*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 : $10 \times 1 = 10$

   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.



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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) $(1-s)P_g$.



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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.

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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-$\phi$ transformers.

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

6. Write a note on three winding transformers.



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**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

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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 3$\phi$ 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

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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

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