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3 Hours / 100 Marks   Seat No.

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) Use of Non-programmable Electronic Pocket Calculator is permissible.

(6) 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 why three phase induction motor never run on synchronous speed ?

(ii)   State the effect of change in supply voltage on torque characteristics of an Induction motor.

(iii) Explain with neat sketches, the production of rotaling magnetic field in three phase Induction motor.

(iv)   Draw a neat diagram of autotransformer starter used in 3ϕ Induction motor.

  b) **Attempt any ONE of the following:**   **6**

(i)   Explain voltage frequency method of speed control of 3ϕ Induction motor.

Marks

    (ii)   Draw a schematic diagram of an AC series motor. How to change its speed and direction of rotation? Give two applications of AC series motor.

2.   **Attempt any <u>FOUR</u> of the following:**   **16**

    a) A 3ϕ, 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 1Ω and standstill reactance of 4Ω, Calculate the rotor power factor at -

            (1) Standstill

            (2) a speed of 1440 rpm.

    b) Derive torque equation of 3ϕ Induction motor.

    c) Explain concept of synchronocy impedance and synchronus reactance. Draw vector dia of alternator at leading p.f.

    d) A 12 pole, 3ϕ, alternator is coupled to an engine running at 500 rpm. It supplied an Induction motor which has full load speed of 1440 rpm. Find the slip and no. of poles of the Induction Motor.

    e) What is universal motor ? Comment briefly on its constructional features and speed torque characteristics. Mention its any two applications.

    f) Explain the working principal of permanent magnet motor.

3.   **Attempt any <u>FOUR</u> of the following:**   **16**

    a) A 12 pole, 50 Hz, 3 phase Induction motor has rotor resistance of 0.15 Ω and stand still reactance of 0.2 Ω per phase. On full load, it is running at a speed of 400 RPM. The rotor induced emf per phase at standstill is obsound to be 32 V. Calculate.

        (i)   Starting torque

        (ii) Full load torque

        (iii) Maximum torque

        (iv) Speed of maximum torque.

b) Draw a block diagram showing power stages of a 3 phase Induction Motor.

c) A 16 pole, 3 phase star connected alternator armature has 12 slots with 24 conductors per slot and the flux per pole 150.1 wb. Sinusoidally distributed. Calculate the line emf generated at 50 Hz.

d) Derive emf equation of alternator.

e) Why a single phase Induction motor doesn't have a self starting torque ? Explain the double revolving field theory.

f) Descibe DOL starter with neat dia.

4. a) **Attempt any THREE of the following:**   **12**

   (i) A 500 V, 3 ph, 50 Hz IM developes 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 flip

   (2) the rotor copper loss

   (3) the motor input

   (4) the line current

   (ii) Explain the procedure to calculate voltage regulation of a 3 phase alternator by synchronous impedance method with necessary graph and phasor diagram.

   (iii) Why it is necessary to run the alternators in parallel.

   (iv) Explain working principle of stepper motor.

Marks

b) **Attempt any ONE of the following:** 6

    (i)   Define voltage regulation of alternator. On what factors regulation depends explain in brief.

    (ii)   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. : If = 10 A, V_{sc} = 3000 V

        S.C. If = 10 A, I_{sc} = 150 A

        Ra/ph = 1 Ω

        Calculate the percentage, regulation for full load condition at 0.8 pf lagging by synchronous impedance method.

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

a) Explain 1 dark and 2 equally bright 'Lamp method' of synchronising alternator to the bus bar.

b) Define each of following terms of alternator

    (i)   Leakage reactance

    (ii)   Synchronous impedance

    (iii) Distribution factor

    (iv) Pitch factor

c) Compare salient pole and cylindrical rotor alternator (any four points)

d) Explain the effect of change in frequency on load sharing.

e) Explain the principle of operation of linear Induction motor.

f) What is an induction generator ? State its principle of operation.

Marks

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

a) Describe with the help of curves the effect of variation of a rotor circuit resistance on the torque slip characteristics of an induction motor.

b) State applications of induction generator and linear induction motor.

c) State two application each for the single phase capacitor start capacitor run and shaded pole Induction motor.

d) Explain role of capacitor in a single phase capacitor start capacitor run induction motor.

e) With neat schematic diagram, briefly explain the principle of operation of a shaded pole single phase induction motor.

f) Describe the various conditions to be fullfilled for parallel operation of alternator. How it is fullfilled ?

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