

# 17511

**11819**

**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 of the following: **12****
- (i) State any four applications of 3 phase induction motor.
  - (ii) Compare squirrel cage induction motor and slip ring induction motor any four points.
  - (iii) Explain DOL starter used for 3 phase induction motor.
  - (iv) Derive the relationship between Synchronous speed ( $N_s$ ) and Frequency ( $f$ ) of alternator.

P.T.O.

b) Attempt any ONE of the following: 6

- (i) Explain speed control method of 3 phase induction motor by the following methods:
- (1) Pole changing
  - (2) Rotor resistance control
  - (3) Stator voltage
- (ii) Draw and explain working of universal motor. Give two applications of universal motor.

2. Attempt any FOUR of the following: 16

- a) State the function of following parts of a slip ring induction motor:
- (i) Slip ring
  - (ii) Fan
  - (iii) Brushes
  - (iv) Frame
- b) A  $3\phi$ , 50 Hz, 4 pole IM has a slip of 4% calculate:
- (i) Speed of motor
  - (ii) Frequency of rotor emf if the rotor has a resistance of  $1\Omega$  and standstill reactance of  $4\Omega$ . Calculate the rotor power factor at:
    - (1) Stand still
    - (2) A speed of 1440 rpm
- c) Define pitch factor and distribution factor and state the advantages of short pitches coils for an alternator.
- d) The stator of 3 phase, 8 pole, 750 rpm alternator has 72 slots, each of which contains 10 conductors. Calculate the rms value of the emf per phase if the flux per pole is 0.1 wb. Sinusoidally distributed. Assume full pitch coils and a winding distribution factor is 0.96.
- e) Explain construction and working of permanent magnet stepper motor.
- f) Explain construction and working of DC servomotor.

- 3. Attempt any FOUR of the following:** **16**
- a) Derive the condition for maximum running torque of 3 phase induction motor.
  - b) Draw and explain star delta starter for 3 phase induction motor.
  - c) A 12 pole, 3 $\phi$  alternator is coupled to an engine running at 500 rpm. It supplies an induction motor which has full load speed of 1440 rpm. Find the slip and no. of poles of the induction motor.
  - d) Explain the procedure to calculate voltage regulation of a 3 phase alternator by synchronous impedance method with necessary graphs and phasor diagrams.
  - e) Draw torque characteristics of shaded pole IM. State its any two applications.
- 4. a) Attempt any THREE of the following:** **12**
- (i) A 12 pole, 50 Hz, 3 phase induction motor has rotor resistance of 0.15  $\Omega$  and stand still reactance of 0.25  $\Omega$  per phase. On full load, it is running at a speed of 480 rpm. The rotor induced emf per phase at standstill is observed to be 32 V. Calculate:
    - (1) Starting torque
    - (2) Full load torque
    - (3) Maximum torque
    - (4) Speed at maximum torque
  - (ii) A 500 V, 3ph, 50Hz induction motor develops an output of 15 kW at 950 rpm. If the input power factor is 0.86 lagging. Mechanical losses are 730 W and the stator losses 1500 W: Find
    - (1) The slip
    - (2) The rotor Cu loss
    - (3) The motor input
    - (4) The line current

- (iii) A 3300V, 50 Hz star connected alternator has a full load current of 90A. When the output terminals of alternator are shorted a field current of 6A produces a full load current. The open circuit emf for the same field current was 1000 V. If the armature resistance per phase is  $0.5\Omega$ , find voltage regulation at 0.8 p.f. lagging.
- (iv) Two alternators are operating in parallel and supply a load of 10 MW at 0.8 log. The output of one of the alternator is adjusted to 6 MW at 0.92 log. Find pt. of the other alternator.

b) **Attempt any ONE of the following:**

**6**

- (i) OC and SC test were performed on a 3 phase 0.5 MVA, 3.6 kV, star connected alternator. The results are given below:

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

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

$R_a / \text{ph} = 1\Omega$ , Calculate the percentage regulation for full load condition at 0.8 p.f. lagging.

- (ii) Define Armature reaction and explain armature reaction at various power factor with sketch.

**5. Attempt any FOUR of the following:**

**16**

- State the methods of slip measurement and explain any one method.
- Explain the effect of Armature resistance and leakage reactance on the terminal voltage of alternator.
- Explain the concept of load sharing.
- State any four advantages of operating alternators in parallel.
- Explain working principle of induction generator.
- Explain with diagram working of Linear induction motor.

**6. Attempt any FOUR of the following:****16**

- a) Explain the method of finding regulation of an alternator by ampere turn method.
  - b) Why single phase induction motor is not self starting? Explain.
  - c) Describe with phasor diagrams phase splitting technique in capacitor start run inductor motor.
  - d) Write two applications of the following 1 phase 1 M.
    - (i) Resistance start induction run.
    - (ii) Capacitor start induction run
  - e) Write two application of the following motor
    - (i) AC servo motor
    - (ii) Stepper motor
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