DEPARTMENT OF PHYSICS
Teaching Plan

Session: 2023-2024 (August-December)

Name of the teacher: Himanshu Bora
Programme Name: B.Sc. Physics (CBCS), FYUGP B.Sc. Major in Physics

Semester: 1st Semester (FYUGP)
Paper Name and Code:
1. Mathematical Physics & Mechanics (PHY0100104)

Semester: 3rd Semester (CBCS)
Paper Name and Code:
1. Mathematical Physics II (PHY-HC-3016)
2. Computational Physics Skills (PHY-SE-3024)

1. Mathematical Physics and Mechanics (FYUGP 1st SEM)

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
August 2023	**Part A Unit– II: Curvilinear coordinates** • Introduction to curvilinear coordinates. • Orthogonal curvilinear coordinates. • Examples of spherical, cylindrical and plane polar coordinates. • Line element- transformation from Cartesian to curvilinear coordinates (spherical and cylindrical). • Gradient, divergence and curl in spherical and cylindrical coordinates. **Part A Unit-III: Dirac delta function** • Definition and properties of Dirac delta function. • Representation of delta function by Gaussian function, rectangular function and Laplacian of 1/r . • 3-Dimensional delta function.	4 2	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment
September 2022	**Unit–IV: Dynamics of rigid bodies** Rigid body motion. Rotational motion. Moment of inertia of rectangular lamina, disc, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.	7	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
November 2022	**Unit –VI: Oscillations** • Oscillation - differential equation of simple harmonic motion and its solution. • Total energy of oscillation.	2	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Assignment
December 2022	**End Semester Examination**			

2. Mathematical Physics II (PHY-HC-3016)

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
August 2023	**Unit I: 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, Hermite and Laguerre Differential Equations. • Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials.	12	**Learning Materials:** • Recommended Textbooks • Lecture Notes **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment
September 2023	**Unit II: Partial Differential Equations** • Solutions to partial differential equations, using separation of variables: • Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. • Wave equation and its solution for vibrational modes of a stretched **Unit III: Some Special Integrals** • Beta and Gamma Functions and Relation between them. • Expression of Integrals in terms of Gamma Functions.	10 6	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
October 2023	**Unit IV: Matrix** • Matrix algebra using index notation, • Properties of matrices, • Special matrix with their properties: Transpose matrix, complex conjugate matrix, Hermitian matrix, Anti-Hermitian matrix, special square matrix, unit matrix, diagonal matrix, co-factor matrix, adjoint of a matrix, self- adjoint matrix, symmetric matrix, anti-symmetric matrix, unitary matrix, orthogonal matrix, • trace of a matrix, inverse matrix. • Determinant, Rank, • Eigen value, Eigen vector and diagonalisation of matrix.	9	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment
November 2023	**Unit V: 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 coeffcients. • Complex representation of Fourier series. • Expansion of functions with arbitrary period. • Application to square and triangular waves.	6	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Assignment
December 2023	**End Semester Examination**			

2. Computational Physics Skills (PHY-SE-3024)

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
August 2023	**Unit I: Introduction** Importance of computers in Physics, paradigm for solving physics problems for solution. Introduction to various OS, Linux OS such as RedHat, Ubuntu, Scientific Linux, Usage of Basic linux commands. Text editors such as vi and Emacs.	2	**Learning Materials:** • Recommended Textbooks • Lecture Notes **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
	Unit II: Basics of Scientific Programming Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.	6	**Learning Materials:** • Recommended Textbooks • Lecture Notes **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Assignment
September 2023	**Unit III: Scientific Programming** Variables and Formatting: Introduction to HLL, Concepts of a Compiler. Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of a Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.	10	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Assignment

Week / Month	Unit / Topic	No. of Classes	Learning Resources & Teaching Methods	Evaluating Modes
October 2023	**Unit IV: Control Statements, Functions, and Subroutines:** Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file.	9	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Class Test • Assignment
November 2023	**Unit V: Visualization** Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, curve fitting – straight line, polynomials, user defined function. Physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot	5	**Learning Materials:** • Recommended Textbooks • Lecture Notes • Video Lectures **Teaching Methods:** • Chalk and Talk • Digital Demonstration • Classroom Discussion • Problem Solving Methodologies	• Assignment
December 2023	**End Semester Examination**			