DEPARTMENT OF MATHEMATICS

PG SYLLABUS

Effective from the Academic Year 2015-16

H.H. The Rajah's College

(Autonomous)

Accredited at B+ by NAAC

Pudukkotai

Sem.	Course	Course Title	Ins. Hrs. / Week	Credit	Exam Hrs	Marks		Total
						Int	Ex	
I	CC I	Algebra	7	5	3 Hrs	25	75	100
I	CCII	Real Analysis – I	7	5	3 Hrs	25	75	100
I	CCIII	Ordinary and Partial Differential equations	7	5	3 Hrs	25	75	100
I	ECI	Elective - I	7	5	3 Hrs	25	75	100
II	CCIV	Linear Algebra	6	5	3 Hrs	25	75	100
II	CCV	Real Analysis – II	6	5	3 Hrs	25	75	100
II	CCVI	Optimization Techniques	6	5	3 Hrs	25	75	100
II	ECII	Elective - II	6	5	3 Hrs	25	75	100
II	ECIII	Elective - III	6	5	3 Hrs	25	75	100
III	CCVII	Complex analysis	6	5	3 Hrs	25	75	100
III	CCVIII	Functional Analysis	6	5	3 Hrs	25	75	100
III	CCIX	Mathematical Statistics	6	5	3 Hrs	25	75	100
III	ECIV	Elective - IV	6	5	3 Hrs	25	75	100
III	ECV	Elective - V	6	5	3 Hrs	25	75	100
IV	CCX	Classical Mechanics	6	5	3 Hrs	25	75	100
IV	CCXI	Stochastic Process	6	5	3 Hrs	25	75	100
IV	ECVI	Elective - VI	6	5	3 Hrs	25	75	100
IV	CCXII	Dissertation	12	5		25	75	100
		Total		90				1800

List of Electives

Course Title

Elective – I (Any one from the list)

- Graph theory with applications
- Analytic Number theory

Elective – II (Any one from the list)

- Topology
- Calculus of variations and Integral equations

Elective - III (Any one from the list)

- Matlab
- Cryptography

Elective - IV (Any one from the list)

- Fuzzy Mathematics
- Fluid Dynamics

Elective - V (Any one from the list)

- Numerical Analysis
- Automata Theory

Elective - VI (Any one from the list)

- Discrete mathematics
- Combinatorics

M.Sc. Applied Mathematics
HARD CORE: ALGEBRA

Unit-I
Group Theory:A counting Principle – Normal subgroups and Quotient groups – Homomorphism. –
Chapter: 2Sections – 2.5 to 2.7

Unit-II
Automorphisms – Cayley's theorem – permutation groups.
Chapter: 2Sections – 2.8 to 2.10

Unit-III
Another counting principle - Sylow theorem - Direct products.
Chapter: 2 Sections – 2.11 to 2.13

Unit-IV
Ring theory: Definition and examples of rings - some special classes of rings– Homomorphism - ideal and quotient rings.
Chapter: 3 Sections – 3.1 to 3.4

Unit-V
More ideals and quotient rings - the field of quotients of an integral domain - Euclidean Ring –Particular Euclidean Ring - Polynomial rings - Polynomials over the rational field – Polynomial rings over Commutative rings.
Chapter: 3 Sections – 3.5 to 3.11

Text Book:
I.N.Herstein, "**Topics in Algebra**", Wiley Eastern Ltd., New Delhi, 1975.

Reference books:
1. M. Artin: Algebra, Prentice-Hall of India, **1991**
2. N.Jacobson: Basic Algebra, Volumes I & II, W.H.Freeman, **1980**
3. S.Lang: Algebra, 3rd edition, Addison-Wesley, **1993**
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian edition, **1997**

M.Sc. Applied Mathematics
Hard Core: REAL ANALYSIS - I

Unit-I

Basic Topology: Finite, Countable and uncountable sets - Metric Spaces - Compact Sets - Perfect sets - Connected sets.

Chapter 2

Unit- II

Numerical Sequence and series: Convergent Sequence - Subsequences - Cauchy Sequences - Upper and lower limits – Some special sequences - Series of non- negative terms - The Number e – The Root and Ratio Tests - Power Series.

Chapter 3

Unit- III

Continuity: Limits of functions - Continuous Functions - Continuity and Compactness - Continuity and Connectedness - Discontinuities - Monotonic Functions - Infinite Limits and Limits at Infinity.

Chapter 4

Unit- IV

Differentiation: The Derivative of a Real Function - Mean Value Theorems – The Continuity of Derivatives - L'Hospital's Rule - Derivatives of Higher Order - Taylor's Theorem - Derivatives of vector – valued Functions.

Chapter 5

Unit- V

The Riemann-Stieltjes Integral: Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector- valued functions - Rectifiable Curves.

Chapter 6

Text Book:

Walter Rudin, "**Principles of Mathematical Analysis**" McGraw Hill International Editions, Mathematics series, Third Edition **(1964).**

Reference Books:

1. Patrick M. Fitzpatrick, —Advanced Calculus, AMS, Pure and Applied Undergraduate Texts, Indian Edition, **2006**

2. Apostol, Mathematical Analysis, Narosa Publishing House, Indian edition, **1974**

M. Sc. Applied Mathematics
Hard Core: ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Ordinary Differential Equations:

Unit-I

The general solution of the homogenous equation – Use of known solution to find another – The method of variation of parameter – power series solution – series solutions of first order equations – Regular singular point.

Unit- II

Regular singular point(continued) - Legendre polynomials – Properties of Legendre polynomial – Bessel Functions – The Gamma functions – Properties of Bessel function.

Unit- III

Linear system – Homogeneous equations with constant coefficient - The method of successive approximations – Picard's theorem.

Partial Differential Equations

Unit- IV

Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ – Orthogonal trajectories of a system of curves on a surface – Pfaffian differential forms and equations – solution of Pfaffian differential equations in three variables – Linear equations of the first order.

Unit- V

Integral surface passing through a given curve – surface orthogonal to a given system of surfaces – compatibility system of first order partial differential equations – Charpit's methods – Jacobi's Method.

Text Book:

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

Unit I: 3.15, 3.16, 3.19, 5.26, 5.28
Unit II: 5.29, 6.32 to 6.35.
Unit III: 7.37, 7.38, 11.55 and 11.56

2. I.N. Snedden, "**Elements of Partial Differential Equations**", McGraw Hill, 1985.

Unit IV: 1.3 to 1.6, 2.4
Unit V: 2.5, 2.6, 2.9, 2.10, 2.13

Reference Books:

1. S.G.Deo, V. Lakshmikantham and V. Raghavendra, **"Ordinary Differential Equations"**, Secind edition, Tata McGraw-Hill publishing company Ltd, Delhi, 2004.
2. Clive R.Chester, "**Techniques in Partial Differential Equations**", McGraw-Hill, 1970.

M.Sc. Applied Mathematics
Hard core: LINEAR ALGEBRA

Unit-I
Vector Spaces and Modules: Vector Spaces – Linear Independence and bases – Dual spaces – Inner product Spaces, Modules.
Chapter 4 Sections: 4.1, 4.2, 4.3, 4.4 and 4.5

Unit-II
Linear Transformations: The Algebra of Linear transformations, characteristic roots, Similarity of linear transformations, Invariant subspaces and Matrices.
Chapter 6 Sections: 6.1, 6.2 and 6.3

Unit-III
Reduction to triangular forms, Nilpotent transformations, Index of nilpotency and Invariant of Nilpotent transformation.
Chapter 6 Sections: 6.4 and 6.5

Unit-IV
Jordan forms, rational canonical form, trace, transpose and Determinants.
Chapter 6 Sections: 6.6, 6.7, 6.8 and 6.9

Unit-V
Hermitian, Unitary and Normal transformations - Real quadratic forms.
Chapter 6 Sections: 6.10 and 6.11

Text Book:

I.N.Herstein, **"Topics in Algebra"**, Wiley Eastern Ltd., New Delhi, **(1975)**

Reference books:

1. M.Artin, Algebra, Prentice-Hall of India, **1991**
2. N.Jacobson, Basic Algebra, Volumes I & II, W.H.Freeman, **1980**
3. S.Lang, Algebra, 3rd edition, Addison-Wesley, **1993**
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian edition, **1997**

M. Sc. Applied Mathematics
Hard Core:REAL ANALYSIS – II

Unit-I

Sequence and Series of functions: Uniform convergence - Uniform convergence and Continuity - Uniform convergence and Integration - Uniform convergence and Differentiation.

Text Book 1Chapter 7Pages: 143 - 153

Unit-II

Functions of Several Variables: Linear Transformation - Differentiation - The Contraction Principle.

Text Book 1 Chapter 9 Pages: 204 - 220

Unit- III

The inverse function Theorem - The implicit Function Theorem - The Rank Theorem – Determinants.

Text Book 1 Chapter 9 Pages: 221– 234

Unit- IV

The Lebesgue Measure: Introduction – Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's three principles.

Text Book 2 Chapter 3 Section: 3.1 – 3.3, 3.5 and 3.6

Unit- V

The Lebesgue Integration: The Riemann integral – The Lebesgue integral of a bounded function over a set of finite measure – The integral of a nonnegative function – The general Lebesgue integral – Convergence in measure.

Text Book 2 Chapter 4 Section: 4.1 – 4.5

Text Book:

1.Walter Rudin, Principles of Mathematical Analysis, McGraw Hill International Editions (1976)

2. Real Analysis – H.L. Royden (3rd Edition), Macmillan Publishing Company, (1988).

Reference Books:

1. Patrick M. Fitzpatrick, —Advanced Calculus, Amer. Math. Soc. Pine and Applied Undergraduate Texts, Indian Edition, **2006**

2. Apostol, Mathematical Analysis, Narosa Publishing House, Indian edition, **1974.**

M. Sc. Applied Mathematics
Hard Core: OPTIMIZATION TECHNIQUES

UNIT- I
Introduction: Concept as optimization – statement of the problem – classical optimization – classical treatment as inequality constraints.
Chapter 1 Sections: 1.1 to 1.4

UNIT -II
Nonlinear Programming: Kuhn Tucker necessary condition – Quadratic Programming and Duality.
Chapter 2 Sections: 2.1, 2.2 2.5 to 2.7

UNIT- III
Search method for unconstrained optimization: Gride Search- Hooke and Jeeves Method – Fibbonacci series.
Chapter 3Sections: 3.1 to 3.3, 3.6

UNIT- IV
Gradient method for unconstrained optimization: The Newton-Raphson method – The Davident – Fletcher power method – The complementary DFF formula
Chapter 4 Sections: 4.1 to 4.5

UNIT- V
Dynamic Programming: The Allocation Problem – Oriented and Non-Network – The Farmer's problem – Scheduling problem.
Chapter 6 Sections: 6.1 to 6.6.

Text book:
G.R. Walsh, "**Method of Optimization**",John Wiley and Sons, New York 1975.

Reference Books:

1. HamdyA.Taha, "**Operations Research An Introduction**", Ninth edition, Dorling Kindersley(India) Pvt.Ltd. 2012.
2. Fredericks. Hiller, G.J.Libeberman,"**Operations Research**", second edition, CBS Publishers & distributers.

M.Sc. Applied Mathematics
Hard Core: COMPLEX ANALYSIS

Unit-I:
Analytic Functions: Functions, Limits and Continuity - Differentiability.
Chapter 2 Sections: 2.1 to 2.2.

Unit-II:
Complex Integration:Curves in the Complex Plane – Basic Properties of Complex Integral – Winding Number or Index of a curve – Morera's theorem.
Chapter 3 Sections: 3.1 to 3.3 and 3.6.

Unit-III:
Cauchy Integral formula – Laurent series – The maximum modulus principle – Schwar's lemma – Liouville's theorem.
Chapter 3 Sections: 3.7 to 3.11.

Unit-IV:
Classification of Singularities: Isolated and Non-isolated Singularities – removable singularity – poles – Further illustrations - singularities at infinity.
Chapter 4 Sections: 4.1 to 4.5.

Unit-V:
Evaluation of certain Integrals: Integrals of Type $\int_{\alpha}^{2\pi+\alpha} R(cos\theta, sin\theta)d\theta$ - Integrals of Type $\int_{-\infty}^{\infty} f(x)dx$ - Integrals of Type$\int_{-\infty}^{\infty} g(x)cosmxdx$ – singularities on Real axis.
Chapter 6 Sections: 6.1 to 6.4.

Text book:
S.Ponnusamy, "**Foundations of Complex Analysis**", Narosa Publishing House, New Delhi, 2000.

Reference Books:

1. Lars V. Ahlfors, "**Complex Analysis**", Third Ed. McGraw-Hill Book Company, Tokyo, 1979.
2. John B. Conway,**"Functions of One Complex Variable**", Second edition, **1980**
3. V. Karunakaran, "**Complex Analysis**", second edition, Narosa, Delhi.

M. Sc.Applied Mathematics
Hard Core: FUNCTIONAL ANALYSIS

Unit-I

Normed Spaces, Banach Spaces: Vector space – Normed space, Banach space – further properties of normed spaces – finite dimensional normed spaces and subspaces – compactness and finite dimension.
Chapter 2 Sections: 2.1 to 2.5.

Unit- II

Linear operators – Bounded and continuous linear operators – Linear functionals – Linear operators and functionals on finite dimensional spaces – Normed spaces of operators – Dual spaces.
Chapter 2 Sections: 2.6 to 2.10.

Unit-III

Inner Product spaces, Hilbert spaces: Inner Product spaces, Hilbert spaces – Further properties of Inner product spaces – Orthogonal complements and direct sums – Orthonormal sets and sequences – Total Orthonormal sets and sequences.
Chapter 3 Sections: 3.1 to 3.4 and 3.6.

Unit-IV

Fundamental theorems for Normed and Banach spaces: Zorn's lemma – Hahn-Banach theorem –Hahn-Banach theorem for Complex Vector spaces and Normed spaces – Application to bounded linear functionals on C[a, b] – Adjoint operator – Reflexive spaces – Category theorem, Uniform boundedness theorem.
Chapter 4 Sections: 4.1 to 4.7.

Unit- V

Strong and weak convergence – convergence of sequences of operators and functionals – application to summability of sequences – Numerical integration and weak convergence – open mapping theorem – closed linear operators – closed graph theorem
Chapter 4 Sections: 4.8 to 4.13.

Text book:

E. Kreyszig, "**Introductory Functional Analysis with applications**", John Wiley, 2011.

Reference books:

1. G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 1963.
2. B.V.Limaye, Functional Analysis, Wiley Eastern, New Delhi, **1981**
3. M. Thamban Nair, —Functional Analysis, Eastern Economy Edition, Prentice Hall of India Private Limited, New Delhi, 2002

M. Sc. Applied Mathematics
Hard Core: MATHEMATICAL STATISTICS

Unit I:
Some special distributions: The Binomial and related distributions – The Poisson distribution – The Gamma and Chi-Square Distributions – The Normal distribution- The Bivariate normal distribution.

Unit II:
Distributions of functions of random variables - Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type – The β, t and F distributions- Distributions of order statistics- The moment generating function technique.

Unit III:
The distributions of $\bar{X}$ and nS^2/σ^2 - Expectations of functions of random variables – Limiting distributions: Limiting moment generating functions – The Central limit theorem.

Unit-IV:
Introduction to statistical inference: Point Estimation – Confidence intervals for means – Confidence intervals for differences of means - χ^2 – test – More about estimation - Bayesian Estimation.

Unit-V:
Theory of statistical tests: Certain best tests - Uniformly most powerful tests-Likelihood ratio test.

Text Book: Robert V. Hogg and Allen T. Craig, "**Introduction to Mathematical Statistics**" (Fifth Edition).

Chapters 3, 4 (except 4.5 and 4.10), 5(Sections 5.3 and 5.4 only) 6(except 6.4 and 6.5), 8 (Section 8.1 only) and 9(Sections 9.1 to 9.3).

M. Sc. Applied Mathematics
Hard Core: CLASSICAL DYNAMICS

UNIT I

Introductory concepts: The mechanical system - Generalized Coordinates - constraints - virtual work - Energy and momentum.
Chapter 1: Sections 1.1 to 1.5

UNIT II

Lagrange's equation: Derivation and examples - Integrals of the Motion.
Chapter 2: Sections 2.1 to 2.3

UNIT III

Special Applications of Lagrange's Equations: Rayleigh's dissipation function - impulsive motion - velocity dependent potentials.
Chapter 3: Sections 3.1 - 3.2 and 3.4

UNIT IV

Hamilton's equations: Hamilton's principle - Hamilton's equations - Other variational principles.
Chapter 4: Sections 4.1 to 4.3

UNIT V

Hamilton - Jacobi Theory: Hamilton's Principal Function – The Hamilton - Jacobi equation.
Chapter 5: Sections 5.1 to 5.3

Text Book:

1. Donald T. Greenwood, Classical Dynamics, PHI Pvt. Ltd., New Delhi, 1985.

Reference Books:

1. H. Goldstein, Classical Mechanics, (2nd Edition), Narosa Publishing House, New Delhi, 1998.
2. Narayan Chandra Rana&PromodSharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.

M. Sc. Applied Mathematics
Hard Core: 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.
Chapter II Section: 2.1 to 2.3, Chapter III Section: 3.1 to 3.3

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.
Chapter III Section: 3.4 to 3.6, 3.8, 3.9 and 3.11

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).
Chapter IVI Section: 4.1 to 4.5

UNIT IV

Renewal processes and theory: Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.
Chapter VI Section: 6.1 to 6.5

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.
Chapter X Section: 10.1 to 10.3, 10.7 and 10.8

Text Book:

J. Medhi, Stochastic Processes, Wiley Eastern, 1982.

Reference Books:

1. Samuel Karlin, Howard M. Taylor, A first course in stochastic processes, 2nd edition, Academic Press, 1975.
2. Narayan Bhat , Elements of Applied Stochastic Processes, 2nd edn, John Wiley, 1984.
3. S.K. Srinivasan and K.Mehata, Stochastic Processes, Tata McGraw Hill, 1976.
4. N.U. Prabhu, Stochastic Processes. Macmillan, 1965.

M. Sc. Applied Mathematics
Soft Core: GRAPH THEORY WITH APPLICATIONS

Pre requisites: Graphs and simple graphs - Special graphs (Complete graphs, Complement of graphs and null graphs) - Graph isomorphism – Sub graphs - Vertex degrees - Degree sequences and graphic sequences - walks, paths, Cycles - Graph connection and components - Bipartite graphs and their characterizations.
Chapter 1 No questions from this chapter
Unit-I
Connectivity and edge connectivity: Vertex cuts and edge cuts - Whitney's inequality (relating K,K and d) - Blocks and blocks of graphs - Characterization of 2 - connected graphs and blocks - Menger's theorem (without proof).
Chapter 3 in which Section 3.3 is omitted

Unit-II
Independent sets:Independent sets and their characterization - Matchings - Vertex as well as edge independence numbers, Covering numbers - Perfect matching – Konig's Theorem (without proof) - Galli's theorem - Ramsey numbers - Theorems on the upper bounds and lower bounds for Ramsey numbers - Ramsey graphs - Erdos theorem.
Chapter 7 – Sections7.1 and 7.2.

Unit-III
Vertex colourings and chromatic numbers of graphs - Critical graphs and their properties - Brook's theorem - Hajo's conjecture and Dirac's theorem.
Chapter 8 - Sections 8.1, 8.2 and 8.3

Unit-IV
Chromatic polynomials - The five colour theorem - The four colour theorem (without proof) - Edge chromatic number - Vizing's theorem (statement only).
Chapter 8 - Section 8.4; Chapter 9 - Section 9.6; Chapter 6 - Sections 6.1 and 6.2.

Unit-V
Directed graphs- Directed paths (Roy-Gallai Theorem) - Tournaments - Directed Hamilton paths and cycles (Moon's theorem, Ghouila - Houri theorem).
Chapter 10 - Sections 10.2 and 10.3

Text Book:

J.A. Bondy and U.S.R. Murthy, "**Graph Theory with Applications**", 1976

Reference books:

1. F. Harary, Graph Theory, Addison –Wesley, **1969**
2. G NarasingaDeo, Graph Theory with Applications to Engineering and Computer

M. Sc. Applied Mathematics
Soft Core: ANALYTICAL NUMBER THEORY

Unit I:
Arithmetical Functions and Dirichlet Multiplication: The Mobius function μ(n) – The Euler totient function φ(n)– A relation connecting μ and φ - A product formula for φ(n) – The Dirichlet product of arithmetical functions – Dirichletinverses and the Mobius inversion formula – The Mangoldt function Λ(n) – Multiplicative functions – Inverse of a completely multiplicative function.

Unit II:
Averages of Arithmetical Function: The big oh notation – asymptotic equality of functions – Euler's summation formula – elementary asymptotic formulas – Average order of d(n), of divisor function σ_α (n),φ(n),μ(n) and Λ(n)

Unit III:
Congruences: Basic properties – Residue classes and complete residue systems – linear congruences – Reduced residue systems and Euler Fermat theorem – Polynomial congruences modulo p –Lagrange's theorem – Applications – Simultaneous linear congruences – The Chinese remainder theorem – Polynomial congruences with prime power moduli.

Unit IV:
Quadratic Residues & the Quadratic Reciprocity Law: Quadratic Residues – Legendre's symbol and its properties – Evaluation of (-1|p) and (2|p) – Gauss' lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol.

Unit V:
Partitions: Geometric representation of partitions – Generating functions for partitions – Euler's pentagonal- number theorem – Euler's recursion formula for p(n).

Text Book:
Tom M. Apostol, Introduction to Analytic Number Theory, Springer International Student Edition, Narosa Publishing House, New Delhi.

Sections: 2.1 to 2.11; 3.1 to 3.7; 3.9; 5.1 to 5.9; 9.1 to 9.7; 14.1 to 14.4; 14.6

Reference Books:
1. Ivan Niven, Herbert S.Zuckermann, An Introduction to the Theory of Numbers, Wiley Eastern University Edition, V Edition, 1989.
2. W.J.Leveque, Topics in Number Theory, Addison Wesley.
3. Bressoud, D., Wagon, S., A Course in Computational Number Theory, Key College Publishing, 2000.

M. Sc. Applied Mathematics
Soft core:CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Unit I:
Calculus of Variations and Applications: Maxima and Minima - The Simplest case-Illustrative examples-Natural boundary conditions and transition conditions – The variational notation-The more general case.

Unit II:
Constraints and Lagrange multipliers-Variable end points - Sturm- Liouville problems-Hamilton's principle-Lagrange's equations

Unit III:
Integral Equations: Introduction – Relations between differential and integral equations – The Green's function – Alternative definition of the Green's function.

Unit IV:
Linear equation in cause and effect: The influence function – Fredholm equations with separable kernels – Illustrative example.

Unit V:
Hilbert – Schmidt theory – Iterative methods for solving equations of the second kind – Fredholm theory.

Text Book:

Method of Applied Mathematics by Francis B. Hilderbrand (Second edition) sections 2.1 to 2.11, 3.1 to 3.9 and 3.11

M.Sc. Applied Mathematics

Soft Core: TOPOLOGY

Unit - I:

Topological spaces and continuous functions: Topological Spaces – Bases for a Topology – The Order Topology – The Product Topology on XxY – The Sub-space topology – Closed sets and limit points – Continuous functions – The Product topology – The metric Topology.

Chapter 2 Section: 12 to 20

Unit-II:

Connectedness and Compactness: Connected spaces – Connected sets in the real line – Components and Local connectedness.

Chapter 3 Section: 23 to 25

Unit-III:

Compact Spaces – Compact sets in the real line – Limit point compactness – Local compactness – Complete metric spaces – Compactness in metric spaces.

Chapter 3 Section: 26 to 29 and Chapter 5 Section: 43 and 45

Unit -IV:

Countability and Separation axioms: The countability axioms - The separation axioms – Normal space.

Chapter 4 Section: 30 to 32

Unit-V:

The Urysohn's Lemma – The Urysohn'sMetrization theorem (statement only) - The Tychonoff theorem.

Chapter 4 Section: 33, 34 and 37

Text Book:

James R. Munkres,"**Topology**"– second edition, Prentice Hall, New Delhi (2003).

Reference Book:

J. Dugundgi, "**Toplogy"**, Allyn and Bacon, Boston, (1966)

M. Sc. Applied Mathematics

Soft Core: MATLAB

Unit – I

Introduction: Basics of MATLAB -MATLAB windows – on line help - Input – Output, File types – Platform dependence – General commands.

Chapter 1 Section: 1.6

Unit – II

Interactive Computation: Matrices and Vectors – Matrix and Array operations – Character Strings – A special note on array operators – command line functions - Using Built-in Functions and On-line Help – Saving and loading data – Plotting simple graphs.

Chapter 3 Section: 3.1 to 3.8

Unit – III

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

Chapter 4 Section: 4.1 to 4.4

Unit – IV

Applications: Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations.

Chapter 5 Section: 5.1 to 5.6

Unit – V

Graphics: Basic 2-D Plots – Using subplot to Layout multiple graphs - 3 – D Plots – Handle Graphics – Saving and printing Graphs – Errors.

Chapter 6 Section: 6.1 to 6.6 and 7

Text Book:

RUDRA PRATAP, **Getting Started with MATLAB** – A Quick Introduction for Scientistsand 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

M. Sc. Applied Mathematics
Soft Core: CRYPTOGRAPHY

Unit-I

Basic concepts: Factoring and primality testing – Perfect numbers – Fermat's divisibility test – Fermat numbers – Base representation of integers – Computational complexity.

Unit-II

Symmetric key crypto systems: An overview of congruences – Block ciphers – The DES key Schedule – The DES Cryptosystem

Unit-III

Public key cryptosystems: Exponentiation, discrete logs and protocols – Public key cryptography – RSA system – Rabin system – Elgamal system.

Unit-IV

Authentication and knapsack: Digital signatures – Signature schemes related to public key Crypto Systems – Knapsack problem – Merkle Hellman system – ChorRivest system.

Unit-V

Primality testing: Primitive roots – Gauss's algorithm – Primitive root theorem – Index calculus – Mersenne number – Pocklington's theorem – Proth's theorem – Pepin's primality test.

Text book:

Richard A. Mollin: An Introduction to Cryptography, Chapman & Hall / CRC, Boca Raton, 2000

Reference book :

Dominic Walsh: Codes and Cryptography, Oxford Science Publications, Clarendon Press, Oxford, 1988

M. Sc. Applied Mathematics
Soft Core:FUZZY MATHEMATICS

UNIT – I

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

Chapter 1 Section 1.3, 1.4 and Chapter 2 Section 2.1, 2.3

UNIT – II

Operations on Fuzzy sets: Types of operations – Fuzzy complements – t-Norms – Fuzzy Unions.

Chapter 3 Section 3.1 to 3.4

UNIT – III

Combinations of operations -Fuzzy Arithmetic – **Fuzzy Arithmetic**: Fuzzy numbers.

Chapter 3 Section 3.5 to 3.6 and Chapter 4 Section: 4.1

UNIT – IV

Fuzzy Arithmetic: Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers - **Fuzzy relations**: Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations.

Chapter 4 Section 4.3 to 4.4 and Chapter 5 Section: 5.3, 5.5, 5.6.

UNIT - V

Fuzzy ordering relations – fuzzy morphisms

Chapter 5 Section 5.7 to 5.8.

Text Book:

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

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.

M. Sc. Applied Mathematics
Soft Core: FLUID DYNAMICS

UNIT I

Real Fluids and Ideal Fluids - Velocity of a Fluid at a point - Streamlines and Path lines; Steady and Unsteady Flows - The Velocity potential – The Vorticity vector - Local and Particle Rates of Change – The Equation of continuity - Worked examples - Acceleration of a Fluid – Conditions at a rigid boundary - General analysis of fluid motion - Pressure at a point in a Fluid at Rest - Pressure at a point in Moving Fluid - Conditions at a Boundary of Two Inviscid Immiscible Fluids -Euler's equations of motion - Bernoulli's equation - worked examples.

UNIT II

Discussion of a case of steady motion under conservative body forces – Some potential theorems-Some Flows Involving Axial Symmetry - Some special two- Dimensional Flows - Impulsive Motion. Some three-dimensional Flows: Introduction - Sources, Sinks and Doublets - Images in a Rigid Infinite Plane - Axi-Symmetric Flows; Stokes stream function

UNIT III

Some Two-Dimensional Flows: Meaning of a Two-Dimensional Flow - Use of cylindrical Polar coordinates – The stream function – The Complex Potential for Two- Dimensional, Irrotational, Incompressible Flow - complex velocity potentials for Standard Two-Dimensional Flows - Some worked examples – The Milne-Thomson circle theorem and applications – The Theorem of Blasius

UNIT IV

The use of conformal Transformation and Hydrodynamical Aspects - Vortex rows. Viscous flow: Stress components in a Real fluid - relations between Cartesian components of stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses -

UNIT V

Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations Between stress and rate of strain - The coefficient of viscosity and Laminar Flow - The Navier - Stokes equations of Motion of a Viscous Fluid .

TEXT BOOK

1. Content and Treatment as in Text Book of Fluid Dynamics by F. Chorlton (CBS publishers& Distributors, New Delhi-110 002) 1985.

UNIT – I Chapter 2 and Chapter 3: Sections 3.1 to 3.6
UNIT – II Chapter 3: Sections 3.7 to 3.11 and Chapter 4: Sections 4.1, 4.2, 4.3, 4.5
UNIT – III Chapter5 : Sections: 5.1 to 5.9 except 5.7
UNIT – IV Chapter 5: Section 5.10 , 5.12 and Chapter 8: Sections 8.1 to 8.4
UNIT – V Chapter 8: Sections 8.5 to 8.9

REFERENCES

1. J.F. Wendt, J.D. Anderson, G.Degrez and E. Dick, Computational Fluid Dynamics : An Introduction, Springer-Verlag, 1996.
2. J.D. Anderson, Computational Fluid Dynamics, The Basics with Applications, McGraw Hill, 1995.
3. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1984.
4. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer-Verlag, New York, 1993.
5. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Pvt Limited, New Delhi, 1976.
6. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.

M. Sc. Applied Mathematics
Soft Core:NUMERICAL ANALYSIS

UNIT – I

Transcendental and polynomial equations: Rate of convergence of iterative methods – Methods for finding complex roots – Polynomial equations – Birge-Vieta method, Bairstow's method, Graeffe's root squaring method.

UNIT – II

System of Linear Algebraic equations and Eigen Value Problems: Error Analysis of direct and iteration methods – Finding eigen values and eigen vectors – Jacobi and Power methods.

UNIT – III

Interpolation and Approximation : - Hermite Interpolations – Piecewise and Spline Interpolation – Bivariate Interpolation- Approximation – Least square approximation and best approximations.

UNIT - IV

Differentiation and Integration: - Numerical Differentiation - Optimum choice of Step-length – Extrapolation methods – Partial Differentiation – Methods based on undetermined coefficients – Gauss methods.

UNIT – V

Ordinary differential equations: Local truncation error – Euler, Backward Euler, Midpoint, Taylor's Method and second order Runge-Kutta method– Stability analysis.

TEXT BOOK(S):

M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, III Edn. Wiley Eastern Ltd., 1993.

Unit I – Chapter 2 – 2.5 to 2.8
Unit II – Chapter 3 – 3.3, 3.4, 3.5
Unit III – Chapter 4 – 4.5 to 4.9
Unit IV – Chapter 5 – 5.2, 5.3, 5.4, 5.5, 5.8
Unit V - Chapter 6 – 6.2, 6.3, 6.6

REFERENCES

1 Kendall E. Atkinson, An Introduction to Numerical Analysis, II Edn., John Wiley & Sons, 1988.
2 M.K. Jain, Numerical Solution of Differential Equations, II Edn., New Age International Pvt Ltd., 1983.
3 Samuel. D. Conte, Carl. De Boor, Elementary Numerical Analysis, McGraw-Hill International Edn., 1983.

M. Sc. Applied Mathematics
Soft Core: AUTOMATA THEORY

Unit-I

Introduction to the theory of computation: Three basic concepts: Languages, Grammars, Automata – Some application.

Unit-II

Finite Automata: Deterministic finite accepters – Nondeterministic finite accepters – Equivalences of deterministic and nondeterministic finite accepters – Reduction of the number of states in finite automata.

Unit-III

Regular Languages and Regular Grammars: Regular expression – Connection between regular expression and regular languages - Regular grammars.

Unit-IV

Properties of Regular Languages: Closure properties of regular languages – Elementary questions about regular languages – Identifying non regular languages.

Unit-V

Context-Free Languages: Context-free grammars – Parsing and ambiguity – Context – Free Grammars and programming languages.

Text Book:

Peter Linz, —An Introduction to Formal Languages and Automata, Jones and Bartlett Publishers, Inc. 2006

M. Sc.Applied Mathematics
Soft Core:DISCRETE MATHEMATICS

Unit I:
Computability and Formal Languages: ordered sets, Languages – Phrase – Structure grammars – Types of grammars and Language.
Chapter 2 Section: 2.3 to 2.6

Unit II:
Finite state machine: Introduction – Finite state machine as models of physical systems – Equivalent machine – Finite state machines as language recognizers – Finite state languages and type-3 languages.
Chapter7 Section: 7.1 to 7.6

Unit III:
Permutations, combinations and discrete probability: Introduction – The rules of sum and product of permutations – combinations – Generation of permutations and combinations – Discrete probability – Conditional probability.
Chapter 3 Section: 2.3 to 2.6
Unit IV:
Discrete Numeric function and generating functions: Introduction – Manipulation of numeric functions – Generating functions.
Chapter 9 Section: 9.1 to 9.2 and 9.4

Unit V:
Recurrence relations and Recursive algorithm: Introduction – Recurrence relations – Linear recurrence relation with constant coefficients – Homogenous solutions – Particular solutions – Total solution.
Chapter 10 Section: 10.1 to10.6

Text Book:
C. L. Liu, "**Elements of Discrete Mathematics"**, second edition, McGraw-Hills, New York 1987.

Reference Books:

J.P.TrembelayR.Manohar, "**Discrete Mathematics with Applications to Computer Science"**, Tata McGraw-Hill, New Delhi.

M. Sc. Applied Mathematics
Soft Core:COMBINATORICS

UNIT I

Permutations and combinations - distributions of distinct objects ~ distributions ofnon distinct objects - Stirlings formula.

UNIT II

Generating functions. - generating function for combinations - enumerators forpermutations - 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 coefficientssolutions by the technique of generating functions - a special class of nonlineardifference equations - recurrence relations with two indices.

UNIT IV

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

UNIT V

Polya's theory of counting - equivalence classes under a permutation groupBurnside theorem - equivalence classes of functions - weights and inventories offunctions - Polya' s fundamental theorem – generation of Polya's theorem

Text Book:

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, Carus, Mathematical Monograph,No.14