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EE 181403

Roll No. of candidate

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Azara, Halkhowra,  
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2022

B.Tech. 4<sup>th</sup> Semester End-Term Examination

ELECTRICAL MACHINES — II

(New Regulation) & (New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks  
for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following (MCQ/Fill in the blank questions) : (10 × 1 = 10)
- (i) An induction motor is preferred to a D.C. motor because it
- (a) provides high starting torque
  - (b) provides fine speed control
  - (c) Has simple and rugged construction
  - (d) None of the above
- (ii) When the rotor of a 3-phase induction motor is blocked, the slip is
- (a) zero
  - (b) 0.5
  - (c) 0.1
  - (d) 1
- (iii) If the slip of a 3-phase induction motor increases, the power factor of the rotor circuit
- (a) is increased
  - (b) is decreased
  - (c) remains unchanged
  - (d) none of the above
- (iv) A capacitor-start, capacitor-run induction motor has
- (a) low power factor
  - (b) high power factor
  - (c) low efficiency
  - (d) high starting torque

[Turn over

- (v) In the armature winding of an alternator, the coil span falls short of full-pitch by  $60^\circ$  (electrical). The pitch factor is
- (a) 0.866 (b) 0.5  
(c) 0.25 (d) none of the above
- (vi) When a number of alternators are operating in parallel, the power factor at which each Operates is determined by
- (a) power factor of the load  
(b) driving torque of the prime mover  
(c) its field excitation  
(d) none of the above
- (vii) The slip test on an alternator is performed to determine \_\_\_\_\_
- (viii) In closed circuit ventilation system for cooling in an alternator \_\_\_\_\_ is used as cooling Medium.
- (ix) When the synchronous motor runs at synchronous speed, the voltage induced in the damper Winding is
- (a) Maximum (b) Minimum  
(c) Zero (d) None of the above
- (x) At full-load, the rotor poles of a synchronous motor are displaced by a mechanical angle of  $1^\circ$  From their no-load position. If the machine has 40 poles, then torque angle is \_\_\_\_\_
2. (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. (8)
- (b) Explain the principle of operation of a 3-phase induction motor. Derive the expression for the Rotor frequency. (7)
3. (a) Develop an expression to show that the torque developed in a 3-phase induction motor Depends upon the supply voltage, rotor reactance and slip. Obtain the condition of maximum Torque. (7)
- (b) A 3-phase 500 V, 50 Hz induction motor with 6-poles develops 20 B.H.P. at 950 r.p.m. with a p.f. of 0.86 lagging. The mechanical losses total 1 H.P. Calculate for this load
- (i) the slip  
(ii) the rotor Copper loss  
(iii) the input if the stator losses are 1500 W  
(iv) the line current. (8)

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4. (a) What happens when the centrifugal starting switch in a 1-phase induction motor fails to open? (3)
- (b) Explain the principle of operation of a shaded-pole motor. (4)
- (c) At starting, the windings of a 230V, 50 Hz, split-phase induction motor have the following

Parameters :

Main winding :  $R = 4\Omega$ ;  $X_L = 7.5\Omega$  and starting winding :  $R = 7.5\Omega$ ;  $X_L = 4\Omega$

Find

- (i) current  $I_m$  in the main winding
- (ii) current  $I_s$  in the starting winding
- (iii) phase angle between  $I_s$  and  $I_m$
- (iv) line current and
- (v) power factor of the motor. (8)
5. (a) Why is the rotor of a turbo alternator made cylindrical? (3)
- (b) What are the advantages of short pitched winding in an alternator? (2)
- (c) What is the function of damper winding in an alternator? (3)
- (d) A 1500 kVA, 6.6 kV, 3-phase, star-connected alternator has effective armature resistance of  $0.5\Omega$  per phase and a synchronous reactance of  $5\Omega$  per phase. Find the percentage change in Terminal voltage when the rated output of 1500 kVA at (i) unity p.f. (ii) 0.8 p.f. lagging and (iii) 0.8 p.f. leading is switched off. The speed and excitation current remain unchanged. (7)
6. (a) Two reaction theory is applied only to salient pole machines. State the reason. (3)
- (b) Write down the necessary conditions to be fulfilled for synchronising alternators with infinite Busbars. (4)
- (c) A 3-phase alternator has a direct-axis synchronous reactance of 0.85 p.u. and quadrature-axis Synchronous reactance of 0.55 p.u. Draw the phasor diagram for the alternator when operating On full-load at 0.8 p.f. lagging and determine therefrom (i) the load angle (ii) the no-load p.u. Voltage (iii) per unit voltage regulation. Neglect armature resistance. (8)
7. (a) How does a synchronous motor made self-starting? (3)
- (b) Discuss the effects of changing field excitation at constant load in a synchronous motor (6)
- (c) The input to an 11000 V, 3-phase, star connected synchronous motor is 60 A. The effective resistance and synchronous reactance per phase are respectively  $1\Omega$  and  $30\Omega$ . Find (i) the power supplied to the motor at 0.8 p.f lagging (ii) induced e.m.f. for a p.f of 0.8 leading. (6)