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) AC voltmeter is normally calibrated in terms of
(a) average value (b) instantaneous value
(c) peak value (d) RMS value.

(ii) Admittance is the reciprocal of
(a) inductive reactance (b) reactive power
(c) capacitive reactance (d) impedance.

(iii) The reluctance of magnetic circuit is analogous to _____ in an electric circuit.
(a) potential difference (b) current
(c) resistance (d) conductance.

(iv) In a pure capacitive circuit the current
(a) is always in phase with the supply voltage
(b) always lags behind the supply voltage by an angle of 90^0
(c) always leads the supply voltage by an angle of 90^0
(d) may lag or lead the supply voltage by an angle of 90^0.

(v) Eddy current loss in a transformer can be reduced by using
(a) laminated core (b) silicon steel
(c) oil (d) solid steel.

(vi) In a balanced 3-phase system, the emfs are
(a) 30° apart (b) 60° apart (c) 90° apart (d) 120° apart.

(vii) Kirchhoff's voltage law is used for
(a) Loop analysis
(b) Finding out equivalent current
(c) Finding out equivalent resistance
(d) Nodal analysis.

(viii) At maximum efficiency of the transformer
(a) Iron loss = Copper loss (b) Iron loss > Copper loss
(c) Iron loss < Copper loss (d) Iron loss = 2 × Copper loss.

(ix) For a wave connected dc machine, for number of poles = 4, the number of parallel path is
(a) 4 (b) 2 (c) 8 (d) 16.

(x) Open circuit test on the transformer is performed to determine
(a) core loss (b) load current
(c) copper loss (d) friction and windage loss.

Group – B

2. (a) Find current through the 2Ω resistance using Thevenin's theorem for the circuit of Fig.1

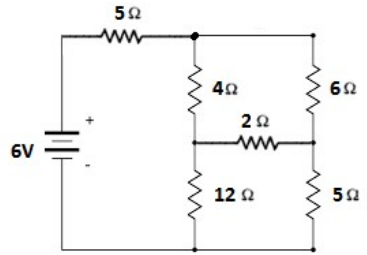

Fig. 1

(b) State and prove Maximum Power Transfer theorem for a DC network.
7 + (2 + 3) = 12

3. (a) State the Ampere's Circuital law.

(b) An iron ring is made up of three parts, l_1 =12cm, a_1= 6cm^2; l_2=10cm, a_2=5cm^2, l_3=8cm and a_3= 4cm^2. It is wound with a coil of 200 turns. Determine the exciting current required to create a flux of 0.5m wb in the iron ring. (Given μ_1 = 2670, μ_2 = 1055, μ_3 = 680). The symbols l and a represent the lengths and the cross sections of the magnetic circuit segments, respectively. μ represents relative permeability.

(c) Define self-inductance, mutual inductance and coefficient of coupling.
3 + 3 + 6 = 12

Group – C

4. (a) Define RMS value, Average value, Form factor and Peak factor of an alternating quantity.

(b) Find the Average and R.M.S. of the waveform shown in Figure 2.

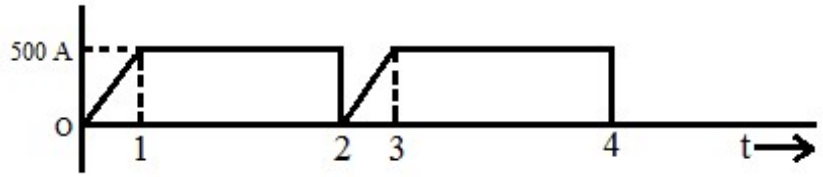

Figure 2

(2 + 2 + 2 + 2) + (2 + 2) = 12

5. (a) A parallel circuit consists of two branches. One branch consists of a resistance 15 ohms and an inductance of 0.05H in series; another a resistance of 20 ohms and a capacitance of 100μF in series. The circuit is energised by an ac source 200V, 50Hz. Find (i) the current in each branch and the total current, (ii) power factor of the parallel circuit.

(b) What do you mean by series resonance? Find the expression for resonating frequency in series RLC circuit. Draw the phasor diagram under resonance condition.

(6 + 2) + (1 + 2 + 1) = 12

Group – D

6. (a) Explain the method of measurement of balanced three phase power by two wattmeter method. Draw the neat circuit diagram.

(b) Three coils each having resistance of 10 Ω and series reactance of 10 Ω are connected in star across a 400 V, three-phase line. Calculate the line current and readings on the two wattmeters which are connected to measure the total power.

6 + 6 = 12

7. (a) Derive the torque equation of a D.C. motor.

(b) What is the necessity of a starter for a D.C. motor?

(c) A 440 V D.C. compound generator has an armature, series field and shunt field resistance of 0.5 Ω, 1 Ω and 200 Ω respectively. Calculate the generated voltage while delivering 40 A to external circuit for both long-shunt and short-shunt connections.

4 + 2 + 6 = 12

Group – E

8. (a) Derive the emf equation of a single-phase transformer.

(b) A 8 kVA, 440/2000V, 50 Hz single phase transformer gave the following test results:
Open circuit test: 440V, 0.8 A, 80 W
Short circuit test: 50 V, 4 A, 20 W
Calculate (i) the magnetizing current and the component corresponding to iron losses at normal voltage and frequency, (ii) the efficiency on full load at 0.8 power factor, (iii) the voltage regulation at full load and unity power factor.

3 + (3 + 3 + 3) = 12

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

(b) A 4-pole, 3-phase induction motor operates from a supply, whose frequency is 50 Hz. Calculate (i) the speed at which the magnetic field of the stator is rotating; (ii) the speed of the rotor, when the slip is 0.04; (iii) the frequency of the rotor currents, when the slip is 0.03, and (iv) the frequency of the rotor currents at stand-still.

4 + (2 + 2 + 2 + 2) = 12