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Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2015

(U.G.—CCSS)

Core Course—Physics

PH 5B 09—ELECTRODYNAMICS—II

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

I. Objective questions (Answer *all* questions) :

1 Which among the following is a wrong statement ?

- (a) Electromagnetic waves are produced by accelerating charges.
- (b) Electromagnetic waves are transverse in nature.
- (c) Electromagnetic waves travel with the same speed irrespective of the nature of the medium.
- (d) Electromagnetic waves travel with the velocity of light in vacuum.

2 The Poynting vector is given by :

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

3 In free space, electromagnetic waves propagate at a speed of :

- (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 magnetic field intensity  $\mathbf{H}$ , magnetic flux density  $\mathbf{B}$  and magnetization  $\mathbf{M}$  is :

- (a)  $\mathbf{B} = \mu_0 (\mathbf{H} + \mathbf{M})$
- (b)  $\mathbf{H} = \mu_0 (\mathbf{B} + \mathbf{M})$
- (c)  $\mathbf{M} = \mu_0 (\mathbf{H} + \mathbf{B})$
- (d)  $\mathbf{B} = \mu_0 (\mathbf{H} \times \mathbf{M})$

Turn over

5 The power factor of a circuit is unity. Then the impedance of the circuit is :

- (a) Inductive.
- (b) Capacitive.
- (c) Resistive.
- (d) Partially inductive and partially capacitive

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 Superposition theorem is based on the concept of :

- (a) Linearity.
- (b) Duality.
- (c) Reciprocity.
- (d) Multiplicity.

State whether the following statements are TRUE or FALSE :

- 9 Magnetic monopoles do not exist.
- 10 In a series LR circuit, as the value of  $L/R$  decreases, it takes a longer time for the current to reach its maximum value.
- 11 An ideal constant current source has infinite resistance.
- 12 Lower the Q-factor of a circuit, narrower is its bandwidth.

(12 × ¼ = 3 weightage)

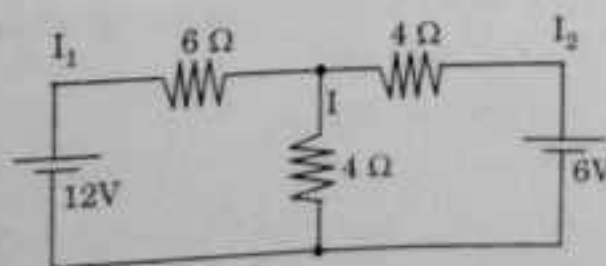
II. Short answer questions (Answer all questions) :

- 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 Show graphically the decay of charge in a series LCR circuit corresponding to over-damped, critically-damped and damped oscillatory cases.
- 19 What do you mean by wattles current ?
- 20 Draw the basic circuit of an a.c. bridge and write down the condition for balance.
- 21 Write down the voltage-current relationship in a purely capacitive and a series RC circuit using  $j$ -operator.

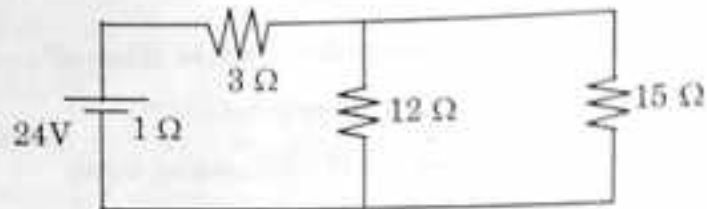
(9 × 1 = 9 weightage)

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

- 22 Obtain an expression for the energy stored in a magnetic field due to the establishment of current.
- 23 Comment on the symmetry of Maxwell's equations in free space.
- 24 Write down the expression for energy density and momentum density of an electromagnetic wave and explain the terms used.
- 25 A coil having  $R = 120 \Omega$  and  $L = 24 \text{ H}$  is connected to a 12 V battery. Determine (i) the time constant of the circuit (ii) current after 0.2 second ; and (iii) current after 1 second.
- 26 A pure resistance of  $50 \Omega$  is in series with a pure 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 Using Thevenin's theorem, find the current through the  $15\ \Omega$  resistance in the following figure :—



(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 Discuss the resonance of a parallel resonant circuit. Compare resonance in series and parallel resonant circuits.

(2 × 4 = 8 weightage)