

2015

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 for the following : **[10×1=10]**
 - i) Three resistors of 2Ω , 3Ω and 4Ω are in parallel. In which resistor power dissipation will be maximum?
 - (a) 2Ω
 - (b) 3Ω
 - (c) 4Ω
 - (d) equal in all resistors
 - ii) For additive flux of two coils connected in series the equivalent inductance can be expressed as
 - (a) L_1+L_2-M
 - (b) L_1+L_2+2M
 - (c) L_1+L_2+M
 - (d) L_1+L_2-2M

iii) The reluctance of a magnetic circuit is given by

(a) $\frac{\ell}{\mu_r \mu_0 A}$

(b) $\frac{\phi}{NI}$

(c) $\frac{\ell}{\mu_0 A}$

(d) $\frac{\ell}{\mu_r A}$

iv) Kirchhoff's current law is used in

(a) loop analysis

(b) node analysis

(c) determination of equivalent resistance

(d) determination of equivalent voltage

v) Electric potential inside a solid charged metallic sphere is

(a) constant

(b) zero

(c) maximum

(d) minimum

vi) In a series R-L-C circuit, current will lead the voltage if

(a) $X_L > X_C$

(b) $X_L < X_C$

(c) $X_L = X_C$

(d) $X_L = 0\Omega$

vii) At maximum efficiency of the transformer

(a) iron loss = copper loss

(b) iron loss > copper loss

(c) iron loss < copper loss

(d) iron loss = 0.5(copper loss)

viii) For balanced star connected 3-phase system, the relation between phase current (I_p) and line current (I_L) is given by

(a) $I_p = I_L$

(b) $I_p = I_L/1.732$

(c) $I_p = 1.732I_L$

(d) $I_p = 1.414I_L$

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

(a) 2 poles

(b) 6 poles

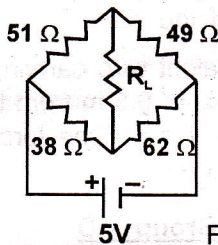
(c) 4 poles

(d) 8 poles

- x) AC voltmeter and ammeters are normally calibrated in
 (a) average value (b) instantaneous value
 (c) peak value (d) RMS value

GROUP - B

2. (a) Three resistances R_a , R_b and R_c are connected in star. Find the expression of the resistances for the equivalent delta connected network.
- (b) For the network shown in Fig. 1, Find
- the current through $R_L = 5\Omega$ using Norton's theorem.
 - the value of R_L for which it will draw maximum power from the circuit.
 - power consumed by R_L under maximum power transfer condition.



$$4 + (5 + 1 + 2) = 12$$

Fig. (1)

3. (a) A 4-pole lap wound armature of a dc shunt generator has 62 slots with 8 conductors per slot. The flux per pole is 0.035Wb. Determine the generated voltage when the machine runs at 750 rpm.
- (b) Derive the speed and torque equations of dc motor.

$$4 + (4 + 4) = 12$$

GROUP - C

4. (a) State and prove Gauss's theorem.
- (b) In a concentric cable capacitor, the diameters of the inner and outer cylinders are 3 mm and 10 mm respectively. If ϵ_r for insulation is 3, find the capacitance per meter. If a potential difference of 600V is applied between the conductors, calculate the value of the electric field and electric flux density
- (i) at the surface of the inner conductor
- (ii) at the inner surface of the outer conductor

4+(4+4) = 12

5. (a) State Ampere's Circuital Law.
- (b) A long straight wire carrying a current of 10 A is placed in air. Assume the relative permeability of air to be unity. Find the magnetic field intensity at a distance of 0.5 m from the centre of the wire.
- (c) If another long straight wire carrying a current of 3 A is placed at a distance of 0.5 m from the first wire, find the direction and magnitude of the force per meter existing between the two wires.

4+3+5 = 12

Group - D

6. (a) Find the average value and the rms value of the full wave rectified sine wave.
- (b) A series RC circuit, with $R = 10\Omega$, has an impedance with an angle of -45° at $f_1 = 500$ Hz. Find the frequency for which the magnitude of the impedance is twice that at f_1 .
- (c) A phasor voltage $\bar{V} = 120\angle 45^\circ$ V is applied across an impedance $\bar{Z} = 15\angle 25^\circ\Omega$. Derive an expression for instantaneous power and the value of average power fed to the impedance. Given $\omega = 50 \frac{\text{rad}}{\text{s}}$.

4+4+4 = 12

7. A three-phase four-wire, RYB system, with an effective line voltage of 110V, has three impedances of $20\angle -45^\circ\Omega$ in a star-connection.

(i) Determine the line currents.

(ii) Draw the voltage-current phasor diagram. **8+4 = 12**

GROUP - E

8. A 100 kVA transformer has a primary and secondary turns 500 and 100 respectively. Its primary and secondary resistance and reactance are :

$R_1 = 0.2\Omega$, $X_1 = 1.2\Omega$, $R_2 = 0.01\Omega$ and $X_2 = 0.05\Omega$ respectively. The supply voltage is 2000 V, Calculate :

(i) equivalent resistance and reactance referred to the primary side.

(ii) voltage regulation and secondary voltage at a power factor of 0.8 lagging.

(iii) the power factor for zero voltage regulation.

4+6+2 = 12

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

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

(i) synchronous speed

(ii) non-load speed

(iii) full-load speed

(iv) frequency of rotor current at stand-still

(v) frequency of rotor current at full load

7+(1+1+1+1+1) = 12