SOLAPUR UNIVERSITY, SOLAPUR

SYLLABUS

FOR

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

WITH EFFECT FROM ACADEMIC YEAR 2017-18

(JUNE-2017)

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:** 40
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	01	100	04
• Seminar/Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester II			
• Theory Papers	05	500	20
• Practical Papers	01	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester III			
• Theory papers	05	500	20
• Practical Papers	01	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester IV			
• Theory papers	05	500	20
• Practical Papers	01	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 2017-18

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	70	30	100	4	--	--	4
HCT 3.2	Advanced Discrete Mathematics	70	30	100	4	--	--	4
HCT 3.3	Linear Algebra	70	30	100	4	--	--	4
	Soft Core Theory (Any one)							
SCT 3.1	Differential Geometry	70	30	100	4	--	--	4
SCT 3.2	Fuzzy Mathematics							
	Open Elective Theory (Any One)							
OET 3.1	Numerical Techniques	70	30	100	4	--	--	4
OET 3.2	Optimization Techniques							
	Practical (Hard and Soft core)							
HCP 3.1	Practical 5 (Practical based on HCT and SCT)	35	15	50	--	--	4	2
	Practical (Open Elective) Any One							
OEP 3.1	Practical 6 (Practical based on OEP 2.1)	35	15	50	--	--	4	2
OEP 3.2	Practical 6 (Practical based on OEP 2.2)							
	Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
Total for Semester-III		**420**	**205**	**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	70	30	100	4	--	--	4
HCT 4.2	Partial Differential Equations	70	30	100	4	--	--	4
HCT 4.3	Integral Equations	70	30	100	4	--	--	4
HCT 4.4	Operations Research	70	30	100	4	--	--	4
	Soft Core Theory (Any one)							
SCT 4.1	Numerical Analysis	70	30	100	4	--	--	4
SCT 4.2	Lattice Theory							
SCT 4.3	Probability Theory							
	Practical and Project							
HCP 4.1	Practical 7 (Practical based on HCT and SCT)	35	15	50	--	--	4	2
HCP 4.2	Practical 8 (Project Work)	35	15	50	--	--	4	2
	Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
Total for Semester-IV		**420**	**205**	**625**	**--**	**--**	**--**	**25**
Total				**2500**	**--**	**--**	**--**	**100**

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 70 marks will be for Term End examination and 30 marks for Internal Assessment. The candidate has to appear for internal evaluation of 30 marks and external evaluation (University Examination) of 70 marks for each paper. Each practical paper and project work will have 50 marks out of which 35 marks will be for Term End examination and 15 marks for Internal Assessment. The candidate has to appear for internal evaluation of 15 marks and external evaluation (University Examination) of 35 marks for each practical paper and project.

Internal Evaluation:

- In case of theory papers internal examinations will be conducted by department / school.
- In case of practical papers, 05 marks shall be for day-to-day journal and 10 marks shall be for internal test, which will be conducted by the department / school.
- In case of project work, 15 marks are reserved for internal evaluation based on primary preparation for the project like selection of topic, collection of primary information, synopsis presentation and day-to-day reporting of the project work etc.

External Evaluation (End of Term University Examination):

I) Nature of Theory question paper:

1) Each Theory paper is of 70 marks.
2) Each Theory paper will be of 2 hours and 30 minutes duration
3) There shall be 7 questions each carrying 14 marks.
4) Students have to attempt **five questions**.
5) Q.No.1 is **compulsory** and shall contain 14 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 3 or 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.

II) Nature of Practical paper and Project: (End of Term Examination)

Practical: Practical examination of each paper will be conducted for 30 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 05 marks.

Project: End of Term assessment of the project for 35 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: HCT3.1

Functional Analysis

Unit - 1

Banach spaces :

Normed linear spaces,Banach spaces, Quotient norm spaces, continuous linear transformations, equivalent norms,the Hahn-Banach theorem and its consequences. Conjugate space and separability, second conjugate space. The open mapping Theorem, The closed graph theorem, The conjugate of an operator, The uniform boundedness principle.

(25 L)

Unit - 2

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 - 3

Separable Hilbert spaces, The conjugate space, Riesz's theorem, The adjoint of on operators, self adjoint operators, Normal and unitary operators, projections. **(15 L)**

Unit - 4

Contraction mapping and Banach fixed point theorem.

(05 L)

Recommended Books :

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 and lattices, sublattices and direct products, Modular and distributive lattices, Homomorphisms, Boolean algebras and applications.

(20 Lectures)

Unit - 2

Graph Theory:

Definition of a graph, vertex degrees, simple, regular complete and bipartite graphs, paths and cycles in a graph, connected graphs, The matrix representation of a graph, Fusion.

(20 Lectures)

Unit - 3

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

(10 Lectures)

Unit - 4

Combinotorics : Basic counting methods**:** Inclusion exclusion principle Pigeonhole principle, recurrence relations and generating functions.

(10 Lectures)

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. Rich and Brualdi **:** Combinatories
4. C.T.Liu **:** Discrete Mathematics.
5. John C. Martin : Introduction to languages and the theory of computation Tata McGraw Hill Publishing Co, Ltd, New Delhi

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.

Paper-XIII

Paper Code: HCT3.3
Linear Algebra

Unit – 1: Linear Transformations
Linear functional, The double dual, The transpose of a linear transformation, characteristic values, Annihilator polynomials, invariant subspaces.

(20 L)

Unit – 2: Elementary canonical forms:
Triangulabity, diagonalizabitlity, Direct sum decompositions, Invariant direct sums,The primary decomposition theorem.

(10 L)

Unit – 3
Jordan and Rational Forms:
The Jordan form, computation of Invariant factors, Companion matrix, the rational form

(20 L)

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 .

(10 L)

Recommended Books :
1. K.Hoffman and Ray Kunze : Linear Algebra, Prentice Hall of India,Pvt Ltd. 1989.
2. Vivek Sahai, Vikas Bist : Linear Algebra, Alpha Science International

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

Paper-XIV

Paper Code: SCT3.1

Differential Geometry

Unit 1 **(15 L)**

1.1 Tangent vectors and tangent vector fields, frame fields.
1.2 Reparametrization of curves, standard curves.
1.3 Directional derivative
1.4 Differential forms
1.5 Speed of curve

Unit 2 **(15 L)**

2.1 Frenet formulas for unit speed and for arbitrary speed curves
2.2 Isometries in E^3
2.3 Translation, Rotation, Orthogonal Transformation
2.4 Frenet approximation of curves
2.5 Covariant derivatives

Unit 3 **(15 L)**

3.1 Calculus on Surface
3.2 Co-ordinate patches
3.3 Surface, Surface of revolution
3.4 Patch Computation
3.5 Parametrization of a region X(D) in M
3.6 Differentiable functions and Tangent vectors

Unit 4 **(15 L)**

4.1 Shape Operator
4.2 Normal curvature
4.3 Guassian and mean curvature

Recommended Books:

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

Reference Books:

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

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

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

Paper-XIV

Paper Code: SCT3.2

Fuzzy Mathematics

Unit 1:
Motivation. Fuzzy set as a generalization of a characteristic function of a set, Different notations describing a fuzzy set. (15L)

Unit 2:
Algebra of fuzzy sets, "Venn diagrams", Level cuts, decomposition theorems, image and inverse image of a fuzzy set under a function. (15L)

Unit 3:
Extension principle, Triangular norm and co-norm, their characterization theorems. (15L)

Unit 4 :
Fuzzy arithmetic: Fuzzy numbers, their characterizations, their relation-ships with closed intervals of real numbers, Lattice of fuzzy numbers. (15L)

Recommended Books :

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 :

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

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

4. Lowen R., Fuzzy Set Theory, 1996

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

6. 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 **(20 L)**

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

1.1 Errors & their computation: Absolute, relative & percentage errors.

1.2 A general error formula

1.3 Error in series approximation

1.4 The Bisection method.

1.5 The method of false position .

1.6 Secant method.

1.7 Newton Raphson method.

Unit – 2 :

Interppolation and Numerical Differentiation. **(20 L)**

2.1 Finite Differences: Forward, Backward & Central Differences, Symbolic relations & separation of symbols.

2.2 Newton's Formula for interpolation.

2.3 Lagrange's interpolation formula and error in Lagrange's interpolation formuls.

2.4 Divided differences & their properties.

2.5 Newton's general interpolation formula.

Unit – 3 : **(10 L)**

Numerical solutions of system of linear equations & Eigen Values.

3.1 Gaussian elimination method.

3.2 Method of factorization (LU decomposition)

3.3 Iterative Method: Gauss Seidal Method.

3.4 Eigen value problem: Householder's method.

3.5 Eigen value of symmetric tridiagonal matrix.

Unit – 4 : **(10 L)**

Numerical Integration and Solutions of ordinary differential equations

4.1 Numerical Integration: Trpezoidal rule Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.

4.2 Solution of differential equation by Taylor's series: Euler's method and Euler's modified method.

Recommended Text Book :

1) S. S. Sastry Introductory Methods of Numerical Analysis, 3^{rd} edition, Prentice Hall of India, 2001
2) M. K. Jain, S.R.K. Iyengar, S.R. Iyenger, R. K. Jain, Numerical Methods for scientific and Engineering computation, 3^{rd} edition, wiley Eastern Ltd., 1992

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.

Paper-XV

Paper Code: OET3.2

Optimization Techniques

Unit 1 :

Formulation of Linear Programming Problem, Graphical solution of Linear Programming Problem, General form of Linear Programming Problem, Standard form of Linear Programming Problem, Assumptions in Linear Programming Problem, Limitations of Linear Programming Problem, Advantages of Linear Programming Problem. **(15 L)**

Unit 2 :

Matrix form of Linear Programming Problem, Slack and surplus variables , basic solution , feasible solution , basic feasible solution and optimum solution of Linear Programming Problem, Simplex method (two variables)**.** **(15 L)**

Unit 3 :

Mathematical formulation of Transportation Problem, Matrix form of Transportation Problem, basic solution , feasible solution , basic feasible solution and optimum solution of Transportation Problem, Methods of Initial basic feasible solution: i) North-West Corner rule ii) Lowest Cost Entry Method iii) Vogel's Approximation Method (Unit-Cost Penalty Method) **(15L)**

Unit 4 :

Mathematical formulation of Assignment Problem, Fundamental theorem of Assignment Problem, Hugarian Method of Assignment Problem, Unbalanced Assignment Problem, Travelling Salesman Problem. **(15 L)**

Recommended Books :

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

Reference Books:

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

Mathematics Practical 5

Paper Code: HCP3.1

Unit – 1 : Functional Analysis
1) Problems on Banach Spaces
2) Problems on Hilberts spaces
3) Problems on Conjugate Spaces

Unit – 2 : Advanced Discrete Mathematics
1) Problems on Graphs
2) Problems on Trees
3) Problems on Matchings

Unit – 3 : Linear Algebra
1) Problems on Linear Transformations
2) Problems on Elementray Canonical forms
3) Problems on Rational and Jordan Forms

Unit – 4: Soft core 3.1/3.2
At least three practical on this paper should be conducted.

Instruction : All practical's should be solved either by using C or C++ language.

Mathematics Practical 6

Paper Code: OEP3.1

1. At least ten practicals 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, Measurable function, Integration Fatous lemma (statement only), Generalization of monotone and Lebesque convergence theorem.

(20 L)

Unit - 2

Signed Measure **:** Hahn Decomposition, Jordan Decomposition, Radon-Nikodym theorem Lebesque Decomposition.

(20 L)

Unit - 3

Measure and Outer Measure :

Outer Measure and measurability, the Extension theorem, Product measures, Fubini's and Tonelli's theorem.

(10L)

Unit - 4

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

(10 L)

Recommend Books:

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 Books :
T. Amarnath: An elementary course in Partial differential equations, Narosa publication, 1987.

Reference Books :
1. Ordinary and Partial Differential Equatios : 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, Conversion of Sturm Liouville problems to integral equations, Solution of Sturm Liouville problems.

(15 L)

Unit - 2
Fredholm Equations **:** Integral equations with separable (Degenerate), Hermitian and symmetric Kernel, The operator method in the theory of integral equations, Hilbert-Schmidt theorem. Construction of Green function and its use in solving Boundary Value Problems

(15 L)

Unit - 3
Volterra Equations **:** Types of Volterra equations, Resolvent kernel of Volterra equations, Methods of successive approximations, Convolution type kernels. Aplication of Fourier and Laplace transforms to the solution of Volterra integral equations.

(20 L)

Unit - 4 Determination of Iterated Kernels and Resolvent Kernels
Solution of fredholms integral equations by successive approximations

(10 L)

Recommended Books :

1. Kanwal, R.P**. :** Linear Integral Equations, Theory and Techniques, Academic Press (1971)
2. Chambers, L.G**. :** Integral Equations : A Short Course, International Text Book Co., (1976)

Reference Books :

1) C.D.Green **:** Integral Equation Methods, Thomas Nelson and Sons (1969)
2) J.A. Cochran **:** The Analysis of linear Integral Equations, Mc-Graw Hill (1972)
3) Krasnow M.A.: Kislov and G. Hakaronke : Problems and exerciscs in integral equations Mir Publications (1971)
4) Pundir and Pundir : Integral Equations
5)M.D.Raisinghania: Linear Integral Equations,Kedar Nath Ram Nath MEERUT DELHI.

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 . **(20 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). **(20 L)**

Unit-3 Quadratic Programming Problem (QPP): Definition of QPP, Kuhn-Tucker conditions, Algorithms for solving QPP: Wolfe's and Beale's algorithm. **(10 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). **(10 L)**

Recommended Books :

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

Reference Books:

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

Paper-XX

Paper Code : SCT4.1

Numerical Analysis.

Unit – 1 **(20 L)**

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

1.8 Numbers and their accuracy

1.9 Mathematical preliminaries.

1.10 Errors & their computation: Absolute, relative & percentage errors.

1.11 A general error formula

1.12 Error in series approximation

1.13 The iteration method & it's rate of convergence.

1.14 The method of false position & its rate of convergence

1.15 Secant method & its rate of convergence.

1.16 Newton Raphson method and its rate of convergence.

Unit – 2 :

Interppolation and Numerical Differentiation. **(20L)**

2.1 Errors in polynomial interpolation.

2.2 Finite Differences: Forward, Backward & Central Differences, Symbolic relations & separation of symbols.

2.3 Newton's Formula for interpolation.

2.4 Lagrange's interpolation formula and error in Lagrange's interpolation formuls.

2.5 Divided differences & their properties.

2.6 Newton's general interpolation formula.

Unit – 3 : **(10 L)**

Numerical solutions of system of linear equations & Eigen Values.

3.1 Gaussian elimination method.

3.2 Method of factorization (LU decomposition)

3.3 Iterative Method: Gauss Seidal Method.

3.4 Eigen value problem: Householder's method.

3.5 Eigen value of symmetric tridiagonal matrix.

3.6 Power method for largest Eigen value.

Unit – 4 : **(10 L)**

Numerical Integration and Solutions of ordinary differential equations

4.1 Numerical Integration: Trpezoidal rule Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.

4.2 Errors in the above methods.

4.3 Solution of differential equation by Taylor's series: Euler's method and Euler's modified method.

Recommended Text Book :

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

4) M. K. Jain, S.R.K. Iyengar, S.R. Iyenger, R. K. Jain, Numerical Methods for scientific and Engineering computation, 3^{rd} edition, wiley Eastern Ltd., 1992

Reference Book :

3) Atkinson K. E., An Introduction to Numerical Analysis, John Wiley and Sons, N. Y., 1978.

4) Froberg C. E., Introduction to Numerical Analysis, Johns Hopkins University Press, Baltimore, 1950.

Paper-XX

Paper Code : SCT 4.2

Lattice Theory

Unit 1:
Poset, Lattice, Homomorphism, Special elements, Congruence relations, Quotient lattices. Fundamental theorem of Homomorphism, Kernel and co-kernel of homomorphism. **(15L)**

Unit 2:
Ideals, Dual ideals, Prime ideals. Minimal prime ideals. Maximal ideals. Distributive Lattices Properties and Characterizations. Stone's Theorem . **(15 L)**

Unit 3:
Stone Spaces, Modular lattices. Properties and Characterizations. (a,b) M and (a,b)M*. Semi modular lattices. **(15 L)**

Unit 4:
Pseudo complemented lattices Properties of S(L) and D(L) in pseudo complemented distributive lattices. Stone lattices. Properties and characterizations, Boolean lattices ,Convertion of Boolean algebras into Boolean rings and conversely, Boolean Spaces.
(15 L)

Recommended Books:

1. Gratzer G.: Lattice Theory – First Concepts and Distributive Lattices.

2. Birkhoff G.: Lattice Theory, (American Mathematical Society, Providence,Rhose Island, 1967) Colloquim Publications, 25.

Paper-XX

Paper Code : SCT 4.3

Probability Theory

Unit-1: Classes of sets, Sequence of sets, limsup and limijf 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, Fatous 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 (3^{rd} 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 8
Paper Code: HCP4.1

Unit – 1 : Measure and Integration

1) Problems on Measurable Space and signed Measure
2) Problems on Inner, Outer Measure and Product Measure.

Unit – 2 Partial Differential Equation

1) Problems on first order Partial Differential Equations
2) Problems on second order Partial Differential Equations

Unit – 3 Integral Equations

1) Problems on Fredholm Equations.
2) Problems on Volterra Equations.

Unit – 4 Operations Research

1) Problems on LPP , Big M Method ,Two Phase Method

2) Problems on IPP Duality, Wolfes method.

Unit – 5 Soft core I

At least two practicals should be conducted

Instruction : All practical's should be solved either by using C or C++ language.

Practical 8
Project Work
Paper Code: HCP4.2

- 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 15 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 35 marks will be done on the basis of presentation, findings and report of the project, out of which 10 marks are reserved for VIVA.