

17511

16117

3 Hours / 100 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. (A) Attempt any THREE : 12

- (a) Compare squirrel cage induction motor & slip ring induction motor.  
(Any four points).
- (b) State why three phase Induction Motor never run on synchronous speed.
- (c) Explain with diagram how star-delta starters are used for reducing the starting current of 3 phase induction motors.
- (d) Define pitch factor & distribution factor and state the advantages of short pitched coils for an alternator.

(B) Attempt any ONE : 6

- (a) Explain speed control method of 3 phase Induction motor by the following methods.
  - (i) Frequency control
  - (ii) Stator voltage control
  - (iii) Rotor resistance control
- (b) Describe with neat sketch the principle of operation of permanent magnet stepper motor.

**2. Attempt any FOUR :****16**

- (a) Draw power stages of three phase induction motor. Derive relation for rotor copper loss.
- (b) Explain the effect of voltage on torque speed characteristics of 3 phase IM.
- (c) A 12 pole, 3 $\phi$ , alternator is couple to an engine running at 500 rpm. It supplies an induction motor which has full load speed of 1440 rpm. Find the slip and the no. of poles of the induction motor.
- (d) Explain the factors which affect the terminal voltage of alternator.
- (e) A motor is to be operated from 230 V, 50 Hz single phase AC and 220 V DC supply. Identify above motor and describe its working with neat sketch.
- (f) Explain construction & working of AC servo motor.

**3. Attempt any FOUR :****16**

- (a) Derive the condition for  $T_{\max}$  of a 3 phase induction motor.
- (b) A 3 phase, 6 pole 50 Hz induction motor has a slip of 1% at no load, and 3% at full load. Determine
  - (i) synchronous speed
  - (ii) no load speed
  - (iii) full load speed
  - (iv) frequency of rotor at standstill
  - (v) frequency of rotor current at full load
- (c) Describe the concept of synchronous impedance. Also define the term leakage reactance, armature reaction reactance with respect to an alternator.
- (d) A 3-phase 50 Hz, & pole alternator has a star connected winding with 120 slots and 8 conductors per slot. The flux per pole is 0.05 wb, sinusoidally distributed. Determine the phase and line voltages.
- (e) Describe with phasor diagrams phase splitting technique in capacitor start run induction motor.

**4. (A) Attempt any TWO :****12**

- (a) A 746 kW, 3 phase 50 Hz, 16 pole induction motor has a rotor impedance of  $(0.02 + j 0.15)\Omega$  at standstill. Full load torque is obtained at 360 rpm. Calculate. (a) speed at which maximum torque occurs (b) the ratio of maximum to full load torque. (c) the external resistance per phase to be inserted in the rotor circuit to get maximum torque at starting.
- (b) Explain how each of the following can reduce starting current of 3 Ph IM.
- (i) By inserting resistance in rotor winding
  - (ii) By connecting auto transformer in stator winding.
- (c) A 3 ph star connected alternator is rated at 1600 kVA, 13500 V. The armature effective resistance and synchronous reactance are  $1.5 \Omega$  and  $30 \Omega$  respectively per phase. Calculate percentage regulation for a load of 1280 kW at power factor of
- (i) 0.8 leading
  - (ii) Unity
  - (iii) 0.8 lag

**(B) Attempt any ONE :****6**

- (a) Describe armature reaction with flux distribution waveforms of a three phase alternator when the nature of load on the alternator is resistive, purely inductive and purely capacitive.
- (b) OC and SC test were performed on a 3 phase 0.5 MVA, 3.6 kV, star connected alternator.

The result are given below :

O.C. :  $I_f = 10 \text{ A}$ ,  $V_{SC} = 3000 \text{ V}$

S.C. :  $I_f = 10 \text{ A}$ ,  $I_{SC} = 150 \text{ A}$

$R_a/\text{ph} = 1\Omega$

Calculate the percentage, regulation for full load condition at 0.8 pf lagging.

**P.T.O.**

**5. Attempt any FOUR :****16**

- (a) A 3 phase induction motor has a starting torque of 100% and a maximum torque of 200% of the full load torque. Determine
  - (i) Slip at which maximum torque occurs.
  - (ii) Full load slip
  - (iii) Rotor current at starting in per unit of full load rotor current.
- (b) Derive the ratio of full load torque and maximum torque of a 3 phase induction motor.
- (c) Explain lamp method of synchronizing alternator to the bus bar.
- (d) A total of 1200 kW is shared equally by two identical alternator at 6000 V and 0.866 lagging p.f., the current one alternator is 70 A at lagging p.f. find the p.f. of both the alternators. Both the alternators are 3 phase star connected.
- (e) Draw the torque-speed characteristics of linear induction motor. Write down any two applications of linear induction motor and universal motor.
- (f) What is induction generator ? State its applications.

**6. Attempt any FOUR :****16**

- (a) Explain the method of finding regulation of alternator by ampere turn methods.
  - (b) Why single phase induction motor is not self starting ?
  - (c) Explain role of capacitor in a single phase capacitor start capacitor run induction motor.
  - (d) Describe with neat sketch the working of shaded pole Induction motor.
  - (e) State applications of the following : (any **two**)
    - (i) DC servo motor
    - (ii) Stepper motor.
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