PART B
General Engineering
(ELECTRICAL)

1.
(a) The resistance of copper winding of a motor at room temperature of 25°C is 3.0 Ω. After an extended operation of the motor at full load, the winding resistance increases to 4.0 Ω. Find the temperature rise. Given that the temperature coefficient of copper at 0°C is 0.00426 Ω/°C/Ω.

(b) A toaster rated at 2000 W, 240 V is connected to a 230 V supply. Will the toaster be damaged? Will its rating be affected?

(c) Define the following terms:
(i) Drift velocity
(ii) Current density
(iii) Power
(iv) Electromotive force

(d) The domestic power load in a house comprises the following:
(i) 10 lamps of 100 W each
(ii) 5 fans of 80 W each
(iii) 1 refrigerator of 0.5 hp
(iv) 1 heater of 1 kW
Calculate the total current taken from the supply of 230 V.

2.
(a) Using Kirchhoff’s law, determine the current $I_A$ and $I_B$ in the network shown in Figure 1.

![Figure 1](image_url)

15
15
20
10
15
(b) For the circuit shown in Figure 2, find I such that current in the 100 Ω resistor is zero.

![Figure 2](image)

(c) A series combination of two capacitances $C_1 = 5 \, \mu F$ and $C_2 = 10 \, \mu F$ is connected across a dc supply of 300 V. Determine the

(i) charge
(ii) voltage
(iii) energy stored in each capacitor

(d) Define the following terms:

(i) Self-inductance
(ii) Flux
(iii) RMS value of alternating waves

3. (a) A circular coil of area 300 cm$^2$ and 25 turns rotates about its vertical diameter with an angular speed of 40 rad/sec in a uniform horizontal magnetic field of magnitude 0.05 T. Find the maximum voltage induced in the coil.

(b) Define the following terms:

(i) Reluctance
(ii) Permeance
(iii) Magnetic Field Strength
A coil has 1000 turns enclosing a magnetic circuit of 20 cm² in cross-section, with 4 A current in the coil, the flux density is 1.5 Wb/m², and with 8 A current, it is 1.9 Wb/m². Find the mean value of inductance between these current limits and the induced emf if the current decreases from 8 A to 4 A in 0.06 sec.

A coil A of 1200 turns and another coil B of 800 turns lie near each other so that 60 percent of the flux produced in one links with the other. It is found that a current of 5 A in coil A produces a flux of 0.35 mWb, while the same current in coil B produces a flux of 0.15 mWb. Determine the mutual inductance and coefficient of coupling between the coils.

4. (a) Determine the average and rms value of the resultant current in a wire carrying simultaneously a dc current of 16 A and sinusoidal current of peak value of 1.414 A.

(b) The resistance of a coil is 3 Ω and its time constant is 1.8 sec. At t = 0 sec, a 10 V source is connected to it. Determine the
(i) current at t = 1 sec
(ii) time at which the current attains half of its final value
(iii) initial rate of growth of current

(c) Explain in brief the following:
(i) Energy meter
(ii) CRO
(iii) 2 wattmeter method
(iv) Multimeter

(d) In a moving coil instrument, the coil has a length of 5 cm, a width of 4 cm and 100 turns. The magnetic flux density in the air gap is 0.2 Wb/m². The hair spring provides a controlling torque of \(0.5 \times 10^{-7}\) Nm/degree deflection of the coil. What current will be required to give a deflection of 60°?
5. (a) A shunt generator gives full load output of 30 kW at a terminal voltage of 200 V. The armature and shunt field resistances are 0.01 Ω and 100 Ω respectively. The iron and friction losses are 1000 W. Calculate the

(i) emf generated
(ii) copper losses
(iii) efficiency

\[ E_g = V + I_a R_a \]

(b) Explain dynamic braking of 3-phase induction motor.

(c) Explain in brief the following:
   (i) Fractional kilowatt motors
   (ii) Auto transformers
   (iii) S.C. test of 3-phase transformer

(d) Explain parallel operation of two alternators.

6. (a) Explain in brief of the following:
   (i) Merz-price system of protection
   (ii) Short-circuit current for symmetrical faults
   (iii) Electric welding

(b) How is the rating of a cable determined?

(c) What are the different configurations of BJT? Explain each with suitable circuit diagram.

(d) Explain electric installation of machines and relevant IE rules in brief.