

Teaching Plan of 2nd Semester 2025-2026

Subject: Physics

Semester: FYUGP 2nd Semester

Paper Name: Mathematical Physics & Electricity and Magnetism

Paper Code: PHY4200104MN

Total Number of Classes: 45

Period: January-June

Total Credit: 4 (Theory 3 + Laboratory 1)

Existing Base Syllabus: HS Mathematics and Physics

Faculty: Dr. Manisha Phukan and Dr. Palash Jyoti Boruah

Lecture No.	Unit/Topic	Mode of Teaching	Assessment Method	Faculty
10	<p>PART – A: Mathematical Physics (Theory)</p> <p>Unit-I: Differential Equations</p> <p>First and second order ordinary differential equations (ODE). Homogeneous and inhomogeneous differential equations.</p> <p>Solutions of first order ODE - integrating factors (physical examples -radioactive decay, Newton’s law of cooling, particle falling under gravity through a resistive medium). Concept of initial/boundary conditions.</p> <p>Solutions of second order ODE with constant coefficients-complementary function and particular integral (physical</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	<p>Sessional & Class-tests</p>	<p>Dr. Manisha Phukan</p>

	<p>examples- simple harmonic oscillation, forced vibration). Wronskian- definition and its use to check linear independence.</p> <p>Partial differential equations (PDE) (physical examples - wave equation, diffusion equation, Laplace and Poisson equation - introduction only).</p> <p>Exact and inexact differentials. Concept of variable separation in a PDE.</p>			
05	<p>Unit-II: Matrices</p> <p>Properties of matrices. Determinant and rank. Transpose and complex conjugate of matrices. Hermitian and anti-Hermitian matrices. Unitary and orthogonal matrices.</p> <p>Representation of linear homogeneous and inhomogeneous equations through matrix equation. Inverse of a matrix. Eigen values and eigen-vectors.</p> <p>Cayley-Hamilton Theorem (statement only), Diagonalisation of simple matrices.</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	Sessional & Class-tests	Dr. Manisha Phukan
13	<p>Part B- Electricity and Magnetism (Theory)</p> <p>Unit-I: Electric field and electric potential</p> <p>Electrostatic field, electric flux.</p> <p>Gauss's law. Application of Gauss's law to charge distributions with planar, spherical and cylindrical symmetric.</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	Sessional & Class-tests	Dr. Palash Jyoti Boruah

	<p>Conservative nature of electrostatic field.</p> <p>Electrostatic potential. Electrostatic energy of a system of charges. Electrostatic boundary conditions.</p> <p>Laplace's and Poisson's equations. Uniqueness theorem. Application of Laplace's equation involving planar, spherical and cylindrical symmetries.</p> <p>Potential and electric field of a dipole. Force and torque on a dipole.</p> <p>Capacitance of a system of charged conductors. Parallel plate capacitor. Capacitance on an isolated conductor.</p>			
04	<p>Unit-II: Dielectric properties of matter</p> <p>Electric field in matter. Polarisation, polarization charges. Electrical susceptibility and dielectric constant.</p> <p>Capacitor (parallel plate, spherical and cylindrical) filled with dielectric. Displacement vector, D. Relation between E, P and D.</p> <p>Gauss's law in dielectrics.</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	<p>Sessional & Class-tests</p>	<p>Dr. Palash Jyoti Boruah</p>
06	<p>Unit-III: Magnetic field</p> <p>Magnetic force on a point charge, definition and properties of magnetic field B.</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p>	<p>Sessional & Class-tests</p>	<p>Dr. Palash Jyoti Boruah</p>

	<p>Curl and divergence. Vector potential, A. Magnetic scalar potential.</p> <p>Magnetic force on (i) a current carrying wire and (ii) between two elements. Torque on a current loop in a uniform magnetic field.</p> <p>Biot-Savart's law and its simple application: straight wire and circular loop.</p> <p>Current loop as a magnetic dipole and its dipole moment (analogy with electric dipole).</p> <p>Ampere's circuital law and its application to (i) solenoid and (ii) torus.</p>	Previous year Question paper solving		
2	<p>Unit-IV: Magnetic properties of matter</p> <p>Magnetization vector 'M', Magnetic intensity 'H'. Magnetic susceptibility and permeability.</p> <p>Relation between B, H and M. Ferromagnetism. B-H curve and hysteresis.</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	Sessional & Class-tests	Dr. Palash Jyoti Boruah

5	<p>Unit-V: Electrical circuits</p> <p>Ac circuits: Kirchhoff's laws for AC circuits. Complex reactance and inductance.</p> <p>Series LCR circuits and parallel LCR circuits : (i) phasor diagram, (ii) resonance, (iii) power dissipation, (iv) quality factor, and (v) band width.</p> <p>Ideal constant-voltage and constant-current sources.</p> <p>Thevenin theorem and Norton theorem (only statements and solving of related problems).</p>	<p>Lectures</p> <p>Oral Questions-P</p> <p>Problem Solving</p> <p>Previous year Question paper solving</p>	<p>Sessional & Class-tests</p>	<p>Dr. Manisha Phukan</p>
Sl. No.	Experiment No. and Aim of the Experiment		Mode of Teaching	Faculty
1.	1. Use a multimeter for measuring (a) Resistances, (b) AC and DC voltages, (c) DC current, (d) Capacitances and (e) Checking electrical fuses		<p>Demonstrating the concepts clearly.</p> <p>Engaging students in hands-on experimental work for better understanding</p>	Dr. Manisha Phukan
2.	2. To study the characteristics of a series RC circuit			Dr. Palash Jyoti Boruah
3.	3. To determine an unknown Low Resistance using Potentiometer			
4.	4. To determine an unknown Low Resistance using Carey Foster's Bridge			
5.	7. To verify the Thevenin and Norton Theorems.			
6.	9. To determine the self-inductance of a coil by Anderson's bridge			

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] Introduction to Electrodynamics, D. J. Griffiths.
- [7] Electricity and Magnetism [With electromagnetic theory and special theory of relativity], D. Chattopadhyay and P. C. Rakshit, 2013, New Central Book Agency (P) Limited.
- [8] Electricity, Magnetism and Electromagnetic Theory, S. Mahajan and S. R. Choudhury, 2012, Tata Mcgraw.
- [9] Schaum' s outline of Theory and Problems of Electromagnetics, J. A. Edminister.
- [10] Electromagnetics, B. B. Laud, New Age International Publishers.
- [11] Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
- [12] Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
- [13] Elements of Electromagnetics, M. N. O. Sadiku, 2008. Pearson Education.
- [14] Electricity and Magnetism, J. W. Fewkes and J. Yarwood, Vol. I, 1991, Oxford Univ. Press.