



# CBCS SCHEME

15EE44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023

## Electric Motors

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Derive the torque equation of a DC motor. (05 Marks)
- b. List the characteristics of DC motors and explain the characteristics of DC series motor. (06 Marks)
- c. A 4-pole, 500 V, dc shunt motor has 700 wave connected conductors on its armature. The full load armature current is 60 A and the flux per pole is 30 MWb. Calculate the full-load speed if the motor armature resistance is  $0.2 \Omega$  and the brush drop is 1V per brush. (05 Marks)

OR

- 2 a. What is meant by back emf? Explain the significance of back emf. (05 Marks)
- b. Explain the necessity of starter in a d.c. motor and describe three-point starter with a neat sketch. (05 Marks)
- c. When running on no-load, a 400 V shunt motor takes 5A. Armature resistance is  $0.5 \Omega$  and field resistance is  $200 \Omega$ . Find the output of the motor and efficiency when running on full load and taking a current of 50 A. Also, find the percentage change in speed from no load to full load. (06 Marks)

### Module-2

- 3 a. Describe Swinburne's test with the help of a neat diagram to find out the efficiency of d.c. shunt machines. (05 Marks)
- b. Two identical DC machines when tested by Hopkinson's method gave the following test results: field currents are 2.5 A and 2A, line current is 220 V. Line current including both the field currents is 10 A. Motor armature current is 73 A. The armature resistance of each machine is  $0.05 \Omega$ . Calculate the efficiency of both the machines. (06 Marks)
- c. Explain torque-slip characteristics of 3- $\phi$  induction motor. (05 Marks)

OR

- 4 a. Explain Hopkinson's test for determination of efficiency of DC shunt machines. (06 Marks)
- b. Define slip. Deduce an expression for the frequency of rotor current in an induction motor. Why cannot an induction motor run at synchronous speed? (06 Marks)
- c. A 4-pole, 50 Hz, 3-phase induction motor has a rotor resistance of  $0.02 \Omega$  per phase and standstill reactance of  $0.5 \Omega$  per phase. Determine the speed at which the maximum torque is developed. (04 Marks)

### Module-3

- 5 a. Explain with phasor diagram, the induction motor on load. (06 Marks)
- b. Explain the procedure of no-load and blocked rotor tests on a 3-phase induction motor. How are the parameters of equivalent circuit determined from the test results? (06 Marks)
- c. Compare a single-cage motor with a double cage induction motor of the same rating. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 6 a. Develop the equivalent circuit of a 3-phase induction motor. (04 Marks)
- b. Draw the circle diagram for a 3- $\phi$ , 6-pole, 50 Hz, 400 V, star connected induction motor from the following data:  
No-load test: 400 V, 10 A, 1400 W  
Blocked rotor test: 200 V, 55 A, 7000 W  
The stator loss at stand still is 60% of the total copper losses and full load current is 30 A, from the circle diagram determine power factor, slip, power output and efficiency. (08 Marks)
- c. Explain the phenomenon of cogging in a 3-phase induction motor. How the effects of cogging are reduced? (04 Marks)

Module-4

- 7 a. List the methods of starting of 3- $\phi$  induction motors and explain any one type with a neat sketch. (05 Marks)
- b. Explain stator voltage control method of speed control of 3- $\phi$  induction motor. (05 Marks)
- c. Explain the construction and operation of split phase induction motor. (06 Marks)

OR

- 8 a. With the help of a neat sketch, explain the working of starter used for slip ring induction motor. (05 Marks)
- b. Explain double revolving field theory of single phase induction motor. (06 Marks)
- c. Describe the construction and working of a shaded pole motor. (05 Marks)

Module-5

- 9 a. Explain the principle of operation of a 3-phase synchronous motor. (05 Marks)
- b. What are V curves of a synchronous motor? (05 Marks)
- c. Explain the operation of a stepper motor. Also state some important applications of stepper motors. (06 Marks)

OR

- 10 a. What methods are generally used to start the synchronous motors? (04 Marks)
- b. What do you mean by Hunting of a synchronous machine? What are the causes and effects of Hunting? How Hunting effects are reduced? (08 Marks)
- c. Explain the operating principle of a linear induction motor. (04 Marks)

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