2 year PG Program structure under NEP-20   to be implemented from Academic year 2023-24

	Sem - I	Sem - II
Major (DSC) 4 credits per course	4 x 3	4 x 3
Major Elective (DSE) 4 credits per course	4 x 1	4 x 1
Research Methodology/ OJT/Field Project 4 credits per course	4 x 1	4 x 1
Total Credits	**20**	**20**

Basket for the 2 year PG Program (M.Sc. Mathematics) under NEP-2020

	Sem - I	Sem - II
Major (DSC)	• Advanced Abstract Algebra • Topology • Linear Algebra	• Field theory • Measure theory • Classical Mechanics
Major Elective (DSE)	• Numerical Analysis • Real Analysis • Ordinary differential Equations • Calculus of Variations • Number Theory • SCILAB Programming • Fuzzy Mathematics • Logic and Set Theory • Elementary Discrete Mathematics	• Operations Research • Differential Geometry • Combinatorics • Graph Theory • Coding Theory • Cryptography • Advanced Topics in Topology • Statistics and Probability • C Programming • Financial Mathematics
Research Methodology/OJT/ Field Project	Research Methodology	OJT/Field Project

Note:

1. Students need to do OJT/Field Project as per NEP guidelines and mentors shall be designated by department/colleges for internship/OJT.
2. Maximum 10 students per teacher shall be allocated for mentorship of OJT/Field Project.
3. The students must complete on-the-job training/internship of 04 credits during summer break, after completion of the second semester of the first year in the respective Major Subject.
4. The assessment of OJT/FP shall be conducted by the Department.
5. Teachers may use software's, if required for teaching contents of a course.
6. SCILAB Programming and C Programming are 4 credit courses, where 2 Theory and 2 practicals per week shall be devoted to them.
7. Term end Theory examination of 80 marks and 20 marks internal assessment shall be conducted for those courses which have theory and practical components.

Semester I for M.Sc. Program in Mathematics

Course	Teaching Scheme (Hours/Week)			Credits			Examination Scheme				
	Theory	Practical	Total	Theory	Practical	Total	Duration in Hrs.	Maximum Marks			Minimun Passing marks
								External assessment Theory	Internal assessment	Total Marks	External assessment + Internal assessment
Major (DSC) 1	4	——	4	4	——	4	3	80	20	100	40
Major (DSC) 2	4	——	4	4	——	4	3	80	20	100	40
Major (DSC) 3	4	——	4	4	——	4	3	80	20	100	40
Elective (DSE)	4	——	4	4	——	4	3	80	20	100	40
Research Methodology	4	——	4	4	——	4	3	80	20	100	40

Semester II for M.Sc. Program in Mathematics

Course	Teaching Scheme (Hours/Week)			Credits			Examination Scheme				
	Theory	Practical	Total	Theory	Practical	Total	Duration in Hrs.	Maximum Marks			Minimun Passing marks
								External assessment Theory	Internal assessment	Total Marks	External assessment + Internal assessment
Major (DSC) 1	4	——	4	4	——	4	3	80	20	100	40
Major (DSC) 2	4	——	4	4	——	4	3	80	20	100	40
Major (DSC) 3	4	——	4	4	——	4	3	80	20	100	40
Elective (DSE)	4	——	4	4	——	4	3	80	20	100	40
On Job Training /Field Project (OJT/FP)	4	——	4	4	——	4	3	80	20	100	40

Guidelines about Internal Assessment for Semester I and II:

The internal assessment marks shall be awarded by the concerned teacher. The internal assessment marks shall be sent to the University.

In case, the candidate fails in Theory Examination, the Internal Assessment marks will be carried forward for his next supplementary Examination.

There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.

The concerned teacher / department / college shall have to keep the record of all the internal assessment activities until six months after the declaration of the results of that semester.

Distribution of marks for Continuous Internal Assessment

Sr. No.	Activities	Max. Marks
1	Attendance	5
2	Home Assignment	5
3	Unit Test	10

Total Marks - 20

Minimum Passing Marks -08

University Question Paper Pattern

A student of M. Sc. Sem-I and Sem-II in Mathematics has to attempt all five questions in each paper.

Q1 to Q4 are long answer questions with internal choice within unit, whereas Q5 is compulsory question of short answers on all four units. Setting of the question paper is as under:

Total Marks: 80			Time 3 Hours
Q 1	(A)	Unit I	08 Marks
	(B)	Unit I	08 Marks
	OR		
	(C)	Unit I	08 Marks
	(D)	Unit I	08 Marks
Q 2	(A)	Unit II	08 Marks
	(B)	Unit II	08 Marks
	OR		
	(C)	Unit II	08 Marks
	(D)	Unit II	08 Marks
Q 3	(A)	Unit III	08 Marks
	(B)	Unit III	08 Marks
	OR		
	(C)	Unit III	08 Marks
	(D)	Unit III	08 Marks
Q 4	(A)	Unit IV	08 Marks
	(B)	Unit IV	08 Marks
	OR		
	(C)	Unit IV	08 Marks
	(D)	Unit IV	08 Marks
Q 5	(A)	Unit I	04 Marks
	(B)	Unit II	04 Marks
	(C)	Unit III	04 Marks
	(D)	Unit IV	04 Marks

Advanced Abstract Algebra

UNIT-I

Permutation Groups, Normal subgroups and quotient groups, Isomorphism Theorems, Automorphisms, Conjugacy and G- Sets.

UNIT-II

Normal Series, Solvable groups, Nilpotent groups, Cyclic decomposition, Alternating groups A_n,, Simplicity of A_n.

UNIT-III

Direct products, Sylow theorems, Groups of order p^2 and pq.

UNIT-IV

Ideals, Homomorphisms, Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and Nil ideals, Zorn's Lemma.

Text Book:

Basic Abstract Algebra (Second Edition): P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Cambridge University Press.

Reference Books:

1. Topics in Algebra (Second Edition): I. N. Herstein, John Wiley.
2. Abstract Algebra: David Summit and Richard M. Foote, John Wiley.

Topology

UNIT-I

Equipotent sets, Cardinal Numbers, Order Types, Ordinal Numbers.

UNIT-II

Open sets and limit points, Closed sets and closure, Operators and Neighbourhoods, Bases and Relative topologies.

UNIT-III

Connected sets and components, Compact and countably compact spaces, Continuous functions, Homeomorphisms.

UNIT-IV

T_0- and T_1- spaces, T_2- spaces and sequences, Axioms of countability, Separability.,Regular and Normal spaces.

Text Book:

Foundations of General Topology: W. J. Pervin, Academic press, 1964.

Reference Books:

1.Topology (Second edition): J. R. Munkres, Prentice Hall of India, 2002.
2. Introduc)on to Topology and Modern Analysis: G. F. Simmons, Mc Graw Hill, 1963.
3. General Topology: J.L. Kelley, Van Nostrand, 1995.
4. Introduc)on to general Topology: K.D.Joshi, Wiley Eastern Ltd., 1983.

Linear Algebra

UNIT-I

Vector Spaces: Definitions and examples, Subspaces, Basis and dimension, Linear transformations, Quotient spaces, Direct sum, The matrix of linear transformation, Duality.

UNIT-II

Canonical Forms: Eigenvalues and eigenvectors, The minimal polynomial, Diagonalizable and triangulable operators, The Jordan form, The rational form.

UNIT-III

Inner Product Spaces: Inner products, Orthogonality, The adjoint of a linear transformation, Unitary operators, Self adjoint and normal operators, Polar and singular value decompositions.

UNIT-IV

Bilinear Forms: Definition and examples, The matrix of a bilinear form, Orthogonality, Classification of bilinear forms.

Text Book:

Linear Algebra (Second Edition): Vivek Sahai, Vikas Bist, Narosa Publishing House.

Reference Books:

1. Linear Algebra (Fourth Edition): S. H. Friedberg, A. J. Insel and L. E. Spence, Prentice-Hall International Inc.

2. Topics in Algebra: I. N. Herstein, Macmillan, Indian Edition.

3. Introduction to Linear Algebra (Second Edition): S. Lang, Springer International Edition.

4. Linear Algebra: K. Hoffman, R. Kunze, Prentice Hall of India.

Numerical Analysis

UNIT-I

The Bisection method, Newton's method, The Secant method, Muller's method, A General theory for one point iteration methods, Aitken extrapolation for linearly convergent sequences, The Numerical evaluation of multiple roots, Roots of polynomials, Systems of Non-linear equations, Newton's method for non- linear systems.

UNIT-II

Polynomial interpolation theory, Newton divided differences, Finite difference and table oriented interpolation formulas, Errors in data and Forward-differences, Hermite interpolation.

UNIT-III

The Weierstrass theorem and Taylor's theorem, The minimax approximation problem, The least square approximation problem, Orthogonal polynomial, The least square approximation problem (continued), Minimax approximation.

UNIT-IV

The Trapezoidal rule and Simpson's rule, Newton- Cotes integration formulas, Gaussian Quadrature.

NB: Use of suitable software to solve relevant problems is recommended.

Text book:

An Introduction to Numerical Analysis: Kendal E. Atkinson, John Wiley and sons, Inc.

Reference Books:

1.Numerical Methods: S. R. K. Iyengar, R. K. Jain, New Age International Publishers.

2.Introductory Methods of Numerical analysis (Fifth Edition): S. S.Sastry, Prentice Hall India Pvt. Ltd..

Real Analysis

UNIT-I

Sequence and Series of functions: Pointwise convergence of sequence of functions, Uniform convergence of sequence of functions, consequences of uniform convergence, Convergence and uniform convergence of series of functions, Integration and differentiation of series of functions, Abel summability, A continuous, nowhere-differentiable function.

UNIT-II

Differentiation: Derivative, Continuously Differentiable functions, Chain rule, Inverse function theorem, Implicit function theorem.

UNIT-III

Integration: integral over a rectangle, existence of the integral, evaluation of the integral, integral over a bounded set and rectifiable sets, improper integrals

UNIT-IV

Change of Variables Theorem: partitions of unity, Change of Variables theorem, applications of Change of Variables theorem, Line integrals with applications

Text Book:

1. Methods of Real Analysis, Richard R. Goldberg, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

2. Analysis on Manifolds , J. R. Munkres.

Reference Books:

1. Calculus on Manifolds, Michael Spivak.

2. Principles of Mathematical Analysis (Third Edition): Walter Rudin, McGRAW – HILL Book Company.

3. Calculus of Several Variables: C Goffman, Harper and Row.

Ordinary differential Equations

UNIT-I

Linear equations of first order, The equation $y' + ay = 0$, The equation $y' + ay = b(x)$, The general linear equation of first order, The second order homogeneous equation, Initial value problems, Linear dependence and independence, A formula for the Wronskian, The homogeneous equation of order n, The non-homogeneous equation of order n, A special method for solving non- homogeneous equation.

UNIT-II

Linear equations with variable coefficients, Initial value problem for the homogeneous equation, Solution of the homogeneous equation, Wronskian and linear independence, Reduction of order of a homogeneous equation, Non- homogeneous equation, Homogeneous equations with analytic coefficients, The Legendre equation, The Euler equation, Second order equation with regular singular points, The Bessel equation.

UNIT-III

Equations with variables separated, Exact equation, The method of successive approximations, The Lipschitz condition, Convergence of successive approximations, Nonlocal existence of solutions, Approximations to and uniqueness of the solutions.

UNIT-IV

Some special equations, Complex n-dimensional space, Systems as vector equations, Existence and uniqueness of solutions to systems, Existence and uniqueness for linear systems, Equations of order n.

Text Book:

An Introduction to Ordinary Differential Equation: E. A. Coddington, Prentice-Hall of India Pvt. Ltd., New Delhi.

Scope: Chapter 1 to 6.

Reference Books:

1. Differential Equations with Applications and Historical Notes (Second edition): G. F. Simmons, McGraw Hill Book Co.

2. Ordinary Differential Equations: G. Birkhoff and G. C. Rota, John Wiley and Sons.

3. Ordinary Differential Equations - A First Course: D. Somasundaram,, Narosa Publishing House.

Calculus of Variations

UNIT-I

Functionals- some simple variational problems, The variation of a functional, A necessary condition for an extremum, The simplest variational problem Euler's equation, The case of several variables, A simple variable end point problem, The variational derivative, Invariance of Euler's equation.

UNIT-II

The fixed end point problem for n-unknown functions, Variational problem in parametric form, Functionals depending on higher order derivatives, Variational problems with subsidiary conditions.

UNIT-III

Derivation of the basic formula, End points lying on two given curves or surfaces, Broken extremals, The Weierstrass Erdmann conditions.

UNIT-IV

The canonical form of Euler equations, First integrals of the Euler equations, The Legendre transformation, Canonical transformations, Noether's Theorem, The principle of least action, Conservation laws, The Hamilton Jacobi equation, Jacobi theorem.

Text Book:

Calculus of Variations: I. M. Gelfand and S. V. Fomin, Dover Publications, 2000.

Reference Books:

1. Calculus of Variations with Applications: A. S. Gupta, Prentice-Hall of India, 2008.

2. Problems and Exercises in the Calculus of Variations: M. L. Krasnov, G. I. Makarenko and A. I. Kiselev, Mir Publishers, Moscow,1975.

Number Theory

UNIT-I

Congruence, Solutions of Congruence, Chinese Remainder Theorem, Techniques of Numerical Calculation, Public-Key Cryptography.

UNIT-II

Prime Power Moduli, Prime Modulus, Primitive Roots and Power Residues, Congruence of Degree Two, Prime Modulus.

UNIT-III

Quadratic Residues, Quadratic Reciprocity, Greatest Integer Function.

UNIT-IV

Arithmetic Functions, Mobius Inversion Formula, The equation $ax + by = c$, Simultaneous linear equations, Pythagorean Triangles, Assorted Examples.

Text Book:

An Introduction to the Theory of Numbers (Fifth edition): Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery John Wiley & Sons Inc. 1991.

Reference Book:

1. Elementary Number Theory (Sixth Edition): David M. Burton, McGraw-Hill Higher Edition,.

2. An Introduction to Number Theory: Graham Everest, Thomas Ward, Springer, 2005.

SCILAB Programming

UNIT-I

Introduction to SCILAB, The SCILAB Environment, Scalars & vectors.

UNIT-II

Matrices, Programming in SCILAB.

UNIT-III

Polynomials, Menus and Dialogue Boxes, Graphic Output.

UNIT-IV

String handling functions, Statistics.

Text Book:

SCILAB (A free software to MATLAB) (First Edition): Er. Hema Ramchandran and Achuthsankar S. Nair, S. Chand & Company Ltd., India, 2012.

Fuzzy Mathematics

UNIT-I

From classical (Crisp) Sets to Fuzzy Sets. Fuzzy sets versus Crisp sets, Operations on Fuzzy sets.

UNIT-II

Fuzzy Arithmetic.

UNIT-III

Fuzzy relations.

UNIT-IV

Fuzzy relation equations.

Text Book:

Fuzzy Sets and Fuzzy Logic, Theory and Applications. George J. Klir and Bo Yuan, Prentice Hall India.

Scope: Chapter 1 to chapter 6.

Reference Book:

1. Fuzzy Logic with Engineering Applications (Third Edition): Timothy J. Ross, Wiley, 2010.

2. Fuzzy Sets and systems Theory and Applications: Didier Dubois, Henri Prade, Academic Press, 1980.

Logic and Set Theory

UNIT-I

Basic notions in set Theory : Axiom of choice, Zorn's Lemma, Hausdorff maximality principle, Well-ordering Theorem, Schroder-Bernstein Theorem

UNIT-II

Propositional Calculus: Truth tables, truth values, logical equivalence, disjunctive normal forms, complete connector systems

UNIT-III

Predicate Calculus: Its language, formulas, structures, satisfaction, normal forms, definability, isomorphisms of structures

UNIT-IV

Axiomatic Systems : Zermelo-Fraenkel Axioms, the Continuum Hypothesis, differentsystems of logic.

Reference Books:

1. K. Kuratowski, Introduction to Set Theory and Topology

2. E. Mendelson, Introduction to Mathematical Logic

Elementary Discrete Mathematics

UNIT-I

Mathematical Logic: Introduction, Proposition, Compound Proposition, Proposition and truth tables, Logical equivalence, Algebra of Proposition, conditional Proposition, Converse, contrapositive & Inverse, Bi-conditional statement, Negation of compound statements, Tautologies & contradictions, normal forms, Logic in proof.

UNIT-II

Lattice: Lattice as partially ordered sets, Their properties, Lattices as algebraic systems, Sub lattices, and Some special lattices eg. Complete, Complemented and Distributive lattices.

UNIT-III

Boolean algebra and Logic Circuits: Boolean algebra, Basic operations, Boolean functions, De-Morgan's theorem, Logic gate, Sum of products and Product of sum forms, Normal form, Expression of Boolean function as a canonical form, Simplification of Boolean expression by algebraic method, Boolean expression form logic & Switching network.

UNIT-IV

Graph Theory: Basic terminology, Simple graph, Multigraph, Degree of a vertex, Types of a graph, Sub graphs of isomorphic graphs, Matrix representation of graphs, Euler's theorem on the existence of Eulerian path & Circuits, Directed graph, Weighted graphs, Strong connectivity, Chromatic number.

Text Book:

Discrete Mathematical structures with applications to computer science by J. P. Tremblay and R. Manohar, McGraw-Hill book company, 1997.

Reference Book:

1. Discrete Mathematics and Its Applications (Eighth Edition): Kenneth Rosen, McGraw - Hill Higher Education, 2018.
2. Essential Discrete Mathematics for Computer Science: Harry Lewis, Rachel Zax, Princeton University Press, 2019.

3. A Beginner's Guide to Discrete Mathematics (Second Edition): W. D. Wallis, Birkhauser Basel, 2012.

Research Methodology

UNIT-I

Introduction to research Methodology: Research: The search for knowledge, Philosophy of Research, Approaches to research, Major research methods, Experimental research, Collection and analysis of data.

UNIT-II

Literature survey in research: Planning and writing a research proposal, Academic databases, Literature review.

UNIT-III

Research documentation and presentation: Preparation of research papers and other articles, The structure of a thesis, Tables and illustrations, Reasoning in research, References: How to cite and list correctly, Conference presentations and posters.

UNIT-IV

Ethics in research: Ethical and related issues in Research, Plagiarism,: Prevention and cure.

Text Book:

Research Methodology and Scientific Writing, C. George Thomas, Ane Books Pvt. Ltd., 2015.

Field Theory

UNIT-I

Unique factorization domains, Principal Ideal domains, Euclidean domains, Polynomial rings over unique factorization domains.

UNIT-II

Irreducible polynomials and Eisenstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed fields.

UNIT-III

Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions.

UNIT-IV

Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra.

Text Book:

Basic Abstract Algebra (Second Edition): P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Cambridge University Press.

Reference Books:

1. Topics in Algebra, I. N. Herstein, Second Edition, John Wiley.

2. Abstract Algebra, David S. Dummit and Richard M. Foote, John Wiley.

Measure Theory

UNIT-I

Introduction, Outer measure, Measurable sets and Lebesgue measure, A non- measurable set, Measurable functions, Littlewood's three principles.

UNIT-II

The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, Integral of a non-negative function, General Lebesgue integral, Convergence in measure.

UNIT-III

Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions.

UNIT-IV

The LP - Spaces, The Holder and Minkowski inequalities, Convergence and Completeness, Bounded linear functionals on LP- Spaces.

Text Book:

Real Analysis (Third edition): H. L. Royden, Prentice Hall India, 1988.

Reference Books:

1. Measure theory and Integration: De Barra G., Wiley Eastern Limited, 1981.

2. An introduction to Measure & Integration: Inder K. Rana, Narosa Publishing House.

Classical Mechanics

UNIT-I

Hamilton's Principle, Some techniques of calculus of variations, Derivation of Lagrange equations from Hamilton's principle, Extension of principle to nonholonomic systems, Conservation theorems and symmetry properties.

UNIT-II

Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Routh's procedure and oscillations about steady motion, The Hamiltonian formulation of relativistic mechanics, The Principle of least action.

UNIT-III

The equations of canonical transformation, Examples of canonical transformations, The symplectic approach to canonical transformations, Poisson brackets and other canonical invariants.

UNIT-IV

Equations of motion, Infinitesimal canonical transformations, and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations, Symmetry groups of mechanical systems, Liouville's theorem.

Text Book:

Classical Mechanics (Second Edition): H. Goldstein, Narosa publishing house, New Delhi.

Reference Books:

1. Lectures in Analytic Mechanics: F. Gantmacher, MIR Publishers, Moscow, 1975. 2. Classical Mechanics: Narayan Chandra Rana and Pramod Sharad Chandra Jog, Tata Mc Graw Hill.

Operations Research

UNIT-I

Linear Programming Problem - Simplex method, Duality in Linear Programming.

UNIT-II

Transportation Problem , Assignment problems.

UNIT-III

Dynamic programming.

UNIT-IV

Games and Strategies.

Text Book:

Operations Research: Kanti Swarup, P. K. Gupta and Man Mohan, Sultan Chand and Sons New Delhi.

Scope:

Unit I - Chapter 4 and 5

Unit II - Chapter 10 and 11 Unit III - Chapter 13

Unit IV - Chapter 17

UNIT-IV

1. Linear Programming: G. Hadley, Narosa Publishing House,1995.

2. Introduction to Operations Research (Sixth Edition): F. S. Hillier and G. J. Lieberman, Mc Graw Hill International Edition, 1995.

3. Operations Research – In Introduction: H.A Taha, Macmillan publishing company Inc., New York

Differential Geometry

UNIT-I

The First Fundamental Form and Local Intrinsic Properties of a Surface.

UNIT-II

Godesics on a Surface.

UNIT-III

The Second Fundamental Form and Local Non-Intrinsic Properties of a Surface.

UNIT-IV

The Fundamental Equations of Surface Theory.

Text Book:

Differential Geometry A First Course: D. Somasundaram, Eighth Reprint 2017, Narosa Publishing House.

Scope: Chapter 2,3,4 &5.

Reference Book:

1. Geometry of curves and surfaces: M. P. Do Carmo, Academic Press.

2. An introduction to Differential Geometry: T. J. Wilmore, Oxford University Press.

Combinatorics

UNIT-I

General Counting Methods for Arrangements and Selections: Two Basic counting Principles, Simple Arrangements and Selections, Arrangements and Selections with Repetitions, Distributions, Binomial Identities

UNIT-II

Generating Functions: Generating Function Models, Calculating Coefficients of Generating Functions, Partitions, Exponential Generating Functions, A Summation Method.

UNIT-III

Recurrence Relations: Recurrence Relation Models, Divide and Conquer Relations, Solution of Linear Recurrence Relations, Solution of Inhomogeneous Recurrence Relations, Solution with Generating Functions.

UNIT-IV

Inclusion-Exclusion: Counting with Venn Diagrams, Inclusion - Exclusion formula, Restricted Positions and Rook polynomials.

Text Book:
Applied Combinatorics (Third edition): Alan Tucker,, John Wiley & Sons, New York, 1995.

Reference Books:

1. Combinatorial Theory and Applications: V. Krishnamurthy, East West Press, New Delhi.

2. How to Count: An Introduction to Combinatorics and Its Applications: Robert A. Beeler, Springer, 2015.

3. Principles and Techniques in Combinatorics: Chen Chuang-Chong, Koh Khee- Meng, World Scientific, 1992.

Graph Theory

UNIT-I

The Definition of a Graph, More Definitions, Vertex Degrees, Subgraphs, Paths and Cycles, The Matrix Representation of Graphs, Fusion, Definition and Simple Properties of Trees, Bridges, Spanning Trees.

UNIT-II

Connector Problems, Shortest Path Problems, Cut Vertices and Connectivity, Euler Tours, The Chinese postman problem.

UNIT-III

Hamiltonian Graphs, Travelling Salesman Problem, Plane and Planar Graphs, Euler's formula, Kuratowski's Theorem, Non-Hamiltonian Plane Graphs, The Dual of a Plane Graph.

UNIT-IV

Definitions and More Definitions on Directed Graphs, Indegree and Outdegree, Tournaments, Traffic flow, Flow and Cuts, The Ford and Fulkerson Algorithm, Separating sets.

Text Book:

A First Look at Graph Theory: John Clark and Derek Allan Holton, Allied Publishers Ltd., 1995.

Reference Books:

1. Graph Theory with Applications to Engineering and Computer Science: Narsing Deo, Prentice Hall of India.

2. Graph Theory: F. Harare, Addison Wesley.

3. Introduction to Graph Theory: Douglas B. West, Prentice- Hall, New

Delhi, 1999.

4.Basic Graph Theory: K. R. Parthasarthy, TataMc Graw- Hill Pub.

Comp. Limited, Delhi.

Coding Theory

UNIT-I

Error detection, correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbour / minimum distance decoding, Distance of a code.

UNIT-II

Linear codes: Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrome decoding.

UNIT-III

Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, Decoding of cyclic codes, Burst-error-correcting codes.

UNIT-IV

Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes.

Text Book:

Coding Theory - A First Course (First edition): San Ling and Chaoping Xing, Cambridge University Press.

Scope: Chapters 2,4,7,8.

Reference Book:

A Student's Guide to Coding and Information Theory: Stefan M. Moser, Po - Ning Chen, Cambridge University Press, 2012.

Cryptography

UNIT-I

Time estimates for doing arithmetic, Divisibility and Euclidean algorithm, Congruences, Some applications to factoring, Finite fields, Quadratic residues and reciprocity.

UNIT-II

The idea of public key cryptography, RSA, Pseudo primes, The Rho method.

UNIT-III

The ElGamal cryptosystem, Algorithms for discrete logarithm problem, Security of ElGamal systems, The ElGamal signature scheme.

UNIT-IV

Elliptic curves: Basic Facts, Elliptic curve cryptosystems, Elliptic curve primality test, Elliptic curve factorization.

Text Books:

1. A Course in Number Theory and Cryptography (Second edition): Neal Koblitz, Springer Verlag.

2. Cryptography: Theory and practice (Third Edition): Douglas R. Stinson, CRC Press.

Scope:

Unit - I - From Koblitz's book (Chapter 1 and Chapter 2 excluding Existence and uniqueness of finite fields with prime power number of elements)

Unit - II – From Koblitz's book (Chapter 4 –sections 1 and 2, Chapter 5- sections 1 and 2)

Unit - III – From Stinson's book (Chapter 7- section 1, 2 and 7, Chapter 8- section 3)

Unit - IV - From Koblitz's book (Chapter 6)

Advanced Topics in Topology

UNIT-I

Completely normal spaces, Completely Regular spaces, Metric spaces as Topological spaces, Topological Properties.

UNIT-II

Finite products, Product invariant properties, Metric products, Tichonov topology, Tichonov theorem.

UNIT-III

Quotient topology, Urysohn's metrization theorem, Paracompact spaces.

UNIT-IV

Nets and filters.

Text books:

1. Foundations of General Topology: W. J. Pervin, Academic press, 1964. (For Unit-I, II & III)

2. Introduction to General Topology: K. D. Joshi, Wiley Eastern Ltd. 1983. (For Unit -IV)

Reference books:

1. Topology (Second Edition): J. R. Munkres, Prentice Hall of India, 2002.

2. Introduction to topology and modern analysis: G. F. Simmons, Mc Graw Hill, 1963.

3. General Topology: J. L. Kelley, Van Nostrand, 1995.

Statistics and Probability

UNIT-I

Introduction to Probability: Sample space, events, probability of an event, additive rules, conditional probability, multiplicative rule, Bayes' rule, Concept of a random variable, discrete probability distribution, continuous probability distribution, joint probability distribution, independent random variables.

UNIT-II

Mean of a random variable, variance and covariance, means and covariances of linear combinations of random variables, Chebyshev's Theorem, Some discrete probability distributions: discrete uniform distribution, binomial and multinomial distributions, hypergeometric distribution, negative binomial and geometric distribution, Poisson distribution and Poisson process.

UNIT-III

Some continuous probability distributions: continuous uniform distribution, normal distribution, area under the normal curve, applications of the normal distribution, normal approximation to the binomial distribution, gamma and exponential distribution, chi-squared distribution, lognormal distribution.

UNIT-IV

Functions of random variables, transformations of variables, moments and moment generating functions. Statistical hypothesis: general concepts, testing a statistical hypothesis, use of p values for decision making, tests concerning a singular mean (variance known), confidence interval estimation, tests on a single mean (variance unknown).

Reference Books:

1. R. Walpole, R.H. Myers, S.L. Myers, and K. Ye, Probability and Statistics for Engineers and Scientists, (Seventh Edition, Pearson India), 2011.

2. S Ross, A first course in probability, (Pearson, ninth edition), 2016.

C Programming

UNIT-I

Getting Started, The Decision Control Structure

UNIT-II

The Loop Control Structure, The Case Control Structure

UNIT-III

Functions & Pointers, Data Types Revisited

UNIT-IV

Arrays, Puppetting On Strings, Structures

Text Book:

Let Us C, Yashvant P. Kanetkar, Fifth Edition, BPB Publications.

Reference Book:

The C Programming Language (Second Edition): Brian W. Kernighan, Dennis Ritchie, Pearson.

Financial Mathematics

UNIT-I

The Measurement of Interest and Solution of Problems in Interest: Introduction, The accumulation and amount functions, The effective rate of interest, Simple interest, Compound interest, Present value, The effective rate of discount, Nominal rates of interest and discount, Forces of interest and discount, Varying interest, Summary of results. Introduction, The basic problem, Equation of value, Unknown time, Unknown rate of interest, Determining time periods, Practical examples.

UNIT-II

Basic Annuities and More General Annuities:

Introduction, Annuity-immediate, Annuity-due, Annuity values on any date, Perpetuities, Unknown time, Unknown rate of interest, Varying interest, Annuities not involving compound interest. Introduction, Differing payment and interest conversion periods, Annuities payable less frequently than interest convertible, Annuities payable more frequently than interest convertible, Continuous annuities, Payments varying in arithmetic progression, Payments varying in geometric progression, More general varying annuities, Continuous varying annuities, Summary of results.

UNIT-III

Amortization Schedules and Sinking Funds:

Introduction, Finding the outstanding loan balance, Amortization schedules, Sinking funds, Differing payment periods and interest conversion periods, Varying series of payments, Amortization with continuous payments, Step-rate amounts of principal.

UNIT-IV

Bonds and Other Securities and Yield Rates:

Introduction, Types of securities, Price of a bond, Premium and discount, Valuation between coupon payment dates, Determination of yields rates, Callable and putable bonds, Serial bonds, Some generalizations, Other securities, Valuation of securities. Introduction, Discounted cash flow analysis, Uniqueness of the yield rate, Reinvestment rates, Interest

measurement of a fund, Time-weighted rates of interest, Portfolio methods and investment year methods, Short sales, Capital budgeting basic technique and other technique.

Text Book:

The Theory of Interest (Third Edition): Stephen G. Kellison, McGraw Hill International Edition , 2009.

Reference Book:

Mathematics of Financial Markets: R. J. Elliott and P. E. Kopp, Springer, 1999.