

A.C. Machines Performance (315333)

MSBTE Diploma · K-Scheme · Model Question Paper — Set B

Time: 3 Hours**Max. Marks: 70****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. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

Q.1 Attempt any FIVE of the following:**10**

- a) Define slip of an induction motor. State its value at standstill and at synchronous speed.
- b) Write the expressions for rotor frequency and rotor power factor of a 3- ϕ induction motor under running condition.
- c) List the main components of a soft starter.
- d) Draw the torque–speed characteristics of a shaded pole induction motor.
- e) List different types of torques in a synchronous motor.
- f) State any four factors affecting the voltage regulation of an alternator.
- g) Define step angle of a stepper motor. A stepper motor makes 200 steps per revolution; find its step angle.

Q.2 Attempt any THREE of the following:**12**

- a) Explain the working of a star–delta starter and show that the starting line current is reduced to one-third of that with DOL starting.
- b) State the necessity of a starter for a 3- ϕ induction motor and list the different types of starters.
- c) Draw the block diagram of a variable frequency drive (VFD) used for speed control of a 3- ϕ induction motor and explain the function of each block.
- d) Explain with a neat sketch the construction and working of a capacitor start induction run motor. Draw its torque–speed characteristics.

Q.3 Attempt any THREE of the following:**12**

- a) Using double field revolving theory, explain why a single phase induction motor produces zero starting torque. Draw the torque–speed curves.
- b) Explain the working of a resistance split-phase induction motor with circuit diagram and phasor diagram.

- c) The main and auxiliary windings of a 230 V, 50 Hz, single phase induction motor are in space quadrature. At standstill the main winding impedance is $(4 + j7.5) \Omega$ and the auxiliary winding impedance is $(12 + j9) \Omega$. Find the value of capacitance to be connected in series with the auxiliary winding for maximum starting torque.
- d) Describe with a neat sketch the working of a two-value capacitor (capacitor start capacitor run) motor. State its applications.

Q.4 Attempt any THREE of the following:

12

- a) Explain the galvanometer method of slip measurement with a neat diagram. Why is it suitable only for slip-ring motors?
- b) Using phasor diagrams at different instants, show that the resultant flux produced by a 3- ϕ winding is constant ($1.5 \phi_m$) and rotates at synchronous speed.
- c) Explain the construction and working of a permanent magnet stepper motor.
- d) Compare single-sided and double-sided linear induction motors (any four points).
- e) A single-stack variable reluctance stepper motor has 12 stator teeth and 10 rotor teeth. It is driven at 150 pulses per second. Determine: (i) step angle (ii) steps per revolution (iii) speed in rpm.

Q.5 Attempt any TWO of the following:

12

- a) Explain the power stages of a 3- ϕ induction motor with power flow diagram. Show that $P_2 : \text{rotor Cu loss} : P_m = 1 : s : (1 - s)$.
- b) A 3- ϕ , 6 pole, star-connected alternator runs at 1000 rpm. The stator has 72 slots with a double layer winding; each coil has 6 turns and the coil span is short by 2 slots. The flux per pole is 0.05 Wb, sinusoidally distributed. Calculate the frequency, the pitch and distribution factors and the no-load phase and line voltages.
- c) Define armature reaction. Explain with phasor diagrams the effect of armature reaction in an alternator for (i) lagging p.f. load and (ii) leading p.f. load.

Q.6 Attempt any TWO of the following:

12

- a) (i) Derive the relation between full-load torque and maximum torque of a 3- ϕ induction motor. (ii) A 6 pole, 50 Hz induction motor has a full-load slip of 3 %. Its rotor resistance and standstill reactance per phase are 0.02Ω and 0.1Ω . Find the ratio of maximum torque to full-load torque, the ratio of starting torque to maximum torque and the speed at maximum torque.
- b) A 3- ϕ , star-connected, 200 kVA, 3300 V alternator has armature resistance 0.8Ω per phase. A field current of 4 A produces full-load current on short circuit and an open-circuit line voltage of 900 V. Find the synchronous impedance,

synchronous reactance and the percentage regulation at full load at (i) 0.8 p.f. lagging (ii) unity p.f.

- c) Explain the principle of operation of a 3- ϕ synchronous motor. Why is it not self-starting? Explain the term load angle.

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in

