

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (EE-New)/SEM-4/EE-401/2010  
2010**

**ELECTRICAL MACHINES-I**

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 armature core of a d.c. machine is laminated to minimize
- a) copper loss due to eddy current
  - b) copper loss due to hysteresis
  - c) vibration loss
  - d) friction loss.

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- ii) The absence of odd harmonics in magnetising current of a 3-phase transformer, will make the
- a) voltage wave sinusoidal
  - b) voltage wave non-sinusoidal
  - c) load current non-sinusoidal
  - d) none of these.
- iii) If the load on a *d.c.* shunt motor is increased, its speed decreases primarily due to
- a) increase in its flux
  - b) decrease in back *emf*
  - c) increase in armature current
  - d) increase in brushdrop.
- iv) Blocked rotor test on a 3-phase induction motor helps to find out
- a) short circuit power factor
  - b) fixed losses
  - c) motor resistance referred to stator
  - d) none of these.



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ix) Tertiary winding is used in the transformer when connected

- a) delta-delta
- b) star-zigzag
- c) star-star
- d) none of these.

x) Star-delta starting of poly-phase induction motor is equivalent to auto transformer starting with

- a) 85% tapping
- b) 58% tapping
- c) 52% tapping
- d) 33% tapping.

xi) Maximum torque of a 3-phase induction motor is

- a) independent of rotor resistance ' $\gamma_2$ '
- b) directly proportional to ' $\gamma_2$ '
- c) inversely proportional to ' $\gamma_2$ '
- d) proportional to ' $\gamma_2^2$ '.

**GROUP - B**

**( Short Answer Type Questions )**

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

2. a) Draw the flux distribution, m.m.f. distribution due to armature conductors carrying current along with the flux distribution due to the main poles of a *d.c.* machine.  
b) Show the shift of the Magnetic Neutral Plane.  
c) Show the position of the interpoles.  $3 + 1 + 1$
3. Explain the phenomenon of cogging and crawling of a 3-phase induction motor.
4. Determine :
  - a) the demagnetising ampere turns per pole and
  - b) cross magnetising ampere turns per pole in a 440 volt, 4 pole, 25 kW *d.c.* generator with 32 slots having 12 conductors per slot in armature winding lap connected when the brushes are given and actual shift of  $10^\circ$ . The generator is not provided with interpoles.
5. Explain the principle of rotor-resistance starting of slip ring type induction motors.
6. How will you check the polarity of transformer windings before connecting them in star connections ?

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**GROUP - C**

**( Long Answer Type Questions )**

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

7. a) Derive an expression of torque developed in a d.c. motor.
- b) Derive necessary expression to draw the speed torque characteristics of d.c. series and shunt motor.
- c) Bring out the differences and explain why d.c. series motor is suitable for traction over shunt motor from their speed-torque characteristics.  $3 + 5 + 7$
8. a) Draw the connection and phasor diagrams of the following three phase transformers :
- i) Dy 11
  - ii) Yd 1
  - iii) Dz 6
  - iv) Yz 11
  - v) Yy 6.
- b) What are the different phasor groups and what is their utility ?  $12 + 3$

9. a) Show that slip at which maximum torque of a polyphase induction motor occurs is directly proportional to the rotor resistance  $r_2$  but the maximum torque  $T_{em}$  is independent of  $r_2$ .
- b) A 10 kW, 400V, 3-phase, 4-pole, 50 Hz slipping induction motor develops rated output ( i.e., 10 kW ) at rated voltage and frequency and with its sliprings short circuited. The maximum torque equal to twice the full load torque, occurs at a slip of 10% with zero external resistance in the rotor circuit. Stator resistance and rotational losses are neglected.

*Determine :*

- i) slip and rotor speed at full load torque
- ii) rotor ohmic loss at full load torque
- iii) starting torque at rated voltage and frequency.

10 + 5

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10. a) Explain with the help of connection diagram how Scott-connections are used to obtain two phase supply from three phase mains.
- b) Why the teaser winding has 86.6% of number of turns compared to the main winding ?
- c) Why the teaser winding is connected at the centre of the main winding ?
- d) Draw the phasor diagram when the loads connected at the 2 phase side are
- at unity power factor
  - at a power factor of 0.86 lagging.
- e) Mention the steps in drawing the phasor diagrams.

3 + 2 + 2 + 6 + 2

11. Write short notes on any *three* of the following : 3 × 5

- 3 point starter for d.c. motor
- Single phase and 3 phase induction regulators.
- Speed control of three phase induction motor.
- On load tap changer.
- Advantages of auto-transformer over two winding transformer.