Total No. of printed pages = 5

3 (Sem 3) PHY M2

2015

PHYSICS

(Major)

Paper : 3.2

(Current Electricity and Magnetostatics)

Full Marks – 60

Time – Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×7=7

(a) Write down the Ohm's law that relates the conductivity, current density and electric field.

(b) Two inductances of co-efficient of self induction L_1 and L_2 are joined in series. What is the net co-efficient of self induction of the combination ?

(c) What do you mean by the time constant in series R-C circuit ?

[Turn over

(d) Why no power is dissipated if a voltage of sinusoidal waveform is applied across a purely inductive or capacitive circuit ?

(e) What is copper losses in transformer ?

(f) Write down the Biot-Savart law.

(g) What is magnetic vector potential ?

2. Answer the following questions : 2×4=8

(a) Set up the e.m.f equation of series LCR a.c circuit.

(b) In a certain thermocouple $E=a\theta + b\theta^2$, where θ^0C is the temperature of the hot junction, the cold junction being at 0^oC, a = 10 microvolts / ^oC and $b = -\frac{1}{40}$ microvolt/^0C. Find the neutral temperature and the temperature of inversion.

(c) Explain the differences between a 'dead-beat galvanometer' and 'ballistic galvanometer'.

(d) Draw the circuit diagram of Anderson's bridge for the measurement of co-efficient of self induction.

3. Answer any *three* of the following questions : 5×3=15

(a) Establish that $\vec{\nabla} . \vec{B} = 0$

(b) Write a short note on Rotating magnetic field.

(c) An alternating voltage of 220 volts and 50 Hz is applied to a circuit which contains an inductance of 0.2 henry and resistance 10 ohms in series. Determine the potential difference across the resistance and the inductance.

(d) The e.m.f of a thermocouple, one junction of which is kept at 0°C, is given by $E=bt+ct^2$. Find the neutral temperature and the Peltier and Thomson co-efficient.

4. (a) Deduce an expression for self inductance of a long solenoid carrying current. 4

(b) An inductor (L = 20 mH), a resistor (R = 100Ω) and a cell (E = 10V) are connected in series. Find the time elapsed before the current reaches 99% of the maximum value. [ln 100=4.6] 3

(c) Establish the relation $\pi_2 - \pi_1 = \frac{\pi_1}{T_1}(T_2 - T_1)$ where π_1 and π_2 are Peltier co-efficients. 3

Or

Why Wheatstone bridge is not suitable for measurement of very low resistance ? Describe with circuit diagram how low resistance can be measured using Kelvin's Double Bridge. 2+8=10

5. (a) In a region the force $\vec{F} = q(\vec{v} \times \vec{B})$ on a charge q is zero. What conclusions can you draw from this ? 2

(b) Using the Biot-Savart law, obtain an expression for the magnetic field due to a long straight conductor carrying steady current. 8

Or

Define magnetic scalar potential. Obtain an expression for the magnetic scalar potential and hence magnetic field near a current carrying loop. 2+6+2=10

6. (a) Derive an expression to show the growth of electric current in a circuit with resistance and self-inductance. 5

(b) What is meant by resonance in an a.c circuit? In an a.c circuit containing L, C and R in series, find the condition under which the resonance is obtained. 2+3=5

Or

What is meant by mutual inductance ? Describe with circuit diagram how the mutual inductance can be measured using Ballistic galvanometer. 2+8=10