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18EE44

**Fourth Semester B.E. Degree Examination, July/August 2022**  
**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? Explain its significance. (06 Marks)  
b. Derive an expression for the torque of a DC motor. (06 Marks)  
c. A 250 V DC shunt motor runs at 1000 rpm on no load and takes 5A. The armature and shunt field resistances are  $0.2 \Omega$  and  $250 \Omega$  respectively. Calculate the speed when loaded and taking a current of 50 A. Due to armature reaction, the field weakened by 3%. (08 Marks)

**OR**

- 2 a. Explain the different methods of controlling speed of a DC shunt motor. (06 Marks)  
b. Explain the necessity of a starter for a DC motor and explain the operation of a star delta starter with a neat sketch. (08 Marks)  
c. Draw and explain the characteristics of DC series motor. (06 Marks)

**Module-2**

- 3 a. Explain the Swinburne's test to determine no load losses of a DC machine. What are the limitations of this test? (08 Marks)  
b. When running on no load, a 400 V DC shunt motor takes 5 A,  $R_a = 0.5 \Omega$  and  $R_f = 200 \Omega$ . Find the output of the motor and efficiency when running on full load and taking current of 50 A. (08 Marks)  
c. Briefly explain the various losses occurring in a DC machine. (04 Marks)

**OR**

- 4 a. Derive Torque equation for a  $3\phi$  induction motor and derive condition for maximum torque. (08 Marks)  
b. Discuss the complete Torque-slip characteristics of a  $3\phi$  induction motor including motoring generating and braking regions. (08 Marks)  
c. A 4 pole,  $3\phi$  induction motor is supplied from 50 Hz supply. Determine its synchronous speed. On full load, its speed is observed to be 1410 rpm. Calculate its full load slip. (04 Marks)

**Module-3**

- 5 a. Starting from the fundamentals develop the equivalent circuit of a polyphase induction motor and explain how mechanical power developed is taken care of in the equivalent circuit. (10 Marks)  
b. Describe the constructional features of a double cage and deep bar rotors of  $3\phi$  induction motors and explain its operation. (10 Marks)

OR

- 6 a. A 415 V, 29.84 kW, 50 Hz Delta connected motor gave the following test data :

No load test	415 V	21 A	1250 W
Blocked Rotor test	100 V	45 A	2730 W

Construct the circle diagram and determine

- (i) Line current and power factor for rated output.  
 (ii) The maximum Torque. Assume stator and rotor copper losses are equal at stand still. (14 Marks)

- b. Explain the phenomenon of cogging and crawling in a 3 $\phi$  Induction motor. (06 Marks)

**Module-4**

- 7 a. List the different methods of starting a squirrel cage induction motor and explain star-delta starter of 3 $\phi$  induction motor with a suitable circuit diagram. (10 Marks)  
 b. Enumerate the speed control methods of 3 $\phi$  induction motor and explain supply frequency control method. (10 Marks)

OR

- 8 a. Explain the double field revolving theory as applied to a single phase induction motor and prove that it cannot produce any starting torque. (10 Marks)  
 b. With a schematic connection diagram, explain the construction, working and applications of capacitor start 1 $\phi$  induction motor. (10 Marks)

**Module-5**

- 9 a. List the methods of starting synchronous motor and explain slip ring-induction motor with a neat sketch. (10 Marks)  
 b. A factory has a total load of 1800 kW at a power factor of 0.6 lagging. If it is desired to improve the factory power factor to 0.95 lagging with the installation of synchronous condenser then calculate, (i) The KVA rating of synchronous condenser (ii) Total KVA of the factory. (10 Marks)

OR

- 10 a. Explain the operation of synchronous motor at constant load variable excitation and V and inverted V curves. (10 Marks)  
 b. Explain the working, characteristics and applications of universal motor. (10 Marks)

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