21EE44

Fourth Semester B.E. Degree Examination, June/July 2023
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. Sketch and explain the speed-current, speed-torque and torque-current characteristics of a shunt motor.   (06 Marks)
   c. A series motor having resistance of 1Ω between its terminals drives a fan, the torque of which is proportional to the square of the speed. At 230V, its speed is 300rpm and takes 15A. The speed of the fan is to be raised to 375rpm by supply voltage control estimate the supply voltage required.   (08 Marks)

OR

2 a. Derive an expression for torque of a DC motor.   (06 Marks)
   b. Briefly explain the necessary of starter to start DC Motor and with a neat diagram explain the operation of 3 point starter.   (08 Marks)
   c. A 200 V shunt motor has $R_a = 0.1\Omega$ and $R_{sh} = 240\Omega$ and rotational loss 236w. On full load the line current is 9.8 with motor running at 1450 rpm.
      Determine :
      i)   Mechanical power developed
      ii) The power output
      iii) The full load efficiency.   (06Marks)

Module-2

3 a. With a neat circuit diagram explain the retardation test conducted on DC shunt motor and show how the stray losses are determined with and without flywheel.   (10 Marks)
   b. A test on two coupled similar tramway motors, with their field connected in series, gave following results when one machine acted as a motor and the other as a generator, calculate the efficiency of motor and generator.
      Motor : Armature current : 56A
              Armature voltage : 590V
              Voltage drop across field wending : 40V
      Generator : Armature current : 44A
              Armature voltage : 400V
              Field wending drop : 40V
      Resistance of each armature : 0.3Ω.   (10 Marks)

OR

4 a. Derive the torque equation for three phase IM and derive condition for maximum torque.   (08 Marks)
   b. Sketch and explain the typical torque – slip characteristics of a three phase IM.   (04 Marks)
   c. A 12-pole, 50Hz, 3ϕ IM has rotor resistance of 0.15Ω and standstill reactance of 0.25 per phase. On full load it is running at a speed of 480rpm. The rotor induced emf per phase at standstill is observed to be 32V. Calculate :
      i) Starting torque   ii) Full load torque
      iii) Maximum torque   iv) Speed at maximum torque.   (08 Marks)

Module-3

5   a. Draw and explain the phasor diagram of 3-phase IM under loaded condition.   (06 Marks)
    b. Draw the power flow diagram of a 3-phase IM and explain.   (06 Marks)
    c. A 6 pole, 3-phase IM develops 30hp including mechanical losses of 2hp at a speed of 950rpm on 550V, 50Hz supply. Calculate for this load :
    i) The slip   ii) The rotor Cu loss   iii) Total input if the stator losses are 2000 watts.   (08 Marks)

OR

6   a. Explain the operation of deep bar rotor IM along with the equivalent circuit diagram and also draw its torque – slip characteristics.   (08 Marks)
    b. Draw the circle diagram for a 20HP, 50Hz, 3-phase, star connected IM with the following data :
    No load test : 400V, 9A, 0.2pf lagging
    Blocked rotor test : 200V, 50A, 0.4pf lagging
    Determine the line current and efficiency for FL condition from circle diagram.   (12 Marks)

Module-4

7   a. Explain the necessity of a starter to start 3-phase IM and with a neat sketch explain the operation of star-Delta Starter and rotor resistance starter.   (10 Marks)
    b. Enumerate the speed control methods of 3φ IM and explain any two methods in detail.   (10 Marks)

OR

8   a. Explain double field revolving theory as applied to a single phase IM and prove that it cannot produce any starting torque.   (08 Marks)
    b. With neat sketch explain the construction and working of capacitor start single phase IM.   (08 Marks)
    c. Write a note on limitations and application of shaded pole IM.   (04 Marks)

Module-5

9   a. List the methods of starting synchronous motor explain any one method with neat sketch.   (08 Marks)
    b. Describe a phenomenon of hunting in synchronous machine and methods to overcome this.   (06 Marks)
    c. What is synchronous condenser? What is its application?   (06 Marks)

OR

10 a. Briefly explain the V and inverted V curves of a synchronous motors and the methods of obtaining them.   (08 Marks)
    b. Explain the construction and working of Chiversal motor and stipper motor.   (12 Marks)

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