

**ELECTRICAL MACHINES - II
(ELEC 3101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) For a P pole machine the relation between electrical and mechanical degree is given by
(a) $\theta_{elec} = \frac{2}{P}\theta_{mech}$ (b) $\theta_{elec} = \frac{4}{P}\theta_{mech}$
(c) $\theta_{mech} = \frac{P}{2}\theta_{elec}$ (d) $\theta_{elec} = \frac{P}{2}\theta_{mech}$.
- (ii) Salient pole type rotors are generally used with prime mover of
(a) high speed (b) low speed
(c) medium speed (d) high and low speed.
- (iii) A 4-pole turbo alternator supplies a 50Hz network. What should be the speed of generator?
(a) 6000 rpm (b) 3000 rpm
(c) 1500 rpm (d) 1000 rpm.
- (iv) In 3-phase synchronous motor running at full load the
(a) generated e.m.f (E_g) lag the terminal voltage (V_t)
(b) generated e.m.f (E_g) lead the terminal voltage (V_t)
(c) generated e.m.f (E_g) may lag or lead the terminal voltage (V_t)
(d) generated e.m.f (E_g) will be in phase with the terminal voltage (V_t).
- (v) The damper winding in a synchronous motor is generally used
(a) to provide starting torque only
(b) to reduce the noise level
(c) to reduce eddy current
(d) to prevent hunting and providing starting torque.

B.TECH/EE/5TH SEM/ELEC 3101/2020

- (vi) If rotor resistance of IM is doubled, keeping the other parameters constant, then the maximum torque of IM will become
(a) Halved (b) Doubled
(c) Remains same (d) One fourth.
- (vii) In a resistor split phase motor, the running winding should have
(a) High resistance and low inductance
(b) High resistance and high inductance
(c) Low resistance and high inductance
(d) Low resistance and low inductance.
- (viii) A 50 Hz single phase induction motor runs with slip 4%. Find the frequency (in Hz) of the current induced in the rotor by the forward field.
(a) 50 Hz (b) 100 Hz
(c) 2 Hz (d) 98 Hz.
- (ix) A three phase three stack variable reluctance stepper motor has 20 poles on each rotor and stator stack. The step angle of this stepper motor is:
(a) 6° (b) 3°
(c) 9° (d) 18°
- (x) The starting capacitor of a single phase motor is:
(a) Electrolytic capacitor (b) Ceramic capacitor
(c) Paper capacitor (d) Either (a) or (b).

Group – B

2. (a) A 3-phase, 50Hz, 4-pole star connected alternator has 72 slots with a 6 conductor per slot. The coil span is 2 slots less than pole pitch. If the machine gives 6600V between the lines on open circuit, determine the useful flux per pole.
- (b) Why the cylindrical rotor alternators have small diameter and large core length but salient pole alternators have large diameter and small core length.
- (c) Explain the brush less excitation system for alternator.
- 4 + 4 + 4 = 12**
3. (a) Two 3-phase alternators A and B are operating in parallel. The rating of alternator A and B are 1000 kW and 1400kW respectively. The frequency load characteristic of alternator A varies from 50 Hz at no load to 48 Hz at full load and that of alternator B varies from 50.5 Hz at no load to 48.5 Hz at full load. Find the shearing of common load of 2000kW by them.
- (b) A synchronous machine is synchronized with an infinite bus and now, without changing its field current, it is made to operate as a generator. Explain whether the machine is delivering or absorbing reactive power.

- (c) Explain the effect of change in mechanical torque when two alternators are connected in parallel at no load.

4 + 4 + 4 = 12

Group – C

4. (a) A 6.6 kV star connected, three phase synchronous motor works at constant voltage and constant excitation. Its synchronous reactance is 18Ω per phase; neglect resistance. When the input is 111.145 kW, the power factor is 0.8 leading. Find the power factor when the input is changed to 1500kW.

- (b) Derive an expression for power developed in a cylindrical-rotor synchronous motor in terms of load angle and synchronous impedance.

- (c) Why the synchronous motor has no starting torque?

6 + 4 + 2 = 12

5. (a) Explain the hunting phenomena in synchronous motor and how to prevent it.

- (b) Explain how the synchronous motor can be made to operate at leading power factor load.

5 + 2 + 5 = 12

Group – D

6. (a) A 3 phase IM has a starting torque of 150% and maximum torque of 250% of full-load torque. Neglect stator resistance and assume constant rotor resistance. Calculate:

(i) Slip at maximum torque.

(ii) Full load slip.

- (b) A 30HP, 3Φ IM has full load efficiency of 84%. The stator and copper losses each equal to stator iron loss at full load. The total mechanical losses are one-fifth the no load loss. Determine the full load slip of the motor.

- (c) Mention two merits of wound rotors over cage rotors.

6 + 4 + 2 = 12

7. (a) Determine the suitable tapping on an auto-transformer starter for an IM required to start the motor with 40% of the full-load torque. The short circuit current of the motor is 5 times the full load current and the full load slip is 0.035. Determine the current drawn from the mains as a fraction of full load current.

- (b) Write short notes on Induction generator.

- (c) What are the reasons behind the cause of space harmonics in air-gap flux?

5 + 5 + 2 = 12

Group – E

8. (a) Explain double field revolving theory as applied to single phase induction motor.
(b) Obtain the value of capacitance to be inserted in series with the auxiliary winding for obtaining maximum torque at starting in a capacitor split phase motor.

6 + 6 = 12

9. (a) A 230V, 50Hz resistor start split phase induction motor has the following data at standstill:

Main Winding: $5.2 + j10.1\Omega$

Auxiliary winding: $12.7 + j9.2\Omega$

Find the value of the external resistance that should be inserted in series with auxiliary winding so that maximum torque at starting is obtained.

- (b) Write short notes on hybrid stepper motor.
(c) What are the main advantages of hybrid stepper motors compared to variable reluctance stepper motors?

4 + 6 + 2 = 12

Department & Section	Submission Link
EE	https://classroom.google.com/c/MTIzNjM1MjE4ODE2/a/MjcxMDEwNjA4NTgz/details