MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : EE-401

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) As compared to Δ-Δ bank, the capacity of the V-V bank of the transformer is

   a) 57.7% b) 56.6%

   c) 58.7% d) 66.6%.

   ii) If a 4 pole lap connected dc generator rotates at a speed of 1200 rpm, no of armature conductors is 80 with useful flux of 0.5 wb. The genreated emf will be :

   a) 780V b) 805V

   c) 800V d) none of these.

iii) The term cogging is associated with the following motor

a) Dc series motor b) Induction motor

c) Repulsion motor d) Dc shunt motor.

iv) The magnetizing current in a transformer is rich in

a) 3rd harmonic b) 5th harmonic

c) 7th harmonic d) 9th harmonic.

v) For a linear electromagnetic circuit, the following statement is true :

a) Field energy is equal to the co-energy

b) Field energy is greater than the co-energy

c) Field energy is less than the co-energy

d) Co-energy is zero.

vi) The emf induced in a conductor rotating in a bi-polar field is

a) ac b) dc

c) both ac and dc d) none of these.

vii) For maximum starting torque of a three phase induction motor

a) $R_2 = X_2$ b) $R_2 = 0.5X_2$

c) $R_2 = 2X_2$ d) $R_2 = 0.4X_2$.

viii) An 8 pole wound rotor induction motor operating at 60 Hz supply is driven at 1800rpm by a prime mover in the opposite direction of the revolving field. The rotor current frequency will be

a) 60 Hz b) 120 Hz

c) 180 Hz d) none of these.

ix) The speed of a dc motor can be increased by

a) Increasing the armature current

b) Decreasing the field current

c) Decreasing the applied voltage

d) Increasing the field current.

x) In an induction motor if the length of the airgap is increased

a) Speed will reduce

b) Efficiency will improve

c) Power factor will be lowered

d) Breakdown torque will be reduced.

xi) Scott connected transformers can convert

a) 3 phase to 2 phase

b) 2 phase to three phase

c) both (a) and (b) above

d) 3 phase to 4 phase.

[Turn over

xii) Two transformers operating in parallel will share the load depending on their

a) ratings

b) leakage impedances

c) efficiency

d) per unit impedance.

xiii) In electromechanical energy conversion devices, a small air gap is left between rotor and the stator in order to

a) reduce the reluctance of the air gap

b) Increase the flux density in the air gap

c) permit mechanical clearance

d) avoid saturation of field.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Prove that for open delta connection the capacity of the transformer bank is reduced by 42.3%.

3. Derive the emf equation for DC generator.

4. Draw and explain the torque speed characteristics of three phase induction motors.

5 **Explain the various methods for reducing armature reaction of DC machines.**

6. Derive the electromechanical energy conversion model based on principle of energy conversion.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) A load of 1400 kVA at 0.866 lagging p.f is supplied by two three phase transformers of 1000 kVA and 500 kVA operating in parallel. The ratio of transformation is the same for both :

6600/400 delta star. If the equivalent secondary impedances are (0.001+j0.003) ohm and (0.0028+j0.005) ohm respectively, calculate the load and power factor of each.

b) It is desired to transform 2400, 5000 kVA three phase power to two phase power by scott connected transformers. Determine the voltage and current ratings of both primary and secondary of each transformer. 8 + 7

8. a) Derive the torque equation of a DC motor.

b) Draw and explain the open circuit characteristics and load characteristics for DC shunt generators. What is critical resistance ?

c) Draw the phasor diagram and the connection diagram for the folowing three phase transformer connections :

i) Dz6 ii) Yy6 iii) Dd6 iv) Dd0 v) Yy0

5 + (4 + 1) + 5

9. a) Draw the equivalent circuit of a three phase induction motor. Discuss the no load test and blocked rotor test for determining the equivalent circuit parameters.

b) What is slip ?

c) Prove that the maximum torque of a three phase induction motor is independent of rotor circuit resistance. (2 + 5) + 2 + 6

10. a) Draw the phasor diagram and connection diagram for double star connection for converting three phase to six phase.

b) Draw and explain the torque-armature current characteristics and speed-armature current characteristics for DC series motors.

c) The power input to a 6 pole, 50 Hz, 3 phase induction motor is 700W at no load and 10 KW at full load. The no load copper losses may be assumed negligible while the full load stator and rotor copper losses are 295W and 310 W respectively. Find the full load speed, shaft torque and efficiency of the motor assuming rotational and core losses to be equal. 4 + (3 + 3) + 5

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

a) Star delta starting of three phase induction motors

b) V-V connection of transformers

c) Swinburne's test.

d) Current transformer

e) MMF distribution for a distributed winding.