

**FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2016**

(CUCBCSS—UG)

Physics/Applied Physics

PHY 5B 06/APY 5B 07—ELECTRODYNAMICS—II

Time : Three Hours

Maximum : 80 Marks

*The symbols used in this question paper have their usual meanings.***Section A***Answer in a word or a phrase.**Answer all questions.**Each question carries 1 mark.*

1. Magnetic field can be produced by a current or by a changing \_\_\_\_\_.
2. If  $\mu_0$  represents the permeability and  $\epsilon_0$  represents the permittivity of free space, the velocity of electromagnetic waves in free space is given by \_\_\_\_\_.
3. The larger the ratio,  $R/L$ , the \_\_\_\_\_ is the decay of current in a series LR circuit.
4. In a purely inductive circuit, the power consumed is \_\_\_\_\_.
5. Lower the Q-factor of a circuit, \_\_\_\_\_ is its bandwidth.

**Write True or False :**

6. A conducting loop favours to maintain a constant flux through it.
7. The wave vector  $k$  points in a direction perpendicular to the direction of propagation and its magnitude is the wave number.
8. Charge in a capacitor takes infinite time to decay to zero.
9. When a.c. flows through an inductance, the back e.m.f. lags behind the current by  $\pi/2$ .
10. An ideal constant current source has zero resistance.

(10 × 1 = 10 marks)

**Section B***Answer in two or three sentences.**Answer all questions.**Each question carries 2 marks.*

11. What is Faraday's law ? Write its differential form.
12. Write down the general wave equation. Give its solution.

**Turn over**

13. What is Poynting vector ? Give an expression for the same.
14. Give an expression for the instantaneous current in a series LR circuit. What are the terms involved ?
15. Show graphically the relation between e.m.f. and current in an AC circuit containing a pure inductance.
16. What do you mean by the Q-factor of a series resonant circuit ?
17. Write Kirchoff's laws in network theory.

(7 × 2 = 14 marks)

## Section C

*Answer in a paragraph of about half a page to one page.*

*Answer any five questions.*

*Each question carries 4 marks.*

18. Explain how Ampere's law is modified by Maxwell to include time varying electric fields.
19. A plane electromagnetic wave of angular frequency  $\omega$ , wave vector  $k_1$ , traveling in the  $z$  direction represented by  $E_1(z, t) = E_{01} e^{i(k_1 z - \omega t)} \hat{x}$  and  $B_1(z, t) = \frac{1}{v_1} E_{01} e^{i(k_1 z - \omega t)} \hat{y}$  enters at normal incidence from one linear medium to another. Write expressions for the electric and magnetic vectors for the reflected and transmitted waves. Assume that in the second medium, the wave vector and velocity are given by  $k_2$  and  $v_2$ , respectively.
20. Show that the radiation pressure caused by an electromagnetic wave is equal to the ratio of the intensity of the electromagnetic wave and the velocity of light.
21. Show graphically the decay of charge in a series LCR circuit corresponding to over-damped, critically-damped and damped-oscillatory cases.
22. Compare a series and a parallel LCR resonant circuit.
23. What are the basic steps for converting a voltage source to a current source ?
24. State :
  - (i) Thevenin's theorem ; and
  - (ii) Superposition theorem.

(5 × 4 = 20 marks)

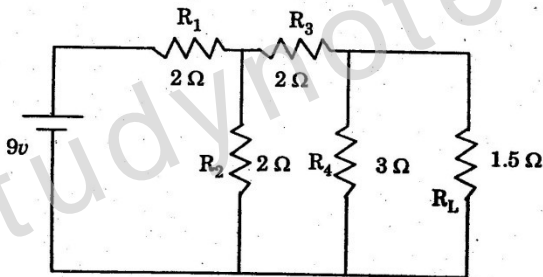
## Section D

Problems-Write all relevant formulas, all important steps carry separate marks.

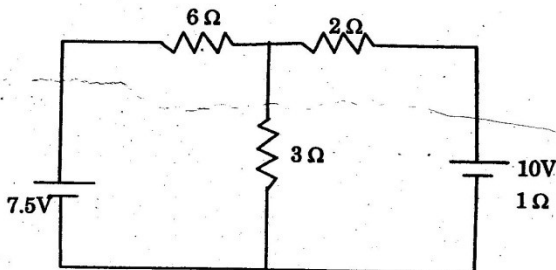
Answer any four questions.

Each question carries 4 marks.

25. Write down the boundary conditions for the electric and magnetic vectors  $E$  and  $B$  at an interface separating two linear dielectrics of permittivities  $\epsilon_1$  and  $\epsilon_2$  and permeabilities  $\mu_1$  and  $\mu_2$ .
26. Write down Neumann formula for mutual induction. Discuss its importance.
27. For a plane monochromatic wave, show that the momentum density stored in the field is the energy density divided by the velocity of the wave.
28. A capacitor is charged by a DC supply through a resistance of  $2\text{ M}\Omega$ . If it takes  $0.5$  sec for the discharge to reach three quarters of its final value, what is the capacitance of the capacitor?
29. What is the resonance frequency of a circuit containing a coil of inductance  $2.5\text{ H}$  and a capacitor of capacity  $40\text{ }\mu\text{F}$ .
30. Find the current through the  $1.5\text{ }\Omega$  resistance in the following circuit using Thevenin's theorem :



31. Find the current through the  $3\text{ }\Omega$  resistor of the following network using superposition theorem :



(4 × 4 = 16 marks)

Turn over

**Section E**

*Essays-Answer in about two pages.*

*Answer any two questions.*

*Each question carries 10 marks.*

32. Discuss the terms electric and magnetic polarization. What is the relation between the microscopic and macroscopic fields, if the medium is linear? Obtain Maxwell's equations in matter.
33. Obtain the wave equation for the E and B vectors in free space. Using a plane wave solution show that the electromagnetic waves are transverse in nature and the E and B vectors are in phase and mutually perpendicular.
34. Discuss the growth of current in a circuit containing an inductance L and a resistance R connected in series with a cell of steady e.m.f. E. Explain the term time constant of the circuit.
35. Discuss the measurement of an inductance using Anderson bridge.

(2 × 10 = 20 marks)