(vii) If V is the line voltage, I is the line current and φ is the phase angle between them, then the total power drawn by a balanced delta connected three-phase load is equal to
(a) 3VI cosφ (b) 3VI $\sin^2\varphi$
(c) $\sqrt{3}$VI cosφ (d) $\sqrt{3}$VI sinφ.

(viii) An open circuit test on a transformer is performed basically to determine
(a) copper loss (b) iron loss
(c) leakage impedance (d) regulation.

(ix) When the induction motor is standstill, the slip is
(a) Zero (b) 1 (c) infinity (d) 0.5.

(x) The rotor of an induction motor cannot run at synchronous speed, because if it did so, then
(a) rotor emf would be zero (b) rotor current would be zero
(c) rotor torque would be zero (d) all of the above.

Group – B

2. (a) Find the current through 10Ω resistance in the circuit shown in Fig.1 using Thevenin's Theorem.

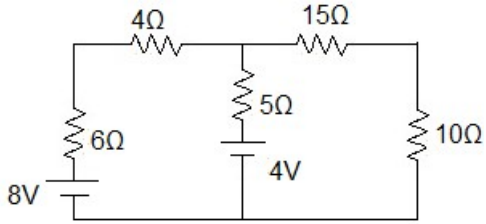


Fig.1

(b) Find the current through 20Ω resistance in the circuit shown in Fig.2 using Superposition Theorem.

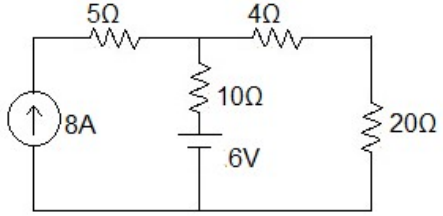


Fig.2

(c) Prove the Maximum Power Transfer theorem for a DC network.

5 + 5 + 2 = 12

3. (a) Derive the emf equation of DC machines.

(b) A 4-pole dc shunt motor working on 220V dc supply takes a line current of 3A at no load while running at 1500rpm. Determine the speed when the motor takes a line current of 50A. Assume armature and field resistance as 0.2Ω and 400Ω respectively.

(c) Draw and explain the torque vs current characteristic of dc series motor.

4 + 5 + 3 = 12

Group – C

4. (a) Derive the expression for the Capacitance of Parallel plate capacitor.

(b) Three capacitors A, B and C are connected in series across 100V d.c. supply. The voltage across the capacitors are 20V, 30V and 50V respectively. If the capacitance of A is 10μF, calculate the capacitances of B and C.

(c) The capacitance of capacitor of two parallel metal plates, each of 200 cm^2 area, separated by a dielectric 4 mm thick, is 0.0004μF. A potential difference of 20kV is applied across it. Calculate (i) the total charge on the plates (ii) the potential gradient in V/m (iii) relative permittivity of dielectric (iv) energy stored in the capacitor.

4 + 4 + 4 = 12

5. (a) A rectangular iron core shown Fig.3 below, has a relative permeability of 1400 and the coil has 500 turns. If the air-gap flux is 1mWb, then find the current through the coil.

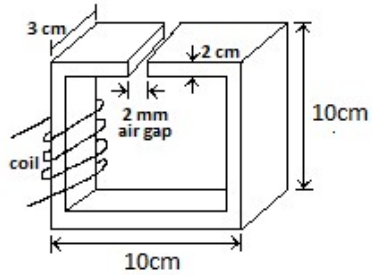


Fig.3

(b) Point out the similarities and dissimilarities of magnetic circuit and electric circuit.

(c) The combined inductance of the two coils connected in series is 0.8H and 0.3H, depending on the relative directions of currents in the coils. If one of the coils, when isolated, has a self inductance of 0.15H, then calculate (i) mutual inductance (ii) coefficient of coupling.

5 + 3 + (2 + 2) = 12

Group – D

6. A series R-L-C circuit containing a resistance of 12Ω, an inductance of 90 mH and a capacitance of 70μF is connected to a 150V, 60Hz supply. Find out (i) Inductive reactance, (ii) capacitive reactance, (iii) Impedance of the circuit, (iv) current flowing thorough the circuit, (v) Voltage across each element, (vi) power factor, (vii) active, reactive and apparent power, (viii) resonant frequency of the circuit, (ix) current at resonance condition. Draw the phasor diagram of the circuit.

9 + 3 = 12

7. (a) Show that 3- phase power can be measured by using two wattmeters.

   (b) A balanced 3-phase 230V load has a power factor of 0.8 lag. Two wattmeters are used to measure power, which shows the input to be 10KW. Find the reading of each wattmeter.

6 + 6 = 12

Group – E

8. The open circuit (O.C.) and short circuit (S.C.) tests conducted on a 230/115V, 1000VA transformer gave the following readings:

O.C. Test :	230V	0.45A	30W
S.C. Test :	19.1V	8.7A	42.3W

   Find the parameters of the equivalent circuit and the efficiency of the transformer at 0.8 power factor and full load.

6 + 6 = 12

9. (a) Explain the principle of operation (or working principle) of a 3-phase squirrel cage Induction Motor.

   (b) The voltage applied to the stator of a 3-phase, 4 pole induction motor has a frequency of 50 Hz. The frequency of the EMF induced in the rotor is 2 Hz. Calculate the slip, and the speed at which motor is running.

   (c) Draw and explain the torque-slip characteristic of a 3-phase induction motor.

4 + (2 + 2) + 4 = 12

BASIC ELECTRICAL ENGINEERING
(ELEC 1001)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

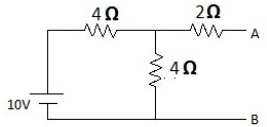
Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) If the source is delivering maximum power to load then efficiency of the circuit is
   (a) 25%
   (b) 50%
   (c) 75%
   (d) dependent on the circuit parameters.

   (ii) The Thevenin's voltage and resistance across 'AB' of the circuit are respectively



   (a) 5V, 4Ω (b) 10V, 2 Ω (c) 5V, 5.33 Ω (d) 10V, 8 Ω.

   (iii) Starter in d.c. motor is used to
   (a) reduce starting current (b) increase starting current
   (c) increase the speed (d) reduce the speed

   (iv) Energy stored in an inductor is given by
   (a) $\frac{1}{2}LI^2$ (b) $\frac{1}{2}L^2I$ (c) LI^2 (d) L^2I

   (v) Power factor of an A.C. circuit is equal to
   (a) R/X_l (b) R/X_c (c) R/Z (d) Z/R.

   (vi) The reluctance of a magnetic circuit is given by
   (a) $\frac{l}{\mu_r\mu_0 A}$ (b) $\frac{\phi}{N}$ (c) $\frac{l}{\mu_0 A}$ (d) $\frac{l}{\mu_r A}$