Class: M.SC – IInd Year Paper: (Functional Analysis)		Semester – III (odd)
S.No.	**Unit**	**Course Outcomes**
1.	I	In Unit I, students will be able to understand about Normed linear spaces, Banach spaces and examples, subspace of a Banach space,completion of a normed space, quotient space of a normed linear space and its completeness, Bounded and continuous linear operators, differentiation and integral operator linear and bounded linear functionals,definite integral, canonical mapping, dual spaces with examples.
2.	II	In Unit II, students will be able to understand about Hahn-Banach theorem for real linear, complex and normed linear spaces, application to bounded linear functionals on C[a,b], Riesz-representation theorem, adjoint operator, norm of the adjoint operator. Reflexive spaces, uniform boundedness theorem and some of its applications to the space of polynomials and fourier series.
3.	III	In Unit III, students would have the understanding of the topics Convergence of uniform, strong operator, weak operator convergence, strong and weak* convergence of a sequence of functionals. Open mapping theorem, bounded inverse theorem, closed linear operators, closed graph theorem. Inner product spaces, Hilbert spaces and their examples, pythagorean theorem,Apolloniu's identity, Schwarz inequality, continuity and completion of an inner product space,Hilbert space, orthogonal complements and direct sums, projection theorem.
4.	IV	In Unit IV, students will have the idea of the concept Orthonormal sets and sequences, Bessel's inequality, Parseval's identity.Riesz representation theorem for bounded linear functionals and sesquilinear forms on a Hilbert space, Hilbert adjoint operator and self adjoint, unitary, normal, positive and projection operators

Class: M.SC II Paper: Analytical Mechanics and Calculus of Variations		Semester-III (odd)
S. No.	**Unit**	**Course Outcomes**
1.	I	In the Unit I, students learn about the shortest distance, Minimum surface of revolution,Brachistochrone problem, Isoperimetric problem, Geodesic. Fundamental Lemma of calculus of variation. Euler's equation for one dependent function of one and several independent variables and its generalization . Variational derivative, invariance of Euler's equations, natural boundary conditions and transition conditions,Variable end points.
2.	II	In Unit II,students are given introduction and details Free and constrained systems, constraints and their classification. Generalized coordinates. Generalized Potential, Lagrange's equations of first kind, Principle of virtual displacements D'Alembert's principle, Holonomic Systems independent coordinates, generalized forces, Lagrange's equations of second kind. Theorem on variation of total Energy. Potential, Gyroscopic and dissipative forces, Lagrange's equations for potential forces for conservative fields.
3.	III	In unit III,the topics of Hamilton's variables. Don kin's theorem. Hamilton canonical equations. Routh's equations. Cyclic coordinates Poisson's Bracket. Poisson's Identity. Jacobi-Poisson theorem. Hamilton's Principle, Poincare-Carton integral invariant. Whittaker's equations. Jacobi's equations. Principle of least action explained to the

		students.
4.	IV	In unit IV,students learn about Canonical transformations, free canonical transformations, Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables for solving Hamilton-Jacobi equation. Testing the Canonical character of a transformation. Lagrange brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets. Simplicial nature of the Jacobian matrix , Invariance of Lagrange and Poisson brackets under canonical transformations.

Class: M.Sc II **Paper: Elasticity**		**Semester-III(odd)**
S. No.	**Unit**	**Course Outcomes**
1.	I	In the Unit I, students learn about Coordinate-transformation, Cartesian Tensor of different order. Properties of tensors, Isotropic tensors of different orders and relation between them,Symmetric and skew symmetric tensors. Tensor invariants, Deviatoric tensors, Eigenvalues and eigen-vectors of a tensor. Tensor Analysis: Scalar, vector, tensor functions, Comma notation, Gradient, divergence and curl of a vector / tensor field.
2.	II	In Unit II,students are given introduction and details about Affine transformation, Infinitesimal affine deformation, Geometrical Interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariance, General infinitesimal deformation. Saint-Venant's equations of compatibility.Finite deformations Analysis of Stress : Stress Vecotr, Stress tensor, Equations of equilibrium, Transformation of coordinates.
3.	III	In unit III,the topics of Stress quadric of Cauchy, Principal stress and invariants. Maximum normal and shear stresses. Mohr’s circles, examples of stress. Equations of Elasticity : Generalised Hooks Law, Anisotropic symmetries, Homogeneous isotropic medium.
4.	IV	In unit IV,students learn about Elasticity moduli for Isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke’s Law, Uniqueness of solution. Beltrami-Michell compatibility equations. Clapeyrom’s theorem.

Class: M.Sc II **Paper: Algebraic Coding Theory**		**Semester-III(odd)**
S. No.	**Unit**	**Course Outcomes**
1.	I	In the Unit I, students learn about the Block Codes. Minimum distance of a code. Decoding principle of maximum likelihood. Binary error detecting and error correcting codes.Minimum distance of a group code (m, m+1) parity check code. Double and triple repition codes. Matrix codes. Generator and parity check matrices. Dual and Polynomial codes. Exponent of a polynomial over the binary field. Binary representation of a number. Hamming codes.
2.	II	In Unit II,students are given introduction and details about Construction of finite fields. Primitive element and Irreducibility of polynomials over finite fields. Primitive polynomials over finite fields. Automorphism group of GF(qn). Normal basis of GF(qn). The number of irreducible polynomials over a finite field. The order of an irreducible polynomial. Generator polynomial of a Bose-Chaudhuri-Hocqhenghem codes(BCH codes) and its construction over finite fields.
3.	III	In unit III,the topics of Generator matrices of linear codes. Equivalent codes and permutation matrices. Relation between generator and parity-check matrix of a linear codes over a finite field. Dual and Self dual codes. Weight distribution and Weight enumerator of a linear code. Hadamard transform. Macwilliams identity.

		Maximum distance separable codes and its Examples, its Characterization in terms of generator and parity check matrices. Dual code of a MDS code. Trivial MDS codes. Weight distribution of a MDS code. Number of code words of minimum distance d in a MDS code. Reed solomon codes explained to the students.
4.	IV	In unit IV,students learn about Existence of a Hadamard matrix of order n. Hadamard codes from Hadamard matrices Cyclic codes. Generator polynomial and Check polynomial of a cyclic code. Equivalent code and dual code of a cyclic code. Idempotent generator, Hamming and BCH codes as cyclic codes. Perfect codes. The Gilbert-varsha-move and Plotkin bounds. Self dual binary cyclic codes.

Class: M.Sc-II **Paper: Integral Equations**		**Semester-III(odd)**
S. No.	**Unit**	**Course Outcomes**
1.	I	In the Unit I, students learn about the Definition of Integral Equations and their classifications. Eigen values and Eigen functions. Special kinds of Kernel Convolution Integral. The inner or scalar product of two functions. Reduction to a system of algebraic equations. Fredholm alternative, Fredholm theorem, Fredholm alternative theorem, An approximate method.
2.	II	In Unit II,students are given introduction and details about Iterative scheme for Fredholm and Volterrra Integral equations of the second kind. Conditions of uniform convergence anduniqueness of series solution. Some results about the resolvent Kernel. Application of iterative scheme to Volterra integral equations of the second kind.Classical Fredholm’s theory and method of solution, Fredholm’s First ,second and third theorem.
3.	III	In unit III,the topics Symmetric Kernels, Complex Hilbert space. An orthonormal system of functions, Riesz-Fisher theorem, A complete two-Dimensional orthonormal set over the rectangle ,Fundamental properties of Eigenvalues and Eigenfunctions for symmetric Kernels. Expansion in eigen functions and Bilinear form. Hilbert-Schmidt theorem and some immediate consequences. Definite Kernels and Mercer’s theorem.The operator method in the theory of integral equations. Rayleigh-Ritz method for finding the first eigenvalue explained to the students.
4.	IV	In unit IV,students learn about The Abel Intergral Equation. Inversion formula for singular integral equation with Kernel of the type h(s)-h(t), 0<a<1, Cauchy’s principal value for integrals solution of the Cauchy-type singular integral equation, closed contour, unclosed contours and the Riemann-Hilbert problem. The Hilbert-Kernel, solution of the Hilbert-Type singular Intergal equation.

Class:-M.Sc.-II **Semester:-IVth(Even)** **Subject:- General Measure and Integration Theory**		
S.No.	**Unit**	**Course Outcomes**
1.	I	Explained measure with its properties and measurable functions. **CO1**: Students have learned the meaning of measure, outer measures, extension of measures, completion of measures and other properties and also learned measurable functions with their limits, algebra of measurable functions, simple functions..
2.	II	Explained Measure space, Almost Everywhere concept and Integration with respect to Measure. **CO2**: Students have learned what is measure space, convergence in measure, almost everywhere and uniform convergence, integrable simple functions, non-negative integrable functions, indefinite integrals and mean convergence.
3.	III	Explained Product Measures and Signed Measures. **CO3**: Students have learned what is product measure and where and how it works, their Cartesian product, product of two finite measure spaces as well as sigma finite measure spaces, iterated integrals ,finite signed measure with contractions, purely positive and purely negative sets, comparison of finite measures, different variations, domination of finite signed measures.
4.	IV	Explained Integration over Locally Compact Spaces. **CO4**: Students have learned continuous functions with compact support, Gdelta and f sigma sets, baire sets and baire functions with baire measure, borel sets, regularity of baire and borel sets in different cases.

Class:-M.Sc-II **Semester:- IV th (Even)** **Subject:- Partial Differential Equations**		
S.No.	**Unit**	**Course Outcomes**
1.	I	Students learn_PDE of k^{th} order,classifications, examples, representation formulas for solutions of linear partial differential equations, Harmonic functions and their properties.
2.	II	Students learn to derive Green's function, its symmetry, construction for half space and unit ball. They also learn to find fundamental solution of heat equation , mean value formula, Properties of solutions and Energy methods.
3.	III	Students learn to find solution of wave equation in 1,2 and 3 dimensions.They also learn about Nonlinear

		First Order PDE, Complete integrals, envelopes, Characteristics, Introduction to Hamilton-Jacobi equations.
4.	**IV**	Students learn Conservative laws, Ways to represent solutions: Separation of variables, Similarity solutions, Transform methods, converting nonlinear into linear PDE by Cole-Hopf transformation, potential functions, Hodograph and Legendre transform.

Class:-M.Sc-II **Semester:- IV th (Even)**
Subject:- Mechanics of solids

S.No.	Unit	Course Outcomes
1.	**I**	Two dimensional problems ,airy stress function,general solution of biharmonic equation, first and second boundary value problem. **CO1**: Students have learnt the Two dimensional problems like plane stress and generalized plane stress , stress and displacements in terma of complex potentials.
2.	**II**	Waves , elastic surface waves , extension. **CO2**: Students have learnt propagation of waves , waves of dilatation and distortion, plane waves , Rayleigh waves and love waves and extension of beams.
3.	**III**	Torsion ,torsion and stress functions, lines of shearing stress,Torsion of anisotropic beams **CO3**: Students have learnt Torsion of circular shaft ,cylindrical bar and anisotropic beams , simple problems related to circle, ellipse and equilateral triangle.
4.	**IV**	Theorem of minimum potential energy, theorem 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. **CO4:** Students have learnt several direct variational methods of solution of elastostatic problems.

Class:-M.Sc-II **Semester:- IV th (Even)**
Subject:- Advanced Discrete Mathematics

S.No.	Unit	Course Outcomes
1.	**I**	**CO1:** Students learnt the basics of graph theory and its applications in solving the problems depending on Euler graphs and Hamiltonian graphs. They also learnt the concepts of trees and forest along with spanning trees.
2.	**II**	**CO2:** Students related the graph with the vector space and studied its properties in connection with the properties of vector spaces. They also learned the matrices related to graphs i.e. cut set matrix, circuit matrix, path matrix incidence matrix etc.
3.	**III**	**CO3:** Students got the idea of the basics of partially ordered sets and lattices and extend the definitions to modular and distributive lattices with their properties.
4.	**IV**	**CO4:** Students learnt the concept of Boolean algebra and fundamental theorem of Boolean algebra also its application to switching circuit theory.

Class:-M.Sc-II **Semester:- IV th (Even)**
Subject:- Mathematical Aspects Of Seismology

S.No.	Unit	Course Outcomes
1.	**I**	Explained the meaning of progressive waves, Harmonic and Plane waves, Wave equation and their types of solutions in detail. Also described D'Alembert formula and relation between phase and group velocity. **CO1**: Students have learnt the difference between the types of waves and their solutions, also analysed where they have to use D'Alembert formula and learnt the relationship between different velocities.
2.	**II**	Explained P and S waves with their characteristics and their polarization, also Reflection and Refraction of P,SV,SH waves at Liquid-Liquid ,Liquid-Solid and Solid-Solid interface. Described Rayieleigh,Love and stoneley waves. **CO2**: Students have learnt how to differentiate between P and S waves, also they analyzed the process of Reflection and Refraction of waves at different interface.
3.	**III**	Explained two and Three dimensional Lamb's problem in an isotropic elastic solid. Described Area source,Line source, Point source in an unlimited elastic solid and on the surface of semi-infinite elastic solid **CO3**: Students have learnt how Normal force, Tangential force, Area source and Point source acts in an unlimited and on the surface of semi-infinite elastic solid.
4.	**IV**	Described the meaning of spherical waves and its expansion into plane waves. Also explained different derivation of formulas , use of seismology in Earthquakes in detail. **CO4**: Learnt about the location, types and energy released by an earthquake. Also analyzed the difference between the solution of various Formula's such as Poisson's , Helmholtz and Kirchhoff's formula.