POOMPUHAR COLLEGE (AUTONOMOUS)

(of the Tamil Nadu H.R & C.E Department)

(Accredited B+ By NAAC)

MELAIYUR 609 107

M.Sc SYLLABUS

(FROM THE ACADEMIC YEAR 2016-2017 ONWARDS)

PG & RESEARCH

DEPARTMENT OF MATHEMATICS

POOMPUHAR COLLEGE (AUTONOMOUS)
of the Tamil Nadu HR & CE Department
Department of Mathematics
(For those who are joining in 2016 – 2017 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper I	**No of credits : 5**

Title of the Paper: LINEAR ALGEBRA

Unit - I

Systems of linear Equations – Matrices and elementary row operations – Row - reduced echelon Matrices – Matrix multiplication – Invertible matrices – Vector spaces – Subspaces – Bases and dimension – Computations concerning subspaces.

Unit - II

The algebra of linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices - Linear functionals - The double dual – The transpose of a linear transformation.

Unit - III

The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial, Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Additional properties of determinants.

Unit - IV

Characteristic values – Annihilating polynomials, Invariant subspaces – Simultaneous triangulation and simultaneous - Diagonalization – Direct-sum decompositions.

Unit - V

Invariant direct sums – The primary decomposition theorem – Cyclic subspaces – Cyclic decompositions and the rational form.

Text Book

[1] Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice – Hall of India Private Limited, New Delhi :1975.

Unit - I - Chapters 1 and 2 (Except sections 1.1, 2.4, 2.5)
Unit - II - Chapter 3
Unit - III - Chapter 4 and Chapter 5, Sections 5.1 to 5.4
Unit - IV - Chapter 6, Sections 6.1 to 6.6
Unit - V -Chapter 6, Sections 6.7 and 6.8 and Chapter 7, Sections 7.1, 7.2

Reference Books

[1] I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975.
[2] I.S. Luther and I.B.S. Passi, Algebra, Vol.I – Groups, Vol.II- Rings, Narosa Publishing House (Vol.I – 1996, Vol.II- 1999)
[3] N. Jacobson, Basic Algebra, Vols. I & II, Freeman, 1980 (also published by Hisdustan Publishing Company)

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Department of Mathematics
(For those who are joining in 2016 – 2017 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper II	**No of credits : 5**

Title of the Paper:REAL ANALYSIS

Unit -I

Basic Topology: Finite, Countable and Uncountable Sets – Metric spaces – Compact sets – Perfect sets – Connected sets.

Unit -II

Numerical Sequences and Series: Sequences – Convergence – Subsequences - Cauchy Sequences – Upper and Lower Limits - Some Special Sequences – Tests of convergence – Power series – Absolute convergence – Addition and multiplication of series – Rearrangements.

Unit -III

Continuity: Limits of functions – Continuous functions – Continuity and Compactness – Continuity and connectedness – Discontinuities – Monotonic functions – Infinite limits and limits at infinity. Differentiation: Derivative of a real function – Mean value Theorems - Intermediate value theorem for derivatives – L'Hospital Rule – Taylor's Theorem – Differentiation of vector valued functions.

Unit -IV

Riemann – Stieltjes Integral: Definition and Existence – Properties – Integration and Differentiation – Integration of vector valued functions **–**Rectifiable curves.

Unit -V

Sequences and Series of Functions: Uniform Convergence and Continuity – Uniform Convergence and Differentiation – Equicontinuous families of functions – The Stone – Weierstrass Theorem.

Text Book

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

Unit – I -Chapters 2
Unit - II -Chapters 3
Unit - III -Chapter 4 & 5
Unit - IV -Chapter 6
Unit - V -Chapter 7

Reference Books

[1] Tom P. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
[2] A.J. White, Real Analysis : An Introduction, Addison Wesley Publishing Co., Inc. 1968.
[3] Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper III	**No of credits : 4**

Title of the Paper:NUMERICAL METHODS

Unit -I

Solution of nonlinear equations: Graeffe's root squaring method - Numerical Differentiation and Integration: Derivatives from Difference tables – Higher order derivatives – Divided difference, Central-Difference formulae (Proof not needed) – Trapezoidal rule – Simpson's rules.

Unit -II

Solution of system of equations: The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss - Methods of Iteration – Jacobi and Gauss Seidal Iteration.

Unit - III

Solution of ordinary differential equations: Taylor series method – Euler and Modified Euler's methods – Runge-kutta methods – Milne's method – Adams Moulton method.

Unit - IV

Boundary value problems: Boundary Value Problems – Finite difference Method – The shooting method – The cubic spline method.

Unit - V

Numerical solution of partial differential equations: Laplace's equation on a rectangular region – Jacobi's method – Gauss – seidal method, Successive method over – relaxation Method

Text Book

[1] S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt Limited, New Delhi, 2006.

Reference Books

[1] S.C. Chapra and P.C. Raymond, Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000.
[2] M.K Venkateraman, Numerical Methods in Science and Engineering, The National Publishing Company.

[3] M.K. Jaoin, S.R.K. Iyengar and R.K Jain, Numerical Method for scientific and Engineering.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper IV	**No of credits : 5**

Title of the Paper:ORDINARY DIFFERENTIAL EQUATIONS

Unit -I

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameters – Power Series solutions – A review of power series – Series solutions of first order equations – Second order linear equations; Ordinary points.

Unit - II

Regular Singular Points – Gauss's hypergeometric equation – The Point at infinity - Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.

Unit - III

Linear systems of first order equations – Homogeneous equations with constant coefficients – The existence and uniqueness of solutions of initial value problem for first order ordinary differential equations.

Unit - IV

Oscillation theory and boundary value problems – Qualitative properties of solutions – Sturm comparison Theorems – Eigenvalues, Eigenfunctions and the vibrating string.

Unit - V

Nonlinear equations: Autonomous Systems – The phase plane and its phenomena – Types of critical points – Stability – Critical points and stability for linear systems.

Text Book

[1] G.F. Simmons, Differential Equations with Applications and Historical Notes, TMH, New Delhi, 1984.

Unit – I -Chapter 3: Sections 15, 16, 19 and Chapter 5: Sections 25 to 27
Unit - II -Chapter 5: Sections 28 to 31 and Chapter 6: Sections 32 to 35
Unit - III -Chapter 7: Sections 37, 38 and Chapter 11: Section 55
Unit - IV -Chapter 4: Sections 22 to 24
Unit -V -Chapter 8: Sections 42

Reference Books

[1] W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, New York, 1971.

[2] E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equaitons, McGraw Hill Publishing Company, New York, 1955.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper V	**No of credits : 5**

Title of the Paper:CALCULUS OF BOUNDED VARIATIONS AND FOURIER TRANSFORMS

Unit -I

Calculus of Variations – Maxima and Minima – The simplest case – Natural boundary and transition conditions – Variational notation – More general case – Constraints and Lagrange Multipliers – Variable and points – Strum – Liouville Problems.

Unit -II

Fourier transform – Fourier sine and cosine transforms – Properties convolution – Solving intergral equations – Finite Fourier transform – Finite Fourier Sine and cosine transforms.

Unit -III

Application of Fourier Transforms in initial and boundary value problem – Application of infinite Fourier transforms – Choice of infinite sine or cosine transform examples – Application of finite Fourier transforms – Finite Fourier transforms of partial derivatives – Choice of finite sine or cosine transforms examples.

Unit - IV

Hankel Transforms: Inversion Formula for the Hankel transform – Some important results for Bessel functions- Linearity property examples Hankel Transform of the derivatives fo a function – Hankel transform of $d^2f / dx^2 + 1/x \; df / dx - n^2 / x^2 (f)$ - Parseval's Theorem examples.

Unit - V

The Finite Hankel Transforms:Another form of Hankel Transform examples – Hankel transform of df / dx - Hankel Transform of $d^2 f / dx^2 + 1/x \; df / dx$ where P is the root of the equation Jn (ap) = 0 - Hankel Transform $d^2f / dx^2 + 1/x \; df / dx - n^2 / x^2 (f)$where P is the root of the equation Jn (ap) = 0 examples.

Text Books

[1] Ram P. Kanwal – Linerar integral equations Theory and practice Academic Press 1971.
[2] A.R.Vasishtha, R.K. Gupta, Integral Transforms, Krishna Prakashan media PVT Ltd, 2002.

Unit - I - Chapter 2 Sections 2.1 to 2.9 of [1]
Unit - II - Chapter 6 and 7 of [2]
Unit - III - Chapter 8 of [2]
Unit - IV - Chapter 9 of [2]
Unit - V - Chapter 10 of [2]

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VI	**No of credits : 5**

Title of the Paper: COMPLEX VARIABLE

Unit - I

Conformality:Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; Linear Transformations: The Linear Group – The Cross Ratio – Symmetry.

Unit - II

Fundamental theorems in complex integration:Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk; Cauchy's Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.

Unit - III

Local Properties of Analytic Functions - Removable Singularities - Taylor's Theorem – Integral representation of the n^{th} term - Zeros and Poles – Algebraic order of f(z) – Essential Singularity - The Local Mapping – The Open Mapping Theorem - The Maximum Principle.

Unit -IV

The General Form of Cauchy's Theorem:Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions; The Calculus of Residues: The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals

Unit- V

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.

Text Book

[1] Lars V.Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979.

Unit - I	-Chapter 3: 2.1-2.4,3.1-3.3
Unit - II	-Chapter 4: 1.1-1.5, 2.1-2.3
Unit - III	-Chapter 4: 3.1, 3.2, 3.3,3.4
Unit - IV	-Chapter 4: 4.1-4.7, 5.1-5.3

Unit - V -Chapter 4: 6.1-6.5, and Chapter 5: 1.1-1.3

Reference Books

[1] Serge Lang, Complex Analysis, Addisn Wesley, 1977.
[2] S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1997.
[3] V.Karunakaran, Complex Analysis.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VII	**No of credits : 5**

Title of the Paper:ALGEBRA

Unit - I

A counting principle – Normal subgroups and quotient groups – Homomorphisms – Automorphisms.

Unit - II

Cayley's theorem – Permutation groups – Another counting principle – Sylow's theorem.

Unit - III

Ring Theory: Homomorphism of rings – Ideals and quotient rings – More ideals and quotient rings – Polynomial rings – Polynomials over the rational field – Polynomials over commutative rings.

Unit - IV

Elementary basic concepts of vector spaces – Linear independence and bases – Dual spaces – Inner product spaces.

Unit - V

Linear Transformations: Canonical forms – Triangular forms – Nilpotent Transformations – Hermitian, Unitary and Normal transformations.

Text Book

[1] I.N. Herstein, Topics in Algebra, Second Edn, Wiley Eastern Limited.

Unit - I - Chapter 2,Sections 2.5 to 2.8
Unit - II - Chapter 2, Sections 2.9 to 2.12
Unit - III - Chapter 3, Sections 3.3, 3.4, 3.5, 3.9, 3.10, 3.11
Unit - IV - Chapter 4, Sections 4.1 to 4.4
Unit - V - Chapter 6, Sections 6.4, 6.5 and 6.10

Reference Books

[1] Surjeet singh , Qazi Zamaeeruddin, Modern algebra, Vikas publishing house Pvt Ltd.
[2] Michael Artin, Algebra,Preantice - Hall of India, New Delhi, 1994.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VIII	**No of credits : 5**

Title of the Paper: TOPOLOGY

Unit - I

Topological spaces: Topological spaces – Basis for a topology – The order topology – The product topology on X x Y – The subspace topology –Closed sets and limit points.

Unit - II

Continuous functions: Continuous functions – the product topology – The metric topology – The metric topology continued.

Unit - III

Connectedness: Connected spaces– Connected subspaces of the Real line –Components and local connectedness.

Unit - IV

Compactness: Compact spaces – Compact subspaces of the Real line – Limit Point Compactness – Local compactness.

Unit - V

Countability and separation axioms: The countability axioms **–** The separation axioms **–** Normal spaces **–** The Urysohn Lemma.

Text Book

[1] James R. Munkres, Topology (2nd Edition), Pearson Education Pvt. Ltd., New Delhi-2002 (Third Indian Reprint).

Unit - I -Chapter 2: Sections 12 to 17
Unit - II -Chapter 2 : Sections 18 to 21 (Omit Section 22)
Unit - III -Chapter 3 : Sections 23 to 25.
Unit - IV -Chapter 3 : Sections 26 to 29.
Unit - V -Chapter 4 : Sections 30 to 33

Reference Books

[1] J. Dugundji, Topology, Prentice Hall of India, ,Ne\v Delhi, 1975.

[2] George F.Simmons, Introduction to Topology and Modern Analysis, s
McGraw Hill Book Co., 1963.
[3] J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York.
[4] L.Steen and J.Seeback, Counter examples in Topology, Holt, Rinchart and Winston, New York, 1970

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper IX	**No of credits : 4**

Title of the Paper: PARTIAL DIFFERENTIAL EQUATIONS

Unit - I

First order P.D.E. – Curves and surfaces – Genesis of first order P.D.E. – Classification of integrals – Linear equations of the first order – Pfaffian differential equations – Compatible systems – Charpit's method – Jacobi's method

Unit -II

Integral surfaces through a given curve – Quasi-Linear equations – Non-linear first order P.D.E.

Unit -III

Second order P.D.E.: Genesis of second order P.D.E. – Classification of second order P.D.E. One-dimensional Wave equation – Vibrations of an infinite string – Vibrations of a semi-infinite string – Vibrations of a string of finite length.

Unit -IV

Laplace's 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 interior problem for a circle - The Dirichlet exterior problem for a circle – The Neumann problem for a circle – The Dirichlet problem for a ectangle – Harnack's theorem – Laplace's equation – Green's function.

Unit - V

Heat conduction problem – Heat conduction – Infinite rod case – Heat conduction finite rod case – Duhamel's principle – Wave equation – Heat conduction equation

Text Book

[1] T.Amarnath,An Elementary Course in Partial Differential Equations, Narosa, 1997.

Unit - I	-Chapter 1: Sections 1.1 to1.8
Unit - II	-Chapter 1: Sections 1.9 to1.11
Unit - III	-Chapter 2: Sections 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3.
Unit - IV	-Chapter 2: Sections 2.4 to 2.4.11
Unit - V	-Chapter 2: Sections 2.5 to 2.6.2

Reference Books

[1] L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19 AMS, 1998.
[2] I.N. Snedden, Elements of Partial Differential Equations [3] F. John,P.Prasad, Partial Differential Equations.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper X	**No of credits : 5**

Title of the Paper: MEASURE THEORY AND INTEGRATION

Unit - I

Measure on Real line – Lebesgue outer measure – Measurable sets – Regularity – Measurable function –Borel and Lebesgue measurability.

Unit - II

Integration of non-negative functions – The General integral– Integration of series – Riemann and Lebesgue integrals.

Unit - III

Abstract measure spaces – Measures and outer measures – Extension of a measure – Uniqueness of the extension – Completion of a measure – Measure spaces – Integration with respect to a measure.

Unit - IV

Convergence in measure – Almost uniform convergence – Signed measures and Halin decompostion – The Jordan decomposition.

Unit - V

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

Text Book

[1] G.De Barra, Measure Theory and Integration, New age international(p) Limited.

Unit - I	-Chapter II: Sections 2.1 to 2.5
Unit - II	-Chapter III: Sections 3.1 to 3.4
Unit - III	-Chapter V: Sections 5.1 to 5.6
Unit - IV	-Chapter VII: Sections 7.1 and 7.2, Chapter VIII: Sections 8.1 and 8.2
Unit - V	-Chapter X: Sections 10.1 and 10.2

Reference Books

[1] Measure and Integration, by M.E. Munroe, Addison - Wesley Publishing Company, Second Edition, 1971.

[2] P.K. Jain, V.P. Gupta, Lebesgue Measure and Integration, New Age International Pvt Limited Publishers, New Delhi, 1986. (Reprint 2000)
[3] Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc. 1977.
[4] Inder, K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, New Delhi, 1997.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper XI	**No of credits : 5**

Title of the Paper: FUNCTIONAL ANALYSIS

Unit - I

Algebraic Systems: Groups – Rings –The structure of rings Linear spaces –The dimension of a linear space –Linear transformations –Algebras Banach Spaces : The definition and some examples Continuous linear transformations –The Hahn-Banach theorem – The natural imbedding of N in N** – The open mapping theorem –The conjugate of an operator.

Unit - II

Hilbert Spaces: The definition and some simple properties – Orthogonal complements – Orthonormal sets – The conjugate space H* – The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.

Unit - III

Finite-Dimensional Spectral Theory: Matrices –Determinants and the spectrum of an operator – The spectral theorem –A survey of the situation.

Unit - IV

General Preliminaries on Banach Algebras: The definition and some examples Regular and singular elements – Topological divisors of zero– The spectrum– The formula for the spectral radius – The radical and semi-simplicity.

Unit - V

The Structure of Commutative Banach Algebras : The Gelfand mapping – Applications of the formula $r(x) = \lim \| x^n \|^{1/n}$ - Involutions in Banach Algebras – The Gelfand-Neumark theorem.

Text Book

[1] G.F.Simmons,Introduction to Topology and Modern Analysis, McGraw-Hill International Ed. 1963.

Unit - I - Chapters 8 and 9
Unit - II - Chapter 10
Unit - III - Chapter 11
Unit - IV - Chapter 12
Unit -V - Chapter 13

Reference Books

[1] Walter Rudin, Functional Analysis, TMH Edition, 1974.
[2] B.V. Limayc, Functional Analysis, Wiley Eastern Limited, Bombay. Second Print, 1985.
[3] K. Yosida, Functional Analysis, Springer-Verlag, 1974.
[4] Laurent Schwarz, Functional Analysis, Courant Institute of Mathematical Sciences, New York University, 1964.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper XII	**No of credits : 4**

Title of the Paper: MATHEMATICAL STATISTICS

Unit - I

Collection, classification and tabulation of data, graphical and diagramatic representation - Bar diagrams, Pie diagram, Histogram, Frequency polygon. frequency curve and Ogives. Measure of central tendency - Mean, Median and Mode in series of individual observations, Discrete series, Continuous series (inclusive), More than frequency, Less than frequency, Mid-value and open-end class.

Unit - II

Measures of dispersion - Range, Quartile deviation, Mean deviation about an average, Standard deviation and co-efficient of variation for individual, discrete and continuous type data.

Unit - III

Correlation - Different types of correlation - Positive, Negative, Simple, Partial Multiple, Linear and non-Linear correlation. Methods of correlation -Karlpearson's Spearman's correlations, Concurrent deviation and Scatter diagram.

Unit - IV

Regression types and method of analysis, Regression line, Regression equations, Deviation taken from arithmetic mean of X and Y, Deviation taken from assumed mean, Partial and multiple regression coefficients – Applications.

Unit - V

Sampling theory - Testing of hypothesis using normal distribution - Single mean, Two mean, Single proportion, Two proportions and Two Standard Deviations and Student - t distribution - Single mean, Two mean, Paired t-test, Simple correlation coefficient - Chi-square test-Independents of attributes and goodness of fit-applications. Analysis of variance - One-way and two-way classification with simple problems.

Text Books

[1] P.N.Arora, Sumeet Arora and S.Arora, Comprehensive Statistical Methods, S.Chand and Sons, New Delhi, 2007. (Unit I)

[2]S.C.Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2002.(Units II to V)

Unit – I - Chapter II, Sections 2.1 to 2.4
Chapter III, Sections 3.1 to 3.79
Chapter IV, Sections 4.1 to 4.19 [1]

Unit – II - Chapter II, Sections 2.13, 2.14 [2]

Unit – III - Chapter X, Sections 10.1 to 10.4
Chapter XII, Sections 12.4, 12.7 to 12.9 [2]

Unit – IV - Chapter XI, Sections 11.2.1 to 11.2.3
Chapter XII, Section 12.2.5 [2]

Unit – V - Chapters XIV, XV, XVI [2]

Reference Books

[1] Freund J.E., Mathematical Statistics, Prentice Hall of India, 2001.

[2] Goon, A.M., Gupta M.K., Dos Gupta, B, Fundamentals of Statistics, Vol.l. World Press, Calcutta, 1991.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Core Paper XIII	**No of credits : 5**

Title of the Paper: DIFFERENTIAL GEOMETRY

Unit - I

Space curves: Definition of a space curve – Arc length – Tangent – Normal and binormal – Curvature and torsion – Contact between curves and surfaces–Tangent surface– Involutes and evolutes– Intrinsic equations – Fundamental existence theorem for space curves– Helices.

Unit - II

Intrinsic properties of a surface: Definition of a surface –- Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients –Families of curves– Isometric correspondence – Intrinsic properties.

Unit - III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesic – Existence Theorems – Geodesic parallels – Geodesies curvature–Gauss– Bonnet Theorem – Gaussian curvature – Surface of constant curvature.

Unit - IV

Non intrinsic properties of a surface: The second fundamental form – Principal curvature – Lines of curvature – Developable –Developable associated with space curves and with curves on surface – Minimal surfaces –Ruled surfaces.

Unit - V

Differential geometry of surfaces: Compact surfaces whose points are umbilics– Hilbert's lemma – Compact surface of constant Gaussian curvature –Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Text Book

[1]T.J. Willmore, An Introduction to Differential Geometry, Oxford UniversityPress, (17th Impression) New Delhi 2002. (Indian Print).

Unit - I - Chapter I: Sections 1 to 9.
Unit - II - Chapter II: Sections 1 to 9.;
Unit - III - Chapter II: Sections 10 to 18.
Unit - IV - Chapter III: Sections 1 to 8.;
Unit - V - Chapter IV : Sections 1 to 8

Reference Books

[1] Struik, D.T. Lectures on Classical Differential Geometry. Addison – Wesley. Mass. 1950.

[2] Kobayashi S. and Nomizu. K. Foundations of Differential Geometry. Interscience Publishers, 1963.

[3] Wihelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag, 1978.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Core Paper XIV	**No of credits : 4**

Title of the Paper: GRAPH THEORY

Unit -I

Graphs, subgraphs and Trees: Graphs and simple graphs – Graph isomorphism – The Incidence and Adjacency matrices – Subgraphs – Vertex degrees – Paths and connection – Cycles – Trees – Cut edges and Bonds – Cut vertices.

Unit - II

Connectivity, Euler tours and Hamilton Cycles: Connectivity – Blocks – Euler tours – Hamilton cycles.

Unit - III

Matchings, Edge Colourings : Matchings – Matchings and coverings in bipartite graphs – Edge chromatic number – Vizing's theorem.

Unit - IV

Independent sets and Cliques, Vertex colourings : Independent sets –Ramsey's theorem – Chromatic number – Brooks' theorem – Chromatic polynomials.

Unit - V

Planar graphs: Plane and planar graphs – Dual graphs – Euler's formula – The Five-colour Theorem – The Four-colour conjecture;

Text Book

[1] J.A.Bondy and U.S.A. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

Unit - I	- Chapter 1 (Section 1.1 -1.7), Chapter 2 (Section 2.1 -2.3)
Unit - II	- Chapter 3 (Section 3.1 - 3.2), Chapter 4 (Section 4.1 - 4.2)
Unit - III	- Chapter 5 (Section 5.1 - 5.2), Chapter 6 (Section 6.1 - 6.2)
Unit - IV	- Chapter 7 (Section 7.1 - 7.2), Chapter 8 (Section 8.1 - 8.2, 8.4)
Unit - V	- Chapter 9 (Section 9.1- 9.3, 9.6)

Reference Books

[1] J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
[2] R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
[3] A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.

[4] R.J..Wilson, and J.J.Watkins, Graphs: An Introductory Approach, John Wiley and Sons, NewYork, 1989.
[5] S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

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POOMPUHAR COLLEGE (AUTONOMOUS)
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Department of Mathematics
(For those who are joining in 2016 – 2017 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Elective I	**No of credits : 4**

Title of the Paper: NON LINEAR DIFFERENTIAL EQUATIONS

Unit - I

First Order Systems In Two Variables And Linearization: The general phase plane- some population models - Linear approximation at equilibrium points - Linear systems in matrix form.

Unit - II

Averaging Methods: An energy balance method for limit cycles - Amplitude and frequency estimates - slowly varying amplitudes - nearly periodic solutions - periodic solutions: harmony balance - Equivalent linear equation by harmonic balance -Accuracy of a period estimate.

Unit - III

Perturbation Methods: Outline of the direct method - Forced Oscillations far from resonance - Forced Oscillations near .resonance with Weak excitation - Amplitude equation for undamped pendulum - Amplitude Perturbation for the pendulum equation -Lindstedt's Method - Forced oscillation of a self - excited equation - The Perturbation Method and Fourier series.

Unit - IV

Linear Systems: Time Varying Systems - Constant coefficient System - Periodic Coefficients - Floquet Theory - Wronskian.

Unit - V

Stability: Poincare stability - solutions, paths and norms - Liapunov stability Stability of linear systems - Comparison theorem for the zero solutions of nearly - linear systems.

Text Book

[1] Nonlinear Ordinary Differential Equations By D.W.Jordan, & P.Smith, Clarendon Press, Oxford, 1977.

Reference Books

[1] Differential Equations by G.F.Simmons, Tata McGraw Hill, NewDelhi (1979)
[2] Ordinary Differential Equations and Stability Theory By D.A.Sanchez, Freeman (1968).
[3] Notes on Nonlinear Systems by J.K.Aggarwal, Van Nostrand, 1972.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Elective II	**No of credits : 4**

Title of the Paper: THEORY OF NUMBERS

UNIT I

Introduction – Divisibility – Primes – The Binomial Theorem – Congruences – Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.

UNIT II

Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and power residues –Congruences of degree two.

UNIT III

Number theory from an algebraic viewpoint – Groups, rings and fields – Quadratic Residues- The Legendre symbol (a/r) where r is an odd prime – Quadratic reciprocity – The Jacobi Symbol (P/q) where q is an odd positive integer.

UNIT IV

Binary Quadratic Forms – Equivalence and reduction of binary quadratic forms – Sums of three squares – Positive definite binary quadratic forms – Greatest integer function – Arithmetic functions – The Mobius inversion formula – Recurrence functions – Combinatorial number theory.

UNIT V

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

Text Book

[1] Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, An Introduction to the Theory of Numbers, Fifth edn., John Wiley & Sons Inc, 2004.

Unit - I - Chapter 1 and Chapter 2, Sections 2.1 to 2.3
Unit - II - Chapter 2, Sections 2.4 to 2.9
Unit - III - Chapter 2, Sections 2.10, 2.11 and Chapter 3, Sections 3.1 to 3.3
Unit - IV - Chapter 3, Sections 3.4 to 3.7 and Chapter 4
Unit - V - Chapter 5, Sections 5.1 to 5.4

Reference Books

[1] David M. Burton, Elementary Number Theory, W.M.C. Brown Publishers, Dubuque, Lawa, 1989.
[2] George Andrews, Theory of Numbers.
[3] Fundamentals of Number Theory, William.J. Leveque, Addison-Wesley Publishing Company, Phillipines, 1977.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Elective III	**No of credits : 4**

Title of the Paper: FUZZY MATHEMATICS

Unit -I

Fuzzy sets – Basic types – Basic concepts – α-cuts – Additional properties of α-cuts – Extension principle for fuzzy sets.

Unit -II

Operations on fuzzy sets – Types of operations – Fuzzy complements – t-Norms – Fuzzy unions – Combinations of operations.

Unit -III

Fuzzy arithmetic – Fuzzy numbers – Arithmetic operations on intervals – Arithmetic operations on fuzzy numbers.

Unit -IV

Fuzzy relations – Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Fuzzy morphisms.

Unit -V

Fuzzy relation equations – General discussion – Problem partitioning – Solution method – Fuzzy relation equations based on Sup-i Compositions - Fuzzy relation equations based on inf-ω_i compositions.

Text Book

[1] George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.

Unit - I - Chapter I, Sections 1.3, 1.4 and Chapter II, Sections, 2.1, 2.3
Unit - II - Chapter II
Unit - III - Chapter IV, sections 4.1, 4.3, 4.4
Unit - IV - Chapter V, Sections 5.3, 5.5 to 5.8
Unit - V - Chapter VI, Sections, 6.1 to 6.5

Reference Books

[1] H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.
[2] G.J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective IV	**No of credits : 4**

Title of the Paper: STOCHASTIC PROCESSES

Unit - I

Stochastic Processes: Some notions – Specification of stochastic processes – Stationary processes – Markov chains – Definitions and examples – Higher transition probabilities – Generalization of independent Bernoulli trails – Sequence of chain – Dependent trains.

Unit - II

Markov chains**:** Classification of states and chains – Determination of higher transition probabilities – Stability of a Markov system – Reducible chains –Markov chains with continuous state space.

Unit - III

Markov processes with discrete state space: Poisson processes and their extensions – Poisson process and related distribution – Generalization of poisson process – Birth and death process – Markov processes with discrete state space (continuous time Markov Chains).

Unit - IV

Renewal processes and theory: Renewal process – Renewal processes in continuous time – Renewal equation – Stopping time – Wald's equation –Renewal theorems.

Unit - V

Stochastic processes in queuing – Queuing system – General concepts – The queuing model M/M/1 – Steady state behaviour – Transient behaviour of M/M/1 Model – Non-Markovian models – The model GI/M/1.

Text Book

[1] J. Medhi, Stochastic Processes, Howard M. Taylor - Second edition.

Unit - I	- Chapter II, Sections 2.1 to 2.3, Chapter III, Sections 3.1 to 3.3
Unit - II	- Chapter III, Sections 3.4 to 3.6, 3.8, 3.9 and 3.11
Unit - III	- Chapter IV, Sections 4.1 to 4.5
Unit - IV	- Chapter VI, Sections 6.1 to 6.5
Unit - V	- Chapter III, Sections 10.1 to 10.3, 10.7, 10.8 (Except 10.2.3 & 10.2.3.1)

Reference Books

[1] Samuel Korlin, Howard M. Taylor, A first course in stochastic processes, II Edn.
[2] Narayan Bhat, Elements of Applied Stochastic Processes,
[3] Srinivasan and Metha, Stochastic Processes, N.V. Prabhu, Macmillan (NY), Stochastic Processes.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective V	**No of credits : 4**

Title of the Paper: COMBINATORICS

Unit - I

Permutations and combinations - distributions of distinct objects - distributions of non distinct objects - Stirlings formula.

Unit - II

Generating functions. - generating function for combinations - enumerators for permutations - distributions of distinct objects into non-distinct cells - partitions of integers - the Ferrers graphs - elementary relations.

Unit - III

Recurrence relation - linear recurrence relations with constant coefficients solutions, by the technique of generating functions - a special class of nonlinear difference equations - recurrence relations with two indices.

Unit - IV

The principle of inclusion and exclusion - general formula - permutations with restriction on relative positions - derangements - the rook polynomials -permutations with forbidden positions.

Unit - V

Polya's theory of counting - equivalence classes under a permutation group Burnside theorem - equivalence classes of functions - weights and inventories of functions - Polya' s fundamental theorem - generation of Polya's theorem

Text Book

[1] C.L. Liu - Introduction of Combinatorial Mathematics, McGraw Hill, Chapters 1 to 5.

Reference Books

[1] Marshall Hall. Jr., Combinatorial Theory.
[2] H.J. Rayser, Combinatorial Mathematics, Cams, Mathematical Monograph, No.14.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective VI	**No of credits : 4**

Title of the Paper: TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

Unit - I

Invariance - Transformations of coordinates and its properties - Transformation by invariance - Transformation by covariance and contra variance - Covariance and contra variance - Tensor and Tensor character of their laws - Algebras of tensors - Quotient tensors - Symmetric and skew symmetric tensors - Relative tensors.

Unit - II

Metric Tensor - The fundamental and associated tensors - Christoffel's symbols - Transformations of Chrisffel's symbols- Covariant Differentiation of Tensors - Formulas for covariant Differentiation- Ricci Theorem - Riemann -Christoffel Tensor and their properties.

Unit - III

Einstein Tensor - Riemannian and Euclidean Spaces (Existence Theorem) - The e-systems and the generalized Kronecker deltas - Application of the e-systems.

Unit - IV

Special Theory of Relativity: Galilean Transformation - Maxwell's equations - The ether Theory - The Principle of Relativity Relativistic Kinamatics: Lorentz Transformation equations - Events and simultaneity - Example Einstein Train - Time dilation -Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - World line - Example - twin paradox - addition of velocities - Relativistic Doppler effect.

Unit - V

Relativistic Dynamics : Momentum - energy - Momentum-energy four vector - Force - Conservation of Energy - Mass and energy - Example - inelastic collision - Principle of equivalence - Lagrangian and Hamiltonian formulations .Accelerated Systems : Rocket with constant acceleration - example - Rocket with constant thrust.

Text Books

[1]I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York, 1964.
[2]D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Unit - I - Chapter 2, Sections 18 to 28 of [1]
Unit - II - Chapter 2, Sections 29 to 37 of [1]

Unit - III - Chapter 2, Section 38 to 41 of [1]
Unit - IV - Chapter 7, Sections 7.1 and 7.2 of [2]
Unit - V - Chapter 7, Sections 7.3 and 7.4 of [2]

Reference Books

[1] J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949.
[2]A.S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930.
[3] P.G. Bergman, An Introduction to Theory of Relativity, New york, 1942.
[4]C.E. Weatherburn, Riemannian Geometry and Tensor Calculus, Cambridge, 1938.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective VII	**No of credits : 4**

Title of the Paper: MATHEMATICAL MODELLING

Unit - I

Mathematical Modelling through Ordinary Differential Equations of First order : Linear Growth and Decay Models - Non-Linear Growth and Decay Models - Compartment Models - Dynamics problems - Geometrical problems.

Unit - II

Mathematical Modelling through Systems of Ordinary Differential Equations of First Order : Population Dynamics - Epidemics - Compartment Models - Economics - Medicine, Arms Race, Battles and International Trade -Dynamics.

Unit - III

Mathematical Modelling through Ordinary Differential Equations of Second Order: Planetary Motions - Circular Motion and Motion of Satellites -Mathematical Modelling through Linear Differential Equations of Second Order -Miscellaneous Mathematical Models.

Unit - IV

Mathematical Modelling through Difference Equations : Simple Models -Basic Theory of Linear Difference Equations with Constant Coefficients -Economics and Finance - Population Dynamics and Genetics - Probability Theory.

Unit - V

Mathematical Modelling through Graphs : Situations that can be Modelled through Graphs - Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

Text Book

[1]J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

Unit – I - Chapter 2
Unit – II - Chapter 3
Unit – III - Chapter 4
Unit – IV - Chapter 5
Unit – V - Chapter 7

Reference Book

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East -West Press Pvt. Limited, New Delhi, 1981.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective VIII	**No of credits : 4**

Title of the Paper: FINANCIAL MATHEMATICS

Unit - I

Single period models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure

Unit - II

Binomial trees and discrete parameter martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem -Overturn to Continuous models.

Unit - III

Brownian motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.

Unit - IV

Stochastic calculus: Non-differentiability of Stock prices - Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem -Girsanov Theorem - Brownian Martingale Representation Theorem - Geometric Brownian Motion - The Feynman - Kac Representation

Unit - V

Block-scholes model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends - Bonds -Market price of risk.

Text Book

[1] Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Reference Books

[1] Martin Boxte and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996.
[2] Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau and Farancois Mantion),
[3] Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall, 1996.

[4] Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.
[5] Robert J.Elliott and P.Ekkehard Kopp, Mathematics of Financial Markets. Springer Verlag, New York, 2001 (3rd Printing).

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective IX	**No of credits : 4**

Title of the Paper: ADVANCED MATHEMATICAL STATISTICS

Unit - I

Some Special Distributions: Introduction – Some discrete distributions – Some Continuous distributions – The bivariate and multivariate normal distribution – The exponential family of distributions.

Unit - II

Limit Theorems: Introduction – Modes of convergence – The weak law of large numbers – The strong law of large numbers – Limiting moment generating functions – The central limit theorem.

Unit - III

Sample moments and Their distributions: Introduction – Random sampling – Sample characteristics and their distributions – Chi – Square, t and F-Distributions: Exact Sampling distributions – The distribution of ($\bar{X}$, S^2) in sampling from a normal population – Sampling from a bivariate normal distribution.

Unit - IV

The Theory of Point Estimation: Introduction – The problem of point estimation – Properties of estimates – Unbaised estimates – Unbaised estimation(continued): A lower bound for the variance of an estimates.

Unit - V

Neyman – Pearson Theory of Testing of Hypotheses: Introduction – Some fundamental notions of hypotheses testing – The Ney-Pearson Lemma – Families with monotone Likehood ratio – Unbaised and invariant tests.

Text Book

[1] V.K Rohatgi, An Introduction to probability Theory and Mathematical Statistics, Wiley Eastern limited, 1976.

Unit - I - Chapter 5, Sec 5.1 – 5.5.
Unit - II - Chapter 6, sec 6.1 – 6.6.
Unit - III - Chapter 7, sec 7.1 - 7.6.
Unit - IV - Chapter 8, sec 8.1 – 8.5.

Unit - V - Chapter 9, sec 9.1 – 9.5.

Reference Book

[1] M.Fisz,Probability Theory and Mathematical Statistics, John wiley and sons, New York, 1963.

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective X	**No of credits : 4**

Title of the Paper: OPTIMIZATION TECHNIQUES

Unit - I

Integer linear programming.

Unit - II

Dynamic (Multistage) programming.

Unit - III

Decision analysis and Games.

Unit - IV

Inventory Models.

Unit - V

Non-Linear Programming algorithms.

Text Book

[1]Hamdy A. Taha, Operations Research (7^{th} Edn.), McGraw Hill Publications, New Delhi, 2007.

Unit - I - Chapter 8, Sections 8.1 to 8.5
Unit - II - Chapter 9, Sections 9.1 to 9.5
Unit - III - Chapter 11, Sections 11.1 to 11.4
Unit - IV - Chapter 11, Sections 13.1 to 13.4
Unit - V - Chapter 19, Sections 19.1,19.2

Reference Books

[1]O.L. Mangasarian, Non Linear Programming, McGraw Hill, New York.
[2]Mokther S. Bazaraa and C.M. Shetty, Non Linear Programming, Theoryand Algorithms, Willy, New York.
[3] Prem Kumar Gupta and D.S. Hira, Operations Research : An Introduction ,S. Chand and Co., Ltd. New Delhi.
[4]S.S. Rao, Optimization Theory and Applications, Wiley Eastern Limited, New Delhi.

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POOMPUHAR COLLEGE (AUTONOMOUS)
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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective XI	**No of credits : 4**

Title of the Paper: STOCHASTIC DIFFERENTIAL EQUATIONS

Unit - I

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

Unit - II

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

Unit - III

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

Unit - IV

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

Unit - V

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

Text Book

[1] Bernt Oksendal,Stochastic Differential Equations - An Introduction with Applications,Sixth Edition, Springer-Verlag, Heidelberg, 2003.

Unit - I	-Chapter 1 and 2
Unit – II	- Chapter 3
Unit – III	- Chapter 4 and 5
Unit – IV	- Chapter 6
Unit - V	- Chapter 7.

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