M.Sc., MATHEMATICS

SEM	SUB CODE	COURSE	SUBJECT TITLE	Hrs/ Wk	Cr.	MARKS		
						Int.	Ext	Tot
I	11PMA1401	Core Course-I	Algebra	6	4	25	75	100
	11PMA1402	Core Course-II	Real Analysis	6	4	25	75	100
	11PMA1403	Core Course-III	Ordinary Differential Equations	6	4	25	75	100
	11PMA1404	Core Course-IV	Classical Dynamics	6	4	25	75	100
	11PMA1405	Core Course-V a	Programming in C++	3	2	15	45	60
	11PMA1405 P	Core Course-V b	C++ Programming Lab	3	2	10	30	40
	TOTAL			**30**	**20**	**125**	**375**	**500**
II	11PMA2406	Core Course –VI	Complex Analysis	6	5	25	75	100
	11PMA2407	Core Course-VII	Differential Geometry	6	5	25	75	100
	11PMA2408	Core Course -VIII	Topology	6	5	25	75	100
	11PMA2409	Core Course - IX	Numerical Analysis	6	5	25	75	100
	11PMA2410	Core Course - X	Integral Equations and Calculus of Variations	6	4	25	75	100
	TOTAL			**30**	**24**	**125**	**375**	**500**
III	11PMA3411	Core Course XI	Advanced Graph Theory	6	5	25	75	100
	11PMA3412	Core Course-XII	Functional Analysis	6	5	25	75	100
	11PMA3413	Core Course-XIII	Mathematical Statistics	6	5	25	75	100
	11PMA3501	Core based Elective-I	Partial Differential Equations	6	4	25	75	100
	11PMA3502	Core based Elective-II	Fuzzy Analysis	6	4	25	75	100
	TOTAL			**30**	**23**	**125**	**375**	**500**
IV	11PMA4414	Core Course-XIV	Fluid Dynamics	6	5	25	75	100
	11PMA4415	Core Course-XV	Measure and Integration	6	5	25	75	100
	11PMA48	Project Work	Project Work	6	5	25	75	100
	11PMA4503	Core based Elective-III	Advanced Operations Research	6	4	25	75	100
	11PMA4504	Core based Elective-IV	Statistical Inference and Stochastic Processes	6	4	25	75	100
	TOTAL			**30**	**23**	**125**	**375**	**500**
GRAND TOTAL				**120**	**90**	**500**	**1500**	**2000**

CORE COURSE – I
ALGEBRA

Sub Code:	**11PMA1401**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Cauchy theorem for abelian group – Sylow's theorem for abelian group - group of Inner automorphisms – Cayley's theorem – Permutation groups

UNIT II

Another Counting Principle – Sylow's theorems.

UNIT III

Direct Products – finite abelian group – Divisibility and Prime element in Euclidean rings- unique factorization theorem.

UNIT IV

Vector Spaces and Modules – Elementary Basic concepts – Dual Spaces – Inner Product space

UNIT V

Fields – Extension fields – Roots of Polynomials – More about roots - Finite Fields

Text Book:

I. N. Herstein , Topics in Algebra, Second Edition, John Wiley & Sons, Pvt. Ltd, 2000.

UNIT I	Sections 2.7 – 2.10
UNIT II	Sections 2.11 and 2.12
UNIT III	Sections 2.13 & 2.14, 3.7, 3.8
UNIT IV	Sections 4.1 – 4.4
UNIT V	Sections 5.1, 5.3, 5.5, 7.1.

Reference Books:

1. P.B.Bhattacharya, S.K.Jain and S.R. Nagpaul, Basic Abstract Algebra, Second Edition, Cambridge University Press, 1995.
2. John B. Fraleigh, A First Course in Abstract Algebra, Addison Wesley Publishing Company, 1970.

CORE COURSE – II
REAL ANALYSIS

Sub Code:	**11PMA1402**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Basic topology, metric spaces, compact sets, perfect sets.

UNIT II

The Riemann-stieltjes integral, definition and existence of the integral, properties of the integral, integration and differentiation, Rectifiable Curves.

UNIT III

Sequences and series of functions, uniform convergence, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, the Stone-Weierstrass theorem.

UNIT IV

Multivariable differential calculus – Directional derivatives, total derivative, matrix of linear function, the Jacobian matrix, the chain rule, mean value theorem, sufficient condition for differentiability, equality of partial derivatives, Taylor's formula.

UNIT V

Functions with non zero Jacobian determinant, the inverse function theorem, the implicit function theorem.

Text Books:

T.B-1: Walter Rudin, Principles of Mathematical Analysis, Third edition, Mcgraw-Hill International Editions, 1987.

T.B-2: Tom M. Apostol, Mathematical Analysis, Second edition, Addison Wesley Publishing Company, 1974.

UNIT I	Chapter 2: 2.15 to 2.43	**T.B-1**
UNIT II	Chapter 6: 6.1 to 6.22, 6.26, 6.27	**T.B-1**
UNIT III	Chapter 7: 7.1 to 7.18, 7.26, 7.27	**T.B-1**
UNIT IV	Chapter 12	**T.B-2**
UNIT V	Chapter 13: 13.1 to 13.4	**T.B-2**

Reference Books:

1. V. Ganapathy Iyer, Mathematical analysis, Tata Mcgraw-Hill Publishing Company, Ltd, 1977.
2. Gabriel Klambauer, Real Analysis, American Elsevier Publishing Company, Inc, 1973.

CORE COURSE – III

ORDINARY DIFFERENTIAL EQUATIONS

Sub Code:	**11PMA1403**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Second order linear equations - The general solution of the homogeneous equation – The use of Known Solution to find another – The homogeneous equation with constant coefficients - The method of Variation of Parameters

UNIT II

Oscillations and the sturm separation theorem - The Sturm comparison theorem – Series solutions of first order equations - Second order linear equations - ordinary points.

UNIT III

Regular Singular points – Regular Singular points (continued) – Gauss's hyper geometric equation – The Point at infinity.

UNIT IV

Legendre polynomials - Properties of Legendre polynomials - Bessel functions – The Gamma function - Properties of Bessel functions.

UNIT V

Linear systems – Homogeneous linear systems with constant coefficients – The Method of Successive approximations – Picard's Theorem.

Text Book:

G.F. Simmons, Differential Equations with applications and Historical notes, Second edition, Tata McGraw- Hill Publishing Company Ltd, New Delhi, 1974.

UNIT I	Section 14, 15, 16, 17, 19
UNIT II	Section 24, 25, 27, 28
UNIT III	Section 29,30,31,32
UNIT IV	Section 44, 45, 46, 47
UNIT V	Section 55, 56, 68, 69.

Reference Books:

1. Earl. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1961.
2. M.D.Raisinghania, Advanced Differential Equations, Seventh Revised Edition S.Chand and Company Ltd, New Delhi, 2000.

CORE COURSE – IV
CLASSICAL DYNAMICS

Sub Code:	**11PMA1404**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Introductory Concepts: The Mechanical system – Generalized Co-ordinates – constraints – virtual work – Energy and Momentum.

UNIT II

Lagrange's Equation: Derivation of Lagrange`s Equation – examples – Integrals of the motion.

UNIT III

Special Applications of Lagrange`s equations: Rayleigh`s Dissipation Function – Impulsive motion- velocity – dependent potentials.

UNIT IV

Hamilton`s Equations: Hamilton`s principle – Hamilton`s equation-Other variational principles.

UNIT V

Hamilton`s-Jacobi Theory: Hamilton`s principal function – the Hamilton`s – Jacobi equation – separability.

TEXT BOOK:

Donald.T.Green wood, Classical Dynamics, PHI,1985.

UNIT I	Section: 1.1 to 1.5
UNIT II	Section: 2.1 to 2.3
UNIT III	Section: 3.1, 3.2 and 3.4
UNIT IV	Section: 4.1, 4.2,4.3
UNIT V	Section: 5.1,5.2 and 5.3

Reference Books:

1. C.R.Mondal, Classical Mechanics, Revised Edition, PHI, 2008.
2. S.G.Venkatachalapathy, Classical Mechanics, Margham Publications, 2006.

CORE COURSE – V a
PROGRAMMING IN C++

Sub Code:	**11PMA1405**	**Max Marks:**	**60**
Hours/Week:	**3**	**Internal Marks:**	**15**
Credit:	**2**	**External Marks:**	**45**

UNIT I

Object-Oriented Programming Paradigm – Basic concepts of Object-oriented Programming – What is C++ – A simple C++ program – More C++ statements – An example with class – Structure of C++ program – Keywords – Identifiers and Constants – Basic Data types – User defined data types – Derived data types – Symbolic constants – Declaration of variables – Reference variables – Operators in C++ - Scope resolution operators – Expressions and their types – Control structures.

UNIT II

Functions in C++ - The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Function overloading – Specifying a class – Defining member functions – Nesting of member functions – Private member functions – Arrays within a class – Arrays of Objects – Objects as function arguments – Friendly functions – Returning Objects – Pointers to members.

UNIT III

Constructors – Parameterized constructors – Multiple constructors in a class – constructors with default arguments – Copy constructor – constructing two-dimensional arrays – Destructors – Defining operator overloading – Overloading unary operators - Overloading binary operators - Overloading binary operators using friends.

UNIT IV

Inheritance – Defining derived classes – Single inheritance – Making a private member inheritable – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance – Virtual base classes.

UNIT V

Working with files – Introduction – classes for file stream operations – Opening and closing a file – Detecting End-of-File – File pointers and their manipulations – Sequential input and output operations – Updating a file: Random access – Error handling during file operations – Command-Line-Arguments.

Text Book:

E.Balagurusamy, Object Oriented Programming with C++, Second Edition,TMH,2008.

UNIT I Chapter 1 - 1.4,1.5; Chapter 2 – 2.1, 2.3, 2.4, 2.5, 2.6
Chapter 3 – 3.3 to 3.8; 3.10, 3.12, 3.13, 3.14, 3.19, 3.24

UNIT II Chapter 4 – 4.2 to 4.6; 4.9; Chapter 5 – 5.3, 5.4, 5.7, 5.8, 5.9, 5.13 to 5.16; 5.18

UNIT III Chapter 6 – 6.2 to 6.5; 6.7, 6.9, 6.11, Chapter 7 – 7.2 to 7.5

UNIT IV Chapter 8 – 8.2 to 8.9

UNIT V Chapter 11 – 11.1 to 11.4; 11.6 to 11.10

Reference Books:

1. Herbert Schildt, The Complete Reference C++, Fourth Edition, TMH,2003.
2. K.R.Venugopal, Raj Kumar and T.Ravi Shankar, Mastering C++, TMH,2005.

CORE COURSE – V b
C++ PROGRAMMING Lab

Sub Code:	**11PMA1405P**	**Max Marks:**	**40**
Hours/Week:	**3**	**Internal Marks:**	**10**
Credit:	**2**	**External Marks:**	**30**

List of Practicals

1. Simple programs using functions.
2. Simple programs using classes and objects
3. Develop a C++ Program to implement the following:

   a) Friend Function b) In-line Function c) Virtual Function
4. Develop a C++ Program using Operator Overloading
   a) to add complex numbers
   b) to multiply two matrices
5. Develop a C++ Program using pointers for String Manipulations
6. Develop a C++ Program to illustrate the use of Arrays of Objects.
7. Develop a C++ Program to implement Pay Bill application by using Inheritance
8. Develop a C++ Program to implement Mark List Application by using Files.

CORE COURSE – VI
COMPLEX ANALYSIS

Sub Code:	**11PMA2406**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Fundamental theorems – 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.

UNIT II

Local properties of analytical functions – Removable singularities, Taylor's theorem, zeros and poles. The local mapping, the maximum principle. The general form of cauchy theorem – chains and cycles, simple connectivity, Homology.

UNIT III

The general statement of Cauchy's theorem, proof of Cauchy's theorem, locally exact differentials. The calculus of residue - The residue theorem, the argument principle, Evaluation of definite integrals.

UNIT IV

Harmonic functions – definition and basic properties, The mean – value property, Poisson's formula, Schwarz's theorem, the reflection principle. Power series expansions – Weierstrass's theorem, The Taylor series, The Laurent series.

UNIT V

Partial fractions and factorization – partial fractions, infinite products, canonical products, the gamma functions.

Text Book:

Lars.V. Ahlfors, Complex Analysis, Third Edition, McGraw-Hill International Edition,1979.

UNIT I	Chap 4 –Sec 1.1 to 1.5 & 2.1 to 2.3.
UNIT II	Chap 4 –Sec 3.1 to 3.4 & 4.1 to 4.3.
UNIT III	Chap 4 – Sec 4.4 to 4.6, 5.1 to 5.3
UNIT IV	Chap 4 – Sec 6.1 to 6.5 Chap 5 – Sec 1.1 to 1.3
UNIT V	Chap 5 – Sec 2.1 to 2.4

Reference Books:

1. V.Karunakaran, Complex Analysis, Second Edition, Narosa Publications,2005.

2. S.Ponnusamy, Foundations of Complex Analysis, Second Edition, Narosa Publications,2010.

CORE COURSE – VII
DIFFERENTIAL GEOMETRY

Sub Code:	**11PMA2407**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Theory of Space Curve – Arc length –Tangent, Normal, and Binormal – Curvature and torsion of a curve given as the intersection of two surfaces – contact between curves and surfaces – Tangent surfaces, involutes and evolutes – Intrinsic equations – fundamental existence theorem for space curves – Helices

UNIT II

The Metric- Local Intrinsic properties of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic properties

UNIT III

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

UNIT IV

The Second fundamental form – Local non-intrinsic properties of a surface – Principal curvatures – Lines of curvatures – Developables – Developables associated with space curves

UNIT V

Developables associated with curves on surfaces – Minimal surfaces – Ruled surfaces – The fundamental equations of surface theory – Parallel Surfaces.

Text Book :

T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press, 1969.

UNIT I Chapter I, Sections 3 – 9
UNIT II Chapter II, Sections 1-9
UNIT III Chapter II, Sections 10-18
UNIT IV Chapter III, Sections 1 – 5
UNIT V Chapter III, Sections 6 –10

References Books:

1. D.Somasundaram, Differential Geometry A First Course, Narosa Publishing House,2005.
2. Dirk J.Struik, Classical Differential Geometry, Second Edition, Addison Wesley Publishing Company,Inc.,1950.

CORE COURSE – VIII
TOPOLOGY

Sub Code:	**11PMA2408**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Topological spaces, Basis for a topology, the order topology, product topology, subspace topology, closed sets and limit points, continuous functions, product topology.

UNIT II

The metric topology, The metric topology (continued), connected spaces.

UNIT III

Compact spaces, Limit point compactness, The Tychonoff theorem.

UNIT IV

The countability Axioms, The separation axioms, The Urysohn Lemma, The Urysohn Metrization theorem, Completely regular spaces.

UNIT V

Complete Metric Spaces, compactness in metric spaces, Baire Spaces.

Text Book:

James R. Munkres, Topology A First Course, PHI, 1998.

UNIT I	Sections 2.1 to 2.8
UNIT II	Sections 2.9, 2.10, 3.1
UNIT III	Sections 3.5, 3.7, 5.1
UNIT IV	Sections 4.1 to 4.4, 5.2
UNIT V	Sections 7.1, 7.3, 7.7

Reference Books:

1. Sze-Tsen Hu, Elements of General Topology, Holden Day, Inc., 1964.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

CORE COURSE – IX
ADVANCED NUMERICAL METHODS

Sub Code:	**11PMA2409**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Transcendental and Polynomial Equations: Iteration method based on Second degree equations: The Chelyshev Method – Multipoint Iteration Methods – The Bridge Vieta Method – The Baristow Method – Graeffe's root Squaring Method.

UNIT II

System of Algebraic Equations and Eigen Value Problems: Iteration Methods-Jacobi Method, Guass Seidel Method, Successive Over Relaxation Method – Iterative Method for A^{-1} – Eigen Values and Eigen Vectors – Jacobi Method for symmetric Matrices , Power Method.

UNIT III

Interpolation and Approximation – Hermite Interpolation – Piecewise cubic Interpolation and cubic Spline interpolation – Bivariate interpolation – Lagrange and Newton's Bivariate interpolation – Least Square approximation – Gram-Schmidt Orthogonalizing Process.

UNIT IV

Differentiation and Integration; Numerical Diffrentiation – Methods Based on Interpolation – Partial Differentiation – Numerical Integration – Methods Based on Interpolation – Methods Based on Undetermined Coefficients – Gauss Quadrature methods - Gauss Legendre and Gauss Chebyshev Integration Methods – Double Integration – Trapezoidal and Simpson's Rule – Simple Problems.

UNIT V

Ordinary Differential Equations: Numerical Methods – Euler Method – Backward Euler Method – Mid-Point Method – Runge kutta Methods – Implicit Runge Kutta Methods – Predictor – Corrector Methods.

Text Book:

M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Fourth Edition.

UNIT I	Chapter II	Sec. 2.4, 2.9
UNIT II	Chapter III	Sec. 3.4, 3.7,3.11
UNIT III	Chapter IV	Sec. 4.5, 4.6, 4.7, 4.9
UNIT IV	Chapter V	Sec. 5.2, 5.5, 5.6, 5.7, 5.8, 5.11
UNIT V	Chapter VI	Sec. 6.3, 6.4,6.7

Reference Books:

1. Samuel. D. Conte and Carl De Boor, Elementary Numerical Analysis, Third Edition, 1965.
2. F.B.Hildebrand, Introduction to Numerical Analysis, TMH,1979.

CORE COURSE - X
INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS

Sub Code:	**11PMA2410**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Introduction – Definition - Regularity conditions - Special kinds of kernels – Eigenvalues and Eigenfunctions – Convolution Integral – The Inner or Scalar product of two functions. Integral equations with separable kernels - Reduction to a system of Algebraic Equations – Examples – Fredholm Alternative – Examples.

UNIT II

Method of successive approximations - Iterative scheme – Examples – Volterra Integral Equations – Examples – Some results about the resolvent Kernel.

UNIT III

Applications to ordinary differential equations - Initial value problems – Boundary value Problems – Examples. Singular integral equations - The Abel Integral Equation – Examples

UNIT IV

Calculus of variations and applications -Maxima and Minima – The Simplest case – Illustrative examples

UNIT V

Natural Boundary conditions and transition conditions – The Variational notation – The more general case – Constraints and Lagrange multipliers.

Text Books:

T.B-1: Ram P. Kanwal, Linear Integral Equations Theory and Technique, Academic Press, 1971.

T.B-2: Francis B. Hildebrand, Methods of Applied Mathematics, Second edition,.

UNIT I	1.1 to 1.6, 2.1 to 2.4	**T.B-1**
UNIT II	3.1 to 3.5	**T.B-1**
UNIT III	5.1, 5.2, 5.3, 8.1, 8.2	**T.B-1**
UNIT IV	2.1, 2.2, 2.3	**T.B-2**
UNIT V	2.4 to 2.7	**T.B-2**

Reference Books:

1. M.D.Raisinghania, Integral Equations and Boundary Value Problems, S. Chand and Co. Ltd,2007

2. L.Elsgolts, Differential Equations and Calculus of Variations, Mir Publishers, 1977.

CORE COURSE – XI
ADVANCED GRAPH THEORY

Sub Code:	**11PMA3411**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Connectivity and edge-connectivity – 2-connected graphs – Menger's theorem.

UNIT II

Matching – System of Distinct Representatives and Marriage problem – Covering - 1-factor – Stable Matching

UNIT III

Independent sets – Edge-colourings – Vizing's Theorem – Vertex Colourings – Uniquely Colourable graphs – Critical graphs

UNIT IV

Predecessor and Successor – Algorithm – Graceful Labeling – Sequential functions Magic graphs – Conservative graphs

UNIT V

Perfect Graphs – the Perfect Graph Theorem – Chordal Graphs – Interval Graphs – Comparability Graphs .

Text Book:

M. Murugan, Topics in Graph theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, First Edition, 2003.

UNIT I	Chapter 3	Sec. 3.1 to 3.3
UNIT II	Chapter 6	Sec 6.1 to 6.5
UNIT III	Chapter 7	Sec 7.1,7.2,7.4 to 7.7
UNIT IV	Chapter 10	Sec 10.1 to 10.4,10.6 & 10.7
UNIT V	Chapter 12	Sec 12.1 to 12.5

Reference Books:

1. S. A. Choudum, Graph Theory, Macmillan India Limited.
2. F . Harary, Graph Theory, Narosa Publishing House, 2001.

CORE COURSE – XII
FUNCTIONAL ANALYSIS

Sub Code:	**11PMA3412**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Banach Space: The definition and some examples, Continuous linear transformations, The Hahn-Banach theorem.

UNIT II

Banach space (continued): The natural imbedding of N of N**, The open mapping theorem, The conjugate of an operator.

UNIT III

Hilbert spaces: The definition and some simple properties, Orthogonal complements, Orthonormal sets, The conjugate space H*.

UNIT IV

Hilbert spaces (Continued): The adjoint of an operator, self-adjoint operators, Normal and unitary, projections.

UNIT V

Finite Dimensional spectral theory: Matrices Determinants and the spectrum of an operator, The spectral theorem.

Text Book:

G.F Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, International Book company, 1963.

UNIT I	Section 46-48
UNIT II	Section 49-51
UNIT III	Section 52-55
UNIT IV	Section 56-59
UNIT V	Section 60-62

Reference Books:

1. Balmohan V. Limaye, Functional Analysis, Second Edition, New Age International Pvt Ltd, 1997.
2. M.Thamban Nair, Functional Analysis, A First Course, PHI, 2002

CORE COURSE - XIII
MATHEMATICAL STATISTICS

Sub Code:	**11PMA3413**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Axiomatic Probability-Conditional Probability- Baye's theorem- Independent events- Simple results- Inequalities and Problems.

UNIT II

Concept of two dimensional random variables- Marginal and conditional distributions- Independent random variables- Expected values, moments and Liapunov`s inequality on absolute moments- Chebyshev`s inequality; Markov inequality; conditional expectation.

UNIT III

Characteristic function and moments- Properties- Inversion theorem of characteristic functions- Moment generating function and probability generating function- probability distributions such as Normal, Gamma, Beta, Cauchy and Laplace.(Simple derivations only).

UNIT IV

Stochastic convergence- Bernoulli law of large Numbers- Poisson, Chebyshev`s and Khintchins law of large numbers- Strong law of large numbers, Kolmogorov inequality- Kolomogorov theorem; Borel-Cantelli lemma.

UNIT V

Levy-Cramer theorem- Central limit theorems such as De Movire Laplace, Lindeberg Levy and Liapunov. Comparison between central limit theorems and law of large numbers.

Text Book:

Marek Fisz, Probability theory and Mathematical Statistics, Third Edition, John Wiley &Sons,1963.

UNIT I Chapter 1.1 to 1.7
UNIT II Chapter 2.1 to 2.8; 3.1 to 3.4
UNIT III Chapter 4.1 to 4.5,4.7; 5.7 to 5.10
UNIT IV Chapter 6.1 to 6.4; 6.11 & 6.12
UNIT V Chapter 6.6 to 6.10

Reference Books:

1. Murray R. Spiegal , John Jschiller, R. Alu Srinivasan Probability and Statistics, Third Edition, Shaum's Outline Series,2010.
2. B.R.Bhat, Modern Probability Theory Revised Third Edition, New Age International, 2005.

CORE BASED ELECTIVE - I
PARTIAL DIFFERENTIAL EQUATIONS

Sub Code:	**11PMA3501**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Curves and Surfaces – Genesis of First Order P.D.E – Classification of Integrals – Linear equations of the First Order – Pfaffian Differential Equations – Compatible Systems – Charpits's method

UNIT II

Jacobi's Method – Integral Surfaces Through a given Curve – Quasi-Linear Equations

UNIT III

Genesis of Second Order P.D.E – Classification of Second order P.D.E. – One Dimensional Wave Equations – Vibrations of an Infinite String – Vibrations of a Semi-infinite String – Vibrations of a String of Finite length

UNIT IV

Vibrations of a String of Finite length(Method of Separations of Variables) – Lapleace Equation – Boundary Value Problems – Maximum and Minimum Principles – The Cauchy Problem – The Dirichlet Problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Problem for a Circle – The Dirichlet Exterior Problem for a circle – The Dirichlet Problem for a Rectangle

UNIT V

The Dirichlet Problem for a Half Plane – The Dirichlet Problem for a Circle – Heat Conduction Problem – Heat Conduction-Infinite rod Case – Heat Conduction-Finite Rod Case – Duhamel's Principle – Wave Equation – Heat Conduction Equation.

Text Book:

T.Amaranath, An Elementary Course in Partial differential Equations, 2nd edition, Narosa Publishing House-2003.

UNIT I Chapter 1 Sec 1.1–1.7
UNIT II Chapter 1 Sec 1.8–1.10
UNIT III Chapter 2 Sec 2.1–2.3.3
UNIT IV Chapter 2 Sec 2.3.5–2.4.9
UNIT V Chapter 2 Sec 2.4.12–2.6.2

Reference Books:

I. N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1985.
2. M.D.Raisinghania, Advanced Differential Equations, Seventh Revised Edition S.Chand and Company Ltd, New Delhi, 2000.

CORE BASED ELECTIVE - II
FUZZY ANALYSIS

Sub Code:	**11PMA3502**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

From Classical Sets To Fuzzy sets – Fuzzy set: Basic types – Fuzzy sets Versus Crisp sets- Extension Principle for fuzzy sets – Operations on Fuzzy sets – Types of operations – Fuzzy complements.

UNIT II

Fuzzy Arithmetic – Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers – Lattice of Fuzzy numbers – Fuzzy equations.

UNIT III

Fuzzy Logic – Multi-valued Logics – Fuzzy Propositions – Unconditional and Unqualified Fuzzy propositions – Unconditional and qualified Propositions – Conditional and Unqualified propositions – Conditional and Qualified propositions – Linguistic Hedges – Inference from conditional Fuzzy propositions- Inference from conditional and qualified propositions.

UNIT IV

Fuzzy Decision making – Individual decision making – Fuzzy Ranking methods – Fuzzy Linear programming.

UNIT V

Fuzzy Relations – composition of fuzzy relations – properties of fuzzy relations.

Text Book:

T.B-1: George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, PHI,2004.

T.B-2: A.Nagoor Gani and V.J.Chandrasekaran, A first look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd.

UNIT I	Chapter 1 - 1.3,2.3 & Chapter 3 - 3.1&3.2	**T.B-1**
UNIT II	Chapter 4 – 4.1,4.2,4.3,4.4,4.5,4.6	**T.B-1**
UNIT III	Chapter 8 – 8.2,8.3,8.5,8.6,8.7	**T.B-1**
UNIT IV	Chapter 15 – 15.2,15.6,15.7	**T.B-1**
UNIT V	Chapter 1 – 1.3,1.4,1. 5	**T.B-2**

Reference Books:

1. Timothy J.Ross, Fuzzy Logic with Engineering Applications –McGraw-Hill, Inc.,
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, 1991.

CORE COURSE – XIV
FLUID DYNAMICS

Sub Code:	**11PMA4414**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Kinematics of fluids in motion: Real fluids and ideal fluids, velocity of a fluid at a point, streamlines and pathlines, Steady and unsteady flows. The velocity potential, The vorticity vector, Local and particle rates of change, The equation of continuity, worked examples, acceleration of a point of a fluid.

UNIT II

Equations of motion of a fluid : pressure at a point in a fluid at rest, Pressure at a point in a moving fluid, Conditions at a boundary of two inviscid Immissible fluids, Euler's equations of motion, Bernoulli's equation, worked examples, Some flows involving axial symmetry, Some special two dimensional flows, Impulsive motion.

UNIT III

Some three dimensional flows: Introduction, sources, sinks and doublets, Images in a rigid infinite plane, Axi-symmetric flows, stokes stream function, some special form of the stream function for axi-symmetric irrotational motions.

UNIT IV

Some two dimensional flows: Meaning of two dimensional flow, use of cylindrical polar coordinates, The stream function. The complex potential for two-dimensional irrotational, incompressible flow, complex velocity potential for standard two-dimensional flows, uniform stream, line sources and line sinks, line doublets, line vortices, worked examples.

UNIT V

Some two dimensional flows(Continued): Two dimensional image systems, The Milne Thomson circle theorem, some application of the circle theorem, extension of the circle theorem, the theorem of blasius, The use of conformal transformation – some hydro dynamical aspects of conformal transformation worked example, vortex rows – single infinite rows of line vortices, The karman vortex street.

Text Book:

F.Chorlton, Textbook of Fluid Dynamics, CBS Publication and Distribution, 2004.

UNIT I Chapter 2 - sec 2.1 to 2.9
UNIT II Chapter 3 - sec 3.1 to 3.6, 3.9 to 3.11
UNIT III Chapter 4 - sec 4.1 to 4.3, 4.5, 4.5.1
UNIT IV Chapter 5 - sec 5.1 to 5.6
UNIT V Chapter 5 -sec 5.7 to 5.10.2, 5.12 to 5.12.2

Reference Books:

1. M.D. Raisinghania, Fluid Dynamics, S.Chand,2008.
2. G.K.Batchelor, An Introduction to Fluid Mechanics, Foundation Books,1984.

CORE COURSE – XV
MEASURE AND INTEGRATION

Sub Code:	**11PMA4415**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**5**	**External Marks:**	**75**

UNIT I

Measure on a real line – Lebesgue Outer measure – Measurable sets – Regularity – measurable functions.

UNIT II

Borel & Lebesgue measurability– Integration of Functions of a real variable – integration of non-negative functions – The General Integral

UNIT III

Abstract Measure Space – Measure and Outer measure – Uniqueness of the extension – Completion of a measure – Measure space – Integration with respect to measure.

UNIT IV

Inequalities and the L^p Spaces – Convex functions – Jensens Inequalities – The Inequalities of Holder and Minkowski – Completeness of $L^p(\mu)$.

UNIT V

Signed measure and their derivatives – The Hahn Decomposition – The Jordan Decomposition – The Radon Nikodym theorem – some applications of the The Radon Nikodym theorem – Measure and Integration in a Product space – Measurability in a Product Space – The Product Measure and Fubini's theorem.

Text Book:

G. De Barra, Measure Theory and Integration, New Age International Pvt Ltd, 1997.

UNIT I	Sections 2.1 – 2.4
UNIT II	Sections 2.5, 3.1 – 3.2
UNIT III	Sections 5.1 - 5.6
UNIT IV	Sections 6.1 – 6.5
UNIT V	Sections 8.1 – 8.4, 10.1 & 10.2 .

Reference Books:

1. H.L. Royden, Real Analysis, Third Edition, PHI, 2009.
2. Inder K. Rana, An Introduction to Measure and Integration, Second Edition, Narosa, 2007.

CORE BASED ELECTIVE – III
ADVANCED OPERATIONS RESEARCH

Sub Code:	**11PMA4503**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Sensitivity Analysis: Introduction – Sensitivity Analysis – Change in Objective Function Coefficient – Change in the Availability of Resources – Changes in the Input Output Coefficients – Addition of New Variable – Addition of New Constraint

UNIT II

Integer Linear Programming: Introduction – Types of Integer Programming Problems – Enumeration and Cutting Plane Solution Concept – Gomory's All Integer Cutting Plane Method - Gomory's Mixed Integer Cutting Plane Method.

UNIT III

Goal Programming : Introduction – Difference between LP and GP approach – Concept of Goal Programming - Goal Programming model formulation – Single Goal with Multiple sub Goals – Equally ranked Multiple Goals – Ranking and Weighting of Unequal Multiple Goals - General GP Model – Graphical Solution method of GP – Modified Simplex Method of GP.

UNIT IV

Decision and Game Theory: Decision Theory – Introduction – Steps of Decision making process – Types of Decision Making Environments – Decision Making Under Uncertainty - Decision Making Under Risk - Expected Monetary Value.

Theory of Game – Introduction – Two Person Zero Sum Games – Games with Saddle Point – Rules to determine Saddle point - Games with out Saddle Point - related problems – Principles of Dominance – Solution method for Games without Saddle point- Graphical Method.

UNIT V

Dynamic Programming: Introduction – Dynamic Programming Terminology– Developing Optimal Decision Policy – The General Algorithm - Dynamic Programming Under Certainty – Model-I Shortest Route Problem – Model-II, Multiple Separable Return Function and Single Additive Constraint Dynamic Programming Approach for Solving Linear Programming Problems.

Text Book:

J.K. Sharma, Operations Research Theory and Applications, Fourth Edition, Macmillan India Ltd., 2010.

UNIT I	Section 6.1 and 6.2 (6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5)
UNIT II	Section 7.1 to 7.5
UNIT III	Section 8.1 to 8.6
UNIT IV	Section 11.1,11.2,11.3, 11.4 (11.4.1 to 11.4.5), 11.5 (11.5.1) 12.1, 12.2, 12.3(12.3.1), 12.4, 12.5, 12.6(12.6.4)
UNIT V	Section 22.1, 22.2,22.3,22.4(Model - I and Model - II), 22.5

Reference Books:

1. Prem Kumar Gupta and D.S. Hira, Operations research, S Chand, 2000.
2. Kanti swarup, P.K.Gupta and Manmohan, Operations Research, Sultan Chand &Sons,2009

CORE BASED ELECTIVE - IV

STATISTICAL INFERENCE AND STOCHASTIC PROCESSES

Sub Code:	**11PMA4504**	**Max Marks:**	**100**
Hours/Week:	**6**	**Internal Marks:**	**25**
Credit:	**4**	**External Marks:**	**75**

UNIT I

Theory of Estimation; Properties of estimates; asymptotically most efficient estimates; Likelihood function; Cramer-Rao inequality; Rao-Black-Well`s theorem; Properties of Maximum likelihood estimates. Problems related to Maximum likelihood estimates.

UNIT II

Theory of Hypothesis; Power function and OC function; Errors; Most Powerful test; Uniformly Most Powerful test; Unbiased test; Neyman-Pearson fundamental Lemma; Problem.

UNIT III

Non-Parametric test; Introduction; Kolomogorov Smirnov test for two samples; sign test; Wald –Wolfowiz Run test; Median test for two samples and Mann-Whitney U-test.

UNIT IV

Analysis of variance, One-way classification; Two way classification; Principles of Experimental design; CRD, RBD and LSD and simple problems.

UNIT V

Stochastic processes; specification of SP; Markov chain; transition probabilities; Determination of higher order transition probabilities; Chapman-Kolmogorov equation; Poisson processes (introduction only).

Text Books:

T.B-1 Marek Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons,1963.
T.B-2 H.C. Saxena &P.V. Surendran, Statistical Inference, S.Chand.
T.B-3 S.C. Gupta & V.K.Kapoor, Fundamentals of Applied Statistics, S.Chand.
T.B-4 J.Medhi, Stochastic Processes, New Age International Publishers**.**
UNIT I Section-13.1 to 13.7 **T.B-1**
UNIT II Section-16.1 to 16.5 **T.B-1**
UNIT III Section-7.3.1 to 7.3.6 and 7.9 **T.B-2**
UNIT IV Section-5.1 to 5.3; 6.3.1, 6.3.2, 6.4, 6.5, 6.5.1, 6.6, 6.6.1 & 6.7 **T.B-3**
UNIT V Section-2.1, 2.2; 3.1 to 3.4; 4.1 **T.B-4**

Reference Books:

1. W.Feller, An Introduction to Probability Theory and its Applications,Volume I, Third Edition, Wiley, 1968.
2. J.L. Doob, Stochastic Processes, Wiley InterScience,1990.