Major Courses of M.Sc Mathematics


The Syndicate at its meeting held on 30-06-2013 on the recommendations of the Academic Council made at its meeting held on 24-06-2013 approved following new degrees as Saturday and Sunday (two days classes per week).

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<th>Course Title</th>
<th>Credit Hours</th>
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<td>REAL ANALYSIS</td>
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<td>MATH-711</td>
<td>ALGEBRA AND TOPOLOGY</td>
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<td>COMPLEX ANALYSIS</td>
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<td>ELECTROMAGNETIC THEORY</td>
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Minor courses (Already approved) from Deptt.of Statistics and Computer Sciences (each course is of 3 credit hours)

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Learning objectives

The main purpose is to introduce real analysis, and a secondary purpose is used to the idea of writing rigorous mathematical proofs.

Course Contents

Real number system, Ordered sets, Bounded sets, Real Field and extended real number system, Euclidean Spaces, Equivalent sets, Concept of cardinality number, Addition and multiplication of cardinals, Neighbour of a point, Open, Closed, perfects, denes, compact and Connected sets. Numerical Sequences and series, Convergent and diverting sequence series, Subsequences, Cauchy Sequences Completeness, Infinite series, Tests of convergence, Power series, Continuous function on closed and bounded sets, discontinuities Uniform continuity, Differentiability, mean value theorem, LHospital rule and Error estimates.
Suggested readings:


MATH-711: ALGEBRA AND TOPOLOGY 3(3-0)

Learning objectives

The student is expected to learn the basics of the theory of smooth manifolds which appear many areas of research in math and physics.

Course Contents

Group order of a group, order of an element, Subgroup, generators, Cyclic groups, Lagrange theorem, Conjugacy class, Centralizer, Normalizers, Normal Subgroup, Permutations, Symmetric groups, Quotient groups, Homomorphism, Isomorphism theorems, Endomorphism and auto morphism of groups, Rings, Ideals, Zero divisors, Integral domain, Division ring fields.

Metric Space, Peudometric, Open and closed open and closed spheres, open and closed sets, continuous mapping, Topological space, open and closed sets, subspaces, Mertizable Topological space, Neighbourhood, Interior and exterior of a set, clourse of a set, Dense set, separable spaces. Open Basics subspaces. First and second countable spaces. Open and closed mapping, Homeomorphism, separation axiom compactness, connectedness, Compactness, Connectedness,

Suggested readings:


MATH-712 COMPLEX ANALYSIS 3(3-0)

Learning objectives

In this course students will learn the algebra and geometry of complex numbers, mappings in the complex plane, the theory of multi-valued functions, the calculus of functions of single complex variable and the Fourier transform.

Course Contents

Complex function Limits and continuity, Derivatives, Analytic function, Cauchy-Riemann equations, Harmonic function, Entire Function Elementary complex function (exponential, trigonometric, hyperbolic, Logarithmic and general power), simply and multiply connected domains. Complex integration, Properties of complex line integrals. Cauchy Goursat’s theorem, Cauchy’s integration, Properties of complex line integrals, Cauchy Goursat’s theorem, Cauchy’ integral formula Related
Theorems, Power series, Taylor’s and Laurent’s series Zeros and singularities, Poles, Residues, Residue theorem and its applications, Contour integration, Analytic continuation.

Suggested readings:


MATH-713 VECTOR AND TENSOR ANALYSIS 3(3-0)

Learning objectives

Introduce the concepts, theories, and operational implementation of vectors, and more generally tensors, in advanced engineering analysis. The emphasis is on geometric and physical interpretations for engineering applications.

Course Contents

Scalar and vector point functions, Gradient Directional derivative, Divergence, Curl, Vector identities, Tangential line integrals, Green’s theorem in the plane, Gauss divergence theorem, Curvilinear coordinates, Cylindrical and spherical polar coordinates. Independence of Path, Norma surface integrals, volume integrals.

Summation convention, kroneeker delta, alternating symbol, relation between alternating symbol and kroneekar delta, tensors of first second and higher orders algebra of tensors, contraction of a tensor, quotient theorem, symmetric and anti-symmetric tensors, invariance property, isotropic tensors, differentiation of tensors, application to vector analysis, eigenvalues and eigenvector’s of a tensor of rank 2, orthogonally and reality of eigenvalues.

Suggested readings:

Math-714  Differential Equations  3(3-0)

Learning Objectives

Identify differential equation and its order, Verify whether a given function is a solution of a given differential equation (as well as verifying initial conditions when applicable).

Differential equations into linear and nonlinear equations. Find solutions of differential equation.

Course Contents


Suggested readings:


MATH-715  ADVANCED REAL ANALYSIS  3(3-0)

Learning objectives

The objective of this course is to be able to write rigorous mathematical proofs for basic theorems in multi-variable calculus involving the fundamental tools such as continuity and differentiability.

Course Contents

Riemann integration and its properties, fundamental theorem of calculus, Riemann Stelesintegration of functions of bounded variation. Sequences and series of function, Uniform convergence of sequences an series of functions, Red valued functions of several variables, Continuity and differentiability Derivatives and differentials of composite functions, change of order, Schwarz’s and young’s theorems, Taylor’s series for functions of more than one variables. Implicit functions. Jacobean’s Maxima and minima, improper integrals and their kinds, convergence and uniform convergence tests for improper integrals, improper multiple integrals.
Suggested readings:

2. Jonathan, L. 2003, An Interactive to Introduction to Mathematical Analysis
3. Adison Wesley, Published by Cambridge University Press.

MATH-716  LINEAR ALGEBRA  3(3-0)

Learning objectives

Study some of the fundamental rules of linear algebra and show analogies with tensor analysis. Study of Matrices, determinants, systems of linear equations, and eigenvalues and eigenvectors.

Course Contents


Linear transformations, Linear functional and dual spaces. Kernel an range, Inverse linear transformation. Matrices of general linear transformation, Rank and nullity of linear transformation, Applications to relevant problems.

Suggested readings:

3. Poole and David 2010, A Modern Introduction to Linear Algebra, 3rd Edition Cengage - Brooks/Cole,
MATH-717  ELEMENTRY FLUID MECHANICS    3(3-0)

Learning objectives

The course main object to learn the fundamentals of viscous incompressible flows, the basics of non-viscous potential flows. The fundamentals of computational fluid mechanics, the fundamentals of compressible flows.

Course Contents


Suggested readings:


MATH-718  PARTIAL DIFFERENTIAL EQUATIONS    3(3-0)

Learning objective

The structure of linear partial differential equations and how they relate to engineering situations, how analytical solutions are obtained, the general principles of how to construct a Green’s function for a given linear differential equation, and how to use it to solve the inhomogeneous problem.
Course Contents

Modeling of two-and three-dimensional partial differential equations, Multiple Fourier series solutions of boundary value problems, Solutions using Fourier integrals, Solutions of wave and heat equation’s in unbounded domains, Laplace equation in two 0 and three dimensional polar coordinates, Solution of Laplace equation on a semi infinite strip and on a circular region, Solution of boundary value problems using Bessel functions and Legendre functions. The Strum Liouville system. Solutions of boundary value problems using Laplace transforms and Fourier transforms, Green’s function method, reduction of partial differential equation into canonical forms.

Suggested readings:


MATH-719 SPECIAL PROBLEM 1(1-0)
MATH-720 SEMINAR 1(1-0)
MATH-723 RESEARCH REPORT 4(0-4)
MATH-721 ANALYTICAL DYADNAMICS 3(3-0)

Learning objectives

The course aim is familiarize with the peculiar characteristics in Analytical, Dynamics, expose to the need for and demands of mathematics in the Science/Technology and Engineering world and prepare for the contemporary Science/Technology and Engineering world.

Course Contents

Generalized coordinates, Holonomic and non-holonomic systems, D, Alembert’s principles D delta rule, Lanrainge’s theory of holonomic systems, Equations of Lagrange, Quasi coordinates and Lagrange equations in quasi-coordinates, first integrals of Lagrange equations of motion, Energy integral and whitaker’s equations, Ignorable coordinates and Routhian function, Noether’s theorem, Hamilton’s theory Hamailation’s principle, Generalized momenta and phase space, Hamilton’s equation, Ganomical transformations, Generating functions, Hamilton Jascobi theorem.
Suggested readings:


MATH-722 ADVANCED FLUID MECHANICS 3(3-0)

Learning objectives

Identify the significance of each term in the governing equations. Simplify the governing equations for problems involving symmetry, and negligible terms. Specify appropriate mathematical boundary conditions given a complete physical description of a flow obtain dimensionless forms of the Navier-Stokes equations, and identify relevant dimensionless parameters. Perform similarity transformations for Stokes first and second problems, and obtain the exact solution.

Course Contents


Suggested readings:

MATH-723 QUANTUM MECHANICS 3(3-0)

Learning objectives

Familiar with the notions of Hilbert space, self-adjointoperations, unitary operators, commutation relations, understand their relevance to the mathematical formulation of quantum mechanics and be able to use the notions to formulate and solve problems. Moreover understand the probabilistic interpretation of quantum state, and basic aspects of the relation between classical and quantum mechanics.

Course Contents

Review and difficulties of classical Mechanics, Black body radiation, Photoelectric effect, Compton effect, Bohrs theory of atomic structure, wave particle duality, De Broglie,s postulate, Uncertainty principle, Uncertainty of position and momentum, energy time uncertainty, Linear operators, Formalism in Quantum mechanics, Orthonormal system, Hermitian operators and their properties, Parity operators Postulates of Quantum mechanics. Schrodinger wave equation. Three dimensional Schrodingerequations, Step potential, potential barrier, potential well, Harmonic oscillator, scattering theory, Scattering amplitude, Scattering equation, Born approximation, partial wave analysis, Perturbation theory, Time independent perturbation of non-degenerate and generate cases, Time dependent perturbations.

Suggested readings:


MATH-724 ELECTROMAGNETIC THERORY 3(3-0)

Learning objectives

Obtain an understanding of Maxwell,sequations and be able to apply them to solving practical electromagnetic fields problems fundamental concepts covered will include, laws governing electrodynamics, plane wave propagation in different media, power flow, Polarization, transmission and reflection at an interface, transmission lines, microwave networks, waveguides radiation and antennas and wireless systems design.

Course Contents

Maxwell’s equation in free space and material media, Solution of Maxwell’s equations, Constitutive equations, Ohm’s law and currents, Potentials, Wave equations, Plane elect magnetic waves in homogeneous and Isotopic media, Reflection and Reflection of plane waves, wave Guides, Boundary conditions, Maxwell’s equations and constitutive equations for moving media, Lorentz transformations Maxwell stress tensor, Poying’s theorem, Integral form of Maxwell’s equations Convariant formulation of Maxwell’s equation, Energy relationships for the electromagnetic field.
Suggested readings:


MATH-725 INTEGRAL EQUATIONS AND VARIATIONAL CALCULUS 3(3-0)

Learning objectives

Learn the analyse and solve the fundamental problem with prescribed or free boundary conditions in simple cases, solve extensions of the fundamental problem, including that for double integrals and use the canonical theory, Poisson brackets and associated invariants.

Course Contents


Functional, Fundamental lemma, Euler-Lagrange equations, Constrained maxima and minima, Extrema of functions of several variables, Generalization of Euler’s equations, Extremizing multiple integrals, Hamilton’s principal, use of Lagrange multipliers, Sturm Liouville and Rayleigh-Ritz methods.

Suggested reading:

MATH-726  FUNCTIONAL ANALYSIS  3(3-0)

Learning objectives

Learn the metric spaces, completeness, banach spaces, Hilbert spaces, and dual spaces. This course develop the analysis of the function in research.

Course Contents


Suggested


MATH-727  ADVANCED NUMERICAL ANALYSIS  3(3-0)

Learning objectives

To learn numerical methods for data analysis, optimization, Linear algebra and ODEs. Learn MATLAB skills in numerical methods, programming and graphics. To present these solutions in a coherent manner for assessment.

Course Contents


Suggested readings: