M.Sc.Mathematics-II

Choice Based Credit System (**CBCS**)

MATA GUJRI COLLEGE

FATEHGARH SAHIB

DEPARTMENT OF MATHEMATICS

POST-GRADUATE PROGRAMME

(Courses effective from Academic Year 2018-19)

SYLLABUSOFCOURSESTOBEOFFERED
ForM. Sc.Mathematics-II

Details ofcoursesunder M.Sc.Mathematics

Course	***Credits**	
	Theory+ Practical**	Theory+Tutorial**
I. Core Courses (10 Papers)	10X4=40	10X5=50
Core CoursePractical / Tutorial* (10 Papers)	10X1=10	10X 1 =10
II. ElectiveCourses (10 Papers)	10X4=40	10X5=50
ElectiveCourse Practical/Tutorial*(10 Papers)	10X1=10	10X 1=10
Totalcredits	**100**	**120**

*** Wherever there is a practical therewill benotutorial and vice-versa**
****** 1**Hour Tutorial=** 1**Credit and**1 **Hour Practical= ½ Credit**

M.Sc.MATHEMATICS(PART –II) Semester3rdand4th

SYLLABUS
M.Sc. Mathematics (Part-II)
Session 2018-2019
Semester –III

Paper Code	**Paper Name**	**Credits L T P**	**Maximum Marks**	**Internal Marks**	**External Marks**
Core course MM 301	LINEAR ALGEBRA	5 1 0 (6)	100	30	70
Core Course MM 302	FIELD THEORY	5 1 0 (6)	100	30	70
CHOOSE ANY THREE OF THE FOLLOWING ELECTIVE COURSES					
Elective Course MM 303	DIFFERENTIABLE MANIFOLDS	5 1 0 (6)	100	30	70
Elective Course MM 304	MATHEMATICAL STATISTICS	5 1 0 (6)	100	30	70
Elective Course MM 306	CLASSICAL MECHANICS	5 1 0 (6)	100	30	70
Elective Course MM 307	TOPOLOGY II	5 1 0 (6)	100	30	70
Elective Course MM 308	FUZZY SETS AND APPLICATIONS	5 1 0 (6)	100	30	70
Total		30	500		

M.Sc.MATHEMATICS(PART –II) Semester3rdand4th

CORE COURSE

MM 301-LINEAR ALGEBA

L T P — University Exam: 70
5 1 0 — Internal Assessments: 30
Time Allowed: 3 hours — Total: 100

INSTRUCTIONS FOR THE PAPER – SETTER

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Linear Transformations: Introduction to Linear Transformation, the Algebra of Linear Transformation, Isomorphism, Representation of Transformations by Matrices, Linear Functional, the Transpose of Linear Transformation.

Elementary Canonical forms: Characteristic values, Annihilating polynomials, Invariant subspaces, simultaneous triangulation, simultaneous diagonalization, direct sum decompositions, Invariant direct sums, the primary decomposition theorem. (Chapter 3 and 6 of text book 1).

SECTION-B

The rational and Jordan forms: Cyclic subspaces and Annihilators, Cyclic decomposition and the rational forms, The Jordan form, computation of Invariant factors.

Inner product space: Introduction to Inner product space, Cauchy-Schwarz inequality, Holder inequality, Gram-Schmidt orthogonalization process, Bessel inequality. (Chapter 7 and section 8.1 and 8.2 of chapter 8 of text book 1).

TEXT BOOK:

1. K. Hoffmann & R. Kunze: Linear algebra, 2nd Ed., PHI.
2. Vivek Sahai & VikasBist: Linear Algebra, Narosa Publishing House,
3. P. R. Halmos: Finite Dimensional Vector Space.
4. Serge Lang: Linear Algebra, Springer-Verlag Undergraduate Text in Mathematics.

M.Sc.MATHEMATICS(PART –II) Semester3rdand4th

CORE COURSE
MM 302: FIELD THEORY

L T P — UniversityMarks:70
5 1 0 — InternalAssessment:30
Time Allowed: 3 hours — Total: 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION -A

Fields,examples,Algebraic and transcendental elements,Irreducible polynomials.Gauss Lemma,Eisenstein's criterion, Adjunction of roots, Kronecker's theorem, algebraic extensions, algebraically closed fields. Splitting fields, Normal extensions, multiple roots, finite fields, Separable extensions, perfect fields, primitive elements, Lagrange's theorem on primitive elements.

SECTION -B

Automorphism groups and fixed fields, Galois extensions, Fundamental theorem of Galois theory, Fundamental theorem of algebra, Roots of unity and cyclotomic polynomials. Cyclic extension, Polynomials solvable by radicals, Symmetric functions, cyclotomic extension, quintic equation and solvability by radicals.

BOOKS RECOMMENDED

1. Bhattacharya, Jain & Nagpaul: Basic abstract algebra (Chapters15-17,Chapter and 18:excluding section 5)
2. M. Artin: Algebra Prentice Hall Indian Private Limited, 2006

M.Sc.MATHEMATICS(PART –II) Semester3rdand4th

ELECTIVE COURSE
MM 303: DIFFERENTIABLE MANIFOLDS

L T P — UniversityMarks:70
5 1 0 — InternalAssessment:30
Time Allowed: 3 hours — Total: 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Differentiable Manifolds, examples of differentiable manifolds, Differentiable maps on manifolds, tangent vectors and tangent space, cotangent space, Vector Fields, Lie-bracket of vector fields. Immersions and embeddings. Tensors and forms. Exterior product and Grassman algebra, connections. Difference tensor, existence of parallelism and geodesics, covariant derivative, exterior derivative contraction, Lie-derivative.

SECTION-B

Torsion tensor and curvature tensor of a connection, properties of torsion and curvature tensor, Bianchi's identities, Cartan's approach and structure equations of cartan. Riemannian manifolds, Fundamenta ltheorem of Riemannian geometry, Riemannian connection. Riemannian curvature tensor and its properties. Bianchi's identities, Sectional curvature, Schur theorem, Sub-manifolds and hyper-surfaces.

BOOKS RECOMMENDED

1. Hicks, N. J. : Notes on Differential Geometry(Relevant Portion).
2. B.B. Sinha : An introduction to modern Differential Geometry, Kalyani Pub. N. Delhi (Relevant Portion).
3. Y. Matsushima: Differentiable Manifolds, Edition First, 1981.

ELECTIVE COURSE

MM 304: MATHEMATICAL STATISTICS

L T P — UniversityExam:70
5 1 0 — Internal Assessment :30
Time Allowed: 3 hours — TotalMarks : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Probability distributions and Probability densities :random variables, probability distributions, continuous random variables, probability density functions, multivariate distributions, joint distribution, marginal distribution and conditional distribution, independence o random variables, mathematical expectation, moments, Chebyshev's theorem, moment generating functions, product moments, moments of linear combinations of random variables, conditional expectations.
Study of various discrete distributions: Discrete Uniform distribution, Bernoulli distribution, Binomial distribution, Hyper-geometric distribution, Poisson distribution, Poisson distribution as a limiting case of Binomial distribution.
[Text 1:Chapter 3, Chapter4, Chapter5 (Sections 1 to 7)]

SECTION-B

Study of various continuous distributions: Uniform distribution, Normal distribution, The Normal approximation to the Binomial distribution, Gamma distribution, Exponential distribution, Beta distribution.
Statistical Hypothesis: Introduction, Null and Alternative hypothesis, Level of Significance, Critical Region, TypeI & TypeII errors, Test of Significance: t-test, Chi-square goodness of fittest, F-test(applicationsonly).
Point estimation: Unbiasedestimators, Efficiency, Consistency, Sufficiency, Themethod of maximum likehood
Intervalestimation: The estimation of means and variances (applicationsonly)
[Text1:Chapter6 (Sections1to6), Chapter10 (Sections1to5andSection8), Chapter11 (Sections 1, 2, 3, 6 and 7), Chapter12 (Sections 1 to 3), Chapter 13 (Sections 2 to 4)]

TEXT BOOKS

1. Irwin Miller, Marylees Miller: John E. Freund's Mathematical Statistics with Applications, Pearson New International Edition, 8th Edition, Pearson Education Limited.

BOOKS RECOMMENDED

1. A. M. Gun, M.K. Gupta and B. Dasgupta: An Outline of Statistical Theory, Volume two, 3rd edition, The World Press Private Limited.
2. Robert V. Hogg, Joeseph McKean, Allen T. Craig: Introduction to Mathematical Statistics, 7th edition, Pearson.

ELECTIVE COURSE

MM 305: CLASSICAL MECHANICS

L T P — UniversityExam:70
5 1 0 — Internal Assessment :30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Basic Principles: Mechanics of a Particle and a System of Particles, Constraints , Generalized Coordinates, Holonomic and Non-Holonomic Constraints. D'AlembertsPriciple and Lagrange's Equations, Velocity Dependent Potentials and the Dissipation Function, Simple Applications of the Lagrangianformulation.

Variational Principles and Lagrange's Equations: Hamilton's Principle, Derivation of Lagrange's Equations from Hamilton's Principle, Extension of Hamilton's Principle to Non-Holonomic Systems.

Conservation Theorems and Symmetry Properties: Cyclic Coordinates, Canonical Momentum and its Conservation, The Generalized Force, and Angular Momentum Conservation Theorem.

The Two-Body Central Force Problem: Reduction to the Equivalent One-Body Problem, The Equation of Motion, The Equivalent One Dimensional Problem and the Classification of Orbits, The Virial Theorem, Conditions for Closed Orbits, Bertrand's Theorem.

SECTION – B

The Kepler Problem: Inverse Square Law of Force, The Motion in Time in the Kepler Problem, Kepler's Laws, Kepler's Equation, The Laplace-Runge-Lenz Vector.

Scattering in a Central Force Field: Cross Section of Scattering, Rutherford Scattering Cross Section, Total Scattering Cross Section, Transformation of the Scattering Problem to Laboratory Coordinates.

The Kinematics of Rigid Body Motion: The Independent Coordinates of Rigid Body, The Transformation Matrix, The Euler Angles, The Cayley-Klein Parameters and Related Quantities, Euler's Theorem on the Motion of Rigid Bodies, Finite Rotations, Infinitesimal Rotations, The

Coriolis Force.

BOOKS RECOMMENDED

1. Herbert Goldstein: Classical Mechanics, 2nd edition, Narosa Publishing.

ELECTIVE COURSE
MM 306: TOPOLOGYII

L	T	P	University Exam: 70
5	1	0	Internal Assessment:30
Time Allowed: 3 hours			Total: 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Ordinal Numbers : Order types, Product of Order types, Well Ordered Sets, Similarity Mapping, Ordinal Numbers, Principle of Transfinite Induction, Comparability theorems of ordinal and cardinal numbers, Well Ordering of Ordinal Numbers, The first infinite and the first uncountable Ordinal, Statement of Well Ordering Theorem, Axiom of Choice and Zorn's Lemma. Burali-Forti Paradox. Crucial property of the first uncountable ordinal.

Higher Separation Axioms: Regular, Completely Regular, Normal and Completely Normal Spaces. Metric Spaces as Completely Normal T_2 Spaces. Urysohns Lemma and The Tietze Extension Theorem. Point finite and Locally Finite families, Covering Characterization of Normality.

Products : Products of first countable, Regular, T_2 and Completely Regular Spaces. Non invariance of normality under products. Embedding of Tichonov spaces into parallelotop and the Stone Cech Compactification.

SECTION –B

Nets and Filters: Nets and Subnets, Convergence and Clustering of a net, Closures and Nets, Nets and Continuity, Nets in Products, Ultra filter, Relationship between Nets and Filters, Nets and Filter Characterization of Compactness and The Tychonoff Theore

Identification Topology: Identification Topology, Identification Map, Subspaces, General Theorem, Transgression, Transitivity Spaces with Equivalance Relation, Quotient Spaces. Cones and Suspensions, Attaching of Spaces, Adjunction Space, The relation K(f) for continous maps and Weak Topologies.

BOOKS RECOMMENDED

1. W.J. Pervin : Foundations of General Topology, (Sections2.3to2.5), Section 5.5 to 5.6
2. Stephen Willard: GENERAL TOPOLOGY Ch4(excluding section 10), Ch6(Theorems 17.4 and

   17.8 only)
3. James Dugundji: TOPOLOGY. Chapter VI,VII (1.3(3),2.3(2),3.3(3),6.1,7.2to 7.4only

   and theorem 8.2 of Chapter XI)

ELECTIVE COURSE

MM 307:FUZZY SETS & APPLICATIONS

L T P	UniversityExam:70
5 1 0	Internal Assessment :30
Time Allowed : 3 hours	Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Fuzzy Sets: Introduction to fuzzy sets. Membership Function, Compliment ,Intersections , Unions ,α-cuts, Properties of α-cuts, Decomposition Theorems, Extension Principle.

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on intervals and Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

Uncertainty based Information: Information and Uncertainty, Nonspecificity of Fuzzy and Crisp sets, Fuzziness of Fuzzy Sets.

SECTION-B

Fuzzy Relations: Crisp and Fuzzy Relations, Projections and Cylindric Extensions, Binary FuzzyRelations, Binary Relations on single set, Equivalence, Compatibility and Ordering Relations, Morphisms, Fuzzy Relation Equations.

Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges, Inference from conditional fuzzy positions, Inference from conditional and qualified propositions, Inference from quantified propositions

Fuzzy Linear Programming.

TEXT BOOKS

1. Klir G. J. and Yuan B., Fuzzy sets and Fuzzy logic: Theory and Applications, PHI (1995)

BOOKS RECOMMENDED

1. Klir G. J. and Folyger T. A., Fuzzy Sets: Uncertainty and Information, PHI (1988).

2. Zimmermann H. J., Fuzzy Set Theory and its Applications, Allied Publishers (1991).

SYLLABUS
M.Sc. Mathematics (Part-II)
Session 2018-2019
Semester –IV

Paper Code	**Paper Name**	**Credits L T P**	**Maximum Marks**	**Internal Marks**	**External Marks**
Core course MM 401	THEORY OF LINEAR OPERATORS	51 0 (6)	100	30	70
Core Course MM 402	MATHEMATICAL METHODS	51 0 (6)	100	30	70
CHOOSE ANY THREE OF THE FOLLOWING ELECTIVE COURSES					
Elective Course MM 403	DIFFERENTIAL GEOMETRY OF MANIFOLDS	51 0 (6)	100	30	70
Elective Course MM 404	FLUID MECHANICS	51 0 (6)	100	30	70
Elective Course MM 405	ALGEBRAIC CODING THEORY	51 0 (6)	100	30	70
Elective Course MM 406	OPERATION RESEARCH	51 0 (6)	100	30	70
Elective Course MM 407	NON LINEAR PROGRAMMING	51 0 (6)	100	30	70
Elective Course MM 408	ADVANCED NUMERICAL ANALYSIS	51 0 (6)	100	30	70
Elective Course MM 409	COMPLEX ANALYSIS – II	51 0 (6)	100	30	70
Elective Course MM 410	ALGEBRAIC TOPOLOGY	51 0 (6)	100	30	70
Total		30	500		

Semester-IV
CORE COURSE
MM 401:-THEORY OF LINEAR OPERATORS

L T P — UniversityExam:70
5 1 0 — Internal Assessment :30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Spectral theory in normed linear spaces, resolvant set and spectrum. Spectral properties of bounded linear operator. Properties of resolvant and spectrum. Spectral mapping theorem for polynomials, spectral radius of bounded linear operator on a complex Banach space.

Elementary theory of Banach algebras. Resolvant set and spectrum. Invertible elements, Resolvant equation. General properties of compact linear operators.

SECTION-B

Spectral properties of compact linear operators on normed space. Behaviour of compact linear operators with respect to solvability of operator equations. Fredholm type theorems. Fredholm alternative theorems.

Spectral properties of bounded self-adjoint linear operators on a complex Hilbert space. Positive operators. Monotone sequence theorem for bounded self-adjoint operators on a complex Hilbert space. Square roots of positive operators. Spectral family of a bounded self-adjoint linear operator and its properties, Spectral theorem.

BOOKS RECOMMENDED

1. E. Kreyszic: Introductory Functional Analysis with Applications, Wiley Publications.
2. Bachman and Narici: Functional Analysis, Dover Publications.

CORE COURSE

MM 402: MATHEMATICAL METHODS

L T P	UniversityExam:70
5 1 0	Internal Assessment :30
Time Allowed : 3 hours	Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION –A

Linear integral equations of first and second kind, Abel's problem, Relation between linear differential equation and Volterra's equation, Non linear and Singular equations, Solution by successive substitutions, Volterra's equation, iterated and reciprocal functions, Volterra's solution of Fredholm's equation. Fredholm's equation as limit of finite system of linear equations, Hadamard's theorem, convergence proof, Fredholm's two fundamental relations, Fredholm's solution of integral equation when $D(\lambda)\neq 0$, Fredholm's solution of Dirichlet's problem and Neumann's problem, Lemmas on iterations of symmetric kernel, Schwarz's inequality and its applications

SECTION – B

Simple variational problems, Necessary condition for an extremum, Euler's equation, End point problem, Variational derivative, Invariance of Euler's equation, Fixed end point problem for n-unknown functions, Variational problem in parametric form, Functionals depending on higher order derivatives. Euler Lagrange equation, First integral of Euler-Lagrange equation, Geodesics, The brachistochrone, Minimum surface of revolution, Brachistochrone from a given curve to a fixed point.

BOOKS RECOMMENDED

1. F.B. Hildebrand, Method of Applied Mathematics. Prentice Hall, India.
2. I.M. Gelfand& S.V. Fomin, Calculus of Variations, Prentice Hall, India.
3. W.W. Lovitt, Linear Integral Equations, Tata-McGraw Hill, India.
4. Robert Weinstock, Calculus of Variations, McGraw Hill, London.

5. L.B. Chambers, Integral Equations, International Text Book Co.

ELECTIVE COURSE

MM 403: DIFFERENTIAL GEOMETRY OF MANIFOLDS

L T P — UniversityExam:70
5 1 0 — Internal Assessment :30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Topological groups, Lie groups and lie algebras. Product of two Liegroups, One parameter subgroups and exponential maps. Examples of Lie groups, Homomorphism and Isomorphism, Lie transformation groups, General Linear groups.

Principal fibre bundle, Linear frame bundle, Associated fibre bundle, Vector bundle, Tangent bundle, Induced bundle, Bundle homomorphism.

SECTION – B

Sub-manifolds, induced connection and second fundamental form. Normals, Gauss formulae, Weingarten equations, Lines of curvature, Generalized Gauss and Mainardi–Codazzi equations.

Almost Complex manifolds, Nijenhuis tensor, Contravariant and covariant almost analytic vector fields, F-connection.

BOOKS RECOMMENDED

1. B. B. Sinha: An Introduction to Modem Differential Geometry, Kalyani Publishers, New Delhi, 1982 (Rel.Portion).
2. K. Yano and M. Kon :Structure of Manifolds, World. Scientific Publishing Co. Pvt. Ltd., 1984 (Rel. Portion).

3. Y. Matsushima : Differentiable Manifolds

ELECTIVE COURSE

MM 404: FLUID MECHANICS

L T P	UniversityExam:70
5 1 0	Internal Assessment :30
Time Allowed : 3 hours	Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Equations of Fluid Mechanics : Real and continuous fluids, differentiation following the motion, equation of continuity, Stream function, Stream lines, Pressure, Euler's equation of motion. Bernoulli's theorem Steady irrotational non-viscous compressible flow.

Vorticity, circulation, Kelvin's theorem on constancy of circulation, Kinetic energy. Three dimensional problems : Laplace's equation. Three dimensional sources and dipoles. Spherical obstacle in a uniform steam Moving sphere, images.

SECTION-B

Application of complex variable method : Conjugate functions in plane, complex potential, incompressible flow in two dimensions, uniform stream, Source and sink, Vortex, Two dimensional dipole, Superposition, Joukowski's transformation. Milne Thomson circle theorem, Blasius theorem, Drag and lift.

Source and vortex filaments, vortex pair, rows of vortices, Karman cortex street. Viscous flow: Navier Stokes equations, Dissipation of energy. Diffusion of vorticity in an incompressible fluid, condition of no slip, Steady flow between two parallel infinite flat plates, steady flow through a straight circular pipe (Poiseuille Flow).

BOOKS RECOMMENDED

1. D. E. Rutherford : Fluid Dynamics, Oliver & Boyd Ltd.
2. F. Chorlton : Fluid Dynamics, (Relevant portion) Cambridge University Press.

ELECTIVE COURSE

MM 405: ALGEBRAIC CODING THEORY

L T P — UniversityExam:70

5 1 0 — Internal Assessment :30

Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Introduction to error-correcting codes, The main coding theory problem, An introduction to finite fields, Introduction-to Linear codes, Encoding & Decoding with a linear code.

The dual code, the parity-check matrix and syndrome decoding, incomplete decoding.

SECTION-B

Hamming codes, extended binary Hamming codes, Q-ary Hamming codes, Perfect codes, Golay codes, sphere packing bound.

Cyclic codes, Hamming codes as cyclic codes, BCH codes, Quadratic residue codes.

BOOKS RECOMMENDED

1. Raymond Hill : Introduction to Error Correcting Codes (Ch 1-0 & 12).
2. F. J. Macwilliams& NJA Sloane : Theory of Error Correcting Codes, North Holland Mathematical Library.

ELECTIVE COURSE
MM 406: OPERATIONS RESEARCH

L T P | UniversityExam:70
5 1 0 | Internal Assessment :30
Time Allowed : 3 hours | Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Queueing problems: Characteristics of queueing system. Distributions in queueing systems, poisson arrivals and exponential service times, the M/M/I, M/M/S queueing systems, steady state solutions and their measures of effectiveness.

Inventory problems, definition, the nature and structure of inventory system, deterministic models and their solution, multi item inventory problems, stochastic inventory models.

SECTION-B

Replacement and maintenance problems: replacement of capital equipment, discounting cost, replacement in anticipation of failure, preventive maintenance, the general renewal process.

Network Analysis: Introduction to Networks, Minimal Spanning Tree Problem, Shortest Path problem: Dijkstra's Algorithm, Floyd's Algorithm, Maximum Flow Problem, Project Management: Critical Path method, Critical Path Computations, Optimal Scheduling by CPM, Project Evaluation and Review Techniques (PERT)

BOOKS RECOMMENDED

1. Sharma, S.D.: Operation research, Kedar Nath and Co., Meerut.
2. Kanto Swaroop, P.K. Gupta and Man Mohan: Operations Research, Sultan Chand and Sons.
3. Hamdy A. Taha: Operations Research; An Introduction, PHI, New Delhi.
4. Kasana and Kumar: Introductory Operation Research, Springer.
5. Chander Mohan and Kusum Deep: Optimization Techniques, New Age International, 3009.

ELECTIVE COURSE
MM 407:NON LINEAR PROGRAMMING

L T P — UniversityExam:70
5 1 0 — InternalAssessment :30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION –A

Problem formulation, classification, Fritz John and Kuhn Tucker optimality conditions for unconstrained optimization problems and problems with equality and inequality constrained, Lagrange's duality and saddle point conditions.

The concept of computational algorithm, computational algorithm for unconstrained optimization problems, Penalty and Barrier function methods and methods of feasible directions for constrained optimization problem.

SECTION -B

Computational Techniques for Linear Complimentarily Problem, Quadratic Programming, Linear Fractional Programming Problems. Optimization of Nonlinear programming problems by dynamic programming approach.

BOOKS RECOMMENDED

1. Bazaraa, M.S., Sherali, Hanif D and Shetty, C.M., Nonlinear programming: Theory and Algorithm, John Wiley, Second Edition, 1993.
2. Simmons, D.M., Non-Linear Programming for Operations research, Prentice - Hall, 1975.
3. Avriel, M. Non-linear programming, Analysis & methods, Englewood Cliffs, Prentice Hall, 1976.
4. Chander Mohan and Kusum Deep, Optimization Techniques, New Age International, 3009.

ELECTIVE COURSE

MM 408: ADVANCED NUMERICAL ANALYSIS

L T P
5 1 0
Time Allowed : 3 hours

UniversityExam:70
Internal Assessment :30
Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Ordinary Differential Equations: Taylor's series, Euler's method, Modified Euler's method, and Runge-Kutta methods (upto fourth order), Predictor Corrector methods. Stability and convergence of Runge-Kutta Methods and Predictor Corrector Methods (Adam Bashforth, and Milne's Method).

Parabolic Equation: Dirichlet and Neumann boundary conditions, Explicit and Implicit finite difference schemes for solution of one dimensional equations, Crank-Nicolson, Du fort and Frankel schemes for one dimension equations. Discussion of their compatibility, stability and convergence. Peaceman-Rachford A.D.I. scheme for two dimensional equations.

SECTION-B

Elliptic Equation: Finite difference replacement and reduction to block tridiagonal form and its solution, Solution by Gauss-Seidel, Gaussian elimination and SOR Method. Treatment of curved boundaries, Solution by A.D.I. method.

Hyperbolic equations: Solution by finite difference methods on rectangular grids, Solution by finite difference methods on characteristics grids.

Approximate methods: Introduction to methods of weighted residual, collocation, Least-squares and Galerkin' s methods. Variational formulation of a given boundary value problem, Rayleigh-Ritz method. Simple examples based on these methods from ODE and PDE.

TEXT BOOKS

1. R.S. Gupta: Elements of Numerical Analysis, Macmillan India Ltd., 2009

BOOKS RECOMMENDED

1. Smith, G D, Numerical solution of partial differential equations, Oxford Univ. Press (1982)
2. Mitchell, A. R., Computational methods in partial differential equations, John Wiley (1975).
3. Froberg, C. E., Introduction to Numerical Analysis, Addision-Wesley, Reading, Mass (1969).
4. Gerald, C. F., Applied Numerical Analysis Addision Wesley, Reading, Mass (1970).
5. Jain, M. K., Numerical solutions of Differential equations, John Wiley (1984).
6. Collatz, L., Numerical Treatment of Differential Equations, Springer - Verlag, Berlin (1966)

ELECTIVE COURSE
MM 409-COMPLEX ANALYSIS-II

L T P — University Exam:70
5 1 0 — Internal Assessment : 30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER - SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Normal families of analytic functions. Montel's theorem, Hurwitz's theorem, Riemann Mapping theorem, Univalent functions. Distoration and growth theorems for the class S of normalized univalent functions.Koebe 1/4 theorem. Bieberbach Conjecture (statement only) Littlewood's inequality for the class S. Coefficient inequalities for functions in S in case of real coefficients only. Principle of analytic continuation, The general definition of an analytic function. Analytic continuation by power series method.Natural boundary.Schwarz reflection principle, Monodromy theorem.Mittag-Leffler's theorem (only in the case when the set of isolated singularities admits the point at infinity alone as an accumulation point). Cauchy's method of expansion of meromorphic functions. Partial fraction decomposition of cosec Z, Representation of an integral function as an infinite product.Infinite product for sin z.

SECTION - B

The factorization of integral functions.Weierstrass theorem regarding construction of an integral function with prescribed zeros. The minimum modules of an integral function.Hadamard's three circle theorem.The order of an integral function. Integral functions of finite order with no zeros. Jensen's inequality.Exponent of convergence.Borel's theorem on canonical products.Hadmard's factorization theorem. Basic properties of harmonic functions, maximum and minimum principles, Harmonic functions on a disc.Harnack's inequality and theorem.Subharmonic and superharmonic functions.Dirichlet problem.Green's function.

RECOMMENDED READINGS

1. ZeevNihari: Conformal Mapping, Chap.III (section 5), Chap.lV, Chap.V (pages 173-178, 309-230)
2. G. Sansone and J. Gerretsen: Lectures on the theory of functions of a complex variable, sections 4.11.1 and 4.11.2 only.
3. J. B. Conway: Functions of one complex variable. Springer-vertag-International student edition, Narosa Publishing House, 1970 (Chap.X only)
4. E. T. Copson: Theory of Functions of a Complex Variable (OxfordUniversity Press), Chapter IV (4.60, 4.61, 4.62) Chap. VII (excl. Section 7.7) Chap.VIII (Section 8.4).

ELECTIVE COURSE
MM 410: ALGEBRAIC TOPOLOGY

L T P — UniversityExam:70
5 1 0 — Internal Assessment :30
Time Allowed : 3 hours — Total : 100

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections :A,BandC. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly.The weightage of section A and B will be 30% and that of section C will be 40%.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION A

The Fundamental group: Homotopy of paths, Homotopy classes, The Fundamental group, change of base point, Topological invariance, covering spaces, The Fundamental group of the circle. Retractions and fixed points, No Retraction Theorem, The Fundamental theorem of Algebra, The Borsuk - Ulam theorem, The Bisection theorem, Deformation Retracts and Homotopy type, Homotopy invariance.

SECTION – B

Direct sums of Abelian Groups, Free products of groups, uniqueness of free products, least normal subgroup, free groups, generators and relations, The Seifert-Van Kampen theorem, also classical version, The Fundamental group of a wedge of circles.

Classification of covering spaces: Equivalence of covering spaces, The general lifting lemma, the universal covering space, covering transformation, existence of covering spaces.

BOOKS RECOMMENDED

1. James R. Munkres: Topology, Pearson Prentice Hall, Chapter – 9(51-58), Chapter –11(67-71), Chapter - 13 (79-82).