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FIFTH SEMESTER (CUFYUGP) DEGREE EXAMINATION, NOVEMBER 2026

PHYSICS / APPLIED PHYSICS

PHY5CJ301/APH5CJ301: ELECTRODYNAMICS II

2024 Admission onwards

Maximum Time :2 Hours | **Maximum Marks :70**

Section A

All Questions can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)

1	What is the polarization vector **P** of a dielectric material?
2	Distinguish between free charge and bound charge in a polarized dielectric ?
3	Define the electric displacement vector **D** ?
4	State **Ohm's law** in microscopic form. What is meant by **electromotive force (emf)**?
5	State Faraday's law of electromagnetic induction in integral form. Explain how a time-varying magnetic field produces an induced electric field
6	Why did Maxwell modify Ampère's law? Explain the concept of displacement current and write the four Maxwell's equations in differential form.
7	Write the wave equations for the electric field **E** and magnetic field **B** in free space. What is the speed of electromagnetic waves?
8	What is a plane electromagnetic wave? State the relationship between the directions of **E**, **B** and the direction of propagation.
9	What is meant by the **growth of current in an L-R circuit**? Write the expression for the current at any time t.
10	What is meant by **resonance in a series LCR circuit**? Write the condition for resonance and the resonant frequency.

Section B

All Questions can be answered. Each Question carries 6 marks (Ceiling : 36 Marks)

11	Prove that charge density $\rho = -\nabla . P$ for a ono uniformly polarized object ?
12	Find the self-inductance per unit length of a log solenoid of radius R, carrying N turns per unit length ?
13	A parallel plate capacitor has a circular plate of radius 5 cm. It is being charged so that the electric field varies at the rate of 10^{12} volt/m per second. Find the displacement current in it ?
14	A magnetic material is placed in a uniform magnetic field of intensity H = 1000 A m^{-1}. The magnetic susceptibility of the material is $\chi_m = 0.02$. Calculate: • a) The magnetization M of the material. • b) The magnetic flux density B inside the material. • c) The relative permeability μ_r of the material. Take $\mu_o = 4\pi \times 10^{-7}$ H m^{-1}.
15	A long solenoid has 500 turns per metre and carries a current of 2 A. The solenoid is filled with a linear magnetic material having magnetic susceptibility $\chi_m = 3$. Calculate: a) The magnetic field intensity H inside the solenoid.

	• b) The magnetization M of the material. • c) The magnetic flux density B inside the solenoid. Take $\mu_o = 4\pi \times 10^{-7}$ H m^{-1}.
16	State and Prove Poynting theorem ?
17	Explain the decay of current in L-C circuit ?
18	Derive the Energy in Magnetic Fields ?
Section C	
Answer any ONE .Each Question carries 10 marks (1x10=10 Marks)	
19	Explain the propagation of electromagnetic waves in linear media. Derive the wave equation for electric and magnetic fields in a linear, homogeneous, isotropic medium and obtain the expressions for the wave velocity and refractive index.
20	Explain the construction and working of a series LCR circuit. Derive the expression for its impedance and resonant frequency. Discuss the condition for resonance and the behavior of current at resonance.