PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

पुण्यश्लोक अहिल्यादेवी होळकर
सोलापूर विद्यापीठ
।। विद्यया संपन्नता ।।
NAAC Accredited - 2015
'B' Grade (CGPA - 2.62)

SYLLABUS

FOR

M.Sc. (Part-II) MATHEMATICS
(Semester III and IV)
Choice Based Credit System

WITH EFFECT FROM ACADEMIC YEAR 2021-22

(JUNE-2021)

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

SCHOOL OF COMPUTATIONAL SCIENCES

DEPARTMENT OF MATHEMATICS

Revised Syllabi of M.Sc. in Mathematics (Choice Based Credit System)

1) **Title of the course:** M.Sc. in Mathematics
2) **Pattern:** Semester and Credit system.
3) **Duration of Course**: 2 years
4) **Strength of the Students:** 50
5) **Eligibility:** For M. Sc. in Mathematics following candidates are eligible.
   (i) B.Sc. with Mathematics as principal level.
   (ii) B.Sc. with any subject as principal and Mathematics at subsidiary level.

M. Sc. program in Mathematics consists of 100 credits. Credits of a course are specified against the title of the course.

A Four Semester M.Sc. Mathematics Course

Semester	No. of Papers/ Practical's / Seminar	Marks	Credits
Semester I			
• Theory Papers	05	500	20
• Practical Papers	02	100	04
• Seminar/Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester II			
• Theory Papers	05	500	20
• Practical Papers	02	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester III			
• Theory papers	05	500	20
• Practical Papers	02	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester IV			
• Theory papers	05	500	20
• Practical Papers	02	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Total marks and credits for M.Sc. Course		**2500**	**100**

M.Sc. (MATHEMATICS) Part-II w.e.f. June 2021-22

M.Sc. MATHEMATICS SEMESTER-III								
Paper Code	**Title of the Paper**	**Semester Examination**			**L**	**T**	**P**	**Credits**
		Theory	**IA**	**Total**				
	Hard Core Theory							
HCT 3.1	Functional Analysis	80	20	100	4	--	--	4
HCT 3.2	Advanced Discrete Mathematics	80	20	100	4	--	--	4
HCT 3.3	Linear Algebra	80	20	100	4	--	--	4
	Soft Core Theory (Any one)							
SCT 3.1	Differential Geometry	80	20	100	4	--	--	4
SCT 3.2	Fuzzy Mathematics							
	Open Elective Theory (Any One)							
OET 3.1	Numerical Techniques	80	20	100	4	--	--	4
OET 3.2	*SWAYAM course							
	Practical (Hard and Soft core)							
HCP 3.1	Practical 5 (Introduction to SCILAB)	40	10	50	--	--	4	2
	Practical (Open Elective) Any One							
OEP 3.1	Practical 6 (Practical based on OET 3.1)	40	10	50	--	--	4	2
OEP 3.2	Practical /seminar /viva based on SWAYAM course OET 3.2							
	Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
Total for Semester-III		**480**	**145**	**625**	**--**	**--**	**--**	**25**
M.Sc. MATHEMATICS SEMESTER-IV								
Code	**Title of the Paper**	**Semester Examination**			**L**	**T**	**P**	**Credits**
		Theory	**IA**	**Total**				
	Hard Core Theory							
HCT 4.1	Measure & Integration	80	20	100	4	--	--	4
HCT 4.2	Partial Differential Equations	80	20	100	4	--	--	4
HCT 4.3	Integral Equations	80	20	100	4	--	--	4
HCT 4.4	Operations Research	80	20	100	4	--	--	4
	Soft Core Theory (Any one)							
SCT 4.1	Numerical Analysis	80	20	100	4	--	--	4
SCT 4.2	Lattice Theory							
SCT 4.3	Probability Theory							
	Practical and Project							
HCP 4.1	Practical 7 (Advanced SCILAB)	40	10	50	--	--	4	2
HCP 4.2	Practical 8 (Project / Internship)	40	10	50	--	--	4	2
	Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
Total for Semester-IV		**480**	**145**	**480**	**--**	**--**	**--**	**25**
Total				**2500**	**--**	**--**	**--**	**100**

*: The credits will be transferred as per university policy and UGC guidelines after submitting the course completion certificate/ mark list from SWAYAM.

L=Lecture T=Tutorials

P=Practical IA=Internal Assessment

HCT=Hard Core Theory

SCT=Soft Core Theory

HCP=Hard Core Practical

OET=Open Elective Theory

OEP=Open Elective Practical

Evaluation Scheme:

Each theory paper will have 100 marks out of which 80 marks will be for Term End examination and 20 marks for Internal Assessment. The candidate has to appear for internal evaluation of 20 marks and external evaluation (University Examination) of 80 marks for each theory paper.

Each practical paper will have 50 marks out of which 40 marks will be for Term End examination and 10 marks for Internal Assessment. The candidate has to appear for internal evaluation of 10 marks and external evaluation (University Examination) of 40 marks for each practical paper.

Internal Evaluation:

- In case of theory papers internal examinations will be conducted by department / school.
- In case of practical papers 10 marks shall be for internal test, which will be conducted by the department / school.

External Evaluation (End of Term University Examination):

I) Nature of Theory question paper:

1) Each Theory paper is of 80 marks.
2) Each Theory paper will be of 3 hours duration
3) There shall be 7 questions each carrying 16 marks.
4) Students have to attempt **five questions**.
5) Q.No.1 is **compulsory** and shall contain 16 objective type sub-questions each carrying 1 mark.
6) Q.No.2 is **compulsory** and shall contain 4 short answer type sub-questions each carrying 4 marks.
7) Students have to attempt **any three** questions from Q. N0. 3 to Q. No. 7.
8) Q. N0. 3 to Q. No. 7 shall contain 2 long answer type sub-questions (10+6 or 8+8 marks)

II) Nature of Practical question paper: (End of Term Examination)

For Sem-III: Practical examination will be conducted for 40 marks and is of two hours duration. There shall be 05 questions each of 10 marks, of which student has to attempt any 03 questions. VIVA will be for 5 marks and 5 marks shall be for day-to-day journal.

For Sem- IV : **Project/Internship** : End of Term assessment of the project/ Internship for 40 marks will be done on the basis of presentation, findings and report of the project, out of which 10 marks are reserved for VIVA.

Detailed Syllabus of M.Sc. Semester- III (Mathematics)
Paper-XI
Paper Code: HCT 3.1

Functional Analysis

Unit - 1
Banach spaces :
Normed linear spaces, Banach spaces, Quotient norm spaces, continuous linear transformations, equivalent norms, Hahn-Banach theorem and its consequences.

(15 L)

Unit - 2
Conjugate space and separability, second conjugate space. The open mapping Theorem, The closed graph theorem, The conjugate of an operator, The uniform boundedness principle.

(15 L)

Unit - 3
Hilbert spaces :
Definition and examples and simple properties, orthogonal complements, The projection theorem, orthogonal sets, The Bessel's inequality, Fourier expansion and Perseval's equation,

(15 L)

Unit - 4
Separable Hilbert spaces, The conjugate space, Riesz's theorem, The adjoint of an operators, self adjoint operators, Normal and unitary operators, projections. Contraction mapping and Banach fixed point theorem.

(15 L)

Recommended Book :

1. G.F.Simmons **:** Topology and Modern Analysis, McGraw Hill (1963)

Reference Books :

1. D. Somsundram : A First Course in Fuctional Analysis, Narosa Publishing House
2. G.Bochman and Narici **:** Functional Analysis, Academic Press 1964
3. A.E.Taylor **:** Introduction to Functional analysis, John Wiley- and sons (1958)
4. A.L.Brown and Page **:** Elements of Functional Analysis, Van-Nastra Reinehold com (1970)
5. B.V.Limaye **:** Functioned Analysis New age international.
6. Erwie Krey Zig **:** Introduction to Functional Analysis with Applications, John Wiley and Sons.

Paper-XII

Paper Code: HCT3.2

Advanced Discrete Mathematics

Unit - 1

Lattices**:** Definition and examples of posets, Comparability, Product and Lexicographic Order, Hasse Diagrams, Special Elements in Posets, lattices, Sublattices, Complete Lattice, Modular and distributive lattices, Homomorphism's, Finite Boolean algebras and applications.

(15 L)

Unit - 2

Graph Theory:

Definition of a graph, vertex degrees, simple and multigraph, graph isomorphism, regular, complete and bipartite graphs, subgraphs, paths and cycles in a graph, connected graphs, eccentricity, radius and diameter of graph, The matrix representation of a graph, Fusion.

(15 L)

Unit - 3

Trees: Definition and simple properties of a tree, bridges, spanning trees, cut vertices, vertex connectivity.

(15 L)

Unit - 4

Combinatorics : The fundamental principles**,** Permutation and combination, principle of Inclusion-Exclusion, Pigeonhole principle, recurrence relations and generating functions.

(15 L)

Recommended Books :

1. Gorrett Birkhaff and T.C.Bartee,Modern Applied Algebra, CBS Pub. and Distributors.
2. John Clark and Derek Holton A first book at Graph Theory Applied Publishers Ltd.
3. C.T.Liu **:** Discrete Mathematics.

Reference Books:

1. Rudolf Lidl and Gunter Pils : Applied Abstract Algebra, Springer Verlag.
2. J.E. Hopcroft and Jeffery D. Ullman. Introduction to Automata theory, languages and computation Narosa publishing House, 1993
3. K.L.P.Mishra and M Chandrasekaran Theory of Computer Science, Prentice Hall of India Ltd.
4. John C. Martin : Introduction to languages and the theory of computation Tata McGraw Hill Publishing Co, Ltd, New Delhi
5. Swapan Kumar: A text book of Discrete Mathematics
6. Rich and Brualdi **:** Combinatories

Paper-XIII

Paper Code: HCT3.3

Linear Algebra

Unit – 1

Linear Transformations

Linear transformation, Linear functional, Dual space, Dual basis, The Double dual, The Transpose of a linear transformation, Annihilator of a set, Annihilator of Annihilator. Representation of Transformation by matrix, Characteristic values of matrix, Characteristic polynomial of linear operator, Annihilating Polynomial, Invariant subspace.

(15L)

Unit – 2

Elementary canonical forms

Triangulabity, simultaneous Triangulation, Diagonalizability, Simultaneous Diagonalization, Direct sum, Direct sum decompositions, Invariant direct sums, The primary decomposition theorem

(15L)

Unit – 3

Jordan and Rational Forms

Cyclic subspace and Annihilator, Cyclic decomposition and the rational form The Jordan form, computation of Invariant factors, Companion matrix.

(15L)

Unit – 4

Inner Product Spaces:

Linear functional and adjoints, unitary operators, Normal operators, Operators on Inner Product Spaces, Forms on Inner product spaces, positive forms, more on forms, spectral theory .

(15L)

Recommended Book :

1. K.Hoffman and Ray Kunze : Linear Algebra, Prentice Hall of India,Pvt Ltd. 1989.

Reference Books :

1. David M.Barton : Abstract and linear Algebra, Addison Wesley Publishing Co.
2. Sharma, Vasistha & vasistha: Linear Algebra, Krishna prakashan ltd. Meerut. 2005.
3. Friedberg H. Stephen, Insel J. Arnold, Spence E. Lawrence , Eastern Economy Edition
4. Vivek Sahai, Vikas Bist : Linear Algebra, Alpha Science International

Paper-XIV

Paper Code: SCT3.1

Differential Geometry

Unit -1

Tangent vectors and tangent vector fields, frame fields, Reparametrization of curves, standard curves, Directional derivative, Differential forms, Speed of curve

(15 L)

Unit- 2

Frenet formulas for unit speed and for arbitrary speed curves, Isometries in E^3, Translation, Rotation, Orthogonal Transformation, Frenet approximation of curves, Covariant derivatives.

(15 L)

Unit -3

Calculus on Surface, Co-ordinate patches, Surface, Surface of revolution, Patch Computation Parametrization of a region X(D) in M .

(15 L)

Unit- 4

Differentiable functions and Tangent vectors, Shape Operator, Normal curvature, Gaussian and mean curvature .

(15 L)

Recommended Books:

1. O'Neill, B.: Elementary Differential geometry, Academic Press, London 1966

Reference Books:

1. Millman, R. and Parker, G.D. : Elements of differential geometry: Prentice-Hall of India Pvt. Ltd. 1977

2. Hicks, N. : Notes of differential geometry, Princeton University Press (1968)

3. Nirmala Prakash : Differential Geometry, Tata McGraw-Hill 1981

Paper-XIV

Paper Code: SCT3.2

Fuzzy Mathematics

Unit -1

Fuzzy sets and crisp sets, examples of fuzzy sets, types of fuzzy sets, standard operations, cardinality, degree of subset hood, level cuts and its properties, representation of fuzzy sets, decomposition theorems, extension principle, properties of direct and inverse images of fuzzy sets. **(15 L)**

Unit-2

Operations on fuzzy sets, types of operations, fuzzy complement, equilibrium and dual point, Increasing and decreasing generators, fuzzy intersection: t-norms. **(15 L)**

Unit-3

Fuzzy union t-conorms, characterization theorem of t-conorm, combination of operators, aggregation operations, ordered weighted averaging operations. **(15 L)**

Unit-4

Fuzzy numbers, characterization theorem, linguistic variables, arithmetic operations on intervals, arithmetic operations on fuzzy numbers, lattice of fuzzy numbers, fuzzy equations. **(15 L)**

Recommended Book :

1. Klir George J. and Yuan Bo. Fuzzy Sets and Fuzzy Logic, Theory and Applications, Prentice Hall of India Pvt.Ltd, New Delhi 1997

Reference books :

1. Kaufmann A and Gupta M. M. Introduction to Fuzzy Arithmetics, Van Nostrand.

2. Ross Timothy J.,Fuzzy logic with Enginering Applications, McGraw Hill Inc. 1995

3. Lowen R., Fuzzy Set Theory, 1996

4. Zimmerman H.J.,Fuzzy Set Theory and Its Applications 1997.

5. Pedrycz, W. and Gomide F.: An introduction to Fuzzy Sets Analysis and Design. The MIT Press, Massachusetts 1998.

Paper-XV

Paper Code: OET 3.1

Numerical Techniques

Unit–1

Errors in numerical calculations and solution of algebraic and transcendental equations:

Errors& their computation: Absolute, relative & percentage errors. A general error formula, Error in series approximation, The Bisection method, The method of false position, Secant method, Newton Raphson method.

(15 L)

Unit – 2

Interpolation and Numerical Differentiation:

Finite Differences: Forward, Backward & Central Differences, Symbolic relations & separation of symbols, Newton's Formula for interpolation, Lagrange's interpolation formula and error in Lagrange's interpolation formulas, Divided differences & their properties, Newton's general interpolation formula.

(15 L)

Unit –3

Numerical solutions of system of linear equations & Eigen Values:

Gaussian elimination method, Method of factorization (LU decomposition), Iterative Method: Gauss Seidal Method, Eigen value problem: Householder's method, Eigen value of symmetric tridiagonal matrix.

(15 L)

Unit –4

Numerical Integration and Solutions of ordinary differential equations, Numerical Integration:

Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8thrule, Solution of differential equation by Taylor's series, Euler's method and Euler's modified method.

(15 L)

Recommended Book :

1) S. S .Sastry Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India, 2001

Reference Book :

1) Atkinson K. E., An Introduction to Numerical Analysis, John Wiley and Sons, N. Y., 1978.
2) Froberg C. E., Introduction to Numerical Analysis, Johns Hopkins University Press, Baltimore,1950.
3) M. K. Jain, S.R.K. Iyengar, S.R. Iyenger, R. K. Jain, Numerical Methods for scientific and Engineering computation, 3rd edition, wiley Eastern Ltd.,1992

Paper-XV

Paper Code: OET3.2

*SWAYAM COURSE

NOTE:

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Mathematics Practical 5
Paper Code: HCP3.1 Introduction to SCILAB

1. Download and install SCILAB software ,
2. Scilab environment and console
3. Scilab as an interactive calculator
4. Scilab workspace and working directory
5. Creating matrices and some simple matrix operations
6. Creating matrices and some simple matrix operations
7. Sub-matrices
8. Variable, assignment and display

Practical Hands on session should be conducted on SCILAB software.

Mathematics Practical 6

Paper Code: OEP3.1

1. At least five practical's should be conducted on open elective theory OET 3.1/OET3.2.

Detailed Syllabus of M. Sc. Semester – IV (Mathematics)

Paper-XVI

Paper Code: HCT 4.1
Measure and Integration.

Unit - 1

Measure and Integration: Measure space, Complete Measure, Locally measurable Set, Saturated Measure, Measurable function, Fatous lemma (statement only), Monotone Convergence Theorem, Integrable Function, Lebesgue Convergence Theorem, Generalized Fatous Lemma (Statement Only), Generalized Lebesque convergence theorem.

(15 L)

Unit - 2

Signed Measure : Definition of Signed Measure, Positive Set , Negative Set and Null Set, Hahn Decomposition Theorem, Mutually Singular Measure, Jordan Decomposition Theorem, Absolutely Continuous Measure, Radon-Nikodym theorem, Lebesque Decomposition Theorem.

(15 L)

Unit - 3

Product Measure and Outer Measure: Semi algebra, Measurable Rectangle, Product measures, x-cross Section and y-cross Section, Fubini's and Tonelli's theorem, Outer Measure and measurability, The Extension theorem.

(15L)

Unit - 4

Inner measure and its properties, Baire Borel sets and positive linear functional and Borel measures.

(15 L)

Recommend Book :

1.Royden H.L: Real Analysis (Third Edition Practice Hall ,2002).

Reference Books :

1. Berberian, S.K. : Measure and Intergration McMillan, N.Y. 1965
2. Friedman A. : Foundations of Modern Analysis, Helf Rinehart and Winston, 1970
3. Wheeden R.L. and Zygmund A. : Measure and integral, Marcel Dakker, 1977
4. Halmos, P.R. : Measure Theory : Van Nostrand 1950
5. A Murkherjee and K.Pethoven : Real and Functional Analysis, Plenum Press 1978.
6. Rana J.K. : Measure and integration Narosa (1997)
7. P . K. Jain and V.P. Gupta :- Lebesgue measure and Integration , Anushan Publication

Paper-XVII

Paper Code: HCT4.2
Partial Differential Equations

Unit - 1
First order Partial Differential Equations:
Curves and surfaces, classification of integrals, linear equations of first order, Pfaffians, compatible systems, Charpits method, Jacobi method.

(15 L)

Unit -2
Integral surfaces through a given curve, quasi linear equations, nonlinear first order partial differential equations.

(15 L)

Unit - 3
Second order Partial Differential Equations:
Genesis of Second order Partial Differential Equations, Classification, one dimensional wave equations, vibrations, of a string, families of equipotential surface.

(15 L)

Unit -4
Maximum and minimum principles, Dirichlets and Neumann problems. Dirichlet problem for circle, Harnacks theorem. Greens theorem (Statement only), Classification in case of n variables.

(15 L)

Recommended Book:
1. T. Amarnath: An elementary course in Partial differential equations, Narosa publication, 1987.

Reference Books:
1. Ordinary and Partial Differential Equations: M. D. Raisinghania, S Chand Publications
2. Frite John**:** Partial Differential Equations.
3. R.McOwen **:** Partial differential equations, Prentice Hall 1995
4. G.Folland : Partial Differential Equations Prentice Hall India 1995

Paper-XVIII
Paper Code: HCT4.3
Integral Equations

Unit - 1

Preliminary concepts :Introduction, Some problems which give rise to integral equations, Classification of linear integral equations, Integro -differential equations, conversions of initial value problems to Volterra type integral equations and boundary value problems Fredholm type integral equations,

(15 L)

Unit - 2

Fredholm Equations :Integral equations with separable (Degenerate), Hermitian and symmetric Kernel, The operator method in the theory of integral equations, Determination of Iterated Kernels and Resolvent Kernels, Solution of Fredholm's integral equations by successive approximations problems.

(15L)

Unit - 3

Volterra Equations :Types of Volterra equations, Resolvent kernel of Volterra equations, Methods of successive approximations, Convolution type kernels. Conversion of Sturm Liouville problems to integral equations, Solution of Sturm Liouville

(15L)

Unit - 4

Hilbert-Schmidt theorem. Construction of Green function and its use in solving Boundary Value Problems,Application of Fourier and Laplace transforms to the solution of Volterra integral equations.

(15L)

Recommended Book :

1. Kanwal, R.P. :Linear Integral Equations, Theory and Techniques, Academic Press (1971)

Reference Books :

2. Chambers, L.G. :Integral Equations : A Short Course, International Text Book Co., (1976)
3. C.D.Green: Integral Equation Methods, Thomas Nelson and Sons(1969)
4. J.A. Cochran :The Analysis of linear Integral Equations, Mc-Graw Hill (1972)
5. Krasnow M.A.: Kislov and G. Hakaronke : Problems and exerciscs in integral equations Mir Publications(1971)
6. Pundir and Pundir : IntegralEquations
7. M.D.Raisinghania: Linear Integral Equations,Kedar Nath Ram Nath MEERUTDELHI.

Paper-XIX

Paper Code : HCT 4.4
Operations Research

Unit-1

Convex Sets and Functions: Convex sets, supporting and separating hyperplanes, convex polyhedra and polytope, extreme points, convex functions. Linear Programming Problem (LPP): Introduction to linear programming problems, Graphical solution to LPP, Standard LPP (SLPP), basic solution and basic feasible solution to SLPP. Methods for solving LPP: Simplex Algorithm, Two-phase simplex method, Big M method .

(15 L)

Unit-2.

Duality in LPP: Concept of duality, Theorems related to duality, complementary slackness property and development of dual simplex algorithm. Integer Linear Programming Problem (ILPP): The concept of cutting plane, Gomory's method of cutting plane for all ILPP and mixed ILPP, Branch and Bound method (Algorithm only). **(15L)**

Unit-3

Quadratic Programming Problem (QPP): Definition of QPP, Kuhn-Tucker conditions, Algorithms for solving QPP: Wolfe's and Beale's algorithm.

(15 L)

Unit-4

Theory of Games: Two person zero sum games, Minimax and Maxmin principles, Saddle point, Mixed strategies; Rules of dominance, Solution of 2 x 2 game by Algebraic method, Graphical method, Reduction of game problem as LPP, Minimax and Maxmin theorem (without proof).

(15L)

Recommended Book:

1.Sharma S.D : Operations Research, Macmillan Publishers India Ltd.

Reference Books:

2. Hadley G. (1969): Linear Programming, Addision Wesley.
3. Taha H. A. (1971): Operations Research an Introduction, Macmillan N. Y.
4. Kanti Swaroop, Gupta and Manmohan (1985): Operations Research, Sultan Chand & Co.
5. Sharma J. K. (2003): Operations Research Theory and Applications, 2nd Ed. Macmillan India ltd.
6. Sharma J. K. (1986): Mathematical Models Operations Research, Macgraw Hill.

Paper-XX

Paper Code : SCT4.1

Numerical Analysis.

Unit–1

Errors in numerical calculations and solution of algebraic and transcendental equations: Numbers and their accuracy, Mathematical preliminaries, Errors & their computation: Absolute, relative & percentage errors, A general error formula, Error in series approximation, The iteration method & it's rate of convergence, The method of false position & its rate of convergence, Secant method & its rate of convergence, Newton Raphson method and its rate of convergence**.**

(15 L)

Unit – 2

Numerical solutions of system of linear equations & Eigen Values: Gaussian elimination method, Method of factorization (LU decomposition), Iterative Method: Gauss Seidal Method, Eigen value problem: Householder's method, Eigen value of symmetric tridiagonal matrix, Power method for largest Eigenvalue.

(15 L)

Unit –3

Numerical Differentiation: Solution of differential equation by Taylor's series: Euler's method and Euler's modified method, Picard's method of successive approximations, Runge- Kutta Methods**.**

(15 L)

Unit –4

Numerical Solution of Partial differential Equation: Finite difference approximation to derivative, Laplace's equation, Jacobi's method, Gauss-Seidal method, ADI methods, Parabolic equations, iterative methods for solution of equations, Hyperbolic equations.

(15 L)

Recommended Book :

1. S.S.Sastry, Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India, 2001

Reference Book :

2. Atkinson K. E., An Introduction to Numerical Analysis, John Wiley and Sons, N. Y., 1978.
3. Froberg C. E., Introduction to Numerical Analysis, Johns Hopkins University Press, Baltimore,1950.
4. M. K. Jain, S.R.K. Iyengar, S.R. Iyenger, R. K. Jain, Numerical Methods for scientific and Engineering computation, 3rd edition, wiley Eastern Ltd.,1992

Paper-XX

Paper Code : SCT 4.2

Lattice Theory

Unit 1

Basic concepts: Posets: Definition and examples, Two definitions of lattices and their equivalence, examples of lattices. Description of Lattices, some algebraic concepts. Homomorphism, Isomorphism and isotone maps. Polynomials, Identities and Inequalities. Free lattices: definition and examples, Special elements.

(15L)

Unit 2

Special types of Lattices: Distributive lattices – Properties and characterizations. Modular lattices –Properties and characterizations. Congruence relations. Boolean algebras – Properties and characterizations. Topological representation: definition and examples. Pseudo complementation.

(15 L)

Unit 3

Concurrences and Ideals: Ideals and filters in lattices. Lattice of all ideals I(L). Properties and characterizations of I(L).Stone's theorem and its consequences. Distributive, Standard and Neutral Elements

(15 L)

Unit 4

Stone Algebra : Pseudo complemented lattices. S(L) and D(L) – special subsets of pseudo complemented lattices. Distributive pseudo complemented lattice. Stone lattices – properties and Characterizations. Semi modular Lattices: definition and examples

(15 L)

Recommended Books:

1) George Grätzer , General Lattice Theory, Birkhäuser Verlag (Second Edition).
2)G. Birkhoff, Lattice Theory, Amer. Math. Soc. Coll. Publications, Third Edition 1973

Paper-XX

Paper Code : SCT 4.3

Probability Theory

Unit-1

Classes of sets, Sequence of sets, limsup and liminf and limit of sequence of sets, field, σ- field, σ- field generated by a class, Borel σ-field, Probability measure, Probability space, properties of probability measure-continuity, mixture of probability measure. Lebesgue and Lebesgue-Steltjes measures on R. Independence of events. **(15 L)**

Unit 2

Measurable function, random variable, distribution of a random variable, simple random variable, elementary random variable, liminf, limsup and limit of sequence of random variables. Method of obtaining a random variable as a limit of sequence of simple random variables. Integration of a measurable function with respect to a measure, expectation of a random variable, monotone convergence theorem, Fatou's Lemma, Dominated Convergence theorem and their application. **(15 L)**

Unit-3

Convergence of sequence of random variables, almost sure convergence, a characterizing property, convergence in probability, uniqueness of limit, a characterizing property. Yule Slutsky results and preservation under continuous transform (statement only). Convergence in r^{th} mean, interrelationships. **(15 L)**

Unit-4

Independence: Borel-Cantelli Lemma, Characteristics function, simple properties. Inversion theorem and uniqueness property (statements only). Convergence in distribution, continuity theorem (statement only), Weak and Strong laws of large numbers, Kolmogorov's three series theorem for almost sure convergence (statement only), Liaponove's Lindeberg-Feller Theorems on CLT (statement only). Application of the above result. . **(15 L)**

Reference Books:

1. Bhat B. R. (1999): Modern Probability Theory (3rd ed.).New Age International (P) Ltd..
2. Billingsley P.(1986): Probability and Measure-.John Wiley and Sons.
3. Alan Karr (1993): Probability Theory-Springer Verlag.
4. Kingman, J F C and Taylor, S.J.(1966): Introduction to Measure and Probability-Cambridge University Press.
5. Dudly, R.M.(1989): Real Analysis and Probability- Wadsworth and Brooks/ Cole.
6. Ash Robert (1972): Real Analysis and Probability-Academic Press.

Practical 7
Paper Code: HCP4.1
Advanced SCILAB

- Probability and Statistics
- Working with polynomials
- Plotting graphs
- Scilab programming language
- Script files and function files
- Writing Scilab functions
- File operations
- Reading Microsoft Excel files
- Data Structures
    - Practical Hands on session should be conducted on SCILAB software.

Practical 8
Project Work/ Internship

Paper Code: HCP4.2
Project

- Project should be based on New Concept which is not covered in Syllabus, Problem definition, Data collection, Data analysis, Interpretation, Major findings and Report writing.
- Project work will be assessed for 50 marks, out of which 10 marks are reserved for internal evaluation based on primary preparation for the project like selection of topic, preparation of questionnaire, synopsis presentation and day-to-day project work reporting etc.
- End of Term assessment of the project for 40 marks will be done on the basis of presentation, findings and report of the project, out of which 10 marks are reserved for VIVA.

- **Internship**

- In Internship, student is expected to have internship in any Govt./private institute/college(Junior or senior)/industry , where he/she will work on live project with real-life data or take live teaching lessons. Interns shall acquire skills to deal with the situation/ teaching skill. Interns shall also acquire professional and soft skills through Internship. It provides them a practical opportunity to develop true understanding of the teaching profession and future prospects of working conditions in that profession. Students need to submit the attendance logbook and internship report. The continuous assessment of students for 10 marks will be based on day-to-day reporting and follow-up of the live project by student. End of Term

assessment will be based on the internship report and viva. Internship report and its presentation will carry 30 marks, and viva will be for 10 marks.

Equivalence of Papers of M.Sc.II SEM III

Sr.No.	Old Paper	Equivalent paper
HCT 3.1	Functional Analysis	Functional Analysis
HCT 3.2	Advanced Discrete Mathematics	Advanced Discrete Mathematics
HCT 3.3	Linear Algebra	Linear Algebra
SCT 3.1	Differential Geometry	Differential Geometry
SCT 3.2	Fuzzy Mathematics	Fuzzy Mathematics
OET 3.1	Numerical Technique	Numerical Technique
OET 3.1	SWAYAM course	SWAYAM course

Equivalence of Papers of M.Sc.II SEM IV

Sr.No.	Old Paper	Equivalent paper
HCT 4.1	Measure & Integration	Measure & Integration
HCT 4.2	Partial Differential Equations	Partial Differential Equations
HCT 4.3	Integral Equations	Integral Equations
HCT 4.4	Operations Research	Operations Research
SCT 4.1	Numerical Analysis	Numerical Analysis
SCT 4.2	Lattice Theory	Lattice Theory
SCT 4.3	Probability Theory	Probability Theory