



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (CHE)/SEM-3/EE-314/2010-11

2010-11

ELECTRICAL MACHINES

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 no. of parallel path in a 8-pole lap wound & in a wave wound *d.c.* machine are respectively

- | | |
|---------|----------|
| a) 2, 8 | b) 8, 2 |
| c) 2, 2 | d) 8, 8. |

ii) The machine that is used for fraction is

- a) *d.c.* series motor
- b) synchronous motor
- c) *a.c.* series motor
- d) *d.c.* shunt motor.



- iii) In a separately excited d.c. motor, the torque is proportional to
- a) speed
 - b) flux
 - c) field current
 - d) armature current.
- iv) The efficiency of normal transformer is
- a) 85%
 - b) 50%
 - c) 75%
 - d) above 90%.
- v) The relation between input kVA & output kVA of a transformer is
- a) input kVA = output kVA
 - b) input kVA < output kVA
 - c) input kVA > output kVA
 - d) none of these.
- vi) An induction machine is working at a slip greater than 1 the machine is working on
- a) motor
 - b) generator
 - c) traction motor
 - d) ceiling fan.
- vii) Starter is used with a motor to limit
- a) input current
 - b) voltage drop in the network
 - c) torque
 - d) both (a) & (b).



- viii) Armature voltage control method of speed control of d.c. motor is used to have speed
- a) above rated speed
 - b) below rated speed
 - c) in the reverse direction
 - d) none of these.
- ix) Maximum efficiency of a transformer occurs when
- a) variable loss of transformer = constant loss
 - b) power factor is unity
 - c) hysteresis loss equals to eddy current loss
 - d) hysteresis loss & eddy current loss is minimum.
- x) The phase angle between magnetising current & flux developed in the core of the transformer is
- a) 90°
 - b) 0°
 - c) 180°
 - d) none of these.
- xi) Critical resistance of a d.c. shunt generator is
- a) field resistance above which the generator fails to excite
 - b) armature resistance above which the generator fails to excite
 - c) field inductance above which the generator fails to excite
 - d) armature inductance above which the generator fails to excite.



xii) In *a.c.* distribution area, the motor used as ceiling fan is

- a) synchronous motor
- b) three-phase induction motor
- c) single phase induction motor
- d) fraction motor.

GROUP – B

(Short Answer Type Questions)

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

2. What is the function of brush & commutator in *d.c.* machines. What would have been the nature of output voltage in the absence of brush & commutation in *d.c.* generator. Explain.
3. Explain in brief, the principle of operation of a synchronous motor.
4. Deduce the torque-speed characteristics of a 3-phase induction motor. Draw the characteristic.
5. Derive the induced *emf* equation for a single phase transformer.
6. What are the necessary conditions for parallel operation of alternators ?



GROUP – C

(Long Answer Type Questions)

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

7. a) How can the direction of the stator revolving field be reversed in an induction motor ?
- b) Draw the equivalent circuit of an Induction motor & explain what each circuit element represents.
- c) An 8-pole, 3-phase, 50 Hz induction motor runs at a speed of 710 rpm with an input power of 35 kW. The stator copper loss at this operating condition is 1200 W while the rotational losses are 600 W. Find
- i) rotor copper loss
 - ii) gross torque required
 - iii) gross mechanical power delivered
 - iv) net torque. $2 + 5 + 8$
8. a) Describe how the primary current adjusts itself as the load on a transformer is increased.



- b) A 50 kVA, 2200/110 V transformer when tested gave the following results : OC test, measurement on the LV side : 400 W, 10 A, 110 V.

SC test, measurement on the HV side : 808 W, 20.5 A, 90 V.

Compute all the parameters of the equivalent circuit referred to the HV side of the transformer. 5 + 10

9. a) How can speed of a synchronous motor be varied ?
- b) In what operating conditions is a synchronous motor referred to as a synchronous condenser ? How is this condition achieved ?
- c) A 750 kW, 11 kV, 3-phase star connected synchronous motor has a synchronous reactance of $35 \Omega/\text{phase}$ & negligible resistance. Determine the excitation *emf* per phase when the motor is operating on full-load at 0.8 *pf* leading. Its efficiency under this condition is 93%.

3 + 5 + 7



10. a) What are the purpose & location of the following :
- i) an interpole
 - ii) a compensating winding.
- b) Describe how the shunt motor may be run to develop a constant speed torque characteristics.
- c) A 600 V *d.c.* motor drives a 60 kW load at 900 rpm. The shunt field resistance as 100 Ω & the armature resistance is 0.16 Ω . If the motor efficiency is 85%, determine
- i) the speed at no-load & the speed regulation
 - ii) the rotational losses. 4 + 3 + 8
11. a) Discuss different methods of braking of *d.c.* motors.
- b) Explain how starting torque of induction motor be improved.
- c) What is meant by two quadrant & four quadrant operations of motors. Explain with example. 6 + 3 + 6
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