CBCS SCHEME

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21EE44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Electric Motors

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is meant by back emf? Explain the significance of back emf. **(06 Marks)**

b. State the applications of various types of DC motor. **(04 Marks)**

c. A 200 V dc shunt motor takes 22 A and runs at 1000 rpm. Its field and armature resistance are 100 Ω and 0.1 Ω respectively. Determine the valve of additional resistance required in the armature circuit to reduce the speed to 800 rpm, when:
(i) The torque proportional to the speed
(ii) The torque varies as the square of the speed **(10 Marks)**

OR

2 a. Explain the characteristics of DC shunt motor. **(06 Marks)**

b. Derive the condition for maximum efficiency of a DC machine. **(04 Marks)**

c. With a neat sketch, explain the Ward-Leonard method of speed control of DC motor. **(10 Marks)**

Module-2

3 a. Describe the field test applied to two similar DC series motor. **(06 Marks)**

b. Derive an expression for running torque of an induction motor and obtain the condition for maximum torque while running. **(08 Marks)**

c. A 4-pole, 50 Hz, induction motor at rated voltage and frequency has a starting torque of 160% and maximum torque of 200% of full load torque. Determine:
(i) Full load speed
(ii) Speed at maximum torque **(06 Marks)**

OR

4 a. Discuss the torque-slip characteristics of a 3-ϕ induction motor indicating motoring, generating and braking regions on diagram. **(10 Marks)**

b. The Hopkinson's test on two shunt machines gave the following test results for full load:
Line voltage = 250 V
Current taken from supply excluding field current = 50 A
Motor armature current = 380 A
Field currents = 5A and 4.2 A
Calculate the efficiency of the motor and generator. Assume resistance of each machine is 0.02 Ω (Ra). **(10 Marks)**

Module-3

5 a. In a 3 ϕ IM show that rotor input: rotor cu loss : mechanical power developed is 1:5:1 – 5. **(06 Marks)**

b. Explain cogging and crawling phenomenon in 3-ϕ induction motor. **(04 Marks)**

c. The power input to a 500 V, 50 Hz, 6-pole, 3ϕ induction motor at 975 rpm is 40 KW. The stator losses total 1 KW and the friction and windage losses total 2 KW. Calculate:
(i) Slip
(ii) The rotor copper loss
(iii) Mechanical power developed in the rotor
(iv) Efficiency **(10 Marks)**

OR

6 a. Draw the circle diagram from no load and short circuit test of a 3-ϕ, 14.92 KW, 400 V, 6 pole induction motor with the following test data:
No load : 400 V, 11 A, cos ϕ = 0.2
SC load : 100 V, 25 A , cos ϕ = 0.4
The stator and rotor copper losses are equal. Determine from circle diagram:
(i) The line current (ii) Slip (iii) Power factor
(iv) Maximum output (v) Efficiency **(10 Marks)**

b. Explain the construction of deep bar rotor induction motor. **(06 Marks)**

c. Explain the principle of operation of an induction generator. What are its limitations? **(04 Marks)**

Module-4

7 a. Explain double field revolving theory as applied to single phase induction motor and prove that it cannot produce any starting torque. **(10 Marks)**

b. Mention the different methods of speed control of 3ϕ induction motor. Describe any two methods. **(10 Marks)**

OR

8 a. Explain why single phase induction motor is not self starting. **(06 Marks)**

b. Briefly explain torque-speed characteristics of capacitor split phase motor. Mention the application of capacitor split phase method. **(06 Marks)**

c. With neat sketches, explain the construction and operation of capacitor start 1-ϕ induction motor. **(08 Marks)**

Module-5

9 a. Explain the operation of synchronous motor at constant load and variable excitation with phasor diagrams. **(08 Marks)**

b. Describe the different starting methods of synchronous motor. **(06 Marks)**

c. Describe the operation of linear induction motor. List the application. **(06 Marks)**

OR

10 a. Explain the construction and working of universal motor. **(06 Marks)**

b. Write a short note on stepper motor. **(06 Marks)**

c. Describe a phenomenon of hunting in synchronous machine, what are the methods to overcome this. **(08 Marks)**

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