B. Sc. III Year		BPH-E502			Semester-V
DSE 1		MATHEMATICAL PHYSICS			
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
60	3 Hrs	30	70	100	04

NOTE: The question paper shall consist of TWO sections (Sec.-A, Sec.-B). Sec.-A shall contain 10 short answer type questions of Five mark each and student shall be required to attempt any Five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

The emphasis of the course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

Calculus of functions of more than one variable:
Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **(6 Lectures)**

Fourier Series:
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **(10 Lectures)**

Frobenius Method and Special Functions:
Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **(16 Lectures)**

Some Special Integrals:
Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **(4 Lectures)**

Partial Differential Equations:
Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. **(10 Lectures)**

Complex Analysis:
Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. **(14 Lectures)**

Reference Books
- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

(i) Course learning outcome:

- Revise the knowledge of calculus, vectors, vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.
- Learn the Fourier analysis of periodic functions and their applications in physical problems such as vibrating strings etc.
- Learn about the special functions, such as the Hermite polynomial, the Legendre polynomial, the Laguerre polynomial and Bessel functions and their differential equations and their applications in various physical problems such as in quantum mechanics which they will learn in future courses in detail.
- Learn the beta, gamma and the error functions and their applications in doing integrations.
- Know about the basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics.
- Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.
- Learn about the complex numbers and their properties, functions of complex numbers and their properties such as analyticity, poles and residues. The students are expected to learn the residue theorem and its applications in evaluating definite integrals.
- In the laboratory course, learn the fundamentals of the C and C++ programming languages and their applications in solving simple physical problems involving interpolations, differentiations, integrations, differential equations as well as finding the roots of equations.

(ii) Broad contents of the course

- Fourier Series
- Special Functions
- Special Integrals
- Partial Differential Equation
- Complex Analysis

(iii) Skills to be learned

- In this course, the students should acquire proficiency in doing calculations with vectors, beta, gamma and error functions, partial differential equations in rectangular, spherical and cylindrical coordinators, Fourier analysis of periodic functions, special functions, polynomials and their differential equations.
- Ability to learn mathematic of complex variables and solve simple problems with relative functions, complex integrals and their applications to physical problems.
- The students should also acquire the skills in writing programs in the C,C++ languages and doing calculations of physical interests with these languages.
- The students should also become proficient in computing integrations and in solving differential equations by various methods.