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 series R-L-C circuit, the power factor at resonance is

a) unity b) zero

c) 0·5 d) 0·75

ii) In a transformer, electric power is transformed from one circuit to another without change in

a) voltage b) current

c) frequency d) turns.

iii) The efficiency of a transformer is maximum when

a) copper losses are zero

b) iron losses are zero

c) copper losses are 50% of the iron losses

d) copper losses are equal to iron losses.

iv) For any medium, the electric flux $\vec{D}$ is related to electric intensity $\vec{E}$ by the equation

a) $\vec{D} = \varepsilon_0 \vec{E}$ b) $D = \varepsilon_0 \varepsilon_n \vec{E}$

c) $\vec{D} = \vec{E} / \varepsilon_0 \varepsilon_n$ d) $\vec{D} = \varepsilon_0 \frac{\vec{E}}{\varepsilon_n}$.

v) The direction of *emf* generated in a *dc* generator can be determined from

a) Lenz's law

b) Kirchhoff's law

c) Fleming's left hand rule

d) Fleming's right hand rule.

vi) The reluctance of a magnetic circuit depends on its

a) length

b) cross-sectional area and length

c) resistivity

d) cross-sectional area.

vii) The core of a *dc* machine is laminated to reduce

a) copper loss b) eddy current loss

c) hysteresis loss d) thermal loss.

viii) If $e_1 = A \sin wt$ and $e_2 = B \sin (wt - \phi)$, then

a) e_1 lags e_2 by ϕ

b) e_2 lags e_1 by ϕ

c) e_2 leads e_1 by ϕ

d) e_1 is in phase with e_2 .

ix) In three-phase induction motor

a) 3-phase supply is to be given to the stator winding & *dc* supply to 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.

x) Three resistors of 4 Ω, 6 Ω, and 8 Ω are connected in parallel. In which resistor power dissipation is maximum ?

a) 4 Ω b) 6 Ω

c) 8 Ω d) equal in all resistors.

xi) In a 3-phase system, the phase voltages are

a) 30° apart b) 60° apart

c) 90° apart d) 120° apart.

xii) For a coil with N-turns the self-inductance will be proportional to

a) N b) $\frac{1}{N}$

c) N^2 d) $\frac{1}{N^2}$.

GROUP – B

(Short Answer Type Questions)

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

2. a) What do you understand by the terms electric potential and electric potential difference ?

b) State Gauss's law. 3 + 2

3. Define

a) Linear circuit

b) Non-linear circuit

c) Bilateral circuit

d) Unilateral circuit

e) Network. 5×1

4. Deduce an expression of energy stored of in a magnetic circuit. 5

5. Derive the expression of (i) average (ii) R.M.S. value of a half-wave rectified voltage wave. 5

6. Show that power in a three-phase balanced system can be measured by two wattmeters. 5

GROUP – C

(Long Answer Type Questions)

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

7. a) Find the current through resistance (R_2) for the network shown in the figure using the superposition theorem.

b) Find the value of R_2 for which the power transfer across R_2 is maximum. Find the value of this maximum power. 8 + 7

8. a) Compare magnetic circuit with electric circuit.

   b) Define self-inductance and mutual inductance.

   c) An iron ring of mean length 50 cm has an air-gap of 1 mm and a winding of 200 turns. The relative permeability of iron is 300 when 1 amp current flows through the coil. Determine the flux density. 4 + 4 + 7

9. a) Draw neatly the phasor diagram of a single-phase transformer connected with lagging power factor load.

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

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

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

   Find the parameters of the equivalent circuit referred to the primary and draw the equivalent circuit. 5 + 10

10. a) What do you mean by back *emf* ?

    b) Deduce the *emf* equation of a *dc* generator.

c) A 4-pole, 220 V, *DC* shunt motor has armature and shunt field resistance of 0·2 and 220 Ω respectively. It takes 20 A at 220 V from a source while running at a speed of 1000 rpm, Find

i) field current

ii) armature current

iii) back *emf*

iv) torque developed. 3 + 4 + 8

11. a) Draw the circuit diagram, waveform of voltage and current, phases diagram of (i) purely resistive circuit (ii) purely inductive circuit (iii) purely capacitive circuit, supplied by sinusoidal voltage.

b) A coil takes a current of 2A when connected to a 240 V, 50 Hz sinusoidal supply and consumes 200 W. Calculate the resistance, impedance and inductance of the coil.

c) Deduce the expression of resonance frequency in RLC series circuit. 6 + 6 + 3

12. a) A 3-phase induction motor is self-starting motor. In spite of that why we use various starters to start the 3-phase induction motor ?

b) Explain the supply frequency control method of speed control of 3-phase induction motor.

c) A 6-pole, 50 Hz induction motor has no-load speed 980 rpm and full-load speed 960 rpm.

Calculate :

i) synchronous speed

ii) no-load slip

iii) full-load slip

iv) frequency of rotor at full-load. 3 + 5 + 7