

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (EE-N)/SEM-4/EE-401/2011

2011

ELECTRICAL MACHINE – 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 reaction m.m.f. in a d.c machine is

a) sinusoidal

b) trapezoidal

c) rectangular

d) triangular.

ii) For maximum starting torque in an induction motor

a) $r_2 = 0.5x_2$

b) $r_2 = x_2$

c) $r_2 = 2x_2$

d) $x_2 = 0$.

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- iii) The material used for brush is
- a) graphite
 - b) aluminium
 - c) mica
 - d) wood.
- iv) The armature core of a d.c machine is laminated to minimize
- a) Hystousis loss
 - b) Eddy current loss
 - c) Copper loss
 - d) Mechanical loss.
- v) The number of parallel paths for a simple lap winding is equal to
- a) Number of poles
 - b) 2·0
 - c) Number of pair of poles
 - d) None of these.
- vi) The motor used in a lift of a highrise building is
- a) d.c. series motor
 - b) d.c. shunt motor
 - c) d.c. compound motor
 - d) a.c.synchronous motor.
- vii) A delta-zigzag three-phase transformer can be designated as
- a) DZO
 - b) DZI
 - c) DZII
 - d) none of these.

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- viii) In a properly connected delta winding of a 3 phase transformer, a voltmeter connected by opening a node of delta will show
- a) zero voltage
 - b) line voltage
 - c) double the voltage per phase
 - d) phase voltage
 - e) none of these .
- ix) A 3 phase, 400 V, 4 pole induction motor is fed from a 3 phase, 400 V, 50 H, supply and runs at 1440 r.p.m. The frequency of the rotor cmf is
- a) 2.0 Hz
 - b) 50 Hz
 - c) 48 Hz
 - d) 0 Hz.
- x) Tertiary winding is used in transformer connected in
- a) Delta/Delta
 - b) Delta/Star
 - c) Star/Star
 - d) Star/Zig-Zig.
- ix) At 50 Hz, the speed of the rotating Magnetic field for 4 pole 3 phase induction motor is
- a) 1500 r.p.m.
 - b) 3000 r.p.m.
 - c) 750 r.p.m.
 - d) none of these.

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GROUP – B
(Short Answer Type Questions)

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

2. What is armature reaction in a d.c machine ? How does it affect commutation ? What steps are taken to have effective commutation ?
3. Explain the phenomena cogging and crawling of a 3 phase squirrel cage induction motor.
4. Derive the torque equation of a d.c. series motor. Sketch the speed torque characteristics of a d.c. series motor after deriving the necessary relation.
5. State and explain the conditions of parallel operation of two 3 phase transformers.
6. Explain the operation of a single phase induction regulator. Why is a compensating winding used in a single phase induction regulator and why is it not used in 3 phase ?

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GROUP – C

(Long Answer Type Questions)

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

7. Draw the phaser diagram and connection diagram of the following three phase transformer groups : 5×3

- a) Dy 1
- b) Dz 6
- c) Yz 11
- d) Dz 6
- e) Dd 6.

8. a) Show that when the magnetising current of a transformer is sinusoidal, the flux produced is non sinusoidal and when the magnetising current is non sinusoidal, the flux is produced is sinusoidal.

b) Show that third harmonic current and its multiples are co-phasal.

c) Show that when the flux is non-sinusoidal, the effect of harmonics is more pronounced on voltage induced.

d) Explain the use of tertiary winding in a star-star transformer. $6 + 3 + 3 + 3$

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9. a) Why is starter used for starting a d.c. motor ?
- b) Sketch a 3 point starter with proper label.
- c) Derive a relation for determining the starter steps.
- d) State and explain Ward-Leonard method of speed control. 2 + 5 + 5 + 3
10. a) Describe the different losses in a d.c. machine.
- b) Two identical d.c. shunt machines when tested by Hopkinson's method, gave the following data :
- Line voltage 230 V; Line current excluding both the field current 30A; Motor armature current 230 A, Field currents 5 A and 4 A. If the armature resistance of each machine (including brushes) is 0.025 ohms, calculate efficiencies of both the machines.
- c) State the advantages of Hopkinson's test over Swinburn test.

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11. a) Explain how a synchronously rotating magnetic field with constant magnitude is produced in a 3-phase induction motor when a balanced 3-phase supply is applied to its balanced 3-phase stator winding.
- b) A 3 phase, star connected, 400 Volts, 50 Hz, 4 pole induction motor has the following per phase constants in ohms referred to stator :

$$r_1 = 0.15, x_1 = 0.45, r_2 = 0.12, x_2 = 0.45, x_m = 28.5.$$

Fixed losses (Core, Friction and Windage) are 400 Watts.

Calculate the stator current, rotor speed and output torque of the motor when it is operated at rated voltage, frequency and at 4 percent slip. 8 + 7
