2014

BASIC ELECTRICAL ENGINEERING

(ELEC 1001)

Time Alloted : 3 Hours *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 answer for each of the following questions : **[10×1=10]**

   i) For maximum power transfer, the Thevenin's equivalent resistance of the network must be equal to
   (a) half of the load resistance
   (b) the load resistance
   (c) double the load resistance
   (d) zero

   ii) In a transformer, electric power is transformed from one circuit to another circuit without change in
   (a) voltage (b) current
   (c) frequency (d) turns

iii) In a series R-L-C circuit, current will lag the voltage if

(a) $X_L > X_C$ (b) $X_L < X_C$

(c) $X_L = X_C$ (d) $X_L = 0\ \Omega$

iv) The DC motor needs a starter during starting to control

(a) speed (b) armature current

(c) field current (d) flux

v) The number of parallel paths in wave connected armature winding of a DC machine is

(a) number of poles (b) half of number of poles

(c) two (d) four

vi) For balanced delta connected 3-phase system, the phase current is given by

a) $I_P = I_L$ (b) $I_P = I_L / 1.732$

(c) $I_P = 1.732\ I_L$ (d) $I_P = 1.414\ I_L$

vii) If the peak value of a sine wave is 100 V, then its rms value will be

(a) 70.7 V (b) 63.6 V

(c) 10 V (d) 88 V

viii) AC voltmeter and ammeters are normally calibrated in

(a) average value (b) instantaneous value

(c) peak value (d) RMS value

ix) Hysteresis loss in a transformer can be reduced by using

(a) laminated core (b) silicon steel

(c) oil (d) none of these

x) A 50 Hz three phase induction motor has rated speed of 725 rpm. The number of poles is

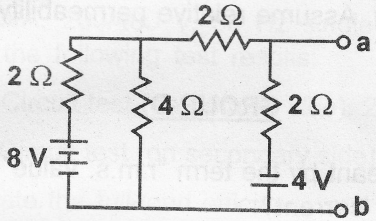
(a) 2 (b) 6

(c) 4 (d) 8

GROUP - B

2. (a) State and prove 'Maximum Power Transfer' theorem.

   (b) In the circuit shown in figure below a resistance R_L=10Ω is connected across terminal ab. Find the current through R_L using Thevenin's theorem. For which value of R_L maximum power will be delivered to R_L?



4+(6+2) = 12

3. (a) Deduce the e.m.f. equation of a D.C. generator.

   (b) What do you mean by 'Critical resistance' and 'Critical speed' of shunt generator?

   (c) A D.C. shunt generator is used to supply 10A current to a load at a terminal voltage of 220V. It has armature resistance and field resistance 0.2Ω and 220Ω respectively. Find (i) the field current, (ii) Armature current, (iii) Armature voltage, (iv) Power supplied to the load and (v) Power generated in armature.

4+3+5 = 12

GROUP-C

4. (a) State and prove Gauss's Theorem.

   (b) Three equal charges, each of magnitude 3×10^{-6} C, are placed at three corners of a right-angled triangle of sides 3 cm, 4 cm and 5 cm. Find the force on the charge at the right-angle corner. **6+6 = 12**

5. (a) "A magnetic circuit is analogous to an electric circuit" — comment on this statement.

(b) A coil of insulated wire with 500 turns and having resistance of 4Ω is closely wound on an iron ring. The ring has a mean diameter of 0.25 m and a uniform cross-sectional area of 700 mm^2. Calculate the total flux in the ring when a DC supply of 6V is applied across the winding. Assume relative permeability of iron is 550.

5+7 = 12

GROUP-D

6. (a) What is meant by the term "r.m.s. value" of a sinusoidal alternating current?

(b) An A.C. series circuit consisting of a pure resistance of 25Ω, inductance of 0.15 H and capacitance of 80 μF is supplied from a 230 V, 50 Hz single phase A.C. Find (i) the impedance of the circuit, (ii) the current, (iii) the power drawn by the circuit from the supply and (iv) the power factor.

(c) Draw the phasor diagram for part (b) above showing the current and voltages across the resistance, inductance and the capacitance. **2+8+2 = 12**

7. (a) Explain the method of measurement of balanced three phase power by two wattmeter method with the help of a circuit diagram.

(b) Three equal impedances (6 + j8) Ω are connected in Y across a 400 V, 3 phase, 50 Hz supply. Calculate (i) the line current and the phase current (ii) the power factor (iii) active and reactive powers drawn by the load per phase. **6+6 = 12**

GROUP-E

8. (a) Justify the use of laminated silicon steel core in a transformer.

   (b) Draw the phasor diagram of a single phase transformer for a lagging power factor load.

   (c) A 4 KVA, 200/400 V, 50 Hz single phase transformer gives the following test results:

   Open Circuit test (on primary side): 200 V, 0.8 A. 50 W.

   Short Circuit test (on secondary side): 17.5 V, 9 A, 50 W.

   Calculate the full-load efficiency and secondary terminal voltage when supplying full-load secondary current at 0.8 power factor lagging. **2+3+7 = 12**

9. (a) Explain how rotating magnetic field is produced in a three phase induction motor.

   (b) A 3 phase, 4 pole, 50 Hz induction motor has a slip of 1% at no load and 3% at full load.

   Calculate (i) synchronous speed (ii) no load speed (iii) full load speed (iv) frequency of rotor current at standstill (v) frequency of rotor current at full load. **4+8 = 12**
