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K – 2430

Reg. No. : .....

Name : .....

Third Semester B.Sc. Degree Examination, March 2021

First Degree Programme under CBCSS

Physics

Core Course

PY 1341 — ELECTRODYNAMICS

(2019 Admission Regular)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in **1** or **2** sentences. Each carries **1** mark.

1. Write down the boundary conditions for electric field.
2. Write down wave equation in one dimension.
3. Give an example for a equipotential surface.
4. Express Amperes circuital theorem in differential form.
5. A charge Q is place the center of a cube. The flux coming out from any surface is _____.
6. The power factor of a CR circuit is _____.
7. Write the electric potential for localized charge distribution.
8. Write relation between RMS value and peak value of alternating current.
9. In free space the electromagnetic waves propagate at with velocity in terms of permeability (μ_0) and permittivity (ε_0) is _____.

P.T.O.

10. An Electromagnetic wave in free space radiating system the maximum value of radiated electric field is 500 V/m, the peak value of Magnetic field is _____.

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. State and explain Faraday's law of electromagnetic induction.

12. Explain Lenz's law.

13. Show that magnetic field does no work.

14. Prove that electrostatic field is conservative.

15. Explain Poisson's and Laplace's equation.

16. What is atomic polarizability? Explain the polarizability tensor.

17. What are Polar and Non Polar molecules? Give an examples for each.

18. Define Q factor of series resonant circuit.

19. Write physical meaning of $\nabla.B = 0$.

20. Differentiate between conduction current and displacement current.

21. State Gauss's theorem for dielectrics.

22. Show graphically the decay of charge in a series LCR circuit corresponding to over damped, critically damped and damped oscillatory.

23. Give an expression for the growth of charge in a series CR circuit. Sketch the variation.

24. Define magnetic vector potential.

25. Show that electric potential obeys super position principle.

26. What are the two fundamental equations of electrostatic fields?

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. **Each** carries **4** marks.

27. Calculate atomic polarizability of hydrogen atom. Assuming hydrogen atom consist of a point nucleus (+q) surrounded by a uniformly charged spherical cloud (–q) of radius a = 0.53 A°.

28. A coil having R = 120 Ω and L = 24 H is connected to a 12 V battery. Determine (i) the time constant of the circuit. (ii) current after 0.2 second (iii) current after 1 second.

29. A plane electromagnetic wave traveling in vacuum has electric field is given by $E(x,t) = (500V/m)\cos\left(\frac{2\pi x}{3} - 10^6 t\right)\hat{z}$. (a) What is the amplitude of the magnetic field component? (b) Parallel to which axis does the magnetic field oscillate? (c) When the electric field component is in the positive direction of the z axis at a certain point P, what is the direction of the magnetic field component there?

30. A coil with 25 turns of wire is wrapped on a frame with a square cross section 1.80 cm on a side. Each turn has the same area, equal to that of the frame, and the total resistance of the coil is 0.350 Ω. An applied uniform magnetic field is perpendicular to the plane of the coil. If the field changes uniformly from 0.00 T to 0.500 T in 0.800 s, what is the induced emf in the coil while the field is changing? Find (a) the magnitude and (b) the direction of the induced current in the coil while the field is changing.

31. A circular wire loop of radius 1.00 m is placed in a uniform magnetic field of magnitude 0.500 T. The normal to the plane of the loop makes an angle of 30.0° with the magnetic field. The current in the loop is 2.00 A in the counter clockwise direction. Find the magnetic moment of the loop and the magnitude of the torque at this instant.

32. Find the vector potential inside and outside of an infinite solenoid with n turns per unit length, radius R. and current I.

33. A sphere of radius R carries a polarization $P(r) = kr$, where k is a constant and r is the vector from the center. Calculate the bound charges σ_b and ρ_b.r

34. A resistance of 10 kΩ is joined in series with an inductance of 0.5 Henry. What capacitance must be put in series with the combination to attain maximum current? What will be the potential drop across each element of the circuit, if it is connected to 200 V, 50 Hz mains?

35. A wire of length '4a' is first bent to form a circle and then a square. What is the magnetic field produced at the center of circle to the center of a square when a current *I* is passed through it.

36. Three charges 20 μC, 30 μC and 40 μC are placed at the corners of an equilateral triangle of side length 10 cm. How much work has to be done in assembling all three charges.

37. Obtain the expression for energy stored for a continuous charge distribution.

38. Explain how Maxwell fixed Ampere's law.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

39. Explain bound charges and physical significance. Show that the potential due to a polarized dielectric is the same as that produced by a volume charge density and surface charged density.

40. How magnetic materials were classified. Explain briefly.

41. State and explain Gauss's law. Find electric field inside and outside of a uniformly charged solid sphere of radius R having total charge Q. Sketch the variation of electric field with distance.

42. Discuss the growth of current in a circuit containing inductance L and resistance R in series with a cell of steady emf *E*. Define time constant. Sketch the growth of current for different time constant.

43. Obtain the wave equations for electric and magnetic field vectors E and B in free space. Discuss the term polarization and prove that electromagnetic waves are transverse in nature.

44. Discuss theory of series and parallel LCR circuit.

(2 × 15 = 30 Marks)
