DEPARTMENT OF MATHEMATICS

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Rathinam Techzone, Pollachi Road, Eachanari, Coimbatore – 641021

Syllabus for

M.Sc. Mathematics

(I -IV Semester) 2016 – 2017 Batch onwards

Detailed Syllabus B.Sc. Mathematics - 2017 – 2018, based on the decision taken by BOS, Mathematics PG, Rathinam College of Arts and Science dated 11-04-2017

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Scheme of curriculum for M.Sc. Mathematics

for the Batch admitted during 2017 - 2018

Board of Studies – Mathematics (PG)

Sem	Part	Type	Sub. Code	Subject & Paper	HRS per week	CIA	ESE	Max mark	Exam Hours	Credit
I	III	C1	16MMA13A	Algebra	7	25	75	100	3	5
I	III	C2	16MMA13B	Real Analysis	7	25	75	100	3	5
I	III	C3	16MMA13C	Ordinary Differential Equations	6	25	75	100	3	5
I	III	C4	16MMA13D	Numerical Methods	6	25	75	100	3	5
I	III	E1	16MMA1EC	Control Theory	4	25	75	100	3	4
II	III	C5	16MMA23A	Complex Analysis	6	25	75	100	3	5
II	III	C6	16MMA23B	Partial Differential Equations	7	25	75	100	3	5
II	III	C7	16MMA23C	Mechanics	7	25	75	100	3	5
II	III	C8	16MMA23D	Operations Research	6	25	75	100	3	5
II	III	E2	16MMA2ED	Differential Geometry	4	25	75	100	3	4
III	III	C9	16MMA33A	Topology	8	25	75	100	3	5
III	III	C10	16MMA33B	Linear algebra	7	25	75	100	3	5
III	III	C11	16MMA33C	Number Theory	7	25	75	100	3	5
III	III	E3	16MMA3EC	Latex theory	6	25	75	100	3	4
III	III	E3	16MMA3EP	Latex Practical	2	40	60	100	3	2
IV	III	C12	16MMA43A	Functional Analysis	8	25	75	100	3	5
IV	III	C13	16MMA43A	Fluid Dynamics	7	25	75	100	3	5
IV	III	C14	16MMA43A	Graph Theory	7	25	75	100	3	5
IV	III	E4	16MMA4ED	Matlab Theory	6	25	75	100	3	4
IV	III	E4	16MMA4EP	Matlab Practical	2	40	60	100	3	2
				Total				2000		90

Elective Subjects:

Elective-I	A	Fuzzy Logic And Fuzzy Sets
	B	Control Theory
	C	Cryptography
Elective-II	A	Mathematical finance
	B	Differential Geometry
	C	Probability theory
Elective-III	A	Latex theory
	B	Mathematics for quantitative aptitude and verbal reasoning
	C	Decision Sciences
Elective-IV	A	Astronomy
	B	Matlab Theory
	C	Statistics For Mathematics

SEMESTER I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Algebra	7			5	core

Introduction: This paper aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics.

Objective: To introduce the concepts and to develop working knowledge on counting principle polynomial rings, extension fields, elements of galois theory, linear transformations.

UNIT I
Group Theory: Another counting principle – Sylow's theorem – Direct products

UNIT II
Ring Theory: Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over therational field.

UNIT III
Fields: Extension Fields – Roots of polynomials – More about roots.

UNIT IV
Fields: Elements of Galois theory – Finite Fields.

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

Treatment as in:

1. Topics in Algebra by I.N.Herstein (II Edition)

Reference Books:

1. J.B.Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House, New Delhi, 1988
2. M.Artin, Algebra, Prentice-Hall, Englewood Cliff, 1991.
3. T.W.Hungerford, Algebra, Springer, New York, 1974

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SEMESTER I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Real Analysis	7			5	core

Introduction: This paper aims to provide a first approach to the subject of Real Analysis, which is one of the basic pillars of modern mathematics.

Objective: To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations

UNIT I

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

UNIT II

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

UNIT III

FUNCTIONS OF SEVERAL VARIABLES: Linear transformation – contraction principle – Inverse function theorem – Implicit function theorem.

UNIT IV

LEBESGUE MEASURE: Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's Theorem

UNIT V

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

Treatment as in:

1. Real Analysis by H.L. Roydon, Third Edition, Macmillan, New York, 1988. Unit IV : Chapter 3 (except Section – 4) Unit V : Chapter 4 (Sections 2, 3 & 4 only)
2. Principles of Mathematical Analysis by W. Rudin, McGraw Hill, New York, 1976. Unit I & II : Chapter 6 & 7. Unit III : Chapter 9 (Pages 204 to 227)

Reference Books:

1. R.G.Bartle, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York, 1976.
2. W.Rudin, Real and Complex Analysis, 3rd Edition, McGraw-Hill, New York, 1986

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SEMESTER I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Ordinary Differential Equations	6			5	Core

Introduction: This paper aims to provide a first approach to the subject of ODE, which is one of the basic pillars of modern mathematics.

Objectives: To develop strong background on finding solutions to linear differential equations with constant and variable coefficients, to Study existence and uniqueness of the solutions of first & second order differential equations.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Treatment as in:

1. Ordinary Differential Equations and Stability Theory by S.G.Deo and V.Raghavendra.

Reference Books:

1. E.A.Coddington and N.Levinson , Theory of Ordinary Differential Equations, McGraw Hill, New York, 1955.
2. D.A.Sanchez, Ordinary Differential Equations and Stability Theory, W.H.Freeman & Co., San Francisco, 1968

SEMESTER I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Numerical Methods	6			5	core

Introduction: This paper aims to provide a first approach to the subject of Numerical Methods, which is one of the important aspects of advanced mathematics.

Objectives: The course will develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs. The course will further develop problem solving skills.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS:

The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

UNIT V

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

Treatment as in:

1. APPLIED NUMERICAL ANALYSIS' by C.F.Gerald and P.O.Wheatley, Fifth Edition, Addison Wesley, (1998).

Reference Book:

1. S.C. Chapra and P.C. Raymond: Numerical Methods for Engineers, tata McGraw Hill, New Delhi, (2000)
2. R.L. Burden and J. Douglas Faires: Numerical Analysis, P.W.S.Kent Publishing Company, Boston (1989), Fourth Edition.
3. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998).
4. P.Kandasamy et al.,Numerical Methods, S.Chand & Co.Ltd., New Delhi

SEMESTER II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Complex Analysis	6			5	core

Introduction: This paper aims to provide a first approach to the subject of Complex Analysis, which is one of the important aspects of advanced mathematics.

Objectives: To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions and also Riemann mapping theorem.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Treatment as in:

1. Complex Analysis by L.V. Ahlfors, Mc Graw Hill, New York, 1979.

Reference Books:

1. Real and Complex Analysis by W. Rudin, McGraw-Hill Book Co., 1966.

SEMESTER II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Partial Differential Equations	7			5	core

Introduction: This paper aims to provide a first approach to the subject of PDE, which is one of the important aspects of advanced mathematics.

Objectives: The aim of the course is to introduce to the students the various types of partial differential equations and how to solve these equations.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Treatment as in:

1. Partial Differential Equations for Scientists and Engineers, 3rdEdition, by Tyn Myint. Uwith Lokenath Debnath.

References:

1. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, London, 1957.
2. L.C.Evans, Partial Differential Equations, AMS, Providence, R I, 2003.

SEMESTER II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Mechanics	7			5	core

Introduction: This paper aims to provide a first approach to the subject of Mechanics, which is one of the important aspects of advanced mathematics.

Objectives: To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Lagrange, Hamilton Jacobi and Theory of Relativity due to Einstein.

UNIT I

INDRODUCTORY CONCEPTS : Mechanical system – Generalized Coordinates – Constraints –Virtual Work – Energy and Momentum.

UNIT II

LAGRANGE'S EQUATIONS : Derivations of Lagrange's Equations : Derivations of Lagrange's Equations – Examples –Integrals of Motion.

UNIT III

HAMITON'S EQUATIONS: Hamilton's Principle – Hamilton's Equations.

UNIT IV

HAMILTON – JACOBI THEORY: Hamilton's Principle function – Hamilton – Jacobi Equation – Separability.

UNIT V

CANONICAL TRANSFORMATIONS: Differential forms and Generating Functions –Lagrange and Poisson Brackets.

Treatment as in:

1. D.T.Greenwood: Classical Dynamics, Dover Publication, New York, 1997.

Reference Books:

1. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.

2. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.

3. S.L. Loney, An Elementary Treatise on Statics, KalyaniPublishers, New Delhi, 1979.

SEMESTER II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Operations Research	6			5	core

Introduction: This paper aims to provide a first approach to the subject of Operations Research, which is one of the important aspects of advanced mathematics.

Objectives: The objective of this subject is to expose student to understand the importance optimization techniques and the theory behind it.

UNIT I

What is operation research? – Modeling with Linear Programming – Simplex method – Artificial starting solution – Special cases in the Simplex method.

UNIT II

Duality – Definition – Prima l– Dual relationship – Dual simplex method –Transportation model – Assignment model.

UNIT III

Network models – Minimal spanning tree algorithm – Shortest root algorithm (Dijkstra's algorithm only) – CPM pert.

UNIT IV

Advanced linear programming –Simplex method –Fundamentals–Revised simplexmethod.

UNIT V

Simulation modeling – Monte Carlo simulation – Types of simulation – Elements of discrete event simulation – Generation of random numbers.

Treatment as in :

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

Reference Books:

1.G.Dantzig, Linear Programming and Extension, Princeton University Press, Princeton , 1963.

2. S.Ross, A Course in Simulation, Macmillion, New York, 1990.

SEMESTER III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Topology	8			5	Core

Introduction: This paper aims to provide a first approach to the subject of Topology, which is one of the important aspects of advanced mathematics.

Objectives: The objective of this subject is to provide the student with the concept and the understanding in topological spaces and compact spaces.

UNIT I

Topological spaces – Basis for a Topology – The Order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions – Metric Topology.

UNIT II

Connectedness and Compactness: Connected Spaces – Connected sets in R – Components and path components – Local connectedness – Compact Spaces – Limit Point Compactness

UNIT III

Count ability and Separation Axioms: Count ability Axioms – Separation Axioms Urysohn's Lemma – Urysohn Metrization Theorem.

UNIT IV

The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

UNIT V

Complete Metric Spaces – Compactness in Metric Spaces – Pointwise and Compact Convergences – The Compact-Open Topology – Ascoil's Theorem – Baire Spaces – A Nowhere-Differentiable Function.

Text Book:

1.Topology; A First Course by James R. Munkres, Prentice Hall of India Private Limited, New Delhi, 2000.

References:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Private Limited.).
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, 1963.
3. J.L. Kelley, Gener
4. al Topology, Van Nostrand, Reinhold Co., New York, 1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
7. Sze – Tsen Hu, elements of General Topology, Holden – Day, Inc. 1965

SEMESTER III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Linear Algebra	7			5	core

Introduction: This course provides knowledge about matrices, vector and dual spaces and linear Transformation.

Objectives: To introduce and develop abstract concepts and to understand the subject as a tool Applicable to all other branches of Science, Engineering and Technology.

UNIT I
Matrices-Characteristic roots of a matrix - Cayley Hamilton theorem statement and proof- verification.

UNIT II
Quadratic Forms: Problems-Linear Transformation-Reduction of real Quadratic Form to Normal Form-Definite, Semi-Definite and Indefinite Real Quadratic Forms.

UNIT III
Vector Spaces: Elementary basic concepts – Linear independence and Basis-Modules.

UNIT IV
Dual Spaces – Inner Product Spaces.

UNIT V
The algebra of linear transformation -characteristic roots – Matrices. **(13 hours)**

Text Book
1. Theory of Matrices -B.S. Vatssa, Second Revised Edition-Wiley Eastern Limited 1995.
2. Topics in algebra I. N. Herstein ,Second Edition-John Wiley Sons (ASIA) Pvt Ltd 2004.

SEMESTER III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Number Theory	7			5	core

Introduction: This course aims to give elementary ideas from number theory which will have applications in mathematics.

Objectives: This course aims to give elementary ideas from number theory

UNIT I
Introduction, Divisibility, Primes.
UNIT II
Congruences, solutions of congruences, Congruences of Degree 1. The functions $\phi(n)$, congruences of higher degree, Prime power moduli, Prime modulus.
UNIT III
Congruences degree 2, prime modulus, POWER Residues, Number theory from an algebraic view point , Multiplicative groups, Rings and fields, quadratic residues.
UNIT IV
Quadratic reciprocity – The Jacobi Symbol – Greatest integer function.
UNIT V
Arithmetic functions – The Moebius Inversion formula – The multiplication of arithmetic functions – Recurrence functions.
Treatment as in:

1. An Introduction to Theory of Numbers by Ivan Nivan and Herberts Zucherman. Third Edition, 1972, Wiley Eastern Limited, New Delhi.

Reference:

1.T.M. Apostol, Introduction to Analytic Number Theory, Springer Verlag, 1976.

2.Kennath and Rosan, Elementary Number Theory and its Applications, Addison Wesley Pulishing Company, 1968.

3.George E. Andrews, Number Theory, Hindustan Publishing, New Delhi, 1989.

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Fluid Dynamics	7			5	core

Introduction: This course is designed to give an overview of fluid dynamics from a mathematical viewpoint.
Objectives: This course aims to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.

UNIT I: Kinematics of Fluids in motion

Real fluids and Ideal fluids - Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.

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 immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

UNIT III

Some three dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function

UNIT IV : SOME TWO DIMENSIONAL FLOWS

Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrotational incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem.

UNIT V : VISCOUS FLOWS

Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principal stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain - The coefficient of viscosity and Laminar flow - The Navier - Stokes equations of motion of a Viscous fluid.

Recommended Text

F. Chorlton, Text Book of Fluid Dynamics ,CBS Publications. Delhi ,1985.

Reference Books

1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.
2. E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.
3. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005
4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
5. T.Petrila,Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics,Springer, berlin, 2004.

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Graph Theory	7			5	core

Introduction: This paper develops the concepts of graphs, subgraphs, trees, connectivity, Euler tours, Hamilton cycles, matching, coloring of graphs, vertex coloring, and planar graphs.

Objective: On successful completion of this course the students should gain knowledge about Graph Theory

UNIT I

Graphs: Vertices of graphs, Walks and connectedness, Degrees, Operations on graphs, Blocks, Cut-points, bridges and blocks, Block graphs and cut- point graphs.

UNIT II

Trees: Elementary properties of trees, Centers and Centroids, Block-cut point trees, Independent cycles.

UNIT III

Connectivity and Traversability: Connectivity and line connectivity, Eulerian graph, Hamiltonian graphs.

UNIT IV

Matchings: Matchings coverings in Bipartite Graphs – Perfect Matchings.
Edge colourings: Edge chromatic number – Vizing's theorem. Vertex Colourings: Chromatic Number – Brook's Theorem

UNIT V

Planarity: Planar graphs, outer planar graphs, Kuratowski's theorem

Text book.

[1] F. Harary, Graph theory, Narosa Publishing House, New Delhi, 1988.

Reference books.

[1]J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976.
[2]R. Balakrishnan and K. Renganathan, A textbook of Graph theory, Springer, 2000
[3]Bela Bollobas, Modern Graph Theory Springer, 2002
[4]G. Chartrand, L. Lesniak, Graphs & digraphs. Fourth edition. Chap- man & Hall/CRC, 2005.
[5]Robin J. Wilson, Introduction to Graph Theory (4th Edition), Addison Wesley, 1996

SEMESTER IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Functional Analysis	8			5	core

Introduction: This course will provide a basic knowledge about functional analysis with reference to mathematics and its applications.

Objective: To study the details of Banach and Hilbert Spaces and to introduce Banach algebras.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Treatment as in:

1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw –Hill Book Company, London, 1963.

Reference Books:

1. C. Goffman and G. Pedrick, A First Course in Functional Analysis, Prentice Hall of India, New Deli, 1987.
2. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York, 1966.
3. L.A. Lusternik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
4. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.

SEMESTER-I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Control Theory	4			4	ELECT

Introduction: This course will provide a basic knowledge about control thoery with reference to mathematics and its applications..

Objective: This course aims to give elementary ideas from mathematics which will have applications in control theory.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

OPTIMAL CONTROL: M Sc Maths (Col) 2009-10 Annexure No. 14 A Page 23 of 33 SCAA Dt. 21.05.2009 Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems

Text Book:

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

References:

1. Linear Differential Equations and Control by R.Conti, Academic Press, London, 1976.
2. Functional Analysis and Modern Applied Mathematics by R.F.Curtain and A.J.Pritchard, Academic Press, New York, 1977.
3. Controllability of Dynamical Systems by J.Klamka, Kluwer Academic Publisher, Dordrecht, 1991.
4. Mathematics of Finite Dimensional Control Systems by D.L.Russell, Marcel Dekker, New York, 1979.
5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley, New York, 1967

SEMESTER-I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Fuzzy Logic and Fuzzy Sets	4			4	ELECT

Introduction: This course will prove an introductory and the basic notions and study the techniques of Fuzzy Mathematics

Objective: This course will enable students to learn concepts about fuzzy logics and fuzzy set.

UNIT I

CRISP SETS AND FUZZY SETS:

Introduction-Crisp sets: An over view-The Notion of Fuzzy Sets-basic concepts of Fuzzy sets – Classical Logic: complement-Fuzzy Union-Fuzzy interaction – Combination of operations – general aggregation of operations.

UNIT II

FUZZY RELATIONS:

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

UNIT III

FUZZY MEASURES:

General discussion – Belief and plausibility Measures –Probability measures – Possibility and Necessity measures – Relationship among Classes of Fuzzy Measures.

UNIT IV

UNCERTAINTY AND INFORMATION:

Types of Uncertainty – Measures of Fuzziness-Classical Measures of Uncertainty – Measures of Dissonance-Measures of Confusion – Measures of Non-Specificity – Uncertainty and Information – Information and Complexity – Principles of Uncertainty and information.

UNIT V

APPLICATIONS:

Natural, life and Social Sciences - Engineering - Medicine - Management and decision making – Computer Sciences-System Science-Other Applications.

Text Book:

1. George J. Klir and Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice- Hall of India Private Limited-Fourth printing-June 1995
   (Treatment as in Chapeters 1 to 6)

Reference Book:

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

SEMESTER-I

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Cryptography	4			4	ELECT

Introduction: This course will provide a basic knowledge about cryptography with reference to mathematics and its applications..
Objective: This course aims to give elementary ideas from mathematics which will have applications in cryptology

UNIT I

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

UNIT II

Finite fields – Basic properties – Arithmetic of polynomials –Factoring polynomials over finite fields – Square free factorization

UNIT III

Symmetric key encryption – Stream ciphers – Block Ciphers – DES

UNIT IV

Public key cryptography – Concepts of public key cryptography – Modular arithmetic – RSA –

Discrete logarithm – Elliptic curve cryptography

UNIT V

Protocols and mechanisms - Key establishment, management and certification – Pseudorandom numbers and sequences – classes of attacks and security models

Reference Books:

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

SEMESTER-II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Mathematical Finance	4			4	ELECT

Introduction: The half course is designed to introduce the main mathematical ideas involved in the Modeling of financial aspects which are related to mathematical background.

Objective: This paper aims to provide some mathematical knowledge in the field of finance.

UNIT I BINOMIAL TREE AND ITO'S LEMMA

One-step binomial model – Two step binomial trees – American options – Delta – Options on other assets – The Markov property – Ito's lemma (including derivations)– The Lognormal property.

UNIT II: THE BLACK-SCHOLES-MERTON MODEL

The expected return – Volatility- Concepts underlying the Black-Scholes-Merton equation – Derivation – Risk-neutral valuation – Black-Scholes pricing formulas – Warrants and executive stock options – Implied volatilities – Dividends.

UNIT III: VARIOUS OPTIONS AND THE GREEK LETTERS

Option pricing formulas – Options on stock indices – Currency options – Futures options – Black's model – Naked and covered positions – Delta hedging – Relationship between delta, theta and gamma – Vega – Rho – Scenario analysis – Stock market volatility.

UNIT IV: VOLATILITY SMILES AND BASIC NUMERICAL PROCEDURES

Put-Call parity – Equity options – Greek letters –Binomial trees – Application on various options, dividend paying stock – Time dependent parameters – Monte Carlo simulation – Finite difference methods.

UNIT V: THE VaR MEASURE AND ESTIMATING VOLATILITIES

The VaR measure – Model-building approach – Linear, Quadratic models – Comparison – Stress testing and back testing – Estimating Volatility – Choosing models – Maximum likelihood models – Correlations.

Treatment as in:

"*Options, Futures, and Other Derivatives*" by John C.Hull, Sixth Edition, Pearson Education, New Delhi (2006).

UNIT I : Chapter 11 & 12
UNIT II : Chapter 13
UNIT III : Chapter 14 & 15
UNIT IV : Chapter 16 & 17
UNIT V : Chapter 18 & 19.

Reference:

1. "An elementary Introduction to Mathematical Finance" by S.M.Ross, First South Asian Edition, Cambridge University Press, Chennai (2005).
2. "Stochastic Calculus and Financial Applications" by J.M.Steele, Springer series on Applications of Mathematics Vol- 45, New York (2000)

SEMESTER-II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Probability Theory	4			4	ELECT

Introduction: This course will provide a basic knowledge about probabilistic approach to statistics.

Objective: To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.

UNIT I

What is Probability? Random Variables and Measurability Results, Expectations and the Lebesgue Theory, Image Measure and the Fundamental Theorem of Probability.

UNIT II

Independence and Strong Convergence- Independence – Convergence Concepts, Series and Inequalities.

UNIT III

Law of Large Numbers, Applications to Empiric Distributions, Densities, Queuing and Random walk.

UNIT IV

Conditional Expectation, Conditional Probabilities. Probability Distributions and Characteristic Functions - Distribution Functions and Selection
Principle – Characteristic Functions, Inversion, and Levy's Continuity Theorem

UNIT V

Weak limit Laws – Classical Central Limit heorems.

Treatment as in

Probability Theory with Applications by M.M. Rao, Academic Press, 1984.

SEMESTER-II

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Differential Geometry	4			4	ELECT

Introduction: This course will highlight the benefits of Differential Geometry in the field of Higher Mathematics.

Objective: This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surfaces are explored.

UNIT I

Curves: Analytic representation - Arc Length – Osculation plane.

UNIT II

Curvature torsion – Formulas of Frenet - Contact – Natural equations – Helices – General solutions of Natural equations.

UNIT III

Evolutes and Involutes - Elementary theory of surface: Analytic representation.

UNIT IV

First fundamental form – Normal, Tangent plane – Developable surfaces - Second fundamental form.

UNIT V

Meusnier's theorem – Euler's Theorem – Dupin's indicatrix –Some surfaces.

Text Book:

1. D. Struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing Company, 1961.

SEMESTER-III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Latex Theory	6			4	ELECT

Introduction: This course will highlight the benefits of MATLAP theory.

Objective: This course aims to practice the students in Mathematics document preparation and utilizing the software facility available for tedious computations.

UNIT I
Text formatting, TEX and its offspring, What's different in LATEX 2ϵ, Distinguishing LATEX 2ϵ , Basics of a LATEX file.

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

UNIT III
Document Layout and Organization – Document class, Page style, Parts of the document, able of contents, Fine - Tuning text, Word division.

UNIT IV
Displayed Text - Changing font, Centering and indenting, Lists, Generalized lists, Theorem–like declarations, Tabulator stops, Boxes, Tables, Printing literal text, Footnotes and marginal notes .

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

Treatment as in:
1.*A Guide to LATEX* by H. Kopka and P.W. Daly, Third Edition, Addison – Wesley, London, 1999.

SEMESTER-III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Programming lab in LATEX	2			2	ELECT

1. Different Font Sizes in LATEX
2. Preparation of Title page in LATEX
3. Divide The Document With Sectioning Hierarchy of Book Environment in LATEX
4. Making Lists Using Itemize Environment in LATEX
5. Preparing Table in LATEX
6. Preparing Table in LATEX
7. Splitting The Equations in LATEX
8. Equation Using Left Cases in LATEX
9. Typing System of Equations in LATEX
10. Equating Right Cases in LATEX
11. Preparing Binomial Equation in LATEX
12. Preparing Christoffel Symbol in LATEX
13. Use of Cross Reference in LATEX Article
14. Importing .eps Picture in LATEX
15. Importing Picture Using LATEX DRAW

Semester III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Mathematics For Quantitative Aptitude And Verbal Reasoning	6	0	0	4	ELECT

Introduction: This paper aims to provide a platform to make students to learn Mathematical Problem Solving knowledge.

Objective: This course will highlight the benefits of quantitative approach to decision making or how to reach for to an optimal decision in the light of uncertain or risky environments.

UNIT I

Area-Average-Calendar-Chain Rule-Puzzles

UNIT II

Partnership-Percentage-Pipes and Circumstances-Problems on age

UNIT III

Problems on boat and steam-Ratio- Simple Interest-Time and work

UNIT IV

Mental Ability and logical reasoning - Analogy Test-Series Test-Same Class (Odd) Test-Logical Venn Diagram- Syllogism.

UNIT V

Analytical Reasoning-Mirror Images-Water Image-(Number Letter Figure)-Completion of Incomplete Pattern-Grouping of Identical figures.

Text Book

Mental Ability and Logical Reasoning – R.S. Agarwal- S. Chand and Company Ltd, New Delhi.

SEMESTER-III

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Decision Sciences	6	0	0	4	ELECT

Introduction: This course is designed to enable to students to study and apply various techniques of Statistics for Business. Particular Emphasis is given so that the student can model business situations into Mathematical forms and solve the same. The focus on topics is on its application in Business, the interpretation of results, the presentation of assumptions, and the evaluation of the assumptions.

Objective: This course will highlight the benefits of quantitative approach to decision making or how to reach for to an optimal decision in the light of uncertain or risky environments.

UNIT I

Decision Sciences and Role of Quantitative Techniques – Linear Programming – Concept, Formulation & Graphical Solution – Assignment Models: Concept, Flood's Technique / Hungarian Method, Applications including restricted & multiple assignments – Transportation Model: Concept, Formulation, Problem Types – Balanced, unbalanced, minimization, maximization basic initial solution using North West Corner, Least Cost & VAM, Optimal Solution using MODI

UNIT II

Queuing Theory: Concept, Single Server (M/M/I, Infinite, FIFO) and Multi Server (M/M/C, Infinite, FIFO) – Markov Chains & Simulation Techniques: Application related to management functional areas, implication of Steady State Probabilities, Decision making based on the inferences Monte Carlo Simulation, scope and limitations.

UNIT III

Decision Theory: Concept, Decision under risk (EMV) & uncertainty – Game Theory: Concept 2 by 2 zero sum game with dominance, Pure and Mixed Strategy

UNIT IV

CPM & PERT: Concept, Drawing network, identifying critical path – Network Calculations: Calculating EST, LST, EFT, LFT, Slack & probability of project completion

UNIT V

Probability: Concept, Addition, Conditional Probability theorem based decision making (Numerical based on functional areas of business expected) – Probability Distributions: Normal, Binomial, Interval estimation, standard errors of estimation

Text Book:

1. Anderson Sweeney & Williams, Statistics for Business & Economics, 11th Edition, Cengage Learning 2012.

Reference Books:

2. R B Khanna, Quantitative Techniques for Managerial Decisions, 1st Edition, PHI Learnings, 2007
3. Doane, Applied Statistics in Business and Economics, 1st Edition, Tata McGraw, 2007.
4. Levin and Rubin, Statistics for Management, 7th Edition, Pearson, 2005

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	MATLAB (Theory)	6			4	ELECTIVES

Introduction: This paper designed to enable students to learn some theoretical knowledge about MATLAP.

Objective: To course will highlight the benefits of MATLAP theory.

UNIT I

Introduction- Basics of MATLAB, Input – Output, File types – Platform dependence – General commands.

UNIT II

Interactive Computation: Matrices and Vectors – Matrix and Array operations

UNIT III

Programming in MATLAB: Scripts and Functions – Script files – Functions files- Language specific features – Advanced Data objects.

UNIT IV

Plotting: Two-dimensional plots - Three-dimensional plots

UNIT V

Applications – Linear Algebra - Solving a linear system – Finding Eigen values and Eigen vectors – Matrix Factorizations.

Text Book

1. RUDRA PRATAP, Getting Started with MATLAB-A Quick Introduction for Scientists and Engineers, Oxford University Press, 2003.

Reference Books:

1. William John Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Professional, 2005.

2. Dolores M. Etter, David C. Kuncicky, Introduction to MATLAB 7, Prentice Hall, 2004

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	MATLAB (Practical)	2			2	ELECTIVES

MATLAB (PRACTICAL) LAB LIST

1. Addition of two matrices.
2. Transpose of a Matrix
3. Matrix Multiplication
4. Finding the determinant of a matrix.
5. Plotting a function.
6. Polar plot.
7. Straight line fit.
8. Exponential curve fitting.
9. Finding Eigen values and Eigen vectors of a matrix.
10. Matrix Factorizations.

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Statistics For Mathematics	6	0	0	4	Elect

Introduction: This paper introduces Applied Statistical concepts and mathematical analysis.

Objective: on successful completion of the paper the students should have understood the concepts of estimation, testing, sampling, design of experiments

UNIT I

Concepts of parameter, random sample and its likelihood. Properties of estimators - Un biasedness, Efficiency, Consistency and sufficient condition for consistency. Sufficiency, Factorization theorem, CR Inequality.

UNIT II

Test of hypothesis: Statistical hypothesis - simple and composite hypothesis, Null and Alternative hypothesis - Sample and Parameter Space – Two Types of errors – Critical Region - Power Test (Concept only). Test of significance - exact tests based on t, chi-square and F distributions - simple applications.

UNIT III

Analysis of variance; one way, two way classifications, Total, Between and within sum of squares – Assumptions - ANOVA table. Elementary ideas on distribution – free and non - parametric tests – Run, Median, Sign and Mann Whitney U tests – Simple Problems

UNIT IV

Test of Significance – Asymptotic and exact test based on – Normal, t, Chi square, f Distributions with regards to simple application.

UNIT V

Census and Sampling, Principal steps in a sample survey, different types of sampling, Organization and execution of large scale sample surveys, errors in sampling (Sampling and non sampling errors) preparation of questionnaire, simple random sampling with and without replacement, Systematic stratified and cluster sampling (concept only).

Text Book:

1.Fundamentals of Applied Statistics S.C.Gupta & V.K.Kapoor, sultan chand & sons, Educational publishers, New Delhi. 2012

Reference Books:

1. Fundamentals mathematical Statistics S.C.Gupta & V.K.Kapoor, sultan chand & sons, Educational publishers, New Delhi. 2015

SEMESTER-IV

Subject Code	Subject Title	Lecture	Tutorial	Practical	Credit	Type
	Astronomy	6	0	0	4	Elect

Introduction: This course focuses on the Solar system, Celestial sphere, Dip-Twilight & Keplar's laws.

Objectives: On successful completion of this course the students should gain knowledge about Astronomy.

UNIT I
General description of the Solar system. Comets and meteorites – Spherical trigonometry.

UNIT II
Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

UNIT III
Dip – Twilight – Geocentric parallex.

UNIT IV
Refration – Tangent formula – Cassinis formula.

UNIT V
Kepler's laws – Relation between true eccentric and mean anamolies.

Treatment as in "ASTRONOMY" by S.Kumaravelu and Susheela Kumaravelu.
Question paper setters to confine to the above text book only.