

CBCS SCHEME

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15EE44

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022 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 armature torque equation of a DC motor. (04 Marks)
b. Draw the speed-torque characteristics of DC shunt and DC series motors. Mention any two applications of each of these motors. (06 Marks)
c. A DC shunt motor runs at 1200 rpm on no-load drawing 5A from 220V mains. Its armature and field resistances are 0.25Ω and 110Ω respectively. When loaded, the motor draws 62A from the mains. What would be its speed? Assume that the armature reaction weakens flux by 5%. (06 Marks)

OR

- 2 a. Classify the losses in a DC motor. (04 Marks)
b. Derive the condition for maximum efficiency of a DC motor. (06 Marks)
c. A 200V DC shunt motor has $R_a = 0.1 \Omega$, $R_{sh} = 240 \Omega$ and rotational loss is 236W. On full load, the line current is 9.8A with the motor running at 1450 rpm. Determine the mechanical power developed and full load efficiency. (06 Marks)

Module-2

- 3 a. The following test results are obtained while Swinburne's test is performed on a dc shunt motor. At no load the input power is 400 W at 220 V and runs at 1000 rpm. The field current is 1A and armature resistance is 0.5Ω . Calculate the efficiency of motor taking 40A from the supply of 220V. (07 Marks)
b. With a neat circuit diagram describe the Hopkinson's test for obtaining the efficiencies of two identical DC shunt machines. (07 Marks)
c. What are the disadvantages of Field test on DC series machines? (02 Marks)

OR

- 4 a. Derive the condition for maximum running torque of 3 phase induction motor and also derive the expression for maximum torque. (06 Marks)
b. With a neat sketch explain torque-slip characteristics of a three phase induction motor in motoring, generating and braking regions. (06 Marks)
c. A 3.3 KV, 20 pole, 50 Hz, 3-phase, star connected induction motor has a slip ring rotor of resistance $0.025 \Omega/\text{ph}$ and standstill reactance of 0.28Ω per phase. The motor runs at a speed of 294 rpm when full-load torque is applied. Compute: (i) slip at maximum torque (ii) the ratio of maximum to full load torque. Neglect stator impedance. (04 Marks)

Module-3

- 5 a. With the help of circle diagram how maximum output and maximum torque of three phase induction motor can be determined. (04 Marks)
b. A 6-pole, 50 Hz, 3-phase induction motor running on full load develops a useful torque of 16 Nm when the rotor emf makes 120 complete cycles per minute. Calculate the shaft power output. If the mechanical torque lost in friction and that for core loss in 10 Nm. Compute the copper loss in the rotor windings. What is the motor efficiency of the input to the motor is 18.6 KW? (08 Marks)
c. Explain the phenomenon of crawling in a three phase induction motor. (04 Marks)

OR

- 6 a. With diagram, explain the principle of operation of double cage induction motor. Draw its equivalent circuit diagram and slip-torque characteristics. (07 Marks)
- b. The impedances at standstill of the inner and outer cages of a double-cage rotor are $(0.01 + j0.5)\Omega$ and $(0.05 + j0.1)\Omega$ respectively. The stator impedance is negligible. Calculate the ratio of the torques due to the two cages at starting. (03 Marks)
- c. With a neat sketch, explain the standalone operation of induction generator. (06 Marks)

Module-4

- 7 a. With diagram write short notes on star-delta starting and auto transformer starting of 3-phase induction motor. (08 Marks)
- b. Explain any two methods of speed control of three phase induction motor. (08 Marks)

OR

- 8 a. Explain why a single phase induction motor does not self start. Describe its operation based on double revolving field theory. (06 Marks)
- b. With schematic diagram, explain the working of capacitor start single phase induction motor. Draw its phasor diagram. (06 Marks)
- c. Mention the applications of shaded pole motor. (04 Marks)

Module-5

- 9 a. Mention the starting methods of synchronous motor. Explain any one method in detail. (05 Marks)
- b. Explain the phenomenon of 'hunting' in a synchronous machine and how can it be prevented. (04 Marks)
- c. Explain with a neat circuit diagram the experimental method of determining V curves and inverted V curves for a synchronous motor. (07 Marks)

OR

- 10 a. Explain the construction and principle of working of a universal motor and mention its applications. (08 Marks)
- b. Explain construction, working of a stepper motor. What are its applications? (08 Marks)
