Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/SEM-1/EE-101/2009-10

2009

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 an *a.c.* circuit having R, L & C in series & operating on lagging p.f., increase in frequency will

a) reduce the current

b) increase the current

c) both (a) and (b) are possible

d) have no effect on current drawn.

ii) KCL is a consquences of law of conservation of

a) energy b) change

c) flux d) all of these.

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iii) In a transformer, the resistance between the primary & secondary msut be

a) zero b) 1 kΩ

c) 100 kΩ d) infinite.

iv) The armature of a *d.c.* machine is laminated

a) to reduce the hysteresis losses

b) to reduce the eddy current losses

c) to ruduce the inductance of the armature

d) to reduce the mass of the armature.

v) What will happen if the supply terminals of *d.c.* shunt motor are interchanged ?

a) Motor will stop

b) The motor will run in the same original direction

c) The direction of rotation will reverse

d) Motor will run at a speed lower than the normal speed in the same direction.

vi) The speed at which the rotating magnetic field produced by stator currents rotates is

a) synchronous speed

b) rotor speed

c) greater than synchronous speed

d) lower than synchronous speed.

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vii) A series circuit is given by $z = 5 - J\ 12$. Its susceptance is

a) $\frac{5}{13}$ b) $\frac{5}{169}$

c) $\frac{12}{13}$ d) $\frac{12}{169}$.

viii) The value of the resistance R_L for miximum power transfer will be

dia.

a) 5Ω b) 2Ω

c) 6Ω d) 3Ω.

ix) The *d.c.* motor needs a starter during starting to control

a) speed b) current

c) voltage d) flux.

x) In a 3-phase star connected system, the relation between the phase & line voltage is

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

c) $V_P = \frac{V_L}{\sqrt{3}}$ d) $V_P = \frac{V_L}{3}$.

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xi) The force experienced by a small conductor of length l, carying current I, placed in a magnetic field $\vec{B}$ at an angle θ with respact to $\vec{B}$ is given by

a) BIl b) $BIl \sin \theta$

c) $BIl \cos \theta$ d) zero.

xii) If a *d.c.* series motor is started on no-load, its speed will be

a) normal b) zero

c) infinite d) below normal.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \infty 5 = 15$

2. State & prove Gauss' law. 5

3. a) What is the phasor relationship between the voltages V_{RY} & V_{RN} for a star connected circuit ?

b) Write down the expression for the instantaneous *emf* of a 3-phase system.

c) What are the various ways in which the three-phases of a 3-phase system can be properly connected ?

d) How would you differentiate the energy consumed by a circuit from its power consumption ? 1 + 2 + 1 + 1

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4. The equation for a voltage wave is

$v = 0{\cdot}02 \sin (4000\, t + 30^\circ)$.

Find the frequency, the instantaneous voltage when t = 320 μ sec. What is the time represented by 30° phase difference ?

5. State & explain

a) Biot-Savart law

b) Ampere's circuital law. 5

6. Explain with the help of diagrams, how a rotating magnetic field is produced in the air-gap of a 3-phase induction motor. 5

GROUP – C

(Long Answer Type Questions)

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

7. a) The circuit shown in the figure is connected to a 230 V, 50 Hz supply. Find the value of

i) the current drawn

ii) voltages V_1 & V_2

iii) power factor.

Draw a phasor diagram, indicating the terminal voltages V_1 , V_2 & the supply voltage with respect to current.

Dia.

b) Prove that the average power in an *a.c.* circuit is equal to $V\, I \cos \phi$. Explain the significance of cos ϕ in the expression. 10 + 5

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8. a) Draw & explain the phasor diagram of transformer when it is operating under no-load.

   b) A 5 kVA, 200 / 400 V, 50 Hz single-phase transformer gave the following results :

   OC test : 200 V, 0·7 A, 60 W on *lv* side

   SC test : 22 V, 10 A, 120 W on *hv* side.

   Determine the values of parameters of the equivalent circuit. 5 + 10

9. a) Why does the *d.c.* motor draw a very high current at starting, when started directly on line ?

   b) How can you control the speed of a *d.c.* motor in the lower range of speed which is less than its rated value ?

   c) A 4-pole *d.c.* shunt generator with lap connected armature supplies a load of 100 A at 200 V. The armature resistance is 0·1 Ω & the shunt field resistance is 80 Ω. Find

      i) total armature current

      ii) current per armature path

      iii) *emf* generated.

   Assume a brush contact drop of 2 V. 3 + 5 + 7

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10. a) Deduce an expression of energy stored in magnetic field.

b) An iron ring of mean length 60 cm has an air gap of 2 mm. It is wound with 300 turns of wire. If the relative permeability of iron is 300 when a current of 0·7 A flows through the coil. Find the flux density.

5 + 10

11. a) Solve the network shown in figure, for the current in the 8 Ω resistor by the following methods :

Dia.

i) Superposition theorem

ii) Thevenin's theorem.

b) Three inductive coils, each with a resistance of 15 Ω & an inductance of 0·03 H are connected in star to 3-phase 400 V, 50 Hz supply. Calculate

i) Phase current & line current

ii) Total power absorbed. 10 + 5

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12. a) Define 'slip' of a 3-phase induction motor.

b) Derive the relationship between the frequency of the rotor induced *emf* & the supply frequency to the stator.

c) Sketch & explain the torque-slip characteristics of a 3-phase induction motor.

d) An 8-pole alternator runs at 750 rpm. It supplies power to a 6-pole, 3-phase induction motor, which has a full load slip of 3%. Find the full load speed of the induction motor & the frequency of its rotor *emf*.

2 + 3 + 3 + 7

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