MASTER OF SCIENCE (MATHEMATICS)
REGULATIONS

ELIGIBILITY

A candidate who has passed B.Sc., (Mathematics) / B.Sc., (Mathematics with Computer Applications) degree of this University or any of the above degree of any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the Master of Science (M.Sc.,) Degree Examination in Mathematics of this University after a course of study of two academic years.

DURATION OF THE COURSE

The course shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

OBJECTIVES OF THE COURSE

- To develop mathematical ability with acute and abstract reasoning.
- To prepare the students to cope up with the advanced developments in various fields of Mathematics.
- Aims to provide choice of elective subjects which are updated on new areas, in various branches of Mathematics.
- Aims to provide a Programming language with practicals which may be used in the field of Mathematics.

SCHEME OF EXAMINATION

First Semester							
Subject Code	**Subject**	**Hrs of Instruction**	**Exam. Duration (Hours)**	**Max.marks**			**Credit Points**
				CA	**CE**	**Total**	
Part A							
15PMAM101	Core I: Linear Algebra	6	3	25	75	100	5
15PMAM102	Core II: Real Analysis	5	3	25	75	100	4
15PMAM103	Core III: Ordinary Differential Equations	6	3	25	75	100	5
15PMAM104	Core IV: Graph Theory	5	3	25	75	100	4
15PMAM105	Core V: Mathematical Statistics	5	3	25	75	100	4
Non – Credit							
15PLS101	Career Competency Skills I	1	---	---	---	---	---
	Total	**28**				**500**	**22**
Second Semester							
Part A							
15PMAM201	Core VI: Algebra	5	3	25	75	100	5
15PMAM202	Core VII: Measure Theory And Integration	5	3	25	75	100	5
15PMAM203	Core VIII: Complex Analysis	5	3	25	75	100	4
15PMAM204	Core IX: Partial Differential Equations	5	3	25	75	100	4
	Elective I	5	3	25	75	100	4
Part B							
15PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non – Credit							
15PLS201	Career Competency Skills II	1	---	---	---	---	---
	Total	**28**				**600**	**24**

Third Semester							
Subject Code	**Subject**	**Hours/ week**	**Exam. Duration (Hours)**	**Max.marks**			**Credit Points**
				CA	CE	Total	
Part A							
15PMAM301	Core X: Topology	6	3	25	75	100	5
15PMAM302	Core XI: Mechanics	6	3	25	75	100	5
15PMAM303	Core XII: Numerical Analysis	6	3	25	75	100	5
	Elective II	5	3	25	75	100	4
15PCSMAI301	IDC: Programming in C++	4	3	25	75	100	3
15PCSMAIP301	IDC Practical : Programming in C++	2	3	40	60	100	2
	Total	**29**				**600**	**24**
Fourth Semester							
Part A							
15PMAM401	Core XIII: Functional Analysis	6	3	25	75	100	5
15PMAM402	Core XIV: Calculus of Variations and Integral Equations	6	3	25	75	100	5
15PMAM403	Core XV: Fluid Dynamics	5	3	25	75	100	5
15PMAM404	Core XVI: Optimization Techniques	5	3	25	75	100	4
15PMAM405	Core XVII: Number Theory	5	3	25	75	100	4
15PMAP401	Core Practical : Mathematical Text Editor Latex (100% Internal evaluation)	2	3	100	-	100	2
	Total	**29**				**600**	**25**
					Grand Total	**2300**	**95**

ELECTIVE SUBJECTS:

Students shall opt an elective subject from the list of ELECTIVE I **(**SEMESTER II)

ELECTIVE I (SEMESTER II)

S. No	Subject Code	Subject
1	15PMAEL201	Control Theory
2	15PMAEL202	Stochastic Process
3	15PMAEL203	Operator Theory

Students shall opt an elective subject from the list of ELECTIVE II (SEMESTER III).

ELECTIVE II (SEMESTER III)

S. No	Subject Code	Subject
1	15PMAEL301	Difference Equations
2	15PMAEL302	Fuzzy Sets And Fuzzy Logic
3	15PMAEL303	Automata Theory

FOR COURSE COMPLETION

Students shall

- opt any one Elective Subject in each of Second and Third semester.
- complete one value education in Second semester.
- complete one IDC in Third semester.

TOTAL CREDIT DISTRIBUTION

Components	Total Marks		Credits
Core	100X17 PAPERS	1700	77
Elective	100X2 PAPERS	200	8
Latex (Internal Evaluation)	100X1 PAPER	100	2
IDC	100X1 PAPER	100	4
IDC Practical	100X1 PAPER	100	2
Value Education	100X1 PAPER	100	2
Total	**No. of papers 23**	**2300**	**95**

15PMAM101	CORE I: LINEAR ALGEBRA	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To learn about the concepts of Algebra of Linear Transformations and Polynomials.
2. Learning about Direct sum and Cyclic Subspaces.
3. To learn about Bi-linear forms.

CONTENTS

UNIT – I **(10 Hours)**

Linear Transformations - The algebra of linear transformations – Isomorphism – Representations of linear transformations by matrices.

(Chapter - 3 Sections: 3.1 - 3.4)

UNIT – II **(10 Hours)**

Polynomials: The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial.

(Chapter - 4 Sections: 4.1 - 4.5)

UNIT – III **(10 Hours)**

Determinants: Commutative Rings – Determinant functions – Permutations and uniqueness of determinants. Characteristic Values – Annihilating polynomials - Invariant subspaces.

(Chapter - 5 Sections: 5.1 - 5.3) (Chapter - 6 Sections: 6.1 - 6.4)

UNIT – IV **(10 Hours)**

Simultaneous triangulation and simultaneous Diagonalization – Direct sum Decompositions - Invariant Direct sums – The Primary Decomposition theorem

(Chapter - 6 Sections: 6.5 - 6.8)

UNIT – V **(10 Hours)**

Bilinear forms – Symmetric Bilinear Forms – Skew-Symmetric Forms – Groups preserving Bilinear Forms.

(Chapter – 10 Sections: 10.1 – 10.4)

TEXT BOOK:

1. Kenneth Hoffman and *Ray Kunze.* 1971. **Linear Algebra.** [Second Edition]. Prentice Hall of India Private Limited, New Delhi.

REFERENCE BOOKS:

1. *Kumaresan, S.* 2000. **Linear Algebra.** Prentice Hall of India Ltd, New Delhi.

2. *Krishnamurthy, V., Ved Prakash Mainra.* and *Jawahar Lal Arora, Z.* 1985. **Introduction to Linear Algebra.** East West Press Ltd.

15PMAM102	CORE II: REAL ANALYSIS	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To understand the functions of bounded variations
2. To learn about the Riemann Stieljes integral
3. To know the importance of inverse function theorem and implicit functions theorems.

CONTENTS

UNIT – I **(10 Hours)**

Differentiation of single variable : Derivatives – The Chain rule – Local extrema – Rolle's theorem – Mean Value theorem – Taylor's formula – Functions of Bounded variation – Total variation.

(Chapter – 5 Sections: 5.1, 5.2, 5.3, 5.5, 5.9, 5.10, 5.12)(Chapter – 6 Sections: 6.3, 6.4)

UNIT – II **(10 Hours)**

Riemann- Stieljies integral : Definition – Linear properties of the integral – Necessary conditions for the existence – First fundamental theorem of Integral calculus – Mean value theorems for integrals – Second fundamental theorem of Integral calculus.

(Chapter - 7 Sections: 7.1, 7.2, 7.3, 7.4, 7.15, 7.16, 7.19, 7.20)

UNIT – III **(10 Hours)**

Sequences and Series of functions – Pointwise convergence – Uniform convergence – Uniform convergence and Integration – Uniform convergence and Differentiation – Sufficient conditions for uniform convergence of a series.

(Chapter – 9 Sections: 9.1 - 9.11)

UNIT – IV **(10 Hours)**

Introduction – Directional derivatives - Directional derivative and continuity – Total derivative – Total derivative expressed in terms of partial derivatives – An Application to complex valued functions – The Jacobian matrix – Chain rule – Mean value theorem – Taylor's formula.

(Chapter – 12 Sections: 12.1 – 12.6, 12.8, 12.9, 12.11, 12.14)

UNIT – V **(10 Hours)**

Introduction – Functions with non-zero Jacobian determinant - Inverse function theorem – Implicit function theorem.

(Chapter - 13 Sections: 13.1 – 13.4)

TEXT BOOK:

1. *Tom M. Apostol*. 1985. **Mathematical Analysis.** [Second Edition]. Narosa Publishing House, New Delhi.

REFERENCE BOOK:

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

15PMAM103	CORE III: ORDINARY DIFFERENTIAL EQUATIONS	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To describe Linear equations with constant and variable coefficients.
2. To study the methods of solving Ordinary Differential Equations.

CONTENTS

UNIT – I **(10 Hours)**

Linear equations with constant coefficients: The second order homogeneous equations – Initial value problems – Linear dependence and independence - A formula for the Wronskian – The non- homogeneous equation of order two.

(Chapter - 2 Sections: 1 – 6)

UNIT – II **(10 Hours)**

Homogeneous and non–homogeneous equations of order n – Initial value problems – Annihilator method to solve a non–homogeneous equation.

(Chapter - 2 Sections: 7, 8, 10, 11)

UNIT – III **(10 Hours)**

Linear equations with variable coefficients: initial value problems for the homogeneous equation- Solutions of the homogeneous equation – Reduction of the order of a homogeneous equation - The Legendre equation.

(Chapter - 3 Sections: 1 – 3, 5, 8)

UNIT – IV **(10 Hours)**

Linear equation with regular singular points: Euler equation - Second order equations with regular singular points –Bessel equation.

(Chapter - 4 Sections: 1 - 4, 7 - 8)

UNIT – V **(10 Hours)**

Existence and uniqueness of solutions to first order equations: Equation with variables separated– Exact equations – The method of successive approximations – The Lipschitz condition –Convergence of the successive approximations.

(Chapter - 5 Sections: 1 – 6)

TEXT BOOK:

1. *Coddington.E.A.* 1957. **An Introduction to Ordinary Differential Equations,** Prentice Hall of India Ltd., New Delhi.

REFERENCE BOOKS:

1. *Agarwal, R. P.* and *Ramesh C.Gupta* 1991. **Essential of Ordinary Differential Equations.** McGraw Hill, New York.
2. *Somasundram, D.* 2002. **Ordinary Differential Equations.** Narosa Publishing House, Chennai.
3. *Raj,D., Choudhury,D.P* and *Freedman,H.I.* 2004.**A course in Ordinary Differential Equations.** Narosa Publishing House, Chennai.

15PMAM104	CORE IV: GRAPH THEORY	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To introduce the concepts of Graph.
2. To learn fundamental properties and some special types of Graph.
3. To introduce Digraphs

CONTENTS

UNIT – I **(10 Hours)**

Graphs and Subgraphs: Graphs and Simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles.

Trees: Trees – Cut Edges and Bonds – Cut vertices – Cayley's formula.

(Chapter - 1 Sections: 1.1 – 1.7)(Chapter - 2 Sections: 2.1 – 2.4)

UNIT – II **(10 Hours)**

Connectivity: Connectivity and Blocks.

Euler Tours and Hamilton Cycles: Euler tours – Hamilton Cycles.

(Chapter - 3 Sections: 3.1 – 3.2)(Chapter - 4 Sections: 4.1 – 4.2)

UNIT – III **(10 Hours)**

Matchings: Matchings- Matchings and Coverings in Bipartite Graphs – Perfect Matchings.

Edge Colourings: Edge chromatic number.

(Chapter - 5 Sections: 5.1 - 5.3)(Chapter - 6 Sections: 6.1)

UNIT – IV **(10 Hours)**

Independent Sets and Cliques: Independent Sets – Ramsey's Theorem.

Vertex Colourings: Chromatic Number.

(Chapter - 7 Sections: 7.1 – 7.2)(Chapter - 8 Sections: 8.1)

UNIT – V **(10 Hours)**

Planar Graphs: Plane and Planar Graphs – Dual Graphs – Euler's Formula – Five colour theorem.

Directed Graphs: Directed Graphs – Directed Paths.

(Chapter - 9 Sections: 9.1 – 9.3, 9.6)(Chapter - 10 Sections: 10.1 – 10.2)

TEXT BOOK:

1. *Bondy, J.A.* and *Murty, U.S.R.* 1976. **Graph Theory with Applications.** North Holland, New York.

REFERENCE BOOKS:

1. *Balakrishnan, R.* and *Ranganathan, K. A.*1999. **Text Book of Graph Theory.** Springer Verlag, New York.

2. *Frank Harary.*1988. **Graph Theory**. Narosa Publishing House, New Delhi.

15PMAM105	CORE V: MATHEMATICAL STATISTICS	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To give a good grip on concepts in Mathematical Statistics.
2. This course provides a sound knowledge about Mathematical problems.

CONTENTS

UNIT – I **(10 Hours)**

Theory of Probability – Introduction – Basic Terminology – Definition of mathematical probability – Examples - Probability axioms – Conditional Probability – Addition theorem – Multiplication theorem – Bayes Theorem – Simple problems.

(Book 1 Sections: 3.1, 3.3, 3.4, 3.8, 3.8.1, 3.8.2, 3.9, 3.9.1, 3.10, 3.11, 4.2)

UNIT – II **(10 Hours)**

Theoretical distributions – Uniform, Binomial, Poisson, geometric, exponential, normal, distributions (Generating function, Mean, variance and Simple problems). Correlation– Regression - Problems– Partial and Multiple Correlation (Three variables only).

(Book 1 Sections: 8.2, 8.3, 8.4, 8.4.1, 8.5, 8.5.2, 8.7, 8.7.2, 9.2, 9.2.2, 9.2.3, 9.2.4, 9.2.5, 9.8, 9.8.1, 10.1, 10.2, 10.3, 10.4, 10.4.1, 10.7, 10.7.1, 11.2, 11.2.1, 11.2.2, 12.7, 12.8)

UNIT – III **(10 Hours)**

Exact sampling Distribution – Student's '*t*' – distribution – Definition – Derivation – Applications – *F* Distribution - Definition – Derivation – Applications – Chi square Distribution - Definition – Derivation – Applications – Relations between *t*, *F*, Chi-square distributions.

(Book 1 Sections: 16.1, 16.2, 16.2.1, 16.3, 16.5, 16.5.1, 16.6, 16.7, 16.8, 15.2)

UNIT – IV **(10 Hours)**

Test of significance -Population, sample –Sampling Methods –Point estimation and interval estimation (Concept only) Hypothesis –Simple hypothesis –Standard error – *t*-test, chi-square test of independent of attributes, ANOVA -One way classification and two way classification and its interpretation with one cell per observations.

(Book 1 Sections: 14.4, 14.6, 14.7, 14.8.3, 14.8.4, 14.8.5)

(Book 2 Sections: 5.1, 5.2, 5.2.1, 5.3, 5.3.1)

UNIT – V **(10 Hours)**

Design of Experiments – Terminology in Experiments – Principals -Complete Randomized Design – Randomized Block Design and Latin Square Design – Analysis – Problems.

(Book 2 Sections: 6.1, 6.2, 6.3, 6.5, 6.6, 6.6.1, 6.6.2, 6.7, 6.7.1, 6.7.2.)

TEXT BOOKS:

1. *Gupta. S.C* and *Kapoor.V.* 2007. **Fundamentals of Mathematical Statistics**, [Eleventh Edition], Sultan Chand and Sons, New Delhi. **(UNIT I-IV)**
2. *Gupta. S.C* and *Kapoor.V*. 2000. **Fundamentals of Applied Statistics**, [Third Edition], Sultan Chand and Sons, New Delhi. **(UNIT IV & V)**

REFERENCE BOOKS:

1. *Fisz.M.* 1963. **Probability Theory and Mathematical Statistics**, John Wiley and Sons, New York.
2. *Trived K.S.*1982. **Probability & Statistics with reliability, queuing & Computer applications**, Prentice Hall.

15PLS101	CAREER COMPETENCY SKILLS – I	SEMESTER – I

Total Hours: 15

OBJECTIVE:

1. To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

Solving Simultaneous Equations Faster - Number System: HCF, LCM - Decimals – Percentages- Averages

UNIT – II **(3 Hours)**

Powers and Roots -Problems on Trains- Problem on ages-Boats and Streams

UNIT – III **(3 Hours)**

Calendar-Clocks -Pipes and cisterns-Permutations and Combinations-Seating Arrangements

UNIT – IV **(3 Hours)**

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions.

UNIT – V **(3 Hours)**

Reading comprehension – Self Introduction – News Paper Review – Book Review

15PMAM201	CORE VI: ALGEBRA	SEMESTER – II

Total Hours : 50

OBJECTIVES :

1. Introducing concept of Field Theory
2. Learning about Galois Theory

CONTENTS

UNIT – I **(10 Hours)**

Group Theory: Another Counting Principle –Sylow's Theorem.

(Chapter - 2 Sections: 2.11 and 2.12)

UNIT – II **(10 Hours)**

Ring Theory: Euclidean Rings –A Particular Euclidean Ring –Polynomial Rings – Polynomials over the Rational Field.

(Chapter - 3 Sections: 3.7 – 3.10)

UNIT – III **(10 Hours)**

Fields: Extension Fields –Roots of Polynomials.

(Chapter - 5 Sections: 5.1, 5.3)

UNIT – IV **(10 Hours)**

Fields: The Elements of Galois Theory –Finite Fields.

(Chapter - 5 Sections: 5.6) (Chapter - 7 Sections: 7.1)

UNIT – V **(10 Hours)**

Linear Transformations: Canonical Forms: Triangular Form –Hermitian, Unitary, and Normal Transformations.

(Chapter - 6 Sections: 6.4, 6.10)

TEXT BOOK:

1. *I.N.Herstein*, 2009. **Topics in Algebra** [Second Edition], John Wiley and sons , New Delhi.

REFERENCE BOOKS :

1. *J.B.Fraleigh*, 1988. **A First Course in Abstract Algebra**, Narosa Publishing House, New Delhi.
2. *M.Artin*, 1991. **Algebra**, Prentice-Hall, Englewood Cliff.
3. *David S.Dummit* and *Richard M.Foote*, 2004. **Abstract Algebra** [Third Edition], John Wiley and Sons Publications , India.

15PMAM202	CORE VII: MEASURE THEORY AND INTEGRATION	SEMESTER – II

Total Hours: 50

OBJECTIVES:

1. To provide a basic knowledge in Lebesgue measure and integration
2. To study inequalities and L^p Spaces.
3. To study signed measures and decomposition theorems.

CONTENTS

UNIT – I **(10 Hours)**

Measure on the Real Line: Lebesgue Outer Measure - Measurable Sets – Regularity - Measurable Functions.

(Chapter - 2 Sections: 2.1 - 2.4)

UNIT – II **(10 Hours)**

Integration of Functions of a Real Variable: Integration of Non-Negative Functions - The General Integral - Integration of Series - Riemann and Lebesgue Integrals.

(Chapter - 3 Sections: 3.1 - 3.4)

UNIT – III **(10 Hours)**

Abstract Measure Spaces: Measures and Outer Measures - Extension of Measure - Uniqueness of the Extension - Completion of a Measure - Measure Spaces.

(Chapter - 5 Sections: 5.1 - 5.5)

UNIT – IV **(10 Hours)**

Inequalities and the L^p Spaces: The L^p Spaces - Convex Functions - Jensen's Inequality - The Inequalities of Holder and Minkowski - Completeness of $L^p(\mu)$

(Chapter - 6 Sections: 6.1 - 6.5)

UNIT – V **(10 Hours)**

Signed Measures and their Derivatives: Signed Measures and the Hahn Decomposition - The Jordan Decomposition - The Radon-Nikodyn Theorem

(Chapter - 8 Sections: 8.1 - 8.3)

TEXT BOOK:

1. *De.Barra* 1981. **Measure Theory and Integration.** [First Edition]. New Age International Publishers, New Delhi.

REFERENCE BOOKS:

1. *Munroe,* M.E. 1953. **Introduction to Measure and Integration**. Addison Wesley, Mascow.
2. *Natanson, I.P.* 1955. **Theory of Functions of a Real Variable.** Frederick Ungar Publishing Company, New York.

15PMAM203	CORE VIII: COMPLEX ANALYSIS	SEMESTER – II

Total Hours: 50

OBJECTIVES:

1. To study the concepts of complex functions.
2. To learn the development of concept of complex integration.
3. To gain the knowledge about singularities and Residues.
4. To gain the knowledge about power series expansions and Entire functions.

CONTENTS

UNIT – I **(10 Hours)**

Conformality: Arcs and closed curves – Analytic functions in Regions – Conformal mapping – Length and Area .**Linear Transformations**: The linear group – the Cross ratio – Symmetry.

(Chapter – 3 Sections: 2.1 – 2.4, 3.1 – 3.3)

UNIT – II **(10 Hours)**

Complex Integration: Fundamental theorems: Line integrals – Rectifiable Arcs – Line integrals as functions of Arcs – Cauchy's theorem for 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.

(Chapter – 4 Sections: 1.1 - 1.5, 2.1 - 2.3)

UNIT – III **(10 Hours)**

Local Properties of Analytical Functions: Removable Singularities, Taylor's theorem – The maximum Principle. **The Calculus of Residues**: The Residue theorem – The Argument Principle – Evaluation of Definite Integrals.

(Chapter – 4 Sections: 3.1, 3.4, 5.1 - 5.3)

UNIT – IV **(10 Hours)**

Harmonic Functions: Definition and Basic properties – the mean- value property – Poisson's Formula – Schwarz's theorem – The Reflection principle.

(Chapter 4 Sections: 6.1 - 6.5)

UNIT – V **(10 Hours)**

Power Series Expansions : Weierstrass's theorem – The Taylor's series – The Laurent Series-Entire Functions – Jensen's formula.

(Chapter – 5 Sections: 1.1 - 1.3, 3.1)

TEXT BOOK:

1. *Lars V.Ahlfors, 1979.* **Complex Analysis** [Third edition] ,McGraw Hill Book Company, New Delhi.

REFERENCE BOOKS:

1. *Ponnusamy,S.* 1980.**Functions of Complex Variables.** Narosa Publishing House, New Delhi.
2. *Convey,J.B.* 1991.**Functions of One Complex Variable**.[Second Edition].Narosa Publishing House, New Delhi.

15PMAM204	CORE IX: PARTIAL DIFFERENTIAL EQUATIONS	SEMESTER – II

Total Hours: 50

OBJECTIVES:

1. To describe the physical systems in terms of Partial Differential Equations by using Mathematical Modeling.
2. To learn analytical methods used to solve Partial Differential Equations.

CONTENTS

UNIT – I **(10 Hours)**

First order, Quasi-linear Equations and Method of Characteristics

Introduction - Classification of first order equations – Construction of a first order equation – Method of characteristics and general solution.

(Chapter – 2 Sections : 2.1 – 2.3, 2.5)

UNIT – II **(10 Hours)**

Mathematical Models: The Classical equation – The vibrating string – The vibrating membrane - Waves in elastic medium. Classification of second order equations: Second order equations in two independent variables – Canonical forms – Equations with constant coefficients – General solution.

(Chapter - 3 Sections: 3.1 – 3.4) (Chapter - 4 Sections: 4.1 – 4.4)

UNIT – III **(10 Hours)**

The Cauchy problem and Wave Equation: The Cauchy problem – Cauchy – Kowlalewsky theorem –Homogeneous wave equation – Initial – Boundary value problems - Non homogeneous boundary conditions – Finite string with fixed ends.

(Chapter - 5 Sections: 5.1 - 5.6)

UNIT – IV **(10 Hours)**

Methods of separation of variables: Separation of variables – The vibrating string problem – Existence and Uniqueness of solution of the vibrating string problem.

(Chapter - 7 Sections: 7.1 – 7.4)

UNIT – V **(10 Hours)**

Boundary value problems: Boundary value problems – Maximum and minimum. Principles - Uniqueness and Continuity Theorems – Dirichlet problems for a circle – Dirichlet problems for a Circular Annulas – Neumann problem for circle.

(Chapter - 9 Sections: 9.1 – 9.6)

TEXT BOOK:

1. *Tyn Myint, U.* and *Lokenath Debnath.* 2007. **Partial Differential Equation for Scientists and Engineers.** Birkhauser publishers, Boston.

REFERENCE BOOKS:

1. *Sneddon, I.N.* 1957. **Elements of Partial Differential Equations.** Tata McGraw Hill Company, New Delhi.
2. *Evans, L.C.* 2003. **Partial Differential Equations.** AMS providence.

15PMAEL201	ELECTIVE I: CONTROL THEORY	SEMESTER – II

Total Hours: 50

OBJECTIVES:

1. To impart analytical skills, in the areas of Initial and Boundary value problem of Control techniques.
2. It serves as a prerequisite for specialized studies and research.

CONTENTS

UNIT – I **(10 Hours)**

OBSERVABILITY: Basic Results of Differential Equations – Fixed Point Methods - Introduction – Linear System - Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems.

(Chapter - 1 Sections: 1.2, 1.3) (Chapter - 2 Sections: 2.1, 2.2)

UNIT – II **(10 Hours)**

CONTROLLABILITY: Linear Systems **-** Controllability Grammian – Adjoint systems – Constant coefficient systems –Steering function – Nonlinear systems.

(Chapter - 3 Sections: 3.1, 3.2)

UNIT – III **(10 Hours)**

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

(Chapter - 4 Sections: 4.1 – 4.3)

UNIT – IV **(10 Hours)**

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

(Chapter - 5 Sections: 5.1, 5.2)

UNIT – V **(10 Hours)**

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

(Chapter - 6 Sections: 6.1, 6.2)

TEXT BOOK:

1. *Balachandran. K* and *Dauer. J.P.*1999 **Elements of Control Theory,** Narosa Publishing House, New Delhi.

REFERENCE BOOKS:

1. *Conti. R*. 1976, **Linear Differential Equations and Control,** Academic Press, London.
2. *J. 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.

15PMAEL202	ELECTIVE I: STOCHASTIC PROCESS	SEMESTER - II

Total Hours: 50

OBJECTIVES:

1. To give a good grip on concepts in Stochastic Process (Random Process).
2. This course provides a sound knowledge about rare events occurrence problems.

CONTENTS

UNIT - I **(10 Hours)**

Stochastic Process – Introduction – Definition – Classification - Stationary process - Second order process - Markov chain - Definition - Transition probability - Order of Markov Chain – Chapman - Kolmogorov equations - Determination of higher transition probability using Chapman – Kolmogorov equations.

(Chapter - 2 Sections: 2.1, 2.2, 2.3, 2.3.1)

(Chapter – 3 Sections: 3. 3.1, 3.1.1, 3.1.2, 3.2, 3.5)

UNIT - II **(10 Hours)**

Markov Process with discrete state space: Introduction – Poisson Process – Postulates – Derivation – Properties - Poisson Process and Related distributions -Inter arrival time – Examples - Pure Birth Process - Birth and Death Process.

(Chapter - 4 Sections: 4.1, 4.1.1, 4.1.2, 4.1.3, 4.2, 4.2.1, 4.3.3, 4.4.)

UNIT - III **(10 Hours)**

Markov Process with continuous state space: Introduction – Brownian motion - Wiener Process - Differential equations for a Wiener process - Kolomogorov equations - First passage time distribution for Wiener process – Distribution of the first passage time to a fixed point.

(Chapter - 5 Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.5.1, 5.5.2.)

UNIT - IV **(10Hours)**

Stationary Process and Time Series: Introduction – Definition – Purely Random process(White Noise Process) – First order Markov process – Moving Average (MA) process – Autoregressive Process (*AR* Process) – *AR* Process of order 2 (Yule process) - Time and Frequency Domain - Power spectrum – Properties of covariance and correlation functions – Birth and Death process of Queuing model .

(Chapter – 8 Sections: 8.1, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5, 8.3, 8.3.1, 10.4.1.)

UNIT - V **(10 Hours)**

Renewal Process and Theory: Renewal Process – Definition – Assumption – Renewal process in discrete time – Relation between *F(S)* and *P(S)*. Renewal processes in continuous time – Renewal function and Renewal density - Statement of Black Well's and Smith's renewal theorems - Residual and excess lifetimes – Poisson Process as a Renewal Process- Distribution of *Y(t)* and *Z(t)* – Moments of the Asymptotic Distributions.

(Chapter – 6 Sections: 6.1, 6.1.1, 6.1.2, 6.2, 6.2.1, 6.5.4, 6.7)

TEXT BOOK:

1. *Medhi, J.* 2006. **Stochastic Processes.** [Second Edition]. New Age International Publications, New Delhi

REFERENCE BOOKS:

1. *Karlin* and *Taylor, H.M.* 1975. **First Course in Stochastic Processes.** [**Volume 1**]. Academic Press.
2. *Bhat, B.R.* 2000, **Stochastic Models: Analysis and Applications.** New Age International Publications, India.

15PMAEL203	ELECTIVE I: OPERATOR THEORY	SEMESTER – II

Total Hours : 50

OBJECTIVES:

1. To study about Linear Operators on a Hilbert space.
2. Introducing the Hyponormal Operator.

CONTENTS

UNIT – I **(10 Hours)**

Bounded Linear Operators on a Hilbert Space.

(Chapter - 2 Section: 2.1)

UNIT – II **(10 Hours)**

Partial Isometry Operator and Polar Decomposition of an operator - Polar Decomposition of an Operator and Its Applications.

(Chapter - 2 Sections: 2.2 , 2.3)

UNIT – III **(10Hours)**

Spectrum of an Operator - Numerical Range of an Operator.

(Chapter - 2 Sections: 2.4 , 2.5)

UNIT – IV **(10 Hours)**

Relations among Several Classes of Non-normal Operators – Characterizations of Convexoid Operators and Related Examples.

(Chapter - 2 Sections: 2.6 , 2.7)

UNIT – V **(10 Hours)**

Young Inequality and Holder-McCarthy Inequality – Lowner-Heinz Inequality and Furuta Inequality – Chaotic Order and the Relative Operator Entropy – Aluthge Transformation on p-Hyponormal Operators and log-Hyponormal Operators.

(Chapter - 3 Sections: 3.1 - 3.4)

TEXT BOOK:

1. *Takayuki Furuta ,* 2001. **Invitation to Linear Operators**, Taylor & Francis.

REFERENCE BOOKS:

1. *P. Aiena*,2004.**Fredholm and Local Spectral Theory with Applications to Multipliers**, Kluwer Academic Publishers, New York, Boston, Dor Drecht, London, Moscow.
2. *J.B.Conway*, 1990.**A Course in Functional Analysis**, Second Edition, Springer Verlag, New York.
3. *K.B.Lawsen, M.M.Neumann*, 2000. **An Introduction to Local Spectral Theory**, London Mathematical Society, Monographs 20, Clarendon press, Oxford.

15PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER- II

Total Hours: 25

OBJECTIVE:

1. To make the students to understand the concepts of human rights.

CONTENTS

UNIT - I **(5 Hours)**

Human Rights: Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution.

UNIT - II **(5 Hours)**

Civil and Political Rights: Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality - Right to Religion - Right to Form Associations and Unions - Right to Movement - Right to Family - Right to Contract - Right to Constitutional Remedies - Right to Vote and Contest in Elections - Right to Hold Public Offices - Right to Petition - Right to Information - Right to Criticise the Government - Right to Democratic Governance.

UNIT - III **(5 Hours)**

Economic Rights: Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment.

UNIT - IV **(5 Hours)**

Women's Rights: Right to Inheritance - Right to Marriage - Divorce and Remarry - Right to Adoption - Right to Education - Right to Employment and Career Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care - Right to Education - Issues Related with Infanticide - Street Children - Child Labour - Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights - Tribal Rights - Nomads Rights.

UNIT - V **(5 Hours)**

Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights - UNO - National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights.

REFERENCE BOOK:

1. *Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.

15PLS201	CAREER COMPETENCY SKILLS – II	SEMESTER – II

Total Hours: 15

OBJECTIVE:

1. To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

Assertiveness and Self Confidence-Career Opportunities-Industry expectations (Skill set)

UNIT – II **(3 Hours)**

Campus to Corporate-Effective Communication

UNIT – III **(3 Hours)**

Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations-Prepared -'Just A Minute' Sessions (JAM)

UNIT – IV **(3 Hours)**

Body Language-Dress code-Telephone etiquettes- Email etiquettes-Group Discussion-Creativity-Presentation skills

UNIT – V **(3 Hours)**

Interviewing Techniques- Do's and Don'ts of Interview- Mock Interview.

15PMAM301	CORE X: TOPOLOGY	SEMESTER – III

Total Hours: 50

OBJECTIVES:

1. To study about Topological spaces.
2. To learn the concepts of continuity, connectedness and compactness.
3. To learn the method of extending functions on subsets to the whole space.

CONTENTS

UNIT – I **(10 Hours)**

Topological Spaces – Basis for a topology – The order topology – The product topology on X x Y – Closed sets and Limit Points.

(Chapter - 2 Sections: 12 - 15, 17)

UNIT – II **(10 Hours)**

The Metric topology – Continuous functions – The product topology.

(Chapter - 2 Sections: 18 – 20)

UNIT – III **(10 Hours)**

Connected spaces – Connected subspaces of the real line – Components and Local Connectedness.

(Chapter - 3 Sections: 23 – 25)

UNIT – IV **(10 Hours)**

Compact Spaces – Compact subspaces of the real line - Limit Point Compactness - Local compactness.

(Chapter - 3 Sections: 26 – 29)

UNIT – V **(10 Hours)**

Countability axioms - The separation axioms - Normal Spaces - The Urysohn lemma – Tietz's Extension Theorem .

(Chapter - 4 Sections: 30 – 33, 35)

TEXT BOOK:

1. *Munkers.R. James.* 2003. **Topology.** [Second Edition]. Prentice Hall of India Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. *Dugundji J. Allyn* and *Bacon*. 1966. **Topology.** Prentice Hall of India Pvt. Ltd., New Delhi.
2. *Simmons, F. George.* 1963. **Introduction to Topology and Modern Analysis**. McGraw Hill Book Company, New Delhi.
3. *Sze-Tsen Hu*. 1965. **Elements of General Topology**. Holden – Day. Inc.

15PMAM302	CORE XI: MECHANICS	SEMESTER – III

Total Hours: 50

OBJECTIVES:

1. To learn the concepts of Mechanical system, Lagrange's and Hamilton's Equations.
2. To introduce the concepts of Hamilton – Jacobi Theory and Canonical Transformations.
3. To enable the learner to apply the principles of Mechanics in Scientific situations and daily life.

CONTENTS

UNIT – I **(10 Hours)**

Introductory Concepts: The Mechanical System – Generalized Co-ordinates – Constraints – Virtual work – Energy and Momentum.

(Chapter - 1 Sections: 1.1 - 1.5)

UNIT – II **(10 Hours)**

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

(Chapter - 2 Sections: 2.1 - 2.3)

UNIT – III **(10 Hours)**

Hamilton's Equations: Hamilton's Principle – Hamilton's Equations.

(Chapter - 4 Sections: 4.1 - 4.2)

UNIT – IV **(10 Hours)**

Hamilton-Jacobi Theory: Hamilton's Principal Function – Hamilton – Jacobi Equation – Separability.

(Chapter - 5 Sections: 5.1 - 5.3)

UNIT – V **(10 Hours)**

Canonical Transformations: Differential forms and generating functions – Special Transformations – Lagrange and Poisson brackets.

(Chapter - 6 Sections: 6.1 - 6.3)

TEXT BOOK:

1. Greenwood, T. 1985. **Classical Dynamics.** Prentice Hall of India, New Delhi.

REFERENCE BOOKS:

1. *Goldstein, H.* 2001. **Classical Mechanics.** Narosa Publishing House, New Delhi.
2. *Synge, J.L.* and *Griffth, B.A.* 1970. **Principles of Mechanics.** McGraw Hill Book Company, New York.
3. *Rane, N.C.* and *Joag, P.S.* 1991. **Classical Mechanics.** Tata McGraw Hill, New Delhi.

15PMAM303	CORE XII: NUMERICAL ANALYSIS	SEMESTER – III

Total Hours: 50

OBJECTIVES:

1. Introducing the concepts of Picard Method.
2. To study the methods of solving ODE, PDE and Runge-Kutta methods

CONTENTS

UNIT – I **(10 Hours)**

Numerical Solution to Ordinary Differential Equations

Introduction – Power Series Solution – Pointwise Methods – Solution by Taylor's Series – Taylor's Series method for simultaneous first order differential equations.

(Chapter – 11 Sections: 11.1 - 11.5)

UNIT – II **(10 Hours)**

Numerical Solution to Ordinary Differential Equations Continued

Taylor series method for higher order differential equations - Picard's Method of successive approximations. Picard's method for simultaneous first order differential equations – Picard's method for second order differential equations.

(Chapter – 11 Sections: 11.6 – 11.9)

UNIT – III **(10 Hours)**

Numerical Solution to Ordinary Differential Equations Continued

Runge-Kutta Methods for simultaneous first order equations – Runge-Kutta method for second order differential equation – Predictor-Corrector Methods – Milne's method – Adams-Bashforth method.

(Chapter – 11 Sections: 11.16 – 11.20)

UNIT – IV **(10 Hours)**

Numerical Solution to Partial Differential Equations

Introduction – Difference Quotients – Geometrical representation of partial difference quotients – Classification of partial differential equations – Elliptic equations – Solution to Laplace's equation by Liebmann's iteration process .

(Chapter – 12 Sections: 12.1 – 12.6)

UNIT – V **(10 Hours)**

Numerical Solution to Partial Differential Equations Continued

Poisson's Equation - It's Solution – Parabolic Equations – Hyperbolic Equations – Solution to Partial Differential Equations by Relaxation Method.

(Chapter – 12 Sections: 12.7 – 12.10)

TEXT BOOK:

1. *Dr. V.N. Vedamurthy, Dr.N.Ch.S.N.Iyengar*. 1998. **Numerical Methods.** Vikas publishing house pvt ltd, New Delhi.

REFERENCE BOOKS:

1. *Jain, M.K., Iyengar, S.R.K.* and *Jain, R.K.* 1993. **Numerical Methods for Scientific and Engineering Computation.** [Third Edition]. New Age International (P) Ltd., New Delhi.
2. *Jain, M.*K. 1983. **Numerical Solution of Differential Equations**. [Second Edition]. McGraw Hill International Edition.

15PMAEL301	ELECTIVE II: DIFFERENCE EQUATIONS	SEMESTER – III

Total Hours: 50

OBJECTIVES:

1. To study the concept of logic.
2. To study the concept of Boolean Algebra
3. Introducing the concept of 'Theory of Automata.

CONTENTS

UNIT-I

DIFFERENCE CALCULUS: (10 Hours)

Difference Operator - Summation – Generating Function and Approximate Summation.

(Chapter - 2 Sections: 2.1 – 2.3)

UNIT-II

LINEAR DIFFERENCE EQUATIONS (10 Hours)

First order equations - General Results for linear equations - Solving Linear equations

(Chapter - 3 Sections: 3.1 – 3.3)

UNIT-III

LINEAR DIFFERENCE EQUATIONS (Contd.) (10 Hours)

Equations with variable Coefficients – The z – Transform

(Chapter - 3Sections: 3.5 and 3.7).

UNIT-IV

STABILITY THEORY (10 Hours)

Initial Value problems for linear systems – Stability of linear systems

(Chapter – 4 Sections: 4.1 and 4.2).

UNIT-V (10 Hours)

ASYMPTOTIC METHODS

Introduction – Asymptotic analysis of sums – linear equations

(Chapter - 5 Sections: 5.1 – 5.3)

TEXT BOOK :

1. *W.G.Kelly* and *A.C.Peterson* , 1991. **Difference Equations**, Second Edition Academic Press , New York.

REFERENCE BOOKS :

1. *S.N.Elaydi*, 1991.**An Introduction to Difference Equations**, Springer – Verlag, New York.
2. *R.Mickens*, 1990.**Difference Equations** ,Van Nostrand Reinhold, New York.
3. *R.P.Agarwal*, 1992. **Difference Equations and Inequalities**, Marcel Dekker, New York,

15PMAEL302	ELECTIVE II : FUZZY SETS AND FUZZY LOGIC	SEMESTER – III

Total Hours: 50

OBJECTIVES:

1. To learn about basic concepts of fuzzy sets.
2. To learn about fuzzy relations and measures.
3. Learning about general applications of fuzzy logic.

CONTENTS

UNIT – I **(10 Hours)**

CRISP SETS AND FUZZY SETS: Fuzzy Sets basic types –Fuzzy Sets basic concepts Fuzzy Set Vs Crisps Sets: Additional Properties of Alpha Cuts-Representations of fuzzy sets – Extension principle for Fuzzy Sets.

(Chapter - 1 Sections: 1.3, 1.4) (Chapter - 2 Sections: 2.1– 2.3)

UNIT – II **(10 Hours)**

OPERATIONS ON FUZZY SETS: Types of Operations - Fuzzy Complements – Fuzzy intersection: t-norms – Fuzzy unions: t-conorms – Combination of Operations – Aggregation operations

(Chapter - 3 Sections: 3.1 – 3.6)

UNIT – III **(10 Hours)**

FUZZY ARITHMETIC: Fuzzy Numbers – Linguistic Variables – Arithmetic Operations on intervals – Arithmetic Operations on Fuzzy Numbers – Lattice of Fuzzy Numbers – Fuzzy Equations.

(Chapter - 4 Sections: 4.1 – 4.6)

UNIT – IV **(10 Hours)**

FUZZY RELATIONS: Crisp and Fuzzy Relations – Projections and Cylindric Extensions – Binary Fuzzy Relations – Binary Relations on a single set – Fuzzy Equivalence Relations.

(Chapter - 5 Sections: 5.1 – 5.5)

UNIT – V **(10 Hours)**

APPLICATIONS: Introduction: Medicine – Economics – Fuzzy Sets and Genetic Algorithms – Fuzzy Regression.

(Chapter - 17 Sections: 17.1 – 17.5)

TEXT BOOK:

1. *George J. Klir* and *Boyuan*, 2006. **Fuzzy Sets and Fuzzy Logic-Theory and Applications,** Prentice-Hall of India Private Limited

REFERENCE BOOKS:

1. *H.J.Zimmermann*, **Fuzzy Set Theory and its applications** [Fourth Edition].Springer International Edition.
2. *George J. Klir* and *Tina A. Folger*, 1995. **Fuzzy Sets, Uncertainty and Information** [Fourth Edition]. Prentice-Hall of India Private Limited.

15PMAEL303	ELECTIVE II: AUTOMATA THEORY	SEMESTER – III

Total Hours: 50

OBJECTIVE:

1. To study the concept of logic.
2. To study the concept of Boolean Algebra
3. Introducing the concept of 'Theory of Automata.

CONTENTS

UNIT-I **(10 Hours)**

Logic – Introduction - TF – statements – Connectives – atomic and compound statements – well formed formulae – Truth Table of a formula – Tautology.
(Chapter - 9 Sections: 1 - 7).

UNIT-II **(10 Hours)**

Tautological implications and equivalence of formulae – Replacement process – Functionally complete sets of connectives and duality law – Normal forms – Principal normal forms.
(Chapter - 9 Sections: 8 - 12).

UNIT-III **(10 Hours)**

Theory of inference – indirect method of proof – open statements – Quantifiers.
(Chapter - 9 Sections: 13 - 15).

UNIT-IV **(10 Hours)**

Boolean Algebra – Boolean Polynomials – Karnaugh map (upto 4 Variables) – Switching circuits (simple circuits)
(Chapter – 10 Sections: 5 - 8).

UNIT-V **(10 Hours)**

Theory of Automata: Definition – Description **-** Transition systems – Properties – Acceptability of a string by a finite automation – Non deterministic finite state machines – Equivalence of DFA and NDFA – Mealy and Moore Models.
(Chapter - 2 Sections: 2.1 - 2.8).

TEXT BOOKS :

1. *M.K.Venkataraman , N.Sridharan* and *N.Chandrasekaran*, 2000. **Discrete Mathematics**, National Publish Company, New Delhi. (For first Four Units)
2. *K.L.P.Mishra* and *Chandrasekaran* , 2001.**Theory of computer sciences** [Second Edition], Prentice Hall of India Private Ltd, New Delhi. (For Unit V)

REFERENCE BOOK :

1. J.*P.Trembley* and *R.Manohar* ,1975. **Discrete Mathematical Structures with applications to Computer Science** , International Edition , Mc Graw Hill.

15PCSMAI301	INTER DICIPLINARY COURSE : PROGRAMMING IN C++	SEMESTER - III

Total Hours: 45

OBJECTIVES:

1. Write robust, maintainable, elegant and efficient C++ code
2. Be able to deploy good C++ programming practices
3. Be able to implement advanced Object-Oriented techniques in C++ to realize efficient and flexible applications

CONTENTS

UNIT - I **(8 Hours)**

Principles of Object Oriented Programming: Object Oriented Paradigm – Basic concepts of OOP – Benefits of OOP – Applications of OOP – Beginning with C++: Structure of C++ program – Simple C++ program – Compiling and Linking.

UNIT - II **(9 Hours)**

Tokens, Expressions and Control Structures: Keywords – Identifiers and Constants – Variables – Data Types – Operators – Control Structures – Functions in C++.

UNIT - III **(9 Hours)**

Classes and Objects: Introduction – Defining Member Function – Arrays within a class – Arrays of Objects – Friendly Functions - Constructors and Destructors: Introduction – Parameterized Constructors – Copy Constructors – Destructors.

UNIT - IV **(10 Hours)**

Operator Overloading: Introduction - Rules – Overloading Unary and Binary Operators – Inheritance: Single – Multilevel – Multiple – Hybrid – Virtual Base Class – s – Virtual Functions.

UNIT - V **(9 Hours)**

Working with Files: Introduction – Opening and Closing a File – File Modes – Sequential Input and Output Operations – Random Access File.

TEXT BOOK:

1. *Balagurusamy, E*. 2007. **Object Oriented Programming with C++**. [Third Edition]. Tata McGraw Hill Publishing Company Limited, New Delhi.

REFERENCE BOOKS:

1. *Ravichandran, D*. 2002. **Programming with C++**. [Second Edition] .Tata McGraw Hill publishing company limited, New Delhi.
2. *Ira Pohl*. 2003. **Object oriented Programming using C++**. [Second Edition] . Pearson Education Asia, New Delhi
3. *Bjarne Stroustrup*. 2000. **The C++ Programming Language**. [Third Edition]. Addison Wesley, Boston.
4. *John R. Hubbard*. 2003. **Programming with C++**. Schaums outline series,TMH, New Delhi.

15PCSMAIP301	INTER DICIPLINARY COURSE PRACTICAL: PROGRAMMING IN C++	SEMESTER - III

1. Program for Classes and Objects.
2. Program for Classes and Objects using Scope Resolution Operator.
3. Program for Inline functions.
4. Program for Friend functions.
5. Program for Function Overloading.
6. Program using Constructor and Destructor.
7. Program using Operator Overloading.
8. Program using Pure Virtual Function.
9. Program for Single and Multiple Inheritances.
10. Program for Hierarchical and Hybrid Inheritances.

15PMAM401	CORE XIII: FUNCTIONAL ANALYSIS	SEMESTER – IV

Total Hours: 50

OBJECTIVES :

1. To study the details of Banach and Hilbert Spaces.
2. To acquire knowledge of Orthonormal sets and convergence of sequences.
3. To have an introduction of Banach algebras.

CONTENTS

UNIT – I **(10 Hours)**

Banach spaces: Definition and some examples – Continuous linear transformations – The Hahn-Banach theorem.

(Chapter – 9 Sections: 46 – 48)

UNIT – II **(10 Hours)**

The natural imbedding of N in N** -The open mapping theorem - The conjugate of an operator – Hilbert spaces: Definition and some simple properties.

(Chapter – 9 Sections: 49 - 51) (Chapter – 10 Sections: 52)

UNIT – III **(10 Hours)**

Orthogonal complements - Orthonormal sets - The Conjugate space H* - The adjoint of an operator.

(Chapter – 10 Sections: 53 –56)

UNIT – IV **(10 Hours)**

Self-adjoint operators - Normal and unitary operators –Projections.

(Chapter – 10 Sections: 57 – 59)

UNIT – V **(10 Hours)**

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

(Chapter – 12 Sections: 64 – 68)

TEXT BOOK:

1. *G.F. Simmons*, 2004.**Introduction to Topology and Modern Analysis**, McGraw – Hill Book Company, London.

REFERENCE BOOKS:

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

2. *G. Bachman* and *L. Narici*, 1966.**Functional Analysis**, Academic Press, New York.

3. *L.A. Lusternik* and *V.J. Sobolev*,1971. **Elements of Functional Analysis**, Hindustan Publishing Corporation, New Delhi.

4. *A.E. Taylor*,1958. **Introduction to Functional Analysis**, John Wiley and Sons, New York.

15PMAM402	CORE XIV: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS	SEMESTER – IV

Total Hours: 50

OBJECTIVES:

1. To learn about the concepts of Fredholm and Volterra integral equations.
2. To learn the applications of integral equations to Ordinary differential equations.
3. To learn the applications of integral equations to Partial differential equations.

CONTENTS

UNIT – I **(10 Hours)**

Introduction – Regularity Conditions-Special kinds of kernels – Eigen values and Eigen functions- Convolution Integral.

Integral Equations with Separable Kernels: Reduction to a System of Algebraic Equations – Examples –Fredhlom Alternative - Fredhlom Alternative Theorem – An Alternative Theorem - An Approximation Method – Examples.

(Chapter - 1 Sections: 1.1 - 1.16) (Chapter – 2 Sections: 2.1 - 2.5)

UNIT – II **(10 Hours)**

Methods of Successive Approximations: Iterative Scheme – Examples - Volterra integral equation – Examples – Some Results about the Resolvent Kernels.

Classical Fredhlom Theory: The method of Solution of Fredhlom- Fredhlom's First Theorem – Examples.

(Chapter - 3 Sections: 3.1 - 3.5) (Chapter - 4 Sections: 4.1 – 4.3)

UNIT – III **(10 Hours)**

Applications To Ordinary differential equations: Initial value problem – Boundary value problem – Examples – Dirac delta function – Green's function Approach- Green's function for N^{th} Order Ordinary differential equations- Modified Green's function.

(Chapter -5 Sections: 5.1 – 5.9)

UNIT – IV **(10 Hours)**

Applications To Partial differential equations: Introduction – Integral Representation Formulas for the solution of the Laplace and Poisson Equations - Green's function Approach-The Helmoltz Equation.

(Chapter - 6 Sections: 6.1 - 6.7)

UNIT – V **(10 Hours)**

Variational Problems with Fixed Boundaries: The concept of variation and its properties – Euler's Equation – Variational Problems for functionals of the form – Functionals dependent on higher order derivatives - Functionals dependent on functions of several independent variables – Variational Problems in Parametric form.

(Chapter – 1 Sections: 1.1 - 1.6)

TEXT BOOKS:

1. *Ram P. Kanwal*. 1971. **Linear Integral Equations.** Academic Press, New York. (For First four units)
2. *Gupta,A.S.*2009.**Calculus of Variations With Applications** PHI Learning Private Limited, New Delhi. (For Unit – V)

REFERENCE BOOKS:

1. *Raisinghania, M.D*. 2009. **Integral Equations and Boundary Value Problems.** S.Chand & Company Ltd., New Delhi.
2. *Sneddon, I.N.* 1996. **Mixed Boundary Value Problems in Potential Theory.** Academic Press, North Holland.

15PMAM403	CORE XV: FLUID DYNAMICS	SEMESTER – IV

Total Hours: 50

OBJECTIVES:

1. To introduce the Equations of motion of a fluid.
2. To provide knowledge about two-dimensional flows, three dimensional flows and viscous flows.

CONTENTS

UNIT – I **(10 Hours)**

Introduction: General Description of Fluid Mechanics - Continuum Mechanics - Fluid Properties.

Kinematics of Fluids: Methods of Describing Fluid Motion - Translation, Rotation and Rate of Deformation - Streamlines Path Lines and Streak Lines - The Material Derivative and Acceleration - Vorticity.

(Chapter – 1 Sections: 1.1 - 1.3) (Chapter – 3 Sections: 3.1 - 3.5)

UNIT – II **(10 Hours)**

Fundamental Equations of the Flow of Viscous Compressible Fluids:

The Equation of Continuity - Conservation of Mass - Equations of Motion (Navier-Stokes Equation) – Conservation of Momentum – The Energy Equation – Conservation of energy.

One – Dimensional Inviscid Incompressible flow:

Equation of continuity – Stream Tube Flow – Equation of Motion – Euler's Equation – The Bernoulli Equation.

(Chapter – 5 Sections: 5.1 - 5.3)(Chapter – 6 Sections: 6.1 - 6.3)

UNIT – III **(10 Hours)**

Two and Three Dimensional, Inviscid Incompressible Flow

Basic Equations and Concepts of Flows: Equation of Continuity - Eulerian Equations of Motion - Circulation Theorems - Velocity Potential - Irrotational Flow - Integration of the Equations of Motion - Bernoulli's Equation. Two-Dimensional Flow Examples.

(Chapter – 7 Sections: 7.1 - 7.5, 7.12)

UNIT – IV **(10 Hours)**

Laminar Flow of Viscous Incompressible Fluids: Similarity of Flows -The Reynolds Number - Flow between Parallel Flat Plates – Couette Flow – Plane Poiseuille Flow Steady Flow in Pipes: Flow between Two Coaxial Cylinders - Flow between Two Concentric Rotating Cylinders.

(Chapter – 8 Sections: 8.1, 8.3 – 8.5)

UNIT – V **(10 Hours)**

The Laminar Boundary Layer: Properties of the Navier-Stokes Equations - Boundary Layer Concept - The Boundary Layer Equations in Two-Dimensional Flow - The Boundary Layer along a Flat Plate – The Blasius Solution – Shearing Stress and Boundary layer Thickness - Momentum Integral Theorems for the Boundary Layer.

(Chapter – 9 Sections: 9.1 – 9.3, 9.5)

TEXT BOOK:

1. *Yuan, S.W.* 1969. **Foundation of Fluid Mechanics**. Prentice-Hall of India Private Limited, New Delhi.

REFERENCE BOOKS:

1. *Curle. N* and *Davies. H.J.* 1968 **Modern Fluid Dynamics Vol-I"** D Van Nostrand Company Ltd., London. Princeton, N.J.Toronto.
2. *Yuan. S.W.* 1988 **Foundations of Fluid Mechanics,** Prentice- Hall of India, New Delhi.
3. *Chorlton, F.* 1985. **Text Book of Fluid Dynamics**. Publishers & Distributors, New Delhi.

15PMAM404	CORE XVI: OPTIMIZATION TECHNIQUES	SEMESTER – IV

Total Hours: 50

OBJECTIVES:

1. To provide the Mathematical techniques to model and analyze decision problems.
2. To provide the effective application of optimization techniques in real life.

CONTENTS

UNIT – I **(10 Hours)**

Advanced Linear Programming: Revised Simplex Method: Development of the optimality and Feasibility conditions – Revised Simplex Algorithm – Bounded Variables Algorithm

(Chapter - 7 Sections: 7.2.1, 7.2.2 and 7.3)

UNIT – II **(10 Hours)**

Integer Linear Programming: Integer programming Algorithms: The branch and bound algorithm - Cutting plane algorithm.

(Chapter - 9 Sections: 9.2.1, 9.2.2)

UNIT – III **(10 Hours)**

Dynamic Programming: Deterministic Dynamic programming - Recursive nature of computation in D.P. – Forward and Backward recursion – Selected DP applications – Work – Force Size Model – Equipment Replacement Model

(Chapter - 10 Sections: 10.1, 10.2, 10.3.2, 10.3.3)

UNIT – IV **(10 Hours)**

Classical Optimization Theory: Unconstrained problems – Necessary and sufficient conditions – The Newton Raphson method – Constrained problems – Equality constrains (Jacobi method and Lagrangian method)

(Chapter - 18 Sections: 18.1.1, 18.1.2, 18.2.1)

UNIT – V **(10 Hours)**

Non Linear Programming: Unconstrained algorithms – Direct search method – Gradient method – Constrained algorithms – Separable programming – Quadratic programming.

(Chapter - 19 Sections: 19.1.1, 19.1.2, 19.2.1, 19.2.2)

TEXT BOOK:

1. *Hamdy A Taha.* 2007. **Operations Research: An Introduction.** [Eighth Edition]. Prentice Hall of India Private Limited, New Delhi.

REFERENCE BOOKS:

1. *Frederick, S. Hillier* and *Gerald J Lieberman.* 2007. **Introduction to Operations Research.** [Eighth Edition]. Tata McGraw Hill Publishing Company Limited, New Delhi.
2. *Sharma, J.K.* 2007. **Introduction to Operations Research Theory and Applications.** [Third Edition]. MacMillan India Ltd., New Delhi.

15PMAM405	CORE XVII: NUMBER THEORY	SEMESTER – IV

Total Hours: 50

OBJECTIVES:

1. Introduction to elementary concepts of number theory.
2. To learn about quadratic reciprocity and some functions in number theory.
3. To provide the knowledge about diaphantine equations.

CONTENTS

UNIT – I **(10 Hours)**

Divisibility and Congruence

Divisibility – Primes – Congruences – Solutions of Congruences.

(Chapter 1: Sections 1.2, 1.3) (Chapter 2: Sections 2.1, 2.2)

UNIT – II **(10 Hours)**

Congruence

Prime power moduli – Prime modulus – Congruences of degree two, Prime modulus –Primitive roots and Power Residues.

(Chapter 2: Sections 2.6 – 2.9)

UNIT – III **(10 Hours)**

Quadratic Reciprocity

Quadratic residues – Quadratic Reciprocity – The Jacobi symbol – Greatest Integer function.

(Chapter 3: Sections 3.1 – 3.3) (Chapter 4: Section 4.1)

UNIT – IV **(10 Hours)**

Some Functions of Number Theory

Arithmetic functions – The Mobius inverse formula – Recurrence functions.

(Chapter 4: Sections 4.2 – 4.4)

UNIT – V **(10 Hours)**

Some Diaphantine Equations

The equation ax + by = c – Simultaneous linear equations – Pythagorean triangles – Assorted examples.

(Chapter 5: Sections 5.1 – 5.4)

TEXT BOOK:

1. *Ivan Niven* and *Zuckerman, H.S.* 1989. **An Introduction to the Theory of Numbers,** [Third Edition]. Wiley Eastern Ltd., New Delhi.

REFERENCE BOOKS:

1. *Burton, D.M.* 2001. **Elementary Number Theory.** Universal Book Stall, New Delhi.
2. *Ireland, K.*and *Rosen, M.* 1972**. A Classical Introduction to Modern Number Theory.** Springer Verlag, New York.

15PMAMP401	CORE PRACTICAL I : MATHEMATICAL TEXT EDITOR – LaTeX	SEMESTER – IV

Total Hours: 30

OBJECTIVES:

1. To develop the basic skills in the area of documents.
2. It also serves as a prerequisite for specialized in research publications.

CONTENTS

UNIT - I **(6 Hours)**

Text formatting, TEX and its offspring, What's different in LaTeX 2e, Distinguishing LaTeX 2e, Basics of a LaTeX file.

(Chapter - 1 Sections: 1.1-1.3, 1.4.1, 1.5)

UNIT - II **(6 Hours)**

Commands and Environments – Command names and arguments, Environments, Declarations, Lengths, Special Characters, Fragile Commands, Exercises.

(Chapter - 2 Sections: 2.1-2.7)

UNIT - III **(6 Hours)**

Document Layout and Organization – Document class, Page style, Parts of the document, Table of contents, Fine – Tuning text, Word division - Displayed Text - Changing font, Centering and indenting, Lists, Generalized lists, Theorem – like declarations, Tabulator stops, Boxes.

(Chapter – 3 Sections: 3.1-3.6) (Chapter – 4 Sections: 4.1-4.7)

UNIT - IV **(6 Hours)**

Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures with LaTeX.

(Chapter – 4 Sections: 4.8-4.10) (Chapter – 6 Sections: 6.1)

UNIT - V **(6 Hours)**

Mathematical Formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine–tuning mathematics.

(Chapter - 5 Sections: 5.1-5.5)

TEXT BOOK:

1. *Kopka, H.* and *Daly, P.W.* 1999. **A Guide to LaTeX.** [Third Edition] Addison – Wesley. London.

REFERNECE BOOKS:

1. *David Frads Griffiths* and *Desmond, J.Higham.* 2007. **Learning LaTeX.** Cambridge Publication.
2. *Leslie Lamport.* 1986. **LaTeX.** Academic Publishing Company, Poland.

LIST OF PRACTICAL:

1. Creation of Mathematical Statements
2. Creation of Mathematical Tables and matrices
3. Exercise using cases
4. Differential equations and Integral equations
5. Report Creation
6. Creating documents of using style files
7. Drawing pictures using LaTeX and Texcard

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS:

Candidates appearing for Practical Examinations shall submit Bonafide Record Note Books prescribed for Practical, otherwise the candidates will not be permitted to appear for the Practical Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical)

(i) THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

***Internal Marks Distribution** [CA- Total Marks: 25]*

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

***Internal Marks Distribution** [CA- Total Marks: 40]*

Experiment/ Documents	: 10 Marks (10-12 Experiments/Documents)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

Internal Marks Distribution *[CA- Total Marks: 100]*

Experiment	: 20 Marks (10-12 Experiments)
Attendance	: 10 Marks
Record	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

CAREER COMPETENCY SKILLS
METHODOLOGY OF ASSESSMENT

1. On Line Objective Examination (Multiple Choice questions) - Semester I

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- On line examination will be conducted at the end of the III Semester.

2. Viva Voce Semester II

- A Student has to come in proper dress code and he/she should bring 2 copies of Resume for the Viva Voce.
- A student may be asked to
  - Give Self Introduction
  - Submit the resume to the examiner(s) and answer the questions based on it.
  - Speak on any given topic for at least two minutes.
  - Give a presentation for 10 minutes on a topic of their choice.
  - Sit with other students in a Group for a Discussion.

QUESTION PAPER PATTERN AND MARK DISTRIBUTION (*THEORY)*

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. **PART – A (5 x 5 = 25 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice

2. **PART – B (5 x 10 = 50 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice

INTER DISCIPLINARY COURSE OFFERED BY THE DEPARTMENT (FOR STUDENTS ADMITTED FROM 2015-2016 ONWARDS)

First Semester			
S. No.	**Subject Code**	**Subject**	**Offered for the students of**
1	15PMACSI101	Numerical Methods and Statistics	M.Sc(C.S)
Second Semester			
S. No.	**Subject Code**	**Subject**	**Offered for the students of**
1	15PMACCI201	Quantitative Techniques	M.Com (CA)
2	15PMACSI201	Resource Management Techniques	M.Sc (C.S)
Third Semester			
S. No.	**Subject Code**	**Subject**	**Offered for the students of**
1	15PMACAI304	Mathematical Foundation for Computer Applications	MCA
2	15PMACCI301	Advanced Business Statistics	M.Com (CA)
Fourth Semester			
S. No.	**Subject Code**	**Subject**	**Offered for the students of**
1	15PMACAI404	Resource Management Techniques	MCA

COURSES OFFERED BY THE DEPARTMENT
(FOR STUDENTS ADMITTED FROM 2015-2016 ONWARDS)

Third Semester			
S. No.	**Subject Code**	**Subject**	**Offered for the students of**
1	15PBCM303	Biostatistics, Research Methodology, Bioethics and IPR	M.Sc (B.C)
2	15PBTM304	Biostatistics and Research Methodology	M.Sc. Biotechnology
Fourth Semester			
1	15PMBM401	Biostatistics and Research Methodology	M.Sc (M.B)