SYLLABI AND COURSE OF STUDY
For
M.Sc. Mathematics
Through Distance Education

Scheme of Examinations

Pass Marks **40% in each paper**

Paper Code	Nomenclature	Maximum Marks
Semester I (w.e.f. 2009-10)		
MAL 511	Algebra	100
MAL 512	Real Analysis	100
MAL 513	Mechanics	100
MAL 514	Ordinary Differential Equations-I	100
MAL 515	Complex Analysis - I	100
Semester II (w.e.f. 2009-10)		
MAL 521	Abstract Algebra	100
MAL 522	Measure & Integration Theory	100
MAL 523	Methods of Applied Mathematics	100
MAL 524	Ordinary Differential Equations-II	100
MAL 525	Complex Analysis-II	100
Semester III (w.e.f. 2009-10)		
MAL 631	Topology	100
MAL 632	Partial Differential Equations	100
MAL 633	Mechanics of Solids-I	100
MAL 634	Fluid Mechanics	100
MAL 635	Advance Discrete Mathematics	100
Semester IV (w.e.f. 2009-10)		
MAL 641	Functional Analysis	100
MAL 642	Differential Geometry	100
MAL 643	Mechanics of Solds-II	100
MAL 644	Integral Equations	100
MAL 645	Programming in C (Theory & Practical)	100 (Th: 60, Prac: 40)

Syllabus
M.Sc. (Mathematics) 1st Semester
Through Distance Education

MAL511: ALGEBRA **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Zassenhaus's lemma, Normal and Subnormal series. Scheiers Theorem, Composition Series. Jordan-Holder theorem. Commutators and their properties. Three subgroup lemma of P.Hall. Central series. Nilpotent groups. Upper and lower central series and their properties. Invariant(normal) and chief series. Solvable groups. Derived series.

Field theory. Prime fields. Extension fields. Algebraic and transcendental extensions. Algebraically closed field. Conjugate elements. Normal extensions. Separable and inseparable extensions. Perfect fields. Finite fields. Roots of unity. Cyclotomic Polynomial in ϕ_n (x). Primitive elements.

Automorphisms of extensions. Galois extension. Fundamental theorem of Galois theory. Solutions of polynomial equations by radicals. Insolvability of the general equation of degree 5 by radicals. Construction with ruler and campass.

References

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya, S.K.Jain and S.R.Nag Paul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. I.D.Macdonald, Theory of Groups.
4. M.Artin, Algebra, Prentice-Hall of India, 1991.
5. I.S.Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol.lI-Rings, Narosa Publishing House (Vol. I-1996, Vol. II-1999).

MAL512: REAL ANALYSIS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Sequences and series of functions, point-wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's theorems.

Functions of several variables, linear transformations, derivatives in an open subset of R^n, chain rule, partial derivatives, interchange of the order of differentiation, derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method.

Definition and existence of Riemann-Stieltjes integral, properties of the integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, rectifiable curves.

Set functions, intuitive idea of measure, elementary properties of measure, measurable sets and their fundamental properties, Lebesgue measure of sets of real numbers, algebra of measurable sets, Borel sets, equivalent formulation of measurable sets in terms of open, closed, F_σ and G_δ sets, non measurable sets.

References

1. Mathematics Analysis (2nd Edition) New AGE INTERNATIONAL (P) Limited, New Delhi.
2. P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000).
3. H.L.Royden, Real Analysis, Macmillan Pub. Co. Inc. 4th Edition, New York, 1993.

Press. MAL513: MECHANICS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, The momental ellipsoid, Equimomental systems, Coplanar distributions. Generalized cooordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Lagrange's equations for a holonomic system., Lagrange's equations for a conservative and impulsive forces. Kinetic energy as quadratic function of velocities. Generalized potential, Energy equation for conservative fields.

Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations. Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem. Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets. Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Gravitation: Attraction and potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

References

1. F.Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi.
2. F.Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow
3. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press.

MAL514: ORDINARY DIFFERENTIAL EQUATIONS-I **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Initial-value problem and the equivalent integral Equation, ε-approximate solution, Cauchy-Euler construction of an ε-approximate solution, Equicontinuous family of functions, Ascoli-Arzela theorem, Cauchy-Peano existence theorem.

Uniqueness of solutions, Lipschitz condition, Picard-Lindelof theorem for local existence and uniqueness of solutions, solution of initial-value problems by Picard method, Approximate methods of Solving first-order Equations: Power Series Methods, Numerical Methods. Continuation of Solutions, Maximum interval of existence, Extension Theorem, Dependence of solutions on initial conditions and function. Matrix method for homogeneous first order systems, nth order equation (Relevant topics from the books by Coddington & Levinson, and by Ross).

Total Differential Equations: Condition of Integrability, Methods of Solution. Gronwall's differential inequality, comparison theorems involving differential inequalities, zeros of solutions, Sturms separation and comparison theorems. Oscillatory and nonoscillatory equations, Riccati's Equation, Pruffer tmasformation, Lagrange's identity and Green's formula for second-order equation, Sturm-Liouville boundary-value problems, properties of eigen values and eigen functions. (Relevant topics from the books by Birkhoff & Rota, and by Ross).

References

1. E.A. Coddington and N. Levinson. Theory of Ordinary Differential Equations, McGraw Hill, NY, 1955.
2. G. Birkhoff and Rota, G.C. Ordinary Differential Equations, John Wiley and sons inc., NY, 1978.
3. S.L. Ross. Differential Equations, John Wiley and sons inc., NY, 1984.
4. Boyce, W.E. and Diprima, R.c. Elementary Differential Equations and Boundary Value Problems, John Wiley and sons Inc., NY, 1986.
5. Philip Hartman, Ordinary Differential Equations, John Wiley & Sons, NY (1964).

MAL515: COMPLEX ANALYSIS-I **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Cauchy Riemann Equations, Analytic functions, Reflection principle, Complex Integration, Antiderivatives, Cauchy-Goursat Theorem, Simply and Multiply connected domains, Cauchy's Integral formula, Higher Order derivatives, Morera's theorem, Cauchy's inequality, Liouville's theorem, The fundamental theorem of Algebra, Maximum Modulus Principle, Schwarz lemma, Poisson's formula.

Branches of many valued functions with special reference to arg z, Log z, z^a. Bilinear transformations, their properties and classification, definition and examples of conformal mapping.

Taylor's Series, Laurent's Series, Isolated Singularities, Meromorphic functions, Argument principle, Rouche's theorem, Residues, Cauchy's residue theorem, Evaluation of Integrals, Mittag Leffler's expansion theorem.

References

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.
4. Mark J. Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
5. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
6. J.W.Brown and R.V.ChurchilI, Complex Variables and Applications, McGraw HilI, 1996.

Syllabus
M.Sc. (Mathematics) 2nd Semester
Through Distance Education

MAL521: ABSTRACT ALGEBRA **Max Marks for Major Test: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Canonical Forms-Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms. Rational canonical form. Generalized Jordan form over any field.

Cyclic modules. Free modules. Simple modules. Semi-simple modules. Schur's Lemma. Noetherian and Artinian modules and rings Hilbert basis theorem. Wedderburn-Artin theorem. Uniform modules, primary modules, and Noether-Lasker theorem. Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated abelian groups and its application to finitely generated Abelian groups.

References

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya, S.K.Jain and S.R.Nag Paul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. P.M.Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
4. N.Jacobson, Basic Algebra, Vols. I & II, W.H.Freeman, 1980.
5. I.S.Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol. I-1996. Vol. II-1999),

MAL522: MEASURE AND INTEGRATION THEORY **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Measurable functions and their equivalent formulations, Properties of measurable functions. Approximation of measurable functions by sequences of simple functions, Measurable functions as nearly continuous functions, Egoroffs theorem, Lusin's theorem, Convergence in measure and F. Riesz theorem for convergence in measure, Almost uniform convergence.

Shortcomings of Riemann Integral. Lebesque Integral of a bounded function over a set of finite measure and its properties, Lebesgue integral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of discontinuities of Riemann integrable functions, Integral of non-negative functions, Fatou's Lemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergence theorem.

Vitali's covering Lemma, Differentiation of monotonic functions, Functions of bounded variation and its representation as difference of monotonic functions. Differentiation of Indefinite .integral. Fundamental Theorem of Calculus. Absolutely continuous functions and their properties.

References

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. T.M.Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000).
4. H.L.Royden, Real Analysis, Macmillan Pub. Co. Inc. 4th Edition, New York, 1993.
5. Walter Rudin, Real and Complex Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1966.

MAL523: METHODS OF APPLIED MATHEMATICS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Fourier Transforms - Definition and properties, Fourier transform of some elementary functions, convolution theorem, Application of Fourier transforms to solve ordinary & partial differential equations.

Curvilinear Co-ordinates : Co-ordinate transformation, Orthogonal Co-ordinates, Change of Co-ordinates, Cartesian, Cylindrical and spherical co-ordinates, expressions for velocity and accelerations, ds, dv and ds^2 in orthogonal co-ordinates, Areas, Volumes & surface areas in Cartesian, Cylindrical & spherical co-ordinates in a few simple cases, Grad, div, Curl, Laplacian in orthogonal Co-ordinates, Contravariant and Co-variant components of a vector, Metric coefficients & the volume element.

Sample spaces, random variables, Mathematical expectation and moments, Binomial, Poisson & Geometric as the discrete distributions, Uniform, Exponential, Normal & Gamma as the continuous distributions. Multiple Regression, Partial and Multiple Coorelation, t, F and Chi-square as sampling distributions, weak law of large numbers and Central Limit Theorem.

References

1. Sneddon, I. N., The Use of integral Transforms, Tata Mc Graw-Hill Publishing Co.Ltd., New Delhi.
2. Schaum's Series, Vector Analysis.
3. Gupta, S.C. and Kapoor, V.K., Fundamentals of Mathematical Statistics, S. Chand & Sons Educational Pub., New Delhi.

MAL524: ORDINARY DIFFERENTIAL EQUATIONS-II **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Linear systems, fundamental set and fundamental matrix of a homogeneous system, Wronskian of a system. Method of variation of constants for a non-homogeneous system, reduction of the order of a homogeneous sy-+stem, systems with constant coefficients, adjoint systems, periodic solutions, Floquet theory for periodic systems (Relevant topics from the book by Coddington and Levinson).

Nonlinear differential equations, plane autonomous systems and their critical points, classification of critical points-rotation points, foci, nodes, saddle points. Stability, asymptotical stability and unstability of critical points, almost linear systems, Perturbations, Simple Critical points, dependence on a parameter, Liapunov function, Liapunov's method to determine stability for nonlinear systems, limit cycles, Bendixson non-existence theorem, Statement of Poincare-Bendixson theorem, index of a critical point (Relevant topics from the books of Birkhoff & Rota, and by Ross).

Motivating problems of calculus of variations, shortest distance, minimum surface of revolution, Brachistochrone problem, isoperimetric problem, geodesic, fundamental lemma of calculus of variations, Euler's equation for one dependent function and its generalization to 'n' dependent functions and to higher order derivatives, conditional extremum under geometric constraints and under integral constraints. (Relevant topics from the book by Gelfand and Fomin)

References

1. E.A. Coddington and N. Levinson. Theory of Ordinary Differential Equations, McGraw Hill, NY, 1955.
2. G. Birkhoff and Rota, G.C. Ordinary Differential Equations, John Wiley and sons inc., NY, 1978.
3. S.L. Ross. Differential Equations, John Wiley and sons inc., NY, 1984.
4. J.M. Gelfand and Fomin, S.V., Calculus of Variations, Prentice Hall, Englewood, Cliffs, New Jersy, 1963.
5. Boyce, W.E. and Diprima, R.C., Elementary Differential Equations and Boundary Value Problems, John Wiley and sons Inc., NY, 1986.
6. Philip Hartman, Ordinary Differential Equations, John Wiley & Sons, NY (1964).

MAL525: COMPLEX ANALYSIS-II **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Spaces of Analytic functions, Hurwitz's theorem, Montel's theorem, Riemann mapping theorem, Weierstrass' factorisation theorem, Gamma function and its properties, Riemann Zeta function, Riemann's functional equation. Runge's theorem.

Analytic Continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along a curve, power series method of analytic continuation. Monodromy theorem and its consequences, Harmonic function on a disk, Harnack's inequality and theorem, Dirichlet problem. Green's function.

Canonical products, Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem. The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the 1/4 theorem.

References

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student- Edition, Narosa Publishing House, 1980.
3. L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.
4. Mark J. Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
5. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
6. J.W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw Hill, 1996.

Syllabus
M.Sc. (Mathematics) 3rd Semester
Through Distance Education

MAL631: TOPOLOGY **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary points of a set. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology. Alternate methods of defining a topology in terms of Kuratowski Closure Operator and Neighbourhood Systems. Continuous functions and homeomorphism. Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-Cech compactification Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric spaces.

First and Second Countable spaces. Lindelof 's theorem. Separable spaces. Second Countability and Separability. Separation axioms. T_0, T_1, and T_2 spaces. Their characterization and basic properties. Regular and normal spaces. Urysohn's Lemma and Tietze Extension theorem. T_3 and T_4 spaces. Complete regularity and Complete normality. $T_{3\frac{1}{2}}$ and T_5 spaces. Product topological spaces, Projection mapping. Tychonoff product topology in terms of standard sub-base and its characterizations.

References

1. W.J.Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
2. J.L.Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
3. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
4. George F.Simmons, Introduction to Topology and Modem Analysis, McGraw-Hill Book Company, 1963.
5. J.Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).
6. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

MAL 632: PARTIAL DIFFERENTIAL EQUATIONS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Solution of Partial Differential Equations
Transport Equation-Initial value Problem. Non-homogeneous Equation.
Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.
Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods.
Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.
Nonlinear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton-Jacobi Equations, Hamilton's ODE, Hopf-Lax Formula, Weak Solutions, Uniqueness.
Representation of Solutions-Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Hopf-Cole Transofrm, Hodograph and Legendre Transforms, Potential Functions.

References

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19. AMS, 1998.
2. Sneddon I. N., Elements of Partial Differential Equations, McGraw Hill International

MAL633: MECHANICS OF SOLIDS-I **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Cartesian Tensor : Coordinate transformation, Cartesian Tensor of different order, Sum or difference and product of two tensors. Contraction theorem, Quotient law, Symmetric & Skewsymmetric tensors, Kronecker tensor, alternate tensor and relation between them, Scalar invariant of second order tensor, Eigen values & vectors of a symmetric second order tensor, Gradient, divergence & curl of a tensor field.

Analysis of Strain : Affine transformations. Infinitesimal affine deformation. Geometrical interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariants. General infinitesimal deformation. Saint- Venant' s equations of Compatibility.

Analysis of Stress: Stress tensor. Equations of equilibrium. Transformation of coordinates. Stress quadric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses.

Equations of Elasticity: Generalised Hooke's law. Homogeneous isotropic media. Elastic moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. BeItrami-MicheIl compatibility equations. Saint- Venant' s principle.

References
1. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1977.
2. Shanti Narayan, Text Book of Cartesian Tensors, S. Chand & Co., 1950.
3. S. Timoshenko and N. Goodier, Theory of Elasticity, McGraw Hill, New York, 1970.

MAL634: FLUID MECHANICS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Kinematics of fluid-Lagrangian and Eulerian methods, Stream lines, Path lines, Streak lines, Velocity potential, Irrotational and rotational motions. Vortex lines, Equation of Continuity. Lagrangian and Eulerian approach, Euler's equation of motion, Bernoulli's theorem, Kelvin circulation theorem, Vorticity equation, Energy equation for an incompressible flow.

Boundary conditions, Kinetic energy of liquid, Axially symmetric flows, Motion of a sphere through a liquid at rest at infinity, Liquid streaming past a fixed sphere, Equation of motion of a sphere, Sources, Sinks and doublets, Images in a rigid impermeable infinite plane and in impermeable spherical surfaces.

Two-dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid, Stream functions, Stokes stream functions, Complex velocity potential, Conformal mapping, Milne-Thomson Circle theorem, Blasius theorem, Vortex Motion and its elementary properties, Kelvin's proof of permanence, Motion due to rectilinear vortices.

References
1. W.H. Besaint and A.S. Ramsey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 1988.
2. F. Chorlton, Textbook of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.
3. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
4. M.E.O'Neil and F.Choriton, Ideal and Incompressible Fluid Dynamics, John Wiley & Sons, 1986.

MAL635: ADVANCED DISCRETE MATHEMATICS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Formal Logic - Statements, Symbolic Representation and Tautologies, Quantifiers, Proposition Logic.

Lattices - Lattices as partially ordered sets, Their properties, Lattices as Algebraic systems, Some special Lattices, e.g., complete, complemented and Distributive Lattices. Sets Some Special Lattices e.g., Bounded, Complemented & Distributive Lattices.

Boolean Algebra - Boolean Algebra as Lattices, Various Boolean Identities, The Switching Algebra example, Join - irreducible elements, Atoms and Minterms, Boolean Forms and Their Equivalence, Minterm Boolean Forms, Sum of Products canonical Forms, Minimization of Boolean Functions, Applications of Boolean Algebra to Switching Theory (using AND, OR and NOT gates).

Graph Theory - Definition of Graphs, Paths, Circuits, Cycles and Subgraphs, Induced Subgraphs, Degree of a vertex, Connectivity, Planar Graphs and their properties, Trees, Euler's Formula for Connected Planar Graph, Complete and Complete Bipartite Graphs, Spanning Trees, Minimal Spanning Trees, Matrix Representation of Graphs, Euler's theorem on the Existence of Eulerian Paths and circuits, Directed Graphs, Indegree and outdegree of a vertex, Weighted undirected Graphs, Strong Connectivity and Warshall's Algorithm, Directed Trees, Search Trees, Tree Traversals.

References

1. J.P. Tremblay & R.Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Book Co., 1997.
2. Seymour Lepschutz, Finite Mathematics (International edition 1983), McGraw-Hili Book Company, New York.
3. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hili Book Co.
   N.Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India.

Syllabus
M.Sc. (Mathematics) 4th Semester
Through Distance Education

MAL641: FUNCTIONAL ANALYSIS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Normed linear spaces, metric on normed linear spaces, Holder's and Minkowski's inequality, completeness of quotient spaces of normed linear spaces. Completeness of l_P, L^P, R^n, C^n and C[a, b]. Bounded linear transformation. Equivalent formulation of continuity. Spaces of bounded linear transformation. Continuous linear functional, conjugate spaces, Hahn Banach extension theorem (Real and Complex form). Riesz Representation theorem for bounded linear functionals on L^P and C[a, b].

Second Conjugate spaces, Reflexive spaces, uniform boundedness principle and its consequence, open mapping theorem and its application, projections, closed graph theorem, Equivalent norms, weak and strong convergence, their equivalence in finite dimensional spaces. Compact operators and its relation with continuous operators, compactness of linear transformation on a finite dimensional space, properties of compact operators, compactness of the limit of the sequence of compact operators.

Inner product spaces, Hilbert spaces, Schwarz's inequality, Hilbert space as normed linear space, convex sets in Hilbert spaces. Projection theorem, orthonormal sets, Bessell's inequality, Parseval's identity, Conjugate of a Hilbert space.

References

1. H.L.Royden, Real Analysis Macmillian Publishing Co., Inc, New York 4th Edition 1993.
2. E.Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
3. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
4. K. Yosida, Functional Analysis, 3rd edition Springer Verlag, New York, 1971.
5. Walter Rudin, Functional Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1973.

MAL 642: DIFFERENTIAL GEOMETRY **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Curves with torsion: Tangent, Principal Normal, Curvature, Binormal, Torsion, Serret Frenet formulae, Locus of centre of spherical Curvature.

Envelopes: Surfaces, Tangent plane, Envelope, Characteristics, Edge of regression (Sections 1-6, 13-16 of Weatherburn's book).

Curvilinear Co-ordinates: First order magnitude, Directions on a surface, Second order magnitudes, Derivative of unit normal, Principal directions and curvatures.

Geodesics: Geodesic property, Equations of geodesics, Torsion of a geodesic (Sections 22-27,29-30,46,47 and 49 of Weatherburn's book).

References:

1. C.E., Weatherburn, Differential Geometry of Three Dimensions.

MAL643: MECHANICS OF SOLIDS-II **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Two-dimensional Problems: Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials. The structure of functions of $\phi(z)$ and $\psi(z)$. First and second boundary value problems in plane elasticity, Thick-walled tube under external and internal pressures.

Viscoelasticity: Spring & Dashpot, Maxwell & Kelvin Models, Three parameter solid, Correspondence principle & its application to the Deformation of a viscoelastic Thick-walled tube in Plane strain.

Torsion:Torsion of cylindrical bars. Tortional rigidity. Torsion and stress functions. Lines of shearing stress. Simple problems related to circle, ellipse and equilateral triangle.

Waves: Propagation of waves in an isotropic elastic solid medium. Waves of dilatation and distortion. Plane waves. Elastic surface waves such as Rayleigh and Love waves.

Variational methods - Theorems of minimum potential energy. Theorems of minimum complementary energy. Reciprocal theorem of Betti and Rayleigh. Deflection of elastic string, central line of a beam and elastic membrane. Solution of Euler's equation by Ritz, Galerkin and Kantorovich methods.

References

1. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata McGraw Hill Publishing Company Ltd., New Delhi,
2. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall, New Delhi.
3. S. Timoshenko and N. Goodier, Theory of Elasticity, McGraw Hill, New York.
4. W. Flugge, Viscoelasticity, Springer Verlag.

MAL644: INTEGRAL EQUATIONS **Max Marks: 100**
Time: 3 Hours

Note : The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

Definitions of Integral Equations and their classification. Relation between integral and differential equations Fredholm integral equations of second kind with separable kernels. Eigen Values and Eigen functions. Reduction to a system of algebraic equations. An approximate Method. Method of successive approximations. Iterative scheme. Condition of convergence and uniqueness of series solution. Resolvent kernel and its results. Fredholm theorems.

Solution of Volterra's integral equations by iterative scheme. Successive approximation. Resolvent kernel. Integral transform methods: Fourier transform, Laplace transform, Convolution integral, Application to Volterra integral equations with Convolution type kernels, Abel's equations.

Symmetric kernel. Complex Hilbert space. Orthonormal system of functions, Fundamental properties of eigen values and eigen functions for symmetric kernels. Expansion in eigen function and bilinear form, Hilbert Schmidt theorem, Solution of integral equations with symmetric kernels

Singular Integral Equations - Inversion formula for singular integral equation with kernel of type (h(s) - h(t) - a, $0< a <1$).

Dirac Delta Function. Green's function approach to reduce boundary value problems of a self-adjoint differential equation with homogeneous boundary conditions to integral equation forms. Auxiliary problem satisfied by Green's function. Modified Green's function.

References

1. R.P. Kanwal, Linear Integral Equation. Theory and Techniques, Academic Press, New York, 1971.
2. S.G. Mikhlin, Linear Integral Equations (translated from Russian), Hindustan Book Agency, 1960.
3. Abdul J. Jerri, Introduction to Integral Equations with Applications.
4. Hildebrand. F.B - Method of Applied Mathematics

MAL 645: PROGRAMMING IN C (Theory & Practical) **Max Marks: 100**
(Th: 60, Prac: 40)
Time: 3 Hours

Note : **The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.**

An overview of programming, Programming languages, Classification, C Essentials Program Development, Anatomy of a C Function. Variables, Constants, Expressions, Assignment Statements, Formatting Source files, Continuation character, The Preprocessor. Scalar Data Types-Declarations, Different Types of Integers, Different kinds of integer constants, Floating point types, Initialization, Mixing types, Explicit conversions-casts. The Void Data Types, Typedefs.

Operators and expressions - Precedence and Associativity. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators. Comma Operator. Relational Operators. Logical Operators. BitManipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operators, Input/Output functions.

Control Flow - Conditional Branching, The Switch Statement. Looping. Nested Loops, The break and continue Statements. The goto statement. Infinite loops.

Arrays - Declaring an array, Arrays and Memory. Initializing arrays, Encryption and Decryption. Multidimensional arrays, Strings.

Functions - Passing Arguments, declarations and calls. Recursion, The main ( ) Function, Passing Arrays as Function Arguments.

Pointers - Pointer Arithmetic, Accessing Array Elements through pointers, Passing Pointers as Function arguments, Arrays of pointers, pointers to pointers, Complex declarations. Introduction to C++

Reference

1. Balagurusamy, E. - Programming in ANSI C, TATA McGraw Hill.
2. Byrons, Gottfried. - Programming in C Schaum's Series.
3. Brain W. Kernighan & Dennis M.Ritchie - The C Programme Language 2^{nd} Edi, ANSI features) Prentice Hall 1989.
4. Peter A. Darnell and Phillip E.Margolis - C : A Software Engineering Approach, Narosa Publishing House (Springer International student Edition) 1993.