



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(CHE-OLD)/SEM-3/EE-314/2012-13  
2012**

**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) The no. of parallel paths in a 8-pole lap wound DC machine is

- |      |        |
|------|--------|
| a) 2 | b) 4   |
| c) 8 | d) 16. |

ii) Which type of d.c. machine is used for traction ?

- |                       |                |
|-----------------------|----------------|
| a) Shunt              | b) Series      |
| c) Separately excited | d) Long shunt. |

iii) Brushes of machines are made of

- |               |                   |
|---------------|-------------------|
| a) copper     | b) graphite       |
| c) CRGO steel | d) none of these. |

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- iv) Which motor is used in ceiling fan ?
- a) Synchronous motor      b) Servo motor
- c) Induction motor      d) None of these.
- v) Which loss in single phase transformer is measured in open circuit test ?
- a) Core loss      b) Copper loss
- c) Mechanical loss      d) None of these.
- vi) In a DC series motor torque is proportional to
- a)  $I_a^2$       b)  $I_a$
- c)  $V^2$       d)  $V$ .
- vii) In a level compound generator the terminal voltage at half of full load is
- a) same as no load voltage
- b) more than no load voltage
- c) less than no load voltage
- d) same as full load voltage.
- viii) The current in the armature of a DC machine is equal to
- a)  $\frac{V}{R_a}$       b)  $\frac{E_b}{R_a}$
- c)  $\frac{(E_b - V)}{R_a}$       d)  $\frac{(V - E_b)}{R_a}$ .



ix) Transformer oil is used in transformer for

- a) lubrication                      b) insulation
- c) cooling                              d) both (b) &(c),

x) A slip ring induction motor should be started with slip rings

- a) shorted
- b) shorted through resistance
- c) open circuited
- d) none of these.

xi) A 25 HP induction motor should be started with

- a) DOL starter                      b) star delta starter
- c) mechanical starter              d) none of these.

xii) For a 3-phase induction motor synchronous speed ( $N_s$ ), the stator frequency ( $f$ ), and number of poles ( $P$ ) are related by

- a)  $N_s = \frac{P}{120 f}$                       b)  $f = \frac{PN_s}{120}$
- c)  $f = 120 \frac{N_s}{P}$                       d)  $N_s = 120 \frac{P}{f}$



**GROUP – B**

**( Short Answer Type Questions )**

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

2. Derive an expression for torque developed in a d.c. machine. 5
3. What is the function of interpole in DC machine ? 5
4. Describe the function of 3-point starter in DC machine. 5
5. Name the types of alternators based on their rotor construction and state the application of each type. 5
6. Draw and explain the different methods of starting a 3-phase induction motor. 5

**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) What is armature reaction in a DC machine ? Describe the methods for compensating armature reaction.  $7\frac{1}{2}$



- b) A DC shunt generator delivers a power of 50 kW at 250 volts when the armature rotates at a speed of 400 r.p.m. The armature resistance and the field resistance of the machine are  $0.02 \, \Omega$  and  $50 \, \Omega$  respectively. Calculate the speed of the machine when running as a shunt motor taking 25 kW input at a terminal voltage of 250 volts.  $7\frac{1}{2}$
8. a) For a single phase transformer prove that the induced *e.m.f.* can be given by  $E_{rms} = 4.44 \, \Phi_m \, fN$  volts, where all the parameters bear the usual meaning. 8
- b) How many losses take place in a transformer ? Why the core of a transformer is made up of the laminated sheet steel ? Write down the expressions of the hysteresis loss and the eddy current loss. 7
9. a) Describe the methods of speed control of induction motors. 9



- b) A three-phase induction motor is wound for 4-poles and is supplied from a 50 Hz system.

Calculate :

- i) synchronous speed,
  - ii) speed of rotor when slip is 4% and
  - iii) rotor current frequency when rotor runs at 1200 r.p.m.
- 6

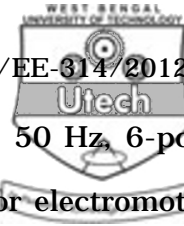
10. a) State the conditions necessary for the operation in parallel of two single phase transformer. 7

- b) A 200 kVA transformer has an efficiency of 98% at full load. If the maximum efficiency occurs at the three quarters of full load, calculate

- i) iron loss
- ii) cu loss at full load
- iii) efficiency at half load.

Ignore magnetizing current and assume a *p.f.* of 0.8 at all loads. 8

11. a) Show that when a balanced 3- $\Phi$  supply is applied across the stator winding of a 3- $\Phi$  induction motor, produces a rotating magnetic field of constant magnitude that is 1.5 times the maximum value of the flux due to any phase. 7



- b) The power input to the rotor of a 440 V, 50 Hz, 6-pole, 3- $\Phi$  induction motor is 100 kW. The rotor electromotive force is observed to make 120 cycles per minute. Calculate
- i) the slip
  - ii) the rotor speed
  - iii) the mechanical power developed
  - iv) the rotor Cu lost per phase
  - v) speed of the stator field with respect to rotor. 8

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