Teaching Plan of 1st Semester 2025-2026

Subject: Physics

Semester: FYUGP 1st Semester

Paper Name: Mathematical Physics & Mechanics

Paper Code: PHY0100104MN

Total Number of Classes: 45

Period: July-December

Total Credit: 4 (Theory 3 + Laboratory 1)

Existing Base Syllabus: HS Mathematics and Physics

Faculty: Dr. Manisha Phukan

Lecture No.	Unit/Topic	Mode of Teaching	Assessment Method	Faculty
08	**PART – A: Mathematical Physics (Theory)** **Unit-I: Vector calculus** Scalar and vector fields. Derivatives of vector functions (physical examples - velocity, centripetal acceleration of a point in circular motion). Gradient of a scalar field (example of Newton's gravitational force as gradient of a scalar potential). Gradient as normal vector to a surface. Divergence and curl of a vector field- solenoidal and irrotational vector fields. Laplacian operator (physical	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan

	problems -Laplacian of gravitational potential, divergence of central force). Vector identities. Vector integration- Line integral (physical example- work done by a force, path dependence/independence and concept of conservative force). Surface and volume integrals. Concept of vector flux. Gauss's divergence theorem and Stokes's theorem (statement only).			
05	**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.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan
02	**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.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan
04	**Part B- Mechanics**	Lectures	Sessional & Class-tests	Dr. Manisha Phukan

	Unit-I: Reference frames Inertial frames. Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.	Oral Questions-P Problem Solving Previous year Question paper solving		
07	**Unit-II: Gravitation and central force motion** Motion under central force. Two-body problem and its reduction to one body problem. Kepler's laws, Gravitational potential and fields due to spherical body. Gauss's law and Poisson's equation for gravitational field.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan
07	**Unit-III: Work and energy, Conservation laws and Collision** Work and kinetic energy theorem. Conservative and non-conservative forces. Potential energy. Force as gradient of potential energy. Work and potential energy. Work done by nonconservative forces. Dynamics of a system of particles. Centre of mass. Principle of conservation of momentum. Torque. Impulse.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan

	Elastic and inelastic collisions between particles. Centre of mass and laboratory frames.			
06	**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.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan
06	**Unit-V: Properties of matter** Relation between elastic constants. Twisting torque on a cylinder or wire. Cantilever. Kinematics of moving fluids: Poiseuille's equation for flow of a liquid through a capillary tube.	Lectures Oral Questions-P Problem Solving Previous year Question paper solving	Sessional & Class-tests	Dr. Manisha Phukan
Sl. No.	**Experiment No. and Aim of the Experiment**		**Mode of Teaching**	**Faculty**
1.	1. To study the motion of spring and calculate (a) spring constant and (b) rigidity modulus.		Demonstrating the concepts clearly. Engaging students in hands-on experimental	Dr. Manisha Phukan
2.	2. To determine the moment of inertia of a cylinder about two different axes of symmetry by torsional oscillation method.			
3.	4. To determine the Young's modulus of the material of a wire by Searle's apparatus.			

4.	6. To determine the value of g using bar pendulum.	work for better understanding	
5.	7. To determine the value of g using Kater's pendulum.		
6.	9. To determine g and velocity for a freely falling body using digital timing technique.		

Reference Books

[1] Essential Mathematical Methods for the Physical Sciences; K.F. Riley and M.P. Hobson, Cambridge University Press.

[2] Advanced Engineering Mathematics; E. Kreyszic, John Wiley & Sons (New York) 17

[3] Mathematical Methods for Physicists; G. B. Arfken, H. J. Weber and F.E. Harris, Elsevier

[4] Mathematical Physics-I; Krishna K. Pathak and Sangeeta Prasher, Vishal Publishing Co, Jalalandhar (Delhi).

[5] Mathematical Physics, H. K. Dass and Dr. Rama Verma, S. Chand Publication.

[6] Theoretical Mechanics, M. R. Spiegel, Tata McGraw Hill.

[7] Mechanics; D. S. Mathur, S. Chand & Company Limited.

[8] An Introduction to Mechanics, D. Kleppner and R. J. Kolenkow, Tata McGraw-Hill.

[9] Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al., Tata McGraw-Hill.

[10] Physics, R. Resnick, D. Halliday and J. Walker, John Wiley& Sons.

[11] Analytical Mechanics, G. R. Fowles and G. L. Cassiday, Cengage Learning.

[12] Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton and M. Sands, Pearson Education.

[13] University Physics, F. W. Sears, M. W. Zemansky and H.D Young, Addison Wesley

[14] Physics for Scientists and Engineers with Modern Phys., J. W. Jewett and R. A. Serway, Cengage Learning.

[15] Mechanics, D. Sarma and K. K Pathak, Vishal Publications, Jalandhar (Delhi).