



CBCS SCHEME

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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 back emf? Derive the armature torque equation of a D.C. motor. (06 Marks)
- b. Sketch the speed v/s I_a and torque vs I_a . Characteristic of d.c. i) Shunt motor ii) Series motor iii) Cumulatively compounded motor iv) Differentially compounded motor. (08 Marks)
- c. What are the losses that occur in d.c. machines? Draw the power flow diagram of d.c. motor. (06 Marks)

OR

- 2 a. Explain the operation of four point starter with neat diagram, mention its advantage. (06 Marks)
- b. A 4 pole, 250V, wave connected shunt motor gives 9.5kW when running at 1000rpm, and drawing armature and field currents of 60A and 1A respectively. It has 560 conductors. Its armature resistance is 0.2Ω . Neglecting brush drop, determine: i) total torque ii) useful torque iii) useful flux per pole iv) rotational losses v) efficiency. (10 Marks)
- c. Briefly explain principle of plugging and rheostatic braking. (04 Marks)

Module-2

- 3 a. Explain back to back test on two identical D.C. machines and calculate the efficiency of machine as generator and as motor. (08 Marks)
- b. A 400V, shunt motor takes 4A on no load. The armature resistance including that of brushes is 0.2Ω and the field current is 1A. Estimate the output and the efficiency when the input current is i) 20A ii) 80A. (08 Marks)
- c. What is slip in induction motor? Explain its significance. (04 Marks)

OR

- 4 a. Explain the Field's test on D.C. series motor and explain the method to find out efficiency. (07 Marks)
- b. Draw and explain the torque slip characteristics covering motoring, generating and braking regions of operation of induction motor. (06 Marks)
- c. With the help of neat diagram, explain how efficiency of d.c. motor can be determined by the retardation test. (07 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.

Module-3

- 5 a. Write the steps to draw circle diagram of three phase induction motor with the help of diagram. (06 Marks)
- b. Draw the circle diagram from no load and short circuit (BR) test of a 3 phase 10kW, 400V, 6 pole induction motor with the following test data (line values):
 No load: 400V, 12A, p.f = 0.2
 Blocked rotor test: 100V, 24A, p.f = 0.4
 Rotor copper loss at standstill is half the total copper loss. From the diagram determine:
 i) Full load current and power factor
 ii) Efficiency
 iii) Maximum possible power output
 iv) Maximum torque. (10 Marks)
- c. Explain the principle of operation of induction generator. (04 Marks)

OR

- 6 a. Obtain the equivalent circuit of a three phase induction motor. Explain the steps involved. (07 Marks)
- b. Explain cogging and crawling of induction motor. (06 Marks)
- c. Explain with diagram, deep bar eage motor and double eage induction motor. (07 Marks)

Module-4

- 7 a. Show that in star-delta starting of squirrel eage induction motor, the starting current and torque are reduced by a factor of 1/3 compared to DOL starting. (07 Marks)
- b. Explain the construction and working of shaded pole type motor. (06 Marks)
- c. Draw and explain the equivalent circuit of a single phase induction motor. (07 Marks)

OR

- 8 a. Explain star-delta starting of induction motor with the help of neat diagram. (06 Marks)
- b. A 260W, 220V, 50Hz single phase capacitor start induction motor has the following constants for the main and auxiliary winding $Z_a = (9.5 + j3.5)\Omega$ and $Z_m = (4.5 + j3.7)\Omega$. Determine the value of the capacitor that will place the main and auxiliary winding currents in quadrature at starting. (08 Marks)
- c. Explain the double-revolving field theory of single-phase induction motors. (06 Marks)

Module-5

- 9 a. State the methods of starting of synchronous motor. Explain the method which needs alternation of pole faces with diagram. (06 Marks)
- b. Explain with neat diagram, the principle of operation of a 3-phase synchronous motor. Explain its v-curve. (08 Marks)
- c. With the help of diagram, explain the phenomenon of hunting in a synchronous motor and also explain damping. (06 Marks)

OR

- 10 a. Describe the construction and working of variable reluctance stepper motor. (07 Marks)
- b. Explain the principle of operation of a.c servomotor with diagram. (06 Marks)
- c. Describe the construction of universal motor. What are two types of compensating windings used? (07 Marks)

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