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 : $10 \times 1 = 10$

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.

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.

v) If the supply voltage decreases by 4%, the torque in a 3-phase induction motor would decrease by

a) 4% b) 16%

c) 8% d) 7·84%.

vi) The full load slip of a 60 Hz, 12 pol squirrel cage induction motor is 5%. Its full load speed is

a) 600 r.p.m. b) 570 r.p.m.

c) 500 r.p.m. d) 475 r.p.m.

vii) The waveform of armature mmf in a D.C. machine is

a) square b) rectangular

c) triangular d) sinusoidal.

viii) In a *d.c.* series generator, the terminal voltage with the increase in load will

a) decrease b) increase

c) remain constant. d) none of these.

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-deta 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 'γ_2'

b) directly proportional to 'γ_2'

c) inversely proportional to 'γ_2'

d) proportional to 'γ_2^2'.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 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.

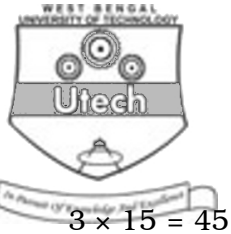
4. Determine :

   a) the dimagnetising 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°. 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 ?



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 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 slipring 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

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

        i) at unity power factor

        ii) 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

    a) 3 point starter for d.c. motor

    b) Single phase and 3 phase induction regulators.

    c) Speed control of three phase induction motor.

    d) On load tap changer.

    e) Advantages of auto-transformer over two winding transformer.