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(Pages : 4)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)  
EXAMINATION, NOVEMBER 2016

(UG—CCSS)

Physics

PH 5B 09—ELECTRODYNAMICS—II

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

I. Objective questions (Answer all questions):

1 An inductor stores energy in :

- (a) Its electric field. (b) Its magnetic field.  
(c) Its electric and magnetic fields. (d) Its coil.

2 The Poynting vector is :

- (a)  $\frac{\mu_0}{E \times B}$  (b)  $\frac{\mu_0}{E \cdot B}$   
(c)  $\frac{E \cdot B}{\mu_0}$  (d)  $\frac{E \times B}{\mu_0}$

3 The speed of electromagnetic waves in free space is given by :

- (a)  $\mu_0 \epsilon_0$  (b)  $\sqrt{\mu_0 \epsilon_0}$   
(c)  $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$  (d)  $\frac{1}{\mu_0 \epsilon_0}$

4. The relation between the vectors electric field intensity  $E$ , electric flux density  $D$  and polarization  $P$  is :

- (a)  $D = \epsilon_0 E + P$  (b)  $\nabla \cdot E = \epsilon_0 D + P$   
(c)  $E = \epsilon_0 P + D$  (d)  $E = \epsilon_0 P - D$

5 The power factor of a series resonant circuit is :

- (a) 1. (b) -1.  
(c) 0. (d) Infinity.

Turn over

6 In an a.c. circuit with voltage  $V$  and current  $I$ , the power developed is :

(a)  $VI$ .

(b)  $\frac{VI}{2}$ .

(c)  $\frac{VI}{\sqrt{2}}$ .

(d) Depends on the phase relation between  $V$  and  $I$ .

7 Assuming  $L, C, R$  representing inductance, capacitance and resistance, respectively, the quantity which has the dimension of frequency is :

(a)  $RC$ .

(b)  $\frac{1}{RC}$ .

(c)  $\frac{RL}{C}$ .

(d)  $\frac{C}{RL}$ .

8 Kirchoff's voltage law is concerned with :

(a) IR drops only.

(b) Battery EMFs only.

(c) Junction voltages only.

(d) Both (a) and (b).

State whether the following statements are True or False :

9 Self inductance of a coil depends on its geometry.

10 During one time constant, the current through a series LR circuit rises to 37 % of its final steady value.

11 An ideal constant voltage source has zero resistance.

12 Higher the resistance of a resonant circuit, better is its selectivity.

(12 × ¼ = 3 weights)

II. Short answer questions (Answer all questions) :

13 Explain Lenz's law in electromagnetic induction.

14 Discuss the necessity of the term displacement current in Maxwell's equations.

15 What do you mean by intensity of electromagnetic waves ?

16 Define the terms phase and phase constant of a sinusoidal wave.

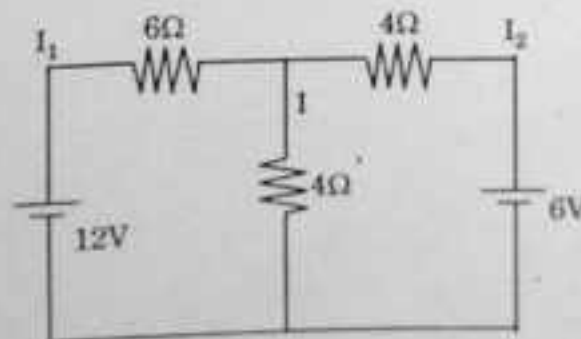
17 What do you mean by a plane wave and write down the equation for a plane wave.

- 18 Draw graphs representing over-damped, critically-damped and damped-oscillatory cases of the growth of charge in a series LCR circuit.
- 19 Discuss the term reactance of an a.c. circuit.
- 20 Draw the basic circuit of an a.c. bridge and write down the condition for balance.
- 21 Using  $j$ -operator, write down the voltage-current relationship in a purely inductive and a series LC circuit.

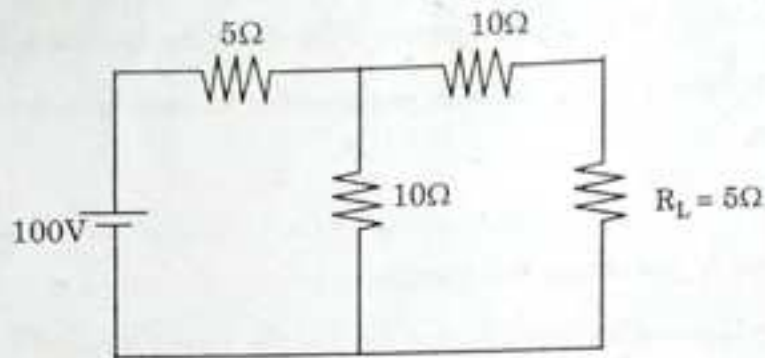
(9 × 1 = 9 weightage)

III. Short essay questions (Answer any five questions) :

- 22 Write down the Maxwell's equations and explain the terms involved.
- 23 Write down the boundary conditions satisfied by electromagnetic fields at the interface between two media of different permeabilities and permittivities.
- 24 Write down the expression for energy density and momentum density of an electromagnetic wave.
- 25 A series combination having  $R = 1 \text{ M}\Omega$  and  $C = 0.02 \mu\text{F}$  is connected to a d.c. voltage source of 100 V. Determine (i) The time constant of the circuit ; (ii) Capacitor voltage after 0.02 second ; and (iii) Capacitor voltage after 0.04 second.
- 26 A pure resistance of  $50 \Omega$  is in series with a capacitance of  $100 \mu\text{F}$ . The combination is connected to a 100 V, 50 Hz supply. Determine the (i) Impedance ; (ii) Power factor ; (iii) Voltage across resistance ; and (iv) Voltage across capacitance.
- 27 Using superposition theorem, calculate the current in each branch of the following network :-



- 28 In the following figure, determine the current through the load resistance  $5\ \Omega$  using Norton's theorem.



(5 × 2 = 10 weightage)

IV. Essay questions (Answer any two questions) :

- 29 Obtain the wave equation for the electric and magnetic field vectors  $E$  and  $B$  in free space. Discuss the term polarization and prove that electromagnetic waves are transverse in nature.
- 30 What is the working principle of a ballistic galvanometer? Obtain an expression relating the charge flowing through a ballistic galvanometer and the corresponding deflection.
- 31 Obtain the relation between voltage and current in a series LCR circuit. Discuss the resonance of the circuit.

(2 × 4 = 8 weightage)