Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (PWE/EE(O))/SEM-4/EE-401/2010

2010
ELECTRICAL MACHINES

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 × 1 = 10

i) In a DC generator, sparking at brushes result due to

a) armature reaction

b) reactance voltage in coil undergoing commutation

c) winding distribution

d) high constant resistance at the brushes.

ii) The function of a commutator in a DC machine is

a) to provide easy speed control

b) to improve commutation

c) to convert AC voltage to DC voltage

d) to convert AC current to DC current.

iii) The back *emf* of a motor at the time of starting is

a) zero b) maximum

c) minimum d) optimum.

iv) A 3-ϕ transformer, over a bank of 3 single phase transformers of equal rating has the advantage(s) of

a) low cost

b) less weight

c) occupation of less space

d) all of these.

v) In a Δ – Δ connection, if one transfer becomes disabled, the capacity will reduce to

a) 66·67% b) 50%

c) 40% d) 57·74%.

vi) The flux involved in the emf equation of a transformer has

a) rms value b) average value

c) total value d) maximum value.

vii) In a 3-ϕ induction motor, the mechanical power developed, on terms of air gap power (P_g) is

a) $(s-1)P_g$ b) $\frac{P_g}{1-s}$

c) $\frac{1}{s}$ d) $(1-s)P_g$.

viii) A 3-ϕ induction motor runs at super-synchronous speed. For self excitation the machine

a) draws real power from the mains

b) draws reactive power from the mains

c) feeds reactive power to the mains

d) generates *emf* at the expanse of residual magnetism.

ix) The stator & rotor of a 3-ϕ induction motor behave like a/an

a) ordinary two winding transformer

b) variable voltage, constant frequency transformer

c) constant voltage, variable frequency transformer

d) variable voltage, variable frequency transformer, V/f remaining constant.

x) Slip test is performed to determine

a) slip

b) direct axis reactance & quadrature axis reactance

c) positive sequence reactance & negative sequence reactance

d) sub-transient reactance.

xi) DC shunt generator has

a) slightly drooping characteristics

b) constant voltage characteristics

c) appreciably rising characteristics

d) appreciably drooping characteristics.

xii) For building up voltage, residual magnetism is essential in field systems of all types of DC generator except

a) series b) shunt

c) compound d) separately excited .

GROUP – B
(Short Answer Type Questions)

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

2. a) What are the conditions to be fulfilled before parallelling two DC compound generators ?

b) What is the difference between compensating winding & interpoles ? 3 + 2

3. a) Why does a shunt motor run at a constant speed ?

b) What will result if the field circuit of a DC motor is opened ? 3 + 2

4. a) Why is it not possible to run an induction motor on synchronous speed ?

b) What factors determine the direction of rotation of induction machine ? 3 + 2

5. a) State the different forms of connections used in 3-ϕ transformers.

b) Where is delta-star connection applied ? 4 + 1

6. Write a note on three winding transformers.

GROUP – C

(Long Answer Type Questions)

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

7. a) Deduce the expression of generated emf of a DC generator.

   b) A 6-pole DC shunt generator supplies full load current at a terminal voltage of 250 V. The armature & field resistances are 0·04 Ω and 100 Ω respectively. It runs at a speed of 100 rpm & has 700 lap connected conductors. The voltage across armature resistance is 7·2 V. Find the following :

      i) Load current

      ii) *emf* generated

      iii) The flux/pole.

      Neglect brush contact drop.

8. a) Explain with relevant circuit diagram, the Ward-Leonard method of speed control.

   b) A 4-pole, 240 V, wave conected DC shunt motor has 1000 conductors & useful flux/pole is 8 mWb. Armature & field resistances one 0·4 Ω & 240 Ω respectively. If the motor draws a current 25 A from the supply mains, find the speed & torque developed by the motor. If magnetic & mechanical losses are 800W, find efficiency at this load. 7 + 8

9. a) Explain the effect of the unbalance loading of a 3-phase transformer.

   b) Write a note on Autotransformer.

   c) Two transformers are connected in open delta supply with a 300 kVA balanced load operating at 0·866 power factor lagging. If the load voltage is 440 V, calculate the following :

      i) kVA supplied by each transformer

      ii) kW supplied by each transformer. 4 + 5 + 6

10. a) What will happen if single phasing occurs while working of a 3ϕ induction motor ?

    b) What is the condition for maximum starting torque for an Induction motor ?

    c) A 3-phase, 6-pole, 50 Hz star connected induction motor delivers useful power 25 kW while running at a speed of 950 rpm. It is connected to a supply of 400 V & takes a current of 60 A. Its stator resistance per phase is 0·14 Ω. Mechanical losses are 900 W. Calculate –

       i) shaft torque

       ii) gross torque developed

       iii) rotor Cu loss

       iv) stator Cu loss

       v) overall efficiency.

       The power factor of the motor is 0·75 (lagging). 3 + 3 + 9

11. a) Discuss a method for 3 phase to six phase conversion with transformers.

b) A 3-phase step-down transformer having turn ratio per phase of 10 takes 10 A when connected to 3·3 kV supply mains. Determine the secondary line voltage, line current & output when the transformer windings are connected in

i) star/delta

ii) delta/star. 5 + 10