTS:

Creating a class FLOAT that contains one float data member overload all the four arithmetic operators so that operate on the objects of FLOAT.

3. OVERLOADING CONVERSIONS:

Designing a class polar which describes a point in a plane using polar Co-ordinates radius and angle. Points into rectangular Co-ordinates and finally converting the result into polar Coordinates.

4. POLAR CONVERSION:

Creating two classes polar and rectangular. By Using conversion routines convert from one system to another.

5. OVRELOADING MATRIX:

Creating a class MAT of size M*N. Define all possible matrix operations for MAT type objects. Verifing the identity*(A-B)*^2 = *A*^2+*B*^2 – 2**A**B*

6. AREA COMPUTATION USING DERIVED CLASS:

Area of rectangle = *X*Y*, Area of triangle = ½ * *X* * *Y*

7. VEXTOR PROBLEM:

Defining a class for vector containing scalar values. Apply overloading concepts for vector addition, Multiplication of a vector by a scalar quantity, replace the values in a position vector.

15PMA1EA	ELECTIVE- I :DISCRETE MATHEMATICS	SEMESTER–I

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into Lattices and finite fields.
2. To understand the concept coding theory.

CONTENTS

UNIT - I

LATTICES: Properties and examples of Lattices -Distributive lattices - Boolean algebras-Boolean polynomials - Ideals – Filters - Minimal Forms of Boolean Polynomials.

UNIT - II

APPLICATIONS OF LATTICES: Switching Circuits-Applications of Switching Circuits – Propositional Logic - Applications of Boolean Algebra.

UNIT - III

FINITE FIELDS: Finite fields – Groups, Rings, Fields – Ideals – Homomorphism - Basic properties – Modular Arithmetic –Factoring polynomials over finite fields – Square free factorization

UNIT - IV

FINITE FIELDS AND POLYNOMIALS: Irreducible Polynomials over Finite fields -Factorization of Polynomials over Finite fields – The Null space of the Matrix .

UNIT - V

CODING THEORY: Introduction to Coding -Linear Codes Bounds on the parameters of the code - Singleton bound, sphere-packing bound, - Reed-Solomon (RS) codes.

TEXT BOOKS:

1. *Rudolf Lidl and Gunter Pilz*. 2006. **APPLIED ABSTRACT ALGEBRA.** Second Indian Reprint. Springer Verlag. NewYork.
2. *Gill,* A.2003.**Applied Algebra for Computer Science.** Prentice Hall Inc., New Jersey.

REFERENCE BOOKS:

1. *Gersting,* J.L. 2000. **Mathematical Structures for Computer Science** (3rdEdn.), Computer Science Press, New York.
2. *Wiitala,S*. 2003. **Discrete Mathematics.** A Unified Approach, McGraw Hill Book Co.

15PMA1EB	ELECTIVE- I : DIFFERENTIAL GEOMETRY	SEMESTER – I

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the curves and arcs.
2. To understand the concept of elementary theory of surface.

CONTENTS

UNIT - I

Curves: Curves in a space – Arc length – Equation of a tangent line to a curve - Analytic representation - Tangent - Osculation plane – Plane of curvature – Tangent plane for the surface - Curvature and torsion.

UNIT - II

Serret and Frenet Formula –Simple problems - Contact – Natural equations – Helices – Circle of curvature – Osculating Sphere - General solutions of Natural equations – Evolutes and Involutes.

UNIT - III

Elementary theory of surface: Parametric equations – Monge's form – Tangential vector to parametric curves - Analytic representation – First fundamental form – Normal, Tangent plane – Developable surfaces.

UNIT – IV

Second fundamental form – Geometrical interpretation of metric - Meusnier's theorem – Euler's Theorem – Dupin's indicatrix – Some surfaces – The fundamental equations – The equations of Gauss-Weingarten.

UNIT -V

The theorem of Gauss and the equations of Codazzi – Some applications of the Gauss and Codazzi equations. The fundamental theorem of surface theory – Geodesic curvature – Geodesics on the surface of the revolution.

TEXT BOOKS:

1. Khanna, M.L. 1965. **Differential Geometry.** Jaiprakash Math & Co, Meerut.
2. *Struik, D.* 1961. **Lectures on Classical Differential Geometry.** Addison Wesley Publishing Company.

15PMA1EC	ELECTIVE- I: FUZZY LOGIC AND FUZZY SETS	SEMESTER–I

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into crisp sets and fuzzy sets.
2. To understand the concept of fuzzy relations and fuzzy measure.

CONTENTS

UNIT - I

CRISP SETS AND FUZZY SETS: The Notion of Fuzzy Sets-basic concepts of Fuzzy sets –Fuzzy complement-Fuzzy Union-Fuzzy intersection – Combination of operations – general aggregation of operations.

UNIT-II

FUZZY RELATIONS: Crisp and Fuzzy relations – Binary relations – Binary relations on a single set – Equivalence and similarity relations – Compatibility on Tolerance Relations-Orderings – Morphism – Fuzzy relations Equations.

UNIT - III

FUZZY MEASURES: Belief and plausibility Measures –Probability measures – Possibility and Necessity measures.

UNIT-IV

UNCERTAINTY AND INFORMATION: Types of Uncertainty – Measures of Fuzziness-Classical Measures of Uncertainty-Hartley information – Shannon entropy– Measures of Dissonance- Measures of Non-Specificity.

UNIT – V

APPLICATIONS: Natural, life and Social Sciences - Engineering - Medicine - Management and decision making.

TEXT BOOK:

1. *George J. Klir and Tina, A. Folger*.1995. **Fuzzy Sets Uncertainty and Information.** Prentice Hall of India Private Limited. Fourth printing.

REFERENCE BOOK:

1. *George J. Klir and Boyuan.* **Fuzzy Sets and Fuzzy Logic Theory and Applications.** Prentice Hall of India Private Limited.

15PMA2EA	ELECTIVE –II: LINEAR ALGEBRA	SEMESTER – II

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the invariant subspaces.
2. To understand the concept of decompositions.

CONTENTS

UNIT - I

Characteristic values – Annihilating Polynomials – Cayley Hamilton Theorem - Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization.

UNIT - II

Direct sum decompositions – Invariant Direct sums – The Primary Decomposition theorem – Cyclic subspaces and Annihilators.

UNIT – III

Cyclic Decompositions and the Rational form – Cyclic decomposition Theorem – Generalized Cayley Hamilton Theorem– The Jordan form – Computation of invariant factors.

UNIT - IV

Forms on Inner Product Spaces – Principal Axis Theorem - Positive Forms – More on Forms – Spectral theory- Spectral Theorem.

UNIT – V

Bilinear forms – Symmetric bilinear forms – Skew-symmetric bilinear forms – Group preserving bilinear forms – Orthogonal group, Orthogonal matrix – Pseudo – Orthogonal groups – Lorentz transformation – Lorentz group.

TEXT BOOKS:

1. Kenneth Hoffman and Ray Kunze, 1972. **Linear Algebra.** Prentice Hall of India.
2. *Artin, M*. 1991. **Algebra.** Prentice-Hall of India

REFERENCE BOOKS:

1. *Ben Noble and James W. Daniel.* 2003. **Applied Linear Algebra.** Prentice Hall of India.

15PMA2EB	ELECTIVE –II: MATHEMATICAL MODELLING	SEMESTER–II

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into mathematical modelling.
2. To understand the concept of dynamic programming techniques.

CONTENTS

UNIT - I

Mathematical modeling through system of ordinary differential equation of first order Mathematical modeling in population dynamics, Mathematical modeling of epidemics through system ordinary differential equations of first order - Mathematical modeling in medicine, arms race, battle and international trading in terms of system of ordinary differential equations of first order

UNIT - II

Mathematical modeling through differential equations The need of mathematical modeling through differential equations – some simple models – basic theorem of linear differential equations with constant coefficient - Mathematical modeling through differential equations in economics and finance

UNIT - III

Mathematical modeling through difference equations (contd.) Mathematical modeling through difference equations in population dynamics and genetics Mathematical modeling through difference equations in probability theory .miscellaneous examples of Mathematical modeling through difference equations

UNIT - IV

Mathematical modeling through graphs Situations that can be modeled through graphs - Mathematical models in terms of directed graphs - Mathematical models in terms weighted graphs.

UNIT - V

Mathematical modeling through calculus variations and dynamic programming Optimization principles and techniques - Mathematical modeling through calculus of variation - Mathematical modeling through dynamic programming.

TEXT BOOKS:

1. *Kapur, J.N.* 2000. **Mathematical Modeling.** Willey Eastern limited. reprint.
2. *James, D.J.G. and Macdonald,* J.J. 2005. C**ase Studies in Mathematical Modeling.** Stanly Thames. Cheltenham.

REFERENCE BOOKS:

1. *Kapur, J.N. 1976.* **Mathematical entropy models**.
2. *Crossand, M. and Moscrcadini, A.O.* 1976. **The Art of Mathematical Modeling**, Ellis Harwood and john Wiley.

15PMA2EC	ELECTIVE- II: INTEGRAL EQUATIONS AND INTEGRAL TRANSFORMS	SEMESTER–II

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the integral transforms.
2. To understand the concept of Fourier transforms.

CONTENTS

UNIT – I

Definition of integral equations – integral equation with separable kernel fredholm alternatives method of successive approximation

UNIT – II

Voltera integral equation – classical fredholm theory – fredholm 1st, 2nd, 3rd theory

UNIT - III

Application to ODE, initial value problems, boundary value problems with example

UNIT - IV

Singular integral equations – awful integral equations – Cauchy principle value of integral – Cauchy type integral type solution of Cauchy type singular integral equation

UNIT - V

Fourier transforms – Fourier integral theorem – Fourier cosine and sine transforms – Fourier transforms of derivatives calculation of Fourier transforms of some simple function

TEXT BOOKS:

1. *Stephen, M.* 2012. **The Classical Theory of Integral Equations.** Zemyan.
2. *Brian Davies.* 2002. Integral Transforms and Their Applications. Springer.

15PMA3EA	ELECTIVE- III: NUMBER THEORY	SEMESTER–III

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into numbers.
2. To understand the concept of Mobeius inversion formula.

CONTENTS

UNIT - I

Divisibility: Introduction- Divisibility-Division Algorithm-Euclid Lemma and algorithm - Primes- The Fundamental theorem of arithmetic functions (or) the unique factorization theorem-Euclid theorem.

UNIT - II

Congruences: Introduction – Residue Classes- Euler's theorem (or) Euler's Generalization of Fermat's theorem- Fermat's theorem- Willson's theorem- Solutions of congruence- Degree of Congruences- Chinese Remainder theorem - Prime power moduli - Hensel's lemma- Prime modulus.

UNIT - III

Primitive roots and Power Residues - Congruences of degree 2, prime modulus - Number theory from an algebraic view point - Groups, Rings and Fields.

UNIT – IV

Quadratic reciprocity and Quadratic Forms: Quadratic residues - Quadratic reciprocity – The Jacobi Symbol

UNIT – V

Some functions of Number Theory: Greatest Integer Function - Arithmetic functions – The Möbius Inversion formula – Recurrence functions.

TEXT BOOKS:

1. *Ivan Nivan and Herberts Zucherman*.1972. **An Introduction to Theory of Numbers**. Third Edition, Wiley Eastern Limited, New Delhi.
2. *Apostol, T.M. 1976*. ***Introduction to Analytic Number Theory***. Springer Verlag.

REFERENCE BOOKS:

1. *Kennath and Rosan,* 1968.***Elementary Number Theory and its Applications.*** Addison Wesley Publishing Company.
2. *George ,E* and *Andrews*.1989. ***Number Theory.*** Hindustan Publishing, New Delhi.

15PMA3EB	ELECTIVE –III: MAGNETO HYDRO DYNAMICS	SEMESTER–III

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the hydro dynamics.
2. To understand the concept of stability.

CONTENTS

UNIT - I

Electromagnetism – Fundamental Laws – Electrostatic Energy – Electrodynamics – Ampere's Law – Lorentz force on a moving charge – Magnetostatic Energy – Faraday's Law of Induction – Poynting stresses – Electromagnetic Equations with respect to moving axes – boundary conditions of electric and magnetic fields.

UNIT – II

Kinematics of fluid motion – equation of continuity – Stress tensor – Navier-stokes equations – boundary condition – Velocity Magneto fluid dynamic equations – MHD approximation – equation of Magnetic diffusion in a moving conducting medium – Magnetic Reynolds number.

UNIT - III

Alfven's theorem Law of isorotation - Magneto hydrostatics – Force-free field – Alfven waves in incompressible MHD.

UNIT - IV

Incompressible viscous flows in the presence of magnetic field – Hartmann Flow – unsteady Hartmann flow – Magnetofluid dynamic pipe flow.

UNIT – V

Stability – Instability of linear pinch – Sausage and flute types – Method of small oscillations – gravitational instability.

TEXT BOOKS:

1. *Crammer ,K.R. and Pai ,S.I.*1973.***Magneto Fluid Dynamics for Engineers and Applied Physicists.*** McGraw Hill.
2. *Ferraro,V.C.A. and Plumpton*.1966. ***Introduction to Magneto Fluid Dynamics***.Oxford.

15PMA3EC	ELECTIVE- III: STOCHASTIC DIFFERENTIAL EQUATIONS	SEMESTER–III

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into Diffusions.
2. To understand the concept of Stochastic Analogs of Classical Differential Equations.

CONTENTS

UNIT – I

Introduction: Stochastic Analogs of Classical Differential Equations, Filtering Problems, Stochastic Approach to Deterministic Boundary Value Problems, Optimal Stopping, Stochastic Control and Mathematical Finance. Some mathematical preliminaries: Probability Spaces, Random Variables and Stochastic Processes and an Important Example: Brownian motion.

UNIT – II

Ito Integrals: Construction of the Ito integral, Some Properties of the Ito Integral and Extensions of the Ito Integral.

UNIT - III

The Ito formula and the Martingale Representation Theorem: The 1-dimentional Ito Formula, the Multi dimensional Ito Formula and the Martingale Reprsentation Theorem. Stochastic Differential Equations: Examples and Some Solution Methods, An Existence and Uniqueness Result and Weak and Strong Solutions.

UNIT - IV

The Filtering problem: Introduction, The 1- dimentional Linear Filtering Problem and the Multi- dimentional Linear Filtering Problem.

UNIT - V

Diffusions: Basic Properties: The Markov Property, the Strong Markov Property, the Generator of an Ito Diffusion, the Dynkin Formula, the Characteristic Operator.

TEXT BOOKS:

1. *Bernt Oksendal*. 2003.**Stochastic Differential Equations - An Introduction with Applications.** (Sixth Edition). Springer-Verlag, Heidelberg.

15PMA4EA	ELECTIVE- IV: CONTROL THEORY	SEMESTER–IV

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. The students should gain knowledge about the observability Grammian.
2. To understand the concept of optimal control.

CONTENTS

UNIT – I

OBSERVABILITY: Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems

UNIT - II

CONTROLLABILITY: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – steering function – Nonlinear systems

UNIT - III

STABILITY: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems

UNIT - IV

STABILIZABILITY: Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback

UNIT - V

OPTIMAL CONTROL: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems

TEXT BOOKS:

1. *Balachandran, K.* and *Dauer, J.*P.1999 .**Elements of Control Theory.** Narosa. New Delhi.
2. *Conti ,R.* 1976.**Linear Differential Equations and Control.** Academic Press. London.

REFERENCE BOOKS:

1. *Curtain , R.F.and Pritchard, A.J.*1977. **Functional Analysis and Modern Applied Mathematics Academic Press.** New York.
2. *Klamka, J.*1991. **Controllability of Dynamical Systems.** Kluwer Academic Publisher. Dordrecht.
3. *Russell, D.L.*1979. **Mathematics of Finite Dimensional Control Systems.** Marcel Dekker. New York.
4. *Lee, E.B.and Markus, L.* 1967.**Foundations of optimal Control Theory**, John Wiley, New York.

15PMA4EB	ELECTIVE- IV:NEURAL NETWORKS	SEMESTER–IV

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into Mathematical Neuron model.
2. To understand the concept of neural networks.

CONTENTS

UNIT - I

Mathematical Neuron Model- Network Architectures- Perceptron-Hamming Network- Hopfield Network-Learning Rules-Perceptron Architectures and Learning Rule with Proof of Convergence.

UNIT - II

Supervised Hebbian Learning-Linear Associator-The Hebb Rule-Pseudo inverse Rule- Variations of Hebbian Learning-Back Propagation-Multilayer Perceptrons-Back propagation Algorithm-Convergence and Generalization.

UNIT – III

Performances Surfaces and Optimum Points-Taylor series-Directional Derivatives- Minima-Necessary Conditions for Optimality-Quadratic Functions-Performance Optimizations- Steepest Descent-Newton's Method-Conjugate Gradient.

UNIT - IV

Associative Learning-Simple Associative Network-Unsupervised Hebb rule-Simple Recognition Network-Instar Rule-Simple Recall Network-Outatar Rule-Competitive Networks- Hamming Network- Competitive Layer-Self Organizing Feature maps- Learning Vector Quantization.

UNIT - V

Adaptative Resonance Theory-Overview of Adaptative Resonance Theory-Orienting Sub System- Learning Law L I-L2 and L2-L1. ART I Algorithm-Other ART Architectures-Stability- Recurrent Networks- Stability Concepts-Lyapunov Stability Theorem-Pendulum Example- Lasalle's Invariance Theorem.

TEXT BOOKS:

1. *Martin T.Hagan. Howard ,B.* Demuth and Mark Beale. 2003. **Neural Network Design.** Vikas Publishing House, New Delhi.
2. *James A. Freeman and* David *M.* Skapura. 2003.**Neural Networks Algorithms, Applications and Programming Techniques.** Pearson Education.

REFERENCE BOOK:

1. *Robert J. Schalkoff.* 1997. **Artificial Neural Network.** McGraw-Hill International Edition.

15PMA4EC	ELECTIVE –IV: CRYPTOGRAPHY	SEMESTER–IV

Total Credits: 4
Hours Per Week: 4

OBJECTIVES:

1. To give an insight into cryptography.
2. To understand the concept of Encryption and secrecy.

CONTENTS

UNIT – I

Introduction – Encryption and Secrecy – The objective of Cryptography – Cryptographic protocols. Mathematical background – Number Theory – Introduction – Modular Arithmetic – Integer factorization problem – Pollard's rho factoring – Elliptic curve factoring – Discreate logarithm problem

UNIT – II

Finite fields – Groups, Rings, Fields - Basic properties – Modular Arithmetic – The Euclidean Algorithm – Finite field of the form GF(P) and GF(2^n)Arithmetic of polynomials –Factoring polynomials over finite fields – Square free factorization

UNIT – III

Block Ciphers principles – The data Encryption standard – The strength of DES – Block cipher design principles –Block cipher mode operation – Stream ciphers - Symmetric key encryption.

UNIT – IV

Public key cryptography – Concepts of public key cryptography – Modular arithmetic – RSA – Description of the algorithm – Computational aspects – Security of RSA- Discrete logarithm – Elliptic curve cryptography

UNIT - V

Protocols and mechanisms - Key establishment, management and certification – Pseudorandom numbers and sequences – classes of attacks and security models – Authentication methods – Kerberos – Security Applications.

TEXT BOOKS:

1. *Hans Delfs and Helmut Knebl.* 2002. **Introduction to Cryptography.** Springer Verlag.
2. *Alfred J.* Menezes. Paul Van *Oorschot and Scott A. Vanstone,C.*2000. **Handbook of Applied Cryptography.** CRC Press.
3. *William Stallings.*2000. **Cryptography and Network Security.** Prentice Hall of India.

REFERENCE BOOK:

1. *Pachghare, V.K.* 2009. **Cryptography and Information Security.** PHI Learning Private Ltd.

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