M.Sc. (Mathematics)
Session 2011-2013

Semester-I

Math 101	*Advanced Abstract Algebra*	*(35, 15)*
Math 102	*Analysis*	*(35, 15)*
Math 103	*Integral Transform*	*(35, 15)*
	Any one of the following	
Math 104	*Computer Fundamentals and Programming in C*	*(35, 15)*
Math 105	*Mechanics*	*(35, 15)*
Math 106	*Practical lab: Practicals with programming in C*	*(35, 15)*

Semester-II

Math 201	*Complex Analysis*	*(35, 15)*
Math 202	*Differential Equations*	*(35, 15)*
Math 203	*Integral Equations and Boundary Value Problems*	*(35, 15)*
	Any one of the following	
Math 204	*Numerical Methods (optional)*	*(35, 15)*
Math 205	*Fluid Mechanics (optional)*	*(35, 15)*
Math 206	*Practical lab: Practicals with Programming in C++*	*(35, 15)*

Math 101 **ADVANCED ABSTRACT ALGEBRA**

Unit-I

Sylows First, Second and Third theorems, p-sylow Subgroups, Double cosets conjugate groups, Normal and Subnormal series, Composition series, Jordan Holder theorem, Solvable groups, and commutator subgroups.

Unit-II

Modules, Cyclic modules, Simple modules, finitely generated modules, Fundamental structure theorem for finitely generated modules,

Unit-III

Field theory, Extension fields, Algebraic Extensions, Roots of polynomials, Simple extension, Splitting fields.

Unit-IV

Elements of Galois Theory, Fixed Fields, Normal extensions, Group of automorphisms, Galois group, Fundamental theorem of Galois theory.

Unit-V

Canonical forms, Similarity of Linear Transformations, Invariant Subspaces, Nilpotent transformations, Reduction of triangular form, Invariants, Jordon blocks & Jordon normal forms, Rational Canonical form, Elementary divisors.

Text Books :

1. Topics in Algebra by I.N. Herstein, Wiley Eastern Ltd., New Delhi, 1975.
2. Basic Abstract Algebra (2^{nd} Edition), Cambridge University Press, Indian Edition, 1997.
3. Algebra by M. Artin, Prentice-Hall of India1991.

Reference Books:

1. Algebra by P.M. Cohn, Vols. I, II & III, John Wiley & Sons, 1982,1989,1991.
2. Basic Algebra, Vols. I & II by N. Jacobson, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
3. Galois theory by J.P. Escofier, GTM, Vol. 204, Springer, 2001.
4. Lectures on Modules and Rings by T.Y. Lam, GTM Vol. 189, Springer-Verlag, 1999.

Math 102 **ANALYSIS**

Unit-I

Metric spaces: compact sets, perfect sets, connected sets, compactness and completeness, limit and continuity of function defined on metric spaces, limits of functions, continuous functions.

Unit-II

Continuity and Compactness, continuity and connectedness, monotonic functions: definition and existence of Riemann – Stieltjes integral, properties of the integral, integration and differentiation, the fundamental theorem of calculus, integration of vector-valued functions.

Unit–III

Sequence & Series of function point wise & uniform Convergence, Cauchy Criterion for uniform Convergence, Weierstrass M-Test for uniform Convergence of Series, Uniform Convergence & Continuity, Uniform Convergence & R-S integral Uniform Convergence & differentiation, Weierstrass approximation Theorem.

Unit-IV

Lebesgue outer measure, Measurable sets & its properties, Borel set & their measurability, Non-measurable set, measurable functions, characteristic function & simple function, Littlewood's three Principles.

Unit-V

Lebesgue integral of bounded function over a set of finite measure, Integration of Non-negative function,The general Lebesgue integral, Monotonic Convergence Theorem, Lebesgue convergence Theorem, Fatou's Lemma.

Text Books:

1. Principles of Mathematical Analysis by Walter Rudin.
2. Real Analysis (UNIT IV & V) by H. L. Roydon.

Reference Books:

1. Mathematical Analysis by Mullick & Arora, New Age International Publisher.
2. Lebsegue Measure & Integration by Jain & Gupta, New Age International Publishers.

Math 103 Integral Transforms

Unit-I

Laplace Transform, Properties of Laplace Transform, Laplace Transform of the derivatives of function, Inverse Laplace transform, Properties of inverse Laplace transform, Inverse Laplace transform of derivatives, convolution theorem, Heaviside's expansion theorem.

Unit-II

Application of Laplace Transform to solution of differential equations; solutions of initial Value problems, Solution of differential equations with constant coefficients, Solution of system of two simultaneous differential equations, Application of Laplace Transform to the solution of integral equations with convolution type kernel.

Unit-III

Applications of Laplace Transform to the solution of initial –boundary value problems-: Solution of Heat equation, Solution of wave equation, Solution of Laplace equation.

Unit-IV

Fourier Transforms, Fourier sine transform, Fourier cosine transform, inverse Fourier Transform, Inverse Fourier sine Transform, Inverse Fourier cosine Transform, Properties of Fourier Transforms, Modulation theorem, Convolution theorem, Fourier Transform of the derivatives of functions, Parseval's identity.

Unit-V

Application of Fourier Transforms to the solution of initial –boundary value problems-: Solution of Heat equation, Solution of diffusion equation, Solution of wave equation, Solution of Laplace equation.

Text Boks

1. Integral Transforms by Vashishtha and Gupta.
2. Integral Transforms by Goyal and Gupta.

Reference Books

1. Integral Transforms by Sneddon.

Math 104 COMPUTER FUNDAMENTALS AND PROGRAMMING IN C

UNIT-1

An overview of functioning of a computer system, Components of a computer system, I/O and auxiliary storage devices ,machine and high level languages, assembler ,compiler and interpreters, flow charts and pseudo codes, Basic concepts of operating system.

Unit-II

Introduction to C Essentials – Programs development, Functions. Anatomy of a Function. Variables and Constants Expressions. Assignment Statements, Scalar Data types – Declarations, Different Types of integers. Different kinds of Integer Constants Floating – point type Initialization, mixing types Explicit conversions – casts Enumeration Types. the void data type, Type definitions.

Unit-III

Operators and expression in C-Precedence and associativity, Control flow statements Conditional branching, the switch statement, looping, nested loops, the break and continue statement, the go to statement, infinite loops.

Unit-IV

Arrays and multidimensional arrays. Storage classes-fixed vs. automatic duration scope, global variable the register specifier, Functions –user defined and library function, Introduction to pointers, structures and unions.

Unit-V

Introduction to C++: Declaration & Definition of Variables, Data Types, Operators, OOPS Fundamentals: OOPS Versus procedural programming, OOPS terminology, Data abstraction, Data hiding, Encapsulation, Class, Object, Inheritance, Polymorphism.

Text books:

1. Computer fundamental by Rajaraman
2. Operating systems concepts by Peterson
3. Programming in ANSI C by E. Balaguruswamy, Tata-McGraw Hill, New Delhi.
4. Programming in C++ by E. Balaguruswamy, Tata-McGraw Hill, New Delhi.
5. Schaum's outline series.

Reference Books:

1 Let us C by Y. Kanetkar.

2 Brain W Kernigham & Dennis M Ritchie the C Programmed language 2nd edition (ANSI features), Prentice Hall 1989.

Math 105 **MECHANICS**

Unit-I

Generalized coordinates, Holonomic and Non–holonomic systems, Scleronomic and Rheonomic systems, Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second Kind, Uniqueness of solution, Energy, equation for conservative fields, Hamilton's variables, Donkin's theorem, Hamilton canonical equations.

Unit-II

Cyclic coordinates, Routh's equations, Poisson's Bracket, Poisson's identity, Jacobi-Poisson Theorem, Motivating Problems of calculus of variations, Shortest distance, Minimum surface of revolution, Brachistochorone Problems, Isoperimetric problems, Geodesic.

Unit-III

Fundamental lemma of calculus of variation, Euler's equation for one dependent function, Generalization of Euler's equations to (i) 'n' dependent functions, (ii) higher order derivatives.

Unit-IV

Conditional extremum under geometric constraints and under integral constraints, Hamilton's Principle, Principle of least action. Poincare Cartan integral invariant, Whittaker's equations, Jacobi''s equations, Statement of Lee Hwa chung's theorem.

Unit-V

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.

Text Books:

1. Calculus of Variation by I.M. Gelfand and S.V. Fomin, Prentice Hall.
2. Analytical Mechanics by Louis N. Hand and Janet D. Finch, Cambridge University, Press, 1998.

Math 201 **COMPLEX ANALYSIS**

Unit-I

Functions of complex variables, Limit and continuity Differentiability, Power Series as an analytic function, Exponential and Trigonometric functions, Complex Logarithms, Zeros of analytic functions.

Unit-II

Complex integration, curves in the complex plane , basic properties of complex integrals winding number of a curve, Cauchy – Goursat Theorem, Cauchy's Integral formula, Morera's Theorem, Laurent's series Maximum modulus principle, Schwarz lemma, Liouville's theorem.

Unit-III

Isolated singularities, removeable singularty, poles, sigularty at infinity calculus of residue at finite point, residue at the point at in finite residue theorem, Number of zeros, Poles Rouche's Theorem.

Unit-IV

Bilinear transformations, their properties and classifications, Definitions and examples of conformal mappings, spaces of analytic functions, Hurwitz's theorem, Montel's theorem, Riemann mapping theorem.

Unit-V

Hypergeometric Series, Generalized Hypergeometric functions, Gamma function and its properties, Riemann Zeta function, Riemann's functional equation.

Text Book:

1. Foundation of Complex Analysis by S. Ponnusamy, Narosa Publishing House, 1997.

Reference Books:

1. Introduction to Complex Analysis by H.A. Priestly, Clarendon Press, Oxford, 1990.
2. Function of one Complex Variable by J.B. Conway, Springer-Verlag. International student-Edition, Narosa Publishing House, 1980.
3. Complex Analysis by L.V. Ahlfors, McGraw-Hill, 1979.
1. Real and Complex Analysis by Walter Rudin, McGraw-Hill Book Co., 1966

Math 202 **DIFFERENTIAL EQUATIONS**

Unit-I

Preliminaries- Initial value problem and the equivalent integral equation, System of first order ordinary differential equations, concepts of local existence, Existence and uniqueness of solutions of scalar differential Equations, Peano's existence theorm and corollary and scalar case.

Unit-II

System of differential equations, Basic Theorems- Ascoli -Arzela theorem, a theorem on convergence of solutions of a family of initial value problems. Picard– Lindel of theorem- Peano's existence theorem and corollary for vector.

Unit-III

Differential Inequalities and integral inequalities – Gronwall's inequality Maximal and Minimal solutions, Differential inequalities Lower and upper function.

Unit-IV

Linear systems of differential equation, characteristic polynomials eigen values, eigen vactors linear homogeneous systems and their properties, wronskian, fundamental matrix, Abel-Liouville formula, periodic linear system and Floguet's theorem, Inhomogeneous linear systems and variation of constants formula.

Unit-V

Poin care – Bendixson Theory- Autonomous systems, Poin care – Bendixson theorem Stability of periodic solutions, foci, nodes and saddle points.

Automomous system of ordinary differential equations, Phase Plane, critical points, Stability, Critical Points and Stability of linear systems, Stability by Liapunov's direct method, Lyapunov functions.

Text Book:

1. Ordinary Differential Equations by M. Rama Mohana Rao, East-West Press.

Reference Books:

1. Ordinary Differential Equations by P. Hartman, John wiley.
2. Theory of ordinary Differential Equations by E.A. Coddington and dSN. Levinson, McGraw- Hill, Ny.
3. Differential equations with applications and historical note by G.F. Simmons, Tata McGraw Hill.
4. Ordinary differential Equations by W.T. Reid, John Wiley & Sons, NY.

Math 203 INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

Unit-I

Definitions of integral equations and their classification, solution of integral equation, Fredholm integral equations of second kind with separable kernels, solution of Fredholm integral equation with separable kernel, method of successive approximations.

Unit-II

Method of successive substitutions, Iterative scheme for Fredholm integral equations of the second kind, resolvent kernel and its results, application of iterative scheme to Volterra integral equations of the second kind.

Unit-III

Conversion of initial value problem to volterra integral equation and conversion of boundary value problem to Fredholm integral equation. Conversion of Fredholm integral equation to boundary value problems and conversion of Voltema integral equation to initial value problem.

Unit-IV

Orthonormal system of functions, symmetric kernels, fundamental properties of Eigen values and Eigen functions Green's function, for symmetric kernels, Hilbert Schmidt theory and solutions of Fredholm integral equations with symmetric kernels.

Unit-V

Definition of a boundary value problem for an ordinary differential equation of the second order, Dirac delta function, Green's function, Green's function approach to reduce boundary value problems of a differential equation with homogeneous boundary conditions to integral equations.

Text Books:

1. Linear Integral Equation Theory and Techniques by R.P. Kanwal, Academic Press, New York, 1971.
2. Linear Integral Equation (translated from Russian) by S.G. Mikhlin, Hindustan book Agency, 1960.

Reference Books:

1. Boundary value problems of Mathematical Physics by I. Stakgold, Vol.I, II, Mac Millan, 1969.

Math 204 **NUMERICAL METHODS**

Unit-I

Solution of Algebraic Transcendental & Polynomial equations: Bisection method, Iteration method based on first-degree equation: Secant method, Regula-Falsi method, Newton-Raphson method, rate of convergence of Newton-Raphson method & Secant method.

Unit-II

System of linear algebraic equations: Gauss Elimination method, Gauss-Jordan Elimination method, Cholesky method. Iteration methods: Jacobi Iteration method, Gauss-Seidel method.

Unit-III

Interpolation & approximation finite difference operators, Newton's forward and backward interpolation, Central difference interpolation, Lagrange's interpolation, Newton Divided Difference interpolation, Hermite interpolation, Spline interpolation.

Unit-IV

Differentiation and integration: Numerical differentiation, Numerical integration, Newton-cotes formula, Trapezoidal rule, Simpson's one-third rule, Gauss-Legendre integration method, Lobatto integration method, Radau integration method.

Unit-V

Ordinary differential equations- Euler method, Backward Euler method, Midpoint method, Taylor Series method, Runge-Kutta methods, Predictor-Corrector methods.

Text Books:

1. Numerical method for Scientific & Engineering Computation by M.K. Jain & R. K. Iyengar & R.K. Jain-Wiley Eastern Ltd.
2. Numerical Method by S S Sastry.

Reference Book:

1. Numerical Methods by V.RajaRaman, PHI.

Math 205 **FLUID MECHANICS**

Unit-I

Lagrangian and Eulerian methods, equation of continuity, types of flow lines, velocity potential, stream function irrotationel and rotational motions, vortex lines.

Unit-II

Lagrange's and Euler's equation of motion, Burnoulli's theorem, irrotational motion in two dimensions, complex velocity potential, sources, sinks conformal mapping, theorem of Blasius.

Unit-III

Motion of a sphere through a liquid at rest as infinity, equation of motion of a sphere, stress components in a real fluid.

Unit-IV

Relations between rectangular components of stress convection between stresses and gradients of velocity, Plane Poiceuille and Coquette flows between two parallel plate, flow through tubes of uniform, cross-section in the former of circle, Annulus under constant pressure gradient.

Unit-V

Dynamical similarity, Reynolds number, Prandt's boundary layer, boundary layer equations in two dimension, Blasius solution, boundary layer thickness, displacement thickness, Karman integral conditions, separation of boundary layer flow.

Text Books:

1. A Text book of fluid mechanics in SI Units by R.K Rajput.
2. An Introduction to fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

Reference Books:

1. Fluid Mechanics (Springer) by Joseph H. Spurk.
2. Fluid Mechanics by Irfan A. Khan (H.R.W.).
3. An introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, New Delhi, 1994.