CBCS SCHEME

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18EE44

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Derive the torque equation of DC motor. **(06 Marks)**

b. What are the applications of shunt, series and compound motor? **(06 Marks)**

c. A 4-pole DC shunt motor takes 22A from 220 V supply. The armature and shunt field resistance are 0.5 Ω and 100Ω respectively. The armature is lap connected with 300 conductors. If the flux per pole is 20 mwb, calculate the speed and developed torque. **(08 Marks)**

OR

2 a. Derive an expression for the condition for maximum efficiency of DC motor. **(06 Marks)**

b. Explain with a neat sketch the working of three point starter. **(06 Marks)**

c. A 250V shunt motor has an armature resistance of 0.2 Ω. It draws an armature current of 60A and runs at a speed of 900 rpm at same load. It is required to raise the speed to twice this value. If the torque of the motor is constant, determine the percentage change in the flux. **(08 Marks)**

Module-2

3 a. Explain Back to Back test to determine efficiency in two identical shunt motors. **(10 Marks)**

b. A DC motor operating on 200 V mains takes 6 A on no load. The armature resistance is 0.5 Ω and the shunt field resistance is 250 Ω. Calculate the efficiency as
i) Generator, when the output is 5 kW
ii) Motor, when the input is 4 kW. **(10 Marks)**

OR

4 a. Derive an expression for full load torque, starting torque and maximum torque of three phase induction motor. **(10 Marks)**

b. Calculate the torque exerted by an 8-pole, 50 Hz, 3-phase induction motor operating with a 4% slip which develops a maximum torque of 150 Kg-m at a speed of 660 rpm. The resistance per phase of the rotor is 0.5 Ω. **(10 Marks)**

Module-3

5 a. Draw and explain the phasor diagram of a three phase induction motor. **(06 Marks)**

b. Derive an expression for the relationship between P_2, P_c and P_m. **(06 Marks)**

c. The full load power input to 4-pole, 50 Hz, 3-phase induction motor is 50 kW running at 1440 rpm. Calculate its full load efficiency if stator losses are 1000 W and frictional losses are 650 W. **(08 Marks)**

OR

6 a. Write a brief note on losses in induction motor. **(06 Marks)**

b. A 15 kW, 400 V, 4-pole, 50 Hz, 3-phase star connected induction motor gave the following test results. No load test (line values) : 400 V, 9A, 1310 W.
Blocked rotor Rest (line values) : 200 V, 50 A, 7100 W stator and rotor ohmic losses at stand still are assumed equal. Draw the induction motor circle diagram and calculate line current, power factor, sip torque (full load) and efficiency. **(14 Marks)**

Module-4

7 a. Explain the necessity of starter for three phase induction motor and briefly explain with neat sketch the working of direct online starter. **(10 Marks)**

b. Describe the various speed control methods of three phase induction motor. **(10 Marks)**

OR

8 a. Describe the construction and working of shaded pole induction motor. **(06 Marks)**

b. Explain with a neat circuit the working of spilt phase induction motor. **(06 Marks)**

c. A 250 W, 230 V, 50 Hz, single phase capacitor start induction motor has the following constraints for the main and auxiliary winding. Main winding $Z_m = (45 + j3.7)\Omega$, auxiliary winding $Z_a = (9.5 + j3.5)\Omega$. Determine the value of the capacitor that will place the main and auxiliary winding currents in quadrature at starting. **(08 Marks)**

Module-5

9 a. Explain briefly the various methods of starting synchronous motor. **(06 Marks)**

b. Explain the operation of synchronous motor at constant load variable excitation. **(08 Marks)**

c. Write a brief note on synchronous condenser. **(06 Marks)**

OR

10 a. Explain the construction, working, characteristics and applications of AC servomotor. **(10 Marks)**

b. Explain with neat diagram, the working of stepper motor and AC series motor. **(10 Marks)**

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