Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (OLD)/SEM-2/EE-201/2013

2013

BASIC ELECTRICAL ENGINEERING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$

   i) In three-phase induction motor

      a) 3-phase supply is to be given to the stator winding and *d.c.* supply the rotor winding

      b) only 3-phase supply is to be given to the stator winding

      c) 3-phase supply is to be given to both stator and rotor winding

      d) 3-phase supply is to be given to rotor winding.

   ii) A 400 V, 50 Hz three-phase induction motor rotates at 1440 rpm on full-load. The motor is wounded for

      a) 2 poles b) 4 poles

      c) 6 poles d) 8 poles.

iii) The slip of 400 V, 3-phase, 4-pole induction motor when rotating at 1440 rpm is

a) 2% b) 3%

c) 4% d) 5%.

iv) A sinusoidal voltage is represented as $v = 141{\cdot}4 \sin\left(314{\cdot}18t - \frac{\pi}{2}\right)$. Its *rms* value of voltages, frequency and phase angle are respectively

a) 141·42 V, 314·16 Hz, 90°

b) 100 V, 100 Hz, – 90°

c) 87·92 V, 56 Hz, 90°

d) 200 V, 50 Hz, – 90°.

v) The direction of current in an *a.c.* circuit is

a) always in one direction

b) varying from time to time

c) unpredictable

d) from positive to negative.

vi) In a three-phase star connected system, the relation between the phase and the line voltage is

a) $V_p = V_L$ b) $V_p = \sqrt{3}\, V_L$

c) $V_p = V_L / \sqrt{3}$ d) $V_p = V_L / 3$.

vii) When a pure inductance is connected to an *a.c.* source, the voltage ..... the current through it by ..... .

a) lags, 90° b) leads, 90°

c) lags, 45° d) leads, 45°.

viii) The power consumed by a pure capacitance connected to *a.c.* source is

a) zero b) very low

c) high d) infinite.

ix) In a series RL circuit the phase difference between the applied *a.c.* voltage and current increases when

a) R is increased

b) X_L is increased

c) X_L is decreased

d) supply frequency is increased.

x) When a phasor is multiplied by j and $-j$, it is rotated through ..... in the anticlockwise direction respectively by

a) 90°, 270° b) 90°, 90°

c) 90°, 180° d) 270°, 90°.

xi) An *a.c.* voltage of $(100 + j\,60)$ V is applied to a circuit to give a current of $(-4 + j\,10)$ A. The power dissipated by the current is

a) – 100 W b) 100 W

c) 200 W d) 400 W.

xii) In a parallel *a.c.* circuit, if the supply frequency is greater than the resonant frequency, then the circuit is

a) inductive b) resistive

c) capacitive d) none of these.

xiii) Q factor of a series circuit consisting R = 10 ohms, L = 0·1 H and C = 10 μF is

a) 115 b) 100

c) 10 d) 1.

xiv) If a parallel circuit is shunted by a resistance then the

a) Q factor is increased

b) impedance is decreased

c) both (a) & (b)

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A 220 volts separately excited DC machine has an armature resistance of 0·4 Ω. If the load current is 20 ampere, find the induced *emf* when the machine operates

   i) as a motor

   ii) as a generator.

3. A 415 V / 220 V transformer takes a no-load current of 1 A and operates at a power factor of 0·19 lagging when the secondary supplies a current of 100 A at 0·8 p.f. lagging. Find the primary current.

4. A 6-pole, lap connected D.C. generator with 125 coils generates a voltage of 400 volts on open circuit when running at 1200 rpm. Find the useful flux per pole. For the same value of the flux per pole, find the voltage at open circuit when the machine runs at 1000 rpm.

5. Describe the Open Circuit Characteristics (OCC) of a D.C. generator.

6. Explain the method of measurement of balanced three phases power by two wattmeter method under different power factor conditions.

7. A 3-phase, 6-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 rotor current at full load.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. a) Explain the method of measurement of balanced 3-phage power by 2-wattmeter method. Draw the neat circuit diagram. 7

   b) Three equal impedances (6 + *j* 8) Ω are connected in across a 400 V, 3-phase and 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. 8

9. a) An *a.c.* series circuit consisting of a pure resistance of 25 Ω, inductance of 0·15 H and capacitance of 80 μF is supplied from a 230 V, 50 Hz *a.c.* Find

   i) the impedance of the circuit

   ii) the current

   iii) the power drawn by the circuit

   iv) the power factor.

   b) Draw the phasor diagram. 10 + 5

10. a) Write short notes on the following :

   i) Active & ractive power

   ii) Power factor

   iii) Apparent power.

   b) The equation of an alternating current is

   $i = 62{\cdot}35 \sin 323\, t$ A. Determine its

   i) maximum value

   ii) frequency

   iii) *rms* value

   iv) average value

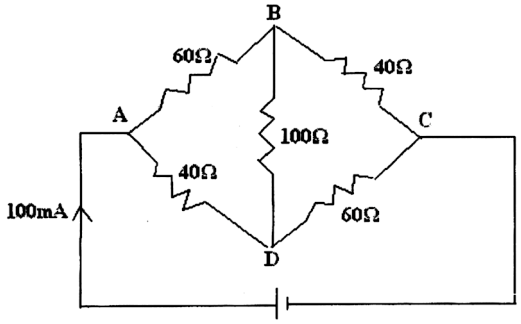
   v) form factor.

11. a) Explain why power loss in a pure inductance / pure capacitance is equal to zero in an *a.c.* circuit. 5

b) A coil of resistance 2 ohms and inductance 0·01 H is connected in series with a capacitor across 200 V mains. What must be the capacitance for maximum current at 25 Hz ? Find also the current and voltage in the capacitor. 10

12. a) State and prove Thevenin's theorem. 5

b) Find the currents through R_{BC} , R_{CD} , R_{BD} in the following circuit. 5



c) Explain with reasons as to why transformer core is made up of silicon steel lamination. 5

13. a) Draw the phasor diagram of single phase transformer for lagging power factor load. 5

b) The open circuit and short circuit test-data of a 5 kVA, 200/400 volts, 50 Hz, single phase transformers are :

i) O.C. test : primary voltage = 200 volts, I = 0·75 A, W = 75 W

ii) S.C. test : primary voltage = 18 volts, S.C. current on the secondary side = 12·5 A, W = 60 W.

Find the parameters of the equivalent circuits. 5

c) State and explain Faraday's law of electromagnetism. 5

14. a) Give the speed control methods of 3-phase induction motor. 6

b) A 4-pole, 3-phase, 275 kW, 440 V, 50 Hz, induction motor has a speed of 1460 rpm on full-load. Calculate the slip and speed of the rotating magnetic field. 9

15. Write short notes on the following : 5 × 3

a) Eddy current losses

b) Hysteresis loss

c) Dielectric constant (K)

d) Principle of operation of 3-phase induction motor.

e) Quality factor.