B.Tech/BT/CE/CHE/EE/ME/2nd Sem/ELEC-1001/2016

2016

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 alternatives for the following : **[10×1=10]**

i) In a pure inductive circuit the current

(a) is always in phase with the supply voltage

(b) always lags behind the supply voltage by an angle 90°

(c) always leads the supply voltage by an angle 90°

(d) may lag or lead the supply voltage by an angle 90°

ii) When Thevenizing a circuit, the Thevenin voltage V_{TH} is equal to

(a) source voltage present in the circuit

(b) infinite

(c) open circuit Voltage across the terminals

(d) short circuit Voltage across the terminals

iii) The armature of a dc machine is laminated

(a) to reduce eddy current loss

(b) hysteresis loss

(c) to reduce inductance

(d) to reduce weight

iv) For any medium, what is the relation between the electric flux density D and electric field intensity E?

(a) $D = \varepsilon_0 E$ (b) $D = \varepsilon_0 \varepsilon_r E$

(c) $D = E$ (d) $D = \frac{\varepsilon_0 E}{\varepsilon_r}$

v) The magnetic energy stored in a coil is given by

(a) $\frac{1}{2} LI^2$ (b) $\frac{1}{2} IL^2$

(c) $\frac{1}{2} BH^2$ (d) $\frac{1}{2} HB^2$

vi) In a three phase star connected system, the relation between place voltage (V_P) and line voltage (V_L) is

(a) $V_P = V_L$ (b) $V_P = \sqrt{3} V_L$

(c) $V_P = V_L / \sqrt{3}$ (d) $V_P = V_L / 2$

vii) The efficiency of a transformer will be maximum when

(a) eddy current loss = hysteresis loss

(b) core loss = copper lose

(c) copper loss = hysteresis loss

(d) eddy current loss = copper loss

viii) When maximum power is transferred in a linear active bilateral circuit, the value of maximum power is

(a) $\frac{V^2}{2R_L}$ (b) $\frac{V}{I^2R_L}$

(c) $\frac{2V}{R_L}$ (d) $\frac{V^2}{4R_L}$

ix) The rotor of an induction motor runs

(a) at Synchronous speed

(b) below synchronous speed

(c) above synchronous speed

(d) at any of the above speed

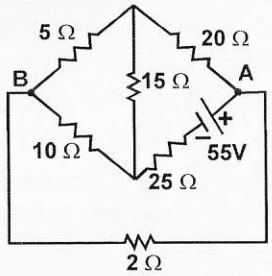
x) The reluctance of magnetic circuit is analogous to which quantity of an electric circuit?

(a) potential difference (b) current

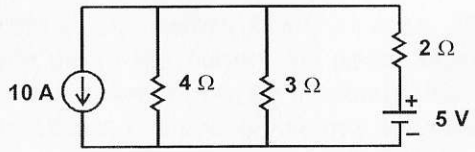
(c) resistance (d) conductance

GROUP - B

2. (a) Calculate the current through 2Ω resistor in the following circuit by using Thevenin's theorem. Hence convert the Thevenin's equivalent circuit into Norton's equivalent circuit.



(b) Use superposition theorem to find out the current through 4Ω resistor in the following circuit.



(6+2)+4 = 12

3. (a) Describe the Open Circuit Characteristic of dc generator. Explain the term 'residual voltage'.

(b) A 4 pole, 600 V wave wound D.C. series generator has 600 conductors. It is used to supply power of 9KW. Find load current and flux per pole if it is running at a speed of 1000 rpm. Armature resistance and field resistance are 0.3Ω and 0.5Ω respectively.

(4+2)+6 = 12

GROUP - C

4. (a) Deduce the expression for capacitance between concentric spherical conducting electrodes with outer sphere earthed.

   (b) The capacitance of a capacitor formed by two parallel metal plates each 200cm^2 in area separated by a dielectric 4mm thick is 0.0004μF. A potential difference of 20kV is applied. Calculate (i) the total charge on the plates (ii) potential gradient in the dielectric (iii) the relative permittivity of the dielectric and (iv) the flux density.

   (c) Derive an expression for the energy stored in a condenser of capacitance C farads charged to a potential difference of V volts.

(5)+(4)+3 = 12

5. (a) Write four statements comparing magnetic circuit with electric circuit.

   (b) Define self-inductance,mutual inductance and coefficient of coupling.

   (c) The mean length of iron path of an electromagnet is 120cm. Its cross sectional area is 16 cm^2. It consists of an air gap of 1mm. It is excited by a coil with 400 turns. Determine the current required to produce a flux of 1.6 mwb. The relative permeability of iron is considered as 600. Neglect fringing and leakage effects.

2+(2+2+1)+5 = 12

Group - D

6. (a) Find the R.M.S.value and the average value of half wave rectified sinusoidal voltage, in terms of the peak value.

   (b) The impedance Z_1 and Z_2 are connected in parallel across a 200V, 50 Hz supply. Z_1 carries 5A at 0.8 lagging p.f. If the total current is 10A at 0.85 lagging p.f., determine (i) value of Z_1 and Z_2 and (ii) total power delivered by the supply.

   (c) What is resonance? Deduce the expression for frequency at which resonance occurs in a series RLC circuit.

(2+2)+(4+1)+(1+2) = 12

7. (a) Three equal impedances each of $(8+j12)\Omega$ are connected in star across 415V, 3 phase, 50 Hz supply. Calculate the (i) line current, (ii) power factor, (iii) active and reactive power drawn by the load. Also draw phasor diagram showing all phase voltages and phase currents.

   (b) Two wattmeters are connected to measure the input to a balanced three-phase circuit. The readings of the wattmeters are 1600 watt and 800 watt respectively. Find the power factor of the circuit when (i) both readings are positive and (ii) when the later reading is obtained after reversing the current coil of the wattmeter.

(2+1+2+2)+(2½+2½) = 12

GROUP - E

8. (a) Derive the condition for maximum regulation for a single phase transformer.

   (b) Draw the equivalent circuit of transformer referred to primary side.

(c) The primary and secondary windings of a 20 kVA transformer have resistance of 2.1Ω and 0.026Ω respectively. The primary and secondary voltages are 2000V and 220V respectively and the core loss is 200W. Calculate the efficiency at half-load assuming the power factor of the load at 0.8 lagging.

(3)+3+6 = 12

9. (a) "In 3-phase Induction motor the flow of 3-phase currents in the stator winding produces a rotating magnetic field of constant amplitude and at synchronous speed". Justify or correct the statement with necessary explanations

(b) A 220 V, 3 phase, 2-pole, 50 Hz induction motor is running at a slip of 5%. Find

(i) the speed of the rotating field relative to stator winding.

(ii) the rotor speed.

(iii) the frequency of rotor induced emf.

(iv) the slip speed of the rotor.

6+4+4 = 12