



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**

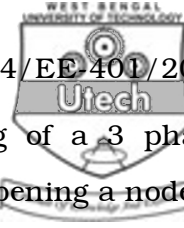
**( Multiple Choice Type Questions )**

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)  $x_2 = 0$ .





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 ?



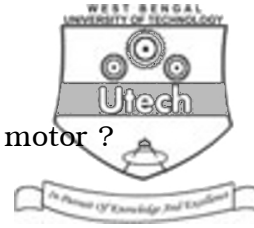
**GROUP – C**

**( Long Answer Type Questions )**

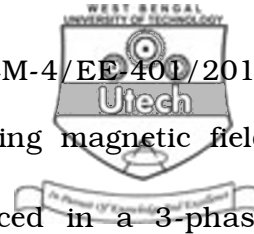
Answer any *three* of the following.  $3 \times 15 = 45$

7. Draw the phaser diagram and connection diagram of the following three phase transformer groups :  $5 \times 3$
- 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.



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