PART—B

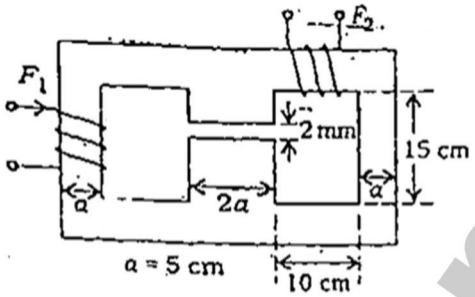
(Electrical and Mechanical)

SECTION—I

(Electrical)

1. (a) Draw electrical analogue of the given magnetic circuit 15

(b) In the magnetic circuit shown, coil F_1 is supplying 4000 AT in the direction indicated. Find the AT of coil F_2 to produce air gap flux of 4 mWb from top to bottom and also current direction. 15



Core thickness = 8 cm

μ for iron = 2500

$\mu_0 = 4\pi \times 10^{-7}$

2. (a) Explain the functioning of a permanent magnet type moving-coil instrument with suitable diagram 15

(b) A 25 kVA, 230/115 V, 50 Hz transformer has the following data :

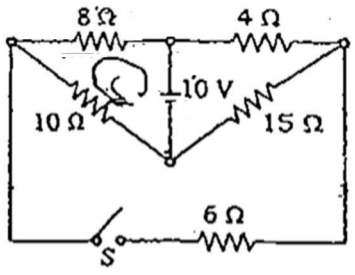
$$r_1 = 0{\cdot}12\,\Omega, \quad r_2 = 0{\cdot}04\,\Omega$$

$$X_1 = 0{\cdot}2\,\Omega, \quad X_2 = 0{\cdot}05\,\Omega$$

Find the transformer loading which will make the primary induced e.m.f. equal in magnitude to the primary terminal voltage when the transformer is carrying full load current. Neglect the magnetizing current. 15

3. (a) State and explain Norton's theorem. 15

(b) Use Thevenin's theorem to find the current through the switch S when it is closed. 15



4. *(a)* Explain in detail about the Ward-Leonard system of speed control of DC motors. 15

(b) A DC shunt motor is operated from 300 V mains. Its no-load speed is 1200 r.p.m. When fully loaded its speed drops to 1100 r.p.m., while it delivers a torque of 400 N m. Find its speed and power when operated with an armature voltage of 600 V, when delivering the same torque. Excitation is assumed unchanged, i.e., the motor field is still excited at 300 V. State any assumption you are required to make. 15

5. *(a)* Explain the Double-field Revolving theory in connection with single-phase induction motor. 15

(b) A 6-pole, 440 V, 3-phase, 50 Hz induction motor has the following parameters of its circuit model (referred to the stator on equivalent star basis) :

$r_1 = 0{\cdot}0$ (stator copper loss negligible), $x_1 = 0{\cdot}7\,\Omega$, $r'_2 = 0{\cdot}3\,\Omega$, $x'_2 = 0{\cdot}7\,\Omega$, $x_m = 35\,\Omega$, rotational loss is 350 W

Calculate net mechanical power output, stator current and power factor when the motor runs at a speed of 950 r.p.m. 15

6. *(a)* Explain in detail armature reaction in synchronous generators. 15

(b) A 600 V, 3-phase, 50 Hz, star-connected synchronous motor has a resistance and synchronous reactance of $0{\cdot}4\,\Omega$ and $7\,\Omega$, respectively. It takes a current of 15 A at unity p.f. when operating with a certain field current. With the field current remaining constant, the load torque is increased until the motor draws a current of 50 A. Find the torque (gross) developed and the new power factor. 15