



S.V. University 4-Year Honours Degree Programme
BSc (Physics) Honours Degree Syllabus (W.E.F. AY-2025-26)

**Model Syllabus for 4-Year UG Honours in B.Sc. (Physics) as Major in
consonance with Curriculum framework w.e.f. AY 2025-26**

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Introduction to Mathematical Physics	3	3
			Introduction to Mathematical Physics-Practical	2	1
		2	Mechanics and Properties of Matter	3	3
			Mechanics and Properties of Matter-Practical	2	1

SEMESTER-I

COURSE 1: INTRODUCTION TO MATHEMATICAL PHYSICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVE:

To equip students with foundational mathematical techniques—such as vector calculus, linear algebra, complex numbers, probability, and Fourier analysis—essential for understanding and solving problems in physics.

LEARNING OUTCOMES:

After successful completion of the course, students will be able to:

1. Apply concepts of vector differentiation and integration to analyze physical fields and prove integral theorems.
2. Use matrix operations and eigenvalue techniques to solve linear systems in physics.
3. Represent and manipulate complex numbers in various forms for solving AC circuit problems.
4. Interpret and apply basic probability concepts and distributions to model physical phenomena.
5. Analyze periodic signals using Fourier series and evaluate Fourier coefficients for common waveforms.

UNIT-I - VECTOR ANALYSIS

(9. Hrs.)

Distinction between Ordinary and partial derivatives, Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II – LINEAR ALGEBRA

(9. Hrs.)

Vector and Scalar quantities in Physics, Matrices and Operations: Types, Addition and Multiplication, Identity and Inverse, Determinant (2x2 and 3x3), Trace, Transpose, Eigenvalues and Eigen Vectors, Calculation of Eigen values using characteristic equations. System of Linear Equations: Solving 2-variable system using matrices, Simple examples from physics (Current, forces)

UNIT – III COMPLEX NUMBERS

(9. Hrs.)

Basic Complex numbers: Real and imaginary parts, Conjugate of complex numbers, Modulus and argument (magnitude and phase), Polar and Exponential (Euler) form of complex numbers. Addition and subtraction of complex numbers, Multiplication and division of complex numbers. Phasor representation: representation of voltage and current as phasors, Derivation of Impedance of a series LCR circuit.

UNIT – IV PROBABILITY

(9. Hrs.)

Probability Theory Basics, Sample space, events, conditional probability, and Bayes' theorem. Independence and mutual exclusivity. Random Variables and Probability Distributions, Concept of random variables (discrete and continuous). Common distributions and their applications: Binomial, Poisson, and Gaussian.

UNIT V FOURIER ANALYSIS

(9. Hrs.)

Introduction to periodic functions: Concept of periodicity (waves, oscillations, AC current), Graphical understanding of Sine and Cosine functions, Need for Fourier analysis, Real world signals (heartbeat, electrical signal, musical tones), Fourier theorem and evaluation of Fourier coefficients, Analysis of periodic wave functions – Square wave, saw tooth wave and triangular wave.

Reference books

1. Mathematical methods for physics sciences (3rd edition) - Mary. L. Boas
2. First Chapter (Vector analysis) in Introduction to Electrodynamics (3rd edition) – David. J. Griffiths
3. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier

Student Activities:

- Problem-solving sessions using real-life physics applications (e.g., using vector calculus in electromagnetism).
- Group projects on solving physical systems using matrix methods and linear algebra tools.
- Mini-lab activity on phasor diagrams and impedance using circuit simulation software (like LTspice or Tinkercad Circuits).
- Data collection and analysis task: Record physical measurements (e.g., decay times, counts) and apply statistical models (Poisson/Gaussian).

SEMESTER-I

COURSE 1: INTRODUCTION TO MATHEMATICAL PHYSICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To develop foundational computational and analytical skills through hands-on exercises that prepare students for understanding and solving problems in various realms of physics.

LEARNING OUTCOMES:

1. Graphing and Visualization:
Students will be able to plot mathematical functions and visualize physical phenomena using Excel, Python, or MATLAB.
2. Vector and Matrix Computations:
Students will perform operations on vectors and matrices and represent them both analytically and graphically.
3. Numerical Methods:
Students will apply numerical techniques like Newton-Raphson, Bisection, and Euler's method to solve equations and differential equations.
4. Data Analysis and Fitting:
Students will analyze experimental data using tools like least squares fitting and compute statistical quantities such as mean, standard deviation, and error.
5. Fourier and Complex Number Representation:
Students will approximate functions using Fourier series and graphically represent complex numbers.

List of Practical

Minimum of 6 experiments to be conducted and recorded

1. Graphing standard functions: $\sin(x)$, $\cos(x)$, e^x , $\ln(x)$, x^2 , $\sqrt{x}$ etc. using Excel/Python/Graph paper
2. Experimental determination and vector diagram verification of vector addition and scalar product using graphical methods.
3. Using MATLAB/Python to visualize vector fields and compute gradient, divergence, and curl.
4. Solve simple non-linear equations (e.g., $x^3 - x - 1 = 0$) using graphical methods and bisection/newton-raphson method (Python or Excel).
5. Fit experimental data (e.g., Hooke's law) to a straight line using least squares method in Excel or Python.
6. Linear equation Solution and System of linear equation solution using MATLAB/OCTAVE
7. Fourier approximation of a square wave up to 5 terms using Python/MATLAB and plotting the result.

8. Numerical solution of $dy/dx=x+y$, given initial condition using Euler's method.
9. Single coin tossing and four coin tossing using MATLAB/OCTAVE and verification of statistical laws
10. Use Python/Excel to perform addition, multiplication, and finding inverse of 2x2 and 3x3 matrices.
11. Simulate and plot s-t, v-t graphs using $s=ut+0.5gt^2$ $s = ut + 0.5gt^2$ using Excel or Python.
12. Calculate mean, standard deviation, and percentage error for a given data set using Excel/Python/Manual calculations
13. Represent the given complex numbers on graph paper
14. Determine the Eigen Values of the given matrix using characteristic equation

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4- Year UG Honours, Major
Syllabus
(2025-26)
Semester-I

Model Question Paper

Time : 3hrs

Marks:75

Part-A

Answer any Five Questions. Each Question carries 3 Marks.

5x3=15

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Answer the following questions. Each question carries 12 Marks

5x12=60

11. a) Unit-I
(Or)
b) Unit-I

12. a) Unit-II
(Or)
b) Unit-II

13. a) Unit-III
(Or)
b) Unit-III

14. a) Unit-IV
(Or)
b) Unit-IV

15. a) Unit-V
(Or)
b) Unit-V