

M.Sc. (PREVIOUS)

MP-01 MATHEMATICAL PHYSICS

(Questions will be set from each unit/section with internal choice)

Units	Topics
I	<p>Vectors, Matrices and Tensors</p> <p>Curvilinear coordinates, Orthogonal curvilinear coordinate system, Derivation of gradient, divergence and curl in polar, spherical and cylindrical coordinate systems.</p> <p>Eigenvalue problem, Cayley-Hamilton theorem, Function of Matrix, Kronecker sum and product of matrices.</p> <p><i>Definition of Tensor, Coordinate transformation, Contravariant, Covariant and Mixed tensors. Addition, subtraction, multiplication and contraction operations with tensor. Quotient law. Christoffel symbols.</i></p>
II	<p>Partial Differential Equations and Group Theory</p> <p>Solutions of the following partial differential equations with boundary and initial conditions.</p> <p>Wave equation, Poisson equation, wave equation. Heat conduction equation and its application, to rectangular bar with finite and infinite length.</p> <p>Definition of group, subgroups, classes, invariant subgroups, factor group, direct sum and product, Reducible and irreducible representations, Schur's lemmas and orthogonality theorem, character of a representation some applications of group theory in physics: classification of states and elementary particles splitting of energy levels, Matrix elements and selection rules.</p>
III	<p>Functions of Complex Variable</p> <p>Definition, Argand diagram, function of a complex variable, Derivatives, Analyticity of complex function. Cauchy-Reimann conditions, Cauchy's theorem, Cauchy's integral formula, poles, residue, Cauchy's Residue theorem, Contour Integration.</p>
IV	<p>Special Functions and Spherical Harmonics</p> <p>Legendre, Bessel; Hermite and Laguerre functions. Their generating functions, Recursions, relations properties.</p> <p>Spherical Harmonics, Series solutions of Hermite and Laguerre polynomials, their generating functions, orthogonality, Associated Laguerre polynomials. Hypergeometric functions, representation of Bessel, Laguerre and Legendre functions in terms of hypergeometric functions.</p>
V	<p>Integral Transform</p> <p>Fourier transform and its properties, Application of Fourier transform to Dirac delta function and potential problems.</p> <p><i>Wave transform and its properties. Applications to potential and oscillatory problems.</i></p> <p>Evaluation of Simple integrals using Fourier and Laplace transforms.</p>