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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) What do you mean by electric current density?
- (b) The coefficient of coupling between two coils is 0.6. What does it mean?
- (c) What is thermocouple?
- (d) The Wheatstone bridge principle is also applicable to AC networks. State true or false
- (e) What is copper loss in transformer?
- (f) If an electron initially moving in the x -direction is subjected to a magnetic field in the z -direction, in which direction the electron will be deflected?
- (g) What do you mean by a magnetic dipole for a current loop?

2. Answer the following :

2×4=8

(a) Draw the circuit diagram of Anderson's bridge for the measurement of inductance.

(b) A condenser of capacitance $10\ \mu\text{F}$ is charged to a potential of 100 volts. On connecting it across an unknown resistance, the voltage is found to fall to 67 volts in 40 seconds. What is the value of R ?

(c) Express the following quantities in exponential form :

(i) j

(ii) $I - j$

(d) Explain the difference between a 'dead-beat galvanometer' and a 'ballistic galvanometer'.

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

(a) Find out an expression for the growth of current in a circuit containing a resistance and inductance. 5

(b) Deduce an expression for self-inductance of a long solenoid carrying current. 5

(c) Describe Peltier and Thomson effect and define thermo-electric power. 2+2+1=5

(d) An a.c. e.m.f. of 200 volts (r.m.s.) frequency 50 Hz is applied to a resistance of 100 ohms and an inductance 0.5 henry in series. Calculate the magnitude and phase of the current. 5

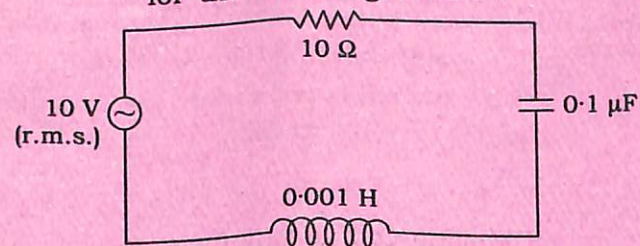
(e) State Ampere's circuital law and prove it. 5

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

(a) State the Kirchhoff's law for the distribution of current in a network. Apply the law to find the current in the galvanometer when the Wheatstone bridge is out of balance. 10

(b) (i) Define and deduce Q -factor. 1+6=7

(ii) Calculate the potential difference across the inductor at resonance for the following circuit : 3

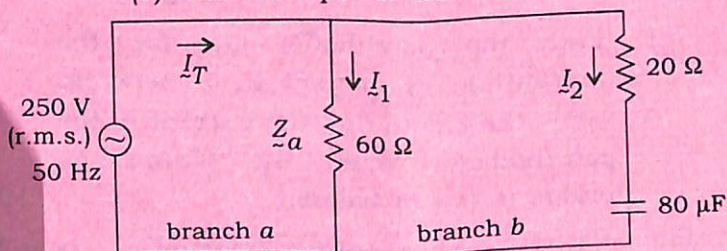


(c) A circuit is made up of two parallel branches a and b . Branch a consists of a resistance of 60 ohms, branch b consists of a resistance of 20 ohms in

(4)

series with a capacitor of capacitance $80 \mu\text{F}$. An e.m.f. of 250 volts (r.m.s.) at 50 Hz is applied to the circuit. Determine—

- (i) the scalar admittance of the circuit;
- (ii) the total r.m.s. current;
- (iii) the r.m.s. current in each branch;
- (iv) the power factor for the circuit;
- (v) the total power absorbed. 10



- (d) Find out an expression for divergence and curl of a magnetic field. 5+5=10
- (e) What do you mean by magnetic scalar potential and vector potential? Derive an expression for the vector potential of current loop. 1+1+8=10
- (f) Write short notes on the following : 5 \times 2=10
 - (i) Moving-coil galvanometer
 - (ii) Self- and mutual-induction

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