MEENAKSHI COLLEGE FOR WOMEN
DEPARTMENT OF MATHEMATICS
M.Sc. MATHEMATICS
COURSE PATTERN

SEMESTER - I

PART A

S.No.	Subject Code	Title	Credits
1.	1MS01a	ABSTRACT ALGEBRA I	05
2.	1MS02a	REAL ANALYSIS I	05
3.	1MS03a	COMPLEX ANALYSIS I	05
4.	1MS04	CLASSICAL MECHANICS	05
5.	1MS05a	ADVANCED DIFFERENTIAL EQUATIONS	05

PART B

	SAR 1	ANALYTICAL REASONING I	02

SEMESTER - II

PART A

S.No.	Subject Code	Title	Credits
1.	2MS06a	ABSTRACT ALGEBRA II	05
2.	2MS07a	REAL ANALYSIS II	05
3.	2MS08a	COMPLEX ANALYSIS II	05
4.	2MS09b	OPERATIONS RESEARCH I	05
5.	2MS10a	TOPOLOGY	05

PART B

	SAR 2	ANALYTICAL REASONING II	02

SEMESTER - III

PART A

S.No.	Subject Code	Title	Credits
1.	3MS11b	DIFFERENTIAL GEOMETRY	05
2.	3MS12a	PROBABILITY AND DISTRIBUTIONS	05
3.	3MS13a	ADVANCED DISCRETE MATHEMATICS	05
4.	3MSE1b	FUZZY SETS & APPLICATIONS	05
5.	3MSE2b	OPERATIONS RESEARCH II	05

PART B

	SAR 3	ANALYTICAL REASONING LEVEL III	02

SEMESTER - IV

PART A

S.No.	Subject Code	Title	Credits
1.	4MS14	FUNCTIONAL ANALYSIS	05
2.	4MS15	OBJECT ORIENTED PROGRAMMING WITH C++	05
3.	4MS16a	ADVANCED GRAPH THEORY	05
4.	4MSE3b	NUMBER THEORY & CRYPTOGRAPHY	05
5.	4MSE4	STOCHASTIC PROCESSES	05
6.	4MSP1	PRACTICAL I – C++ PROGRAMMING	05
7.	4MSPR	PROJECT WORK	10
8.	4MSPV	VIVA-VOCE	10

PART B

	OQCC	QUALITY CONTROL CIRCLES (Theory)	01
	OQCCP	QUALITY CONTROL CIRCLES (Presentation)	01

COURSE: M.Sc., MATHEMATICS
SEMESTER – I
PAPER 1: ABSTRACT ALGEBRA I
SUBJECT CODE: 1MS01a

Unit I:
Group Theory: Another counting principle, Sylow theorems (first part first proof only) direct products internal and external direct products – isomorphism theorem – problems.

Unit II:
Rings: Module theory, fundamental theorem on finitely generated modules – Euclidean ring J (I); problems.

Unit III:
Polynomial rings – principal ideal ring, polynomials over rational field.

Unit IV:
Fields – extension fields, simple algebraic extensions – roots of a polynomial, problems.

Unit V:
Finite fields, division ring, Wedderburn's theorem on finite division rings (first proof only), Jacobson's theorem – simple problems.

Content and Treatment as in

I. N. Herstein. *Topics in Algebra*.

Unit I : § 2.11, 2.12, 2.13
Unit II : § 4.5, 3.8
Unit III : § 3.9, 3.10
Unit IV : § 5.1, 5.3
Unit V : § 7.1, 7.2

Books for Reference

1. Serge Lang, *Algebra*.
2. Maclaine and Birkhoff, *Algebra*.
3. Fraleigh, *Algebra*.

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COURSE: M.Sc., MATHEMATICS
SEMESTER – I
PAPER 2: REAL ANALYSIS I
SUBJECT CODE: 1MS02a

Unit I:
The Riemann Stieltjes integral - linear properties, integration by parts, reduction to a Riemann integral, step function as integrators, Euler's summation formula.

Unit II:
Monotonically increasing integrators, upper and lower integral, Riemann condition, comparison theorems, integrators of bounded variation, sufficient conditions for existence of Riemann Stieltjes integral – necessary condition for existence of Riemann Stieltjes integrals, mean value theorems and fundamental theorems, interchanging the order of integration.

Unit III:
Infinite series and infinite products, Riemann's theorem on conditionally convergent series, double sequence, double series, Ceasaro summability.

Unit IV:
Sequences of functions, point wise convergence of sequence of functions, uniform convergence and continuity, applications of uniform convergence, mean convergence.

Unit V:
Sequence of functions, power series, the substitution theorem, Bernstein theorem, Abel's limit theorem, Tauber's theorem

Content and Treatment as in

Tom. S. Apostol, *Mathematical Analysis.*

Unit I : § 7.1-7.7, 7.10
Unit II : § 7.11-7.25
Unit III : § 8.18-8.26
Unit IV : § 9.1-9.13 (Omit § 9.7)
Unit V : § 9.14-9.23

Books for Reference

1. Walter Rudin, *Elements of Real Analys*.

COURSE: M.Sc. MATHEMATICS
SEMESTER – I
PAPER 3: COMPLEX ANALYSIS I
SUBJECT CODE: 1MS03a

Unit I:
Analytic Functions as Mappings: Conformality – linear transformation – elementary conformal mappings.

Unit II:
Complex Integration: Fundamental theorems – Cauchy's integral formula – local properties of analytic functions.

Unit III:
Calculus of Residues: Cauchy residue theorem – evaluation of definite integrals – the argument principle.

Unit IV:
Harmonic Functions: Mean value property – Poisson formula – Schwarz's theorem – reflexion principle.

Unit V:
Series – Power Series Expansions: Weierstrass theorem – the Taylor's series – the Laurent's series.

Content and Treatment as in

L.V. Ahlfors, *Complex Analysis* (Third edition), Chapters: 3-4 and § 5.1

Unit I : § 3.2-3.4.
Unit II : § 4.1-4.3
Unit III : § 4.5
Unit IV : § 4.6
Unit V : § 5.1

Books for Reference

1. John B. Conway, *Functions of one complex variable*.
2. Carton, *Elementary Theory Of Analytic Functions Of One Or Several Complex Variables*.
3. Schaum Series, *Complex Variables*.

COURSE: M.Sc. MATHEMATICS
SEMESTER – I
PAPER 4: CLASSICAL MECHANICS
SUBJECT CODE: 1MS04

Unit I:
The mechanical system – generalized coordinates – degrees of freedom – configuration space – example – constraints – examples – virtual displacement – virtual work – principle of virtual work – D'Alembert's principle – generalized forms – examples – potential energy – work and kinetic energy – conservation of energy equilibrium and stability – kinetic energy of a system – angular momentum – generalized momentum – example.

Unit II:
Kinetic energy – Lagrange's equations, form of the equations of motion – Non-holonomic systems – examples – spherical pendulum – double pendulum – Lagrange multipliers and constraint forces – particle in whirling tube – particle with moving support – rheonomic constrained system – ignorable coordinates – the Kepler problem – Routhian function – conservative system – natural systems – Liouville systems – examples.

Unit III:
Stationary values of function – constrained stationary values – stationary value of a definite integral – the Brachitochrone problem – geodesic principle – non-holonomic systems – geodesic principle – non-holonomic systems – multiplier rule of the Hamiltonian function – Legendre transformation examples – modified Hamilton's principle – principle of least action – example.

Unit IV:
The canonical integral – Pffaffian differential forms – Jacob's theorem – conservative system and ignorable coordinates – examples, Liouville system – Stäckel's theorem – example.

Unit V:
Canonical transformation – principal forms of generating functions – further comments on the Hamilton Jacobi method – examples – some simple transformations – example – Lagrange and Poisson brackets – The bilinear covariant – example.

Content and Treatment as in

Donald T. Greenwood, *Classical Mechanics.*

Unit I : §1.1, 1.2, 1.3, 1.4, 1.5
Unit II : § 2.1, 2.2, 2.3
Unit III : § 4.1, 4.2, 4.3
Unit IV : § 5.1, 5.2, 5.3
Unit V : § 6.1, 6.2, 6.3

Books for Reference

1. Goldstein H., *Classical Mechanics,* Addison Wesley Press.
2. Whittaker E.T., *A Treatise on Analytical Dynamics of Particles and Rigid Bodies,* 4th edition, Dover Publications.
3. Synge J. Laud and B.A. Griffith, *Principles of Mechanics,* 3rd edition, McGraw Hill Book Company.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – I
PAPER 5
ADVANCED DIFFERENTIAL EQUATIONS
SUBJECT CODE: 1MS05a

Unit I:

Solutions in Power Series: Second order linear equations with ordinary points – Legendre equations and Legendre polynomials – Second order equations with regular singular points – Bessel functions.

Unit II:

Systems of Linear Differential Equations: System of first order equations – Existence and uniqueness theorem – Fundamental matrix–non-homogeneous linear systems – linear system with constant efficients – linear system with periodic coefficients

Unit III:

Existence and Uniqueness of Solution: Introduction - Preliminaries - Successive Approximations - Picard's theorem .

Unit IV:
Boundary Value Problems: Introduction – Sturm-Liouville Problem – Green's Functions

Partial Differential Equations: Basic concepts – methods of separation of variables – wave equation – Laplace equation – heat equation.

Unit V:
Canonical forms of second order linear equations with constant coefficients – characteristics.

30% Theory & 70% Problems / Applicability of the concepts

Content and Treatment as in

1. S.G. Deo and Ragavendra, *Ordinary Differential Equation and Stability Theory,*

Tata Macgraw Hill Publishing Company Limited, Chapters: 3, 4, 5 and 7

Unit I : Chapter 3

Unit II : Chapter 4

Unit III : Chapter 5 - §5.1, 5.2, 5.3, 5.4

Unit IV : Chapter 7 – § 7.1, 7.2, 7.3

2. Shepley Ross, *Differential Equations,* Wiley Eastern Publications, Chapter : 14

Unit IV : §14.1,14.2

Unit V : §14.3,14.4

COURSE: M.Sc. MATHEMATICS
SEMESTER – II
PAPER 6: ABSTRACT ALGEBRA II
SUBJECT CODE: 2MS06a

Unit I: Roots of polynomials and derivatives , the elements of Galois theory – problems.

Unit II:
Solvability by radicals, Galois group over rationals – problems.

Unit III:
Linear transformations – canonical forms: nilpotent transformation – a decomposition of V – Jordan form.

Unit IV:
Trace and transpose, Hermitian, unitary and normal transformation.

Unit V:
Real quadratic form, A theorem of Frobenius.

Content and Treatment as in

I.N. Herstein, *Topics in Algebra.*

Unit I : § 5.5, 5.6
Unit II : § 5.7, 5.8
Unit III : § 6.5, 6.6
Unit IV : § 6.8, 6.10
Unit V : § 6.11, 7.3

Books for Reference

1. Serge Lang, *Algebra*.
2. Fraleigh, *Algebra*.
3. Maclaine and Birkhoff, *Algebra*.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – II
PAPER 7: REAL ANALYSIS II
SUBJECT CODE: 2MS07a

Unit I:
Lebesgue Integral: introduction – upper functions and their integrals – Riemann integrable functions as examples of upper functions – properties of Lebesgue integrals – Levi monotonic convergence theorems – Lebesgue dominated convergence theorem and its applications.

Unit II:
Improper Riemann Integrals: measurable functions – differentiation under integral sign – interchanging the order of integration – measurable sets on the real line – inner products and norm – L^2 (I) of square integral functions – convergence theorem for series of functions in L^2 (I) – Riesz –Fischer theorem.

Unit III:
Fourier Series and Fourier Integrals: introduction – orthogonal system of functions – theorem on best approximation – Fourier series of a function related to orthonormal system – Riesz Fischer theorem.

Unit IV:
Multivariable Differential Calculus: introduction – directional derivative – total derivative – matrix of linear function – chain rule and its matrix form – mean value theorems – sufficient conditions for differentiability and equality of mixed partial derivative – Taylor's formula for functions for R^n to R^1.

Unit V:
Multiple Riemann Integral: introduction – measure of a bounded interval in R^n – The Riemann integral of a bounded function defined on a compact interval in R^n – sets of measure zero. Evaluation of a multiple integral by iteration.

Content and Treatment as in

Tom M. Apostol, *Mathematical Analysis.*

Unit I : § 10.1-10.12
Unit II : § 10.13-10.18
Unit III : § 11.1-11.6
Unit IV : § 12.1-12.4
Unit V : § 14.1-14.5

Books for reference

1.Measure theory and integration: G.de.BARRA
2.Bartle .R.G. and Shebert (1996), Real Analysis, John Wiley and Sons Inc., New York.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – II
PAPER 8: COMPLEX ANALYSIS II
SUBJECT CODE: 2MS08a

Unit I:
Partial fractions – infinite products – canonical products – gamma function – Jenson's formula – Hadamard's theorem.

Unit II:
Riemann – Zeta function and normal families: product development – extension to the whole plane – functional equation – equicontinuity – normality and compactness – Arzela's theorem – families of analytic functions.

Unit III:
Conformal Mapping: Riemann mapping theorem – Schwarz – Christoffel formula –mapping on a rectangle – Triangle function of Schwarz.

Unit IV:
Harmonic Functions and Dirichlets Problem: functions with mean value property – Harnack's principle – sub-harmonic functions – Dirichlets problem.

Unit V:
Elliptic Functions: Simply periodic functions – doubly periodic functions – Weierstrass theory.

Content and treatment as in

L.V. Ahlfors, *Complex Analysis (third edition), Chapter 5 (omit* § 5.1, 5.2.5, 5.4.4, 5.5.5), Chapter 6 (omit § 6.5), Chapter 7 – up to § 7.3.3.

Unit I : § 5.2,5.3
Unit II : § 5.4 -5.5
Unit III : §6.1- 6.2
Unit IV : § 6.3-6.4
Unit V : § 7.1 – 7.3
Books for reference
1. Functions of a complex variable- B.S.Tyagi
2. Complex analysis – A.R. Vasishtha.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – II
PAPER 9: OPERATIONS RESEARCH I
SUBJECT CODE: 2MS09b

Unit I:
General linear programming problems – simplex methods – revised simplex method, bounded variable technique.

Unit II:
Duality principle, dual simplex method, integer programming problem, pure and mixed IPP - cutting plane algorithm – branch and bound method, zero one implicit enumeration.

Unit III:
Dynamic programming problem, elements of DP model definitions and examples computation – problem of dimensionality – solution of LPP by DP method.

Unit IV:
Project scheduling by COM and PERT. Arrow diagram representation. Critical path calculations, determination of the critical path. Determination of the floats. Probability and cost considerations in project scheduling.

Unit V:
Non-linear programming problem. Unconstrained external problems, constrained external problems, constrained non-linear algorithm.

Content and treatment as in

Hamdy A. Taha, *Operations Research – An Introduction* (4^{th} edition).

Books for reference
1 . Operations research (for M.Sc. Mathematics) – S.G. Venkatachalapathy- Margham publications
2. Operations research- Prem Kumar Gupta and D.S.Hira-S.CHAND & COMPANY LTD.

Unit I: § 3.1, 3.2, 7.3, 7.3.1, 7.4
Unit II: § 4.1, 4.2, 4.4, 8.1, 8.3, 8.4
Unit III: § 9.1, 9.2, 9.3, 9.4, 9.5
Unit IV: § 12.1, 12.2, 12.4
Unit V: § 18.1, 18.1.1, 18.2, 18.2.2, 19.2.1, 19.2.2

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COURSE: M.Sc. MATHEMATICS
SEMESTER – II
PAPER 10: TOPOLOGY
SUBJECT CODE: 2MS10a

Unit I:
Topological spaces, the definition and some examples. Elementary concepts, open bases and open subbases, weak topologies, the function algebras C(X,R) and C(X,C).

Unit II:
Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces.

Unit III:
Ascoli's theorem, separation: T_i – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and Tietze extension theorem. The Urysohn's Imbedding theorem.

Unit IV:
The Stone-Cech compactification. The connectedness – connected spaces, the components of a space, totally disconnected spaces.

Unit V:
Locally connected spaces, approximation: The Weierstrass approximation theorem, the Stone-Weierstrass theorems, locally compact Hausdorff spaces. The extended Stone-Weierstrass theorem.

Content and Treatment as in

George F.Simmons, *Topology and Modern Analysis*, Chapters 3, 4, 5, 6 and 7.

Unit I: § 3.16, 3.17, 3.18, 3.19, 3.20.
Unit II: § 4.21, 4.22, 4.23, 4.24.
Unit III: § 4.25, 5.26, 5.27, 5.28, 5.29.
Unit IV: § 5.30, 6.31, 6.32, 6.33.
Unit V: § 6.34, 7.35, 7.36, 6.37, 6.38.

Books for Reference

1. James Munkres, *Topology – A First Course.*
2. S.T. Hu, *Elements of Topology*.

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COURSE: M.Sc., MATHEMATICS
SEMESTER – III
PAPER 11: DIFFERENTIAL GEOMETRY
SUBJECT CODE: 3MS11b

Unit I:
Space Curves : Definition of a space curve – Arc length – Tangent, Normal and binormal ; Serret-Frenet formulae – Curvature and torsion – Contact between curves and surfaces – Tangent surface – Involutes and evolutes – Fundamental Existence Theorem for space curves.

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

Unit III:
Geodesics : Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence theorems – Geodesic parallels – Geodesic curvature – Gauss-Bonnet theorem – Gaussian curvature.

Unit IV:
Non-intrinsic properties of a surface : The second fundamental form- Principle curvatures – Lines of curvature – Developables– Developables associated with space curves and with curves on surfaces – Minimal surfaces.

Unit V:
Differential geometry of surfaces : Compact surfaces whose points are umbilics – Hilbert's lemma – Compact surfaces of constant Gaussian curvature; Compact surfaces of constant Mean curvature.

Content and Treatment as in

T.J.Wilmore, *An Introduction to Differential Geometry*, Oxford University Press, 17th Impression, New Delhi 2002 (Indian Print)

Unit I: Chapter 1: Sections 1 - 8
Unit II: Chapter 2: Sections 1 - 9
Unit III: Chapter 2: Sections 10 - 17
Unit IV: Chapter 3: Sections 1 – 7
Unit V: Chapter 4: Sections 1 - 4

Books for Reference

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. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1078.
4. J. A. Thrope, *Elementary topics in Differential Geometry*, Under – graduate Texts in Mathematics, Springer – Verlag 1979.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – III
PAPER 12: PROBABILITY AND DISTRIBUTIONS
SUBJECT CODE: 3MS12a

Unit I:
Random events: random events and operations performed on them-axioms of the theory of probability – application of combinatorial formula - conditional probability. Baye's theorem – independent events – random variables – concept – distribution function – random variables of the discrete type and continuous type – functions of random variable – multi dimensional random variables, marginal distributions – conditional distributions – independent random variables – functions of multi dimensional random variables.

Unit II:
Parameters of the distribution of a random variable – expected values, moments, the Chebychev inequality – absolute moments – order parameters – moments of random vectors – characteristic functions – definitions, properties of characteristic functions – characteristic function of sum of independent variables – determination of the distribution function by the characteristic function – probability generating function.

Unit III:
Some probability distributions: one point and two point distributions – Binomial distribution, generalized Binomial distribution – Polya and hypergeometric distributions – Poisson distribution – the Normal distribution – the Gamma distribution – the Beta distribution, the Cauchy and Laplace distributions – Compound distribution.

Unit IV:
Stochastic convergence – Bernoulli's formula – the convergence of a sequence of distribution functions – the Levy – Cramer theorem, the Gnedenko theorem, Poisson , Chebychev and Khintchine's law of large numbers – the strong law of large numbers.

Unit V:
The notion of a sample – the notion of a statistic – the distribution of the arithmetic mean of independent normally distributed random variables – the χ^2 – distribution, the student **t** distribution and Fisher's **Z** distribution.

Content and Treatment as in

Marek Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons Inc., New York.

Unit I: Chapter 1-§ 1.1-1.7, Chapter 2--§ 2.1-2.9
Unit II: Chapter 3-§ 3.1-3.6 (Omit pages 89,90), Chapter 4-§ 4.1-4.7.
Unit III: Chapter 5-§ 5.1-5.5, 5.7-5.9,5.13.
Unit IV: Chapter 6-§ 6.2-6.4, 6.6, 6.10-6.12, (Omit pages 225,232),
Unit V: Chapter 9-§ 9-1.9.4,9.6,9.7.

COURSE:M.Sc. MATHEMATICS
SEMESTER – III
PAPER 13: ADVANCED DISCRETE MATHEMATICS
SUBJECT CODE: 3MS13a

Unit I: Mathematical Logic: introduction, connectives well formed formulas, Tautologies, equivalence, implication of statement formula, functionally complete and other connectives principal forms and their representation.

Unit II: Mathematical Logic: inference theory of statement calculus, predicate calculus – definition, examples, properties and inference theory of predicate calculus.

Unit III: Lattices: Definition properties, hasse diagrams, modular and distributive lattices.

Unit IV: Boolean Algebra: Basic properties, Boolean Polynomials, ideals, Minimal forms of Boolean Polynomials.

Unit V: Application of Lattices: Switching, circuits - application to switching circuits – prepositional logic.

Content and Treatment as in

1. J.P.Tremblay and R. Manohar, Discrete Mathematical Structures with Application to Computer Science.
   Unit I : § 1.1-1.3 (omit §1.2.15 and § 1.3.6)
   Unit II : § 1.4-1.6

2. Lidil R. and Pilz G, Applied Abstract Algebra
   Unit III – Chapter 1 : § 1A and 1B
   Unit IV – Chapter 1 : § 2A,2B(omit proofs of theorems) and 3 only
   Unit V - Chapter 2 : § 1A, 1B .

COURSE: M.Sc., MATHEMATICS
SEMESTER – III
PAPER 14: ELECTIVE – 1
FUZZY SETS & APPLICATIONS
SUBJECT CODE: 3MSE1b

Unit I:

Fundamental Notions: Introduction – Review of the Notion of Membership – The Concept of a Fuzzy Subset – Dominance Relations – Simple Operations on Fuzzy Subsets – Set of Fuzzy Subsets for E and M Finite – Properties of the Set of Fuzzy Subsets – Product and Algebraic Sum of Two Fuzzy Subsets.

Unit II:

Fuzzy Graphs: Introduction – Fuzzy Graphs – Fuzzy Relations – Composition of Fuzzy Relations – Fuzzy Subsets Induced by a Mapping – Conditioned Fuzzy Subsets – Properties of Fuzzy Binary Relations – Transitive Closure of a Fuzzy Binary Relation – Paths in a Finite Fuzzy Graph.

Unit III:

Fuzzy Relations: Fuzzy Preorder Relations – Similitude Relations – Similitude Subrelations in a Fuzzy Preorder – Antisymmetry – Fuzzy Order Relations – Antisymmetric Relations without Loops, Ordinal Relations, Ordinal Functions in a Fuzzy Order Relations – Dissimilitude Relations – Resemblance Relations – Various Properties of Similitude and Resemblance – Various Properties of Fuzzy Perfect Order Relations – Ordinary Membership Functions.

Unit IV:

Fuzzy Logic: Introduction – Characteristic Function of a Fuzzy Subset, Fuzzy Variables – Polynomial Forms – Analysis of a Function of Fuzzy Variables : Method of Marinos – Logical Structure of a Function of Fuzzy Variables – Composition of Intervals – Fuzzy Propositions and their Functional Representations – The Theory of Fuzzy Subsets and Theory of Probability.

Unit V:

The Laws of Fuzzy Composition: Introduction – Review of the Notion of a Law of Composition – Laws of Fuzzy Internal Composition. Fuzzy Groupoids – Principal Properties of Fuzzy Groupoids – Fuzzy Monoids – Fuzzy External Composition – Operations on Fuzzy Numbers.

Content and Treatment as in

A. Kaufmann, *Introduction to the Theory of Fuzzy Subsets, Vol. 1*, Academic Press, New York, 1975

Unit I: Chapter I: Sections 1 – 8
Unit II: Chapter II: Sections 10 – 18
Unit III: Chapter II: Sections 19 – 29
Unit IV: Chapter III: Sections 31 – 40 (omit Sections37, 38, 41)
Unit V: Chapter IV: Sections 43 – 49

Books for Reference

1. H.J. Zimmermann, *Fuzzy Set Theory and its Applications*, Allied Publishers, Chennai, 1996
2. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic - Theory and Applications*, Prentice Hall, New Delhi, 2001

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M.Sc. MATHEMATICS
SEMESTER – III
PAPER 15: ELECTIVE: 2
OPERATIONS RESEARCH II
SUBJECT CODE: 3MSE2b

Unit I:
Inventory Models: The ABC inventory system – a generalized memory model – deterministic models – single item static model – single item static model with price breaks – multiple item static model with storage limitation – probabilistic model – single period models.

Unit II:
Queuing Theory: Basic elements of a queuing model – role of Poisson and exponential distributions – queuing models (M/M/1) (GD/∞/∞), (M/M/1) (GD/N/∞), (M/G/1) (GD/∞/∞) – the Pollack-Khintchine formula (M/M/C) (GD/N/∞), C≤N – self service model (M/M/∞)(GD/∞/∞).

Unit III:
Markovian decision process – the garderner example – finite stage dynamic programming model – LP solution of a Markovian decision problem.

Unit IV:
Simulation: Introduction – methodology of simulation – even type simulation – generation of random numbers – Monte Carlo simulation – simulation of queuing system – simulation of inventory system – simulation of networks.

Unit V:
Time Series Analysis: Time series graphs – components of a time series – measurement of trend graphic method – principle of least square method – growth curves and their fitting – measurement of seasonal variations.

Content and Treatment as in

1. Hamdy A. Taha, *Operations Research: An Introduction* (5^{th} ed.)

   Unit I : § 14.1-14.3,14.3.1,14.3.3.
   Unit II : § 15.1, 15.2, 15.5.1-15.5.5
   Unit III : § 18.1, 18.2, 18.4
2. Kanti Swarup, P.K. Gupta & Man Mohan, *Operations Research* (7^{th} edition)
   Unit IV : § 20.1, 20.3-20.9
3. S.C. Gupta & V.K. Kapoor, *Fundamentals of Applied Statistics*
   Unit IV : § 2.2-2.5.

Books for Reference

1. Philps D.T., Ravindra A. & Solberg, *Operations Research Principles and Practice.*
2. F.S. Hillier & G.J. Lieberman, *Introduction to Operations Research* (4^{th} ed.)

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M.Sc. MATHEMATICS
SEMESTER – IV
PAPER 16: FUNCTIONAL ANALYSIS
SUBJECT CODE: 4MS14

Unit I:
Banach Spaces: definition and some examples – Holder's and Minkowski's inequalities, continuous linear transformations – equivalence of various norms in l_p^n, a locally compact normed linear space is finite dimensional.

Unit II:
The Hahn-Banach theorem – N is separable if N^* is so – conjugate spaces of l_p^n and l_∞^n – natural imbedding of N into N^{**} - the open mapping theorem – the closed graph theorem – conjugate of an operator.

Unit III:
Hilbert spaces – some examples orthogonal complements – orthonormal sets – a Hilbert space is separable if every orthonormal set is countable – orthogonal dimension of H^*.

Unit IV:
The conjugate space H^* - adjoint of an operator – self adjoint operators – normal and unitary operators and projections.

Unit V:
Finite dimensional spectral theory – matrices – determinants and the spectrum of an operator – the spectral theorem.

Content and Treatment as in

George F. Simmons, *Introduction to Topology and Modern Analysis,* International Student Edition, McGraw Hill Limited.
Chapter 9 : § 46-51; Chapter 10 : § 52-59, Chapter 11 : § 60-62

Unit I : Chapter 9 : § 46 and 47
Unit II : Chapter10: sections 48 -51
Unit III : Chapter10:sections 52 -54
Unit IV : Chapter10:sections 55-59
Unit V : Chapter11: § 60 and 62

Books for Reference

1. Limaye, *Functional Analysis.*
2. Maddox, *Elements of Functional Analysis.*
3. Bachmann and Narricci, *Functional Analysis.*
4. Walter Rudin, *Functional Analysis.*

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M.Sc. MATHEMATICS
SEMESTER – IV
PAPER 18: ADVANCED GRAPH THEORY
SUBJECT CODE: 4MS16a

Unit I:
Graphs, Sub Graphs and Trees: Graphs and simple graphs – graph isomorphism – incidence and adjacency matrices – sub graphs – 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 – Chinese Postman problem – traveling sales man problem.

Unit III:
Vertex Colourings: Chromatic number – Brooke's theorem – Chromatic polynomials – Girth and chromatic number.

Unit IV:
Planar Graphs: Plane and Planar graphs – dual graphs – Euler's formula – five colour theorem and Four colour conjecture.

Unit V:
Bridges and Directed Graphs: Bridges – directed graphs – paths – directed cycles – application – a job sequencing problem – designing an efficient computer drum.

Content and Treatment as in

Bondy T.A. & Murthy U.S.R., *Graph Theory with Application,* The MacMillan Press Ltd., London.
Unit I : Chapter 1 : § 1.1-1.7, Chapter 2 : § 2.1-2.3
Unit II : Chapter 3 : § 3.1-3.2, Chapter 4 : § 4.1-4.4
Unit III : Chapter 8 : § 8.1, 8.2, 8.4, 8.5
Unit IV : Chapter 9 : § 9.1-9.3, 9.6
Unit V : Chapter 9 : § 9.4, Chapter 10: § 10.1-10.5

Books for Reference

1. Narsing Deo, *Graph Theory with Application to Engineers and Computer Science.*
2. Harary, *Graph Theory.*
3. L.R. Foulds, *Graph Theory Applications.*

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COURSE: M.Sc., MATHEMATICS
SEMESTER – IV
PAPER 19: ELECTIVE: 3
NUMBER THEORY & CRYPTOGRAPHY
SUBJECT CODE: 4MSE3b

Unit I:
Some Topics in Elementary Number Theory: Time Estimates for doing arithmetic – Divisibility and Euclidean algorithm – Congruence – Application to Factoring.

Unit II:
Finite Fields and Quadratic Residues: Finite Fields – Quadratic Residues and Reciprocity

Unit III:
Cryptography: Some simple Cryptosystems – Enciphering Matrices

Unit IV:
Public Key: The Idea of Public Key Cryptography – RSA – Discrete log – Knapsack.

Unit V:
Primality and Factoring: Pseudoprimes - The rho Method.
Elliptic Curves: Basic facts – Elliptic Curve Cryptosystems.

Content and Treatment as in

Neal Koblitz, *A course in Number Theory and Cryptography*, Springer Verlag, New York, 1987.

Unit I: Chapter I: Sections 1 – 4.
Unit II: Chapter II: Sections 1, 2
Unit III: Chapter III: Sections 1, 2
Unit IV: Chapter IV: Sections 1 – 4 (Index calculus algorithm is not included)
Unit V: Chapter V: Sections 1 (Up to Proposition V.1.5) , 2 and Chapter VI: Sections 1, 2.

Books for Reference

1. Niven and Zuckermann, *An Introduction to Theory of numbers (Edn. 3)*, Wiley Eastern Ltd., New Delhi, 1976.
2. David M. Button, *Elementary Number Theory*, Wm C. Brown Publishers, Dubuque, lowa, 1989.
3. K. Ireland and M. Rosen, *A Classical Introduction to modern Number Theory*, Springer Verlag, 1972.
4. G.Alexander Raymand , *A special book in number theory*, 2005.

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COURSE: M.Sc. MATHEMATICS
SEMESTER – IV
PAPER 20: ELECTIVE:4
STOCHASTIC PROCESSES
SUBJECT CODE: 4MSE4

Unit I:
Elements of Stochastic Process Markov Chains: Classification of general stochastic process – definition of stochastic processes. Definitions – transition probability – matrices of Markov chain – classification of states of Markov chain – recurrence – examples of recurrent Markov chains – more on recurrence.

Unit II:
Basic Limit Theorem on Markov Chains and Applications: Discrete renewal equations – proof of theorem 1.1 – absorption probabilities – criteria for recurrence – random walk.

Unit III:
Classical Example s of Continuous Time Markov Chains: General pure birth processes and Poisson processes – more about Poisson processes – birth and death processes – differential equations of birth and death processes and examples of birth and death processes.

Unit IV:
Renewal Processes: Definition of renewal processes – some examples of renewal processes – more on some special renewal processes.

Unit V:
Stationary Processes: Definition and examples – mean square distance – mean square error prediction.

Content and Treatment as in

Samuel Karlin Howard M. Taylor, *A First Course in Stochastic Processes* (second edition)

Unit I : § 1.3-1.4, 2.1, 2.3-2.7
Unit II : § 3.1-3.4, 3.7
Unit III : § 4.1, 4.2, 4.4-4.6
Unit IV : § 5.1-5.3
Unit V : § 9.1-9.3

Books for Reference

1. J. Medhi, *Stochastic Processes,* (2nd edition) Wiley Eastern Ltd.
2. Narayan Bhat, *Elements of Applied Stochastic Processes.*
3. Srinivasan & Mehtha, *Stochastic Processes.*
4. N.V. Prabhu, *Stochastic Process,* Macmillan (New York).

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