

2019

PHYSICS

(Major)

Paper : 3.2

(**Current Electricity and Magnetostatics**)

Full Marks : 60

Time : 3 hours

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

1. Answer the following : 1×7=7
- (a) State Ohm's law.
 - (b) What do you mean by coefficient of self-inductance?
 - (c) What do you mean by the time constant in series R-C circuit?
 - (d) What is impedance?
 - (e) What is transformation ratio?
 - (f) Define Lorentz force.
 - (g) What do you mean by magnetic induction?

(2)

2. Answer the following :

2×4=8

- (a) What are peak value and mean value of alternating current?
- (b) What do you mean by thermocouple and thermo-e.m.f.?
- (c) What are magnetic flux and magnetic flux density?
- (d) Write the relation between true power and power factor.

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

- (a) Calculate the value of the torque on a current loop placed in a uniform magnetic field.
- (b) An e.m.f. of 10 volts is applied to a circuit having a resistance of 10 ohms and an inductance of 0.5 henry. Find the time required by the current to attain 63.2 % of its final value. What is the time constant of the circuit?
- (c) A capacitor of capacitance 0.1 μF is first charged and then discharged through a resistance of 10 megaohms. Find the time, the potential will take to fall to half its original value.

(3)

- (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 coefficient.

- (e) (i) What do you mean by mutual and self-inductance? 2

- (ii) Two coils, a primary of 600 turns and a secondary of 30 turns are wound on an iron ring of radius 0.1 m and cross-section 4×10^{-2} m diameter. Find their mutual inductance (μ for iron = 800). 3

4. Answer any *three* from the following : 10×3=30

- (a) Define the current density at any point. Derive an expression for current density. Prove the equation of continuity

$$\text{div } J + \frac{dy}{dt} = 0$$

- (b) An alternating e.m.f. is applied to a circuit containing an inductor, capacitor and resistor in series. Obtain expression for the current, impedance and phase of current. Obtain the condition for the current to be a resonance with the applied e.m.f. Obtain the resonance frequency.

- (c) A charge capacitor of capacitance C discharges through a circuit containing of a coil of inductance L and a resistance R . Find the charge on the capacitor in t sec after it starts discharging. Deduce the condition under which the discharge is oscillatory. Find the period and frequency of the oscillatory discharge, where R is very small.
- (d) State Biot-Savart law. Using Biot-Savart law, calculate the value of magnetic field due to an infinitely long straight wire carrying a current i amp at a distance d from the wire.
- (e) Write a short note on any *one* of the following :
- (i) Transformer
 - (ii) Anderson's bridge

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