



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.

- 4204



- viii) A 3- $\phi$  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- $\phi$  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.

- erator except

## GROUP – B

Answer any *three* of the following.

$$3 \times 5 = 15$$

- 4 + 1



**GROUP – C**

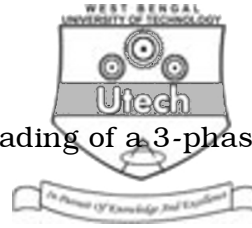
**( Long Answer Type Questions )**

Answer any *three* of the following.

$3 \times 15 = 45$

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  $0.04 \Omega$  and  $100 \Omega$  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 connected DC shunt motor has 1000 conductors & useful flux/pole is 8 mWb. Armature & field resistances are  $0.4 \Omega$  &  $240 \Omega$  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  $3\phi$  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  $0.14 \Omega$ . 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

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