CBCS SCHEME

17EE44

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Electric Motors

Time: 3 hrs.   Max. Marks:100

Note: Answer any FIVE full questions.

1 a. What is back emf? Derive the armature torque equation of a DC motor. **(08 Marks)**
   b. Explain why DC series motor should never started on No-load. **(04 Marks)**
   c. A 4 pole, 220V, DC shunt motor lap wound has 960 conductors. The flux per pole is 20 mwb. Determine the torque developed by the armature and the useful torque in Nm when the current drawn by the motor is 28A. The armature resistance is 0.1Ω and the shunt filed resistance is 125Ω. The rotational losses of the machine amounts to 800watts. **(08 Marks)**

2 a. Draw the power flow diagram of DC motor and derive the condition for maximum efficiency. **(08 Marks)**
   b. Explain the operation of a three point starter with a neat sketch. **(06 Marks)**
   c. A 200V DC shunt motor takes 22A at rated voltage and runs at 1000rpm. Its field resistance is 100Ω armature circuit resistance is 0.1Ω. Compute the value of additional resistance required in the armature circuit to reduce the speed to 800 rpm when the load torque is proportional to the speed. **(06 Marks)**

3 a. With neat diagram, explain the Swinburne's test on a DC motor. Mention the demerits of the test. **(06 Marks)**
   b. Explain the test on a DC motor which determines rotational losses. **(06 Marks)**
   c. The Hopkinson's test on two shunt machines gave the following results for full load
       Line voltage – 250V, current taken from supply system excluding field current = 50A
       Motor armature current = 380A, field currents = 5A and 4.2A (gen and motor respectively)
       calculate the efficiency of the motor and generator. Assume resistance of each machine for the armature as 0.02ohm. **(08 Marks)**

4 a. Discuss the torque-slip characteristics of a three phase induction motor including motoring, generating and braking regions. **(08 Marks)**
   b. Derive the torque equation for a three phase induction motor. **(06 Marks)**
   c. A 400V, 4 pole 3phase 50Hz star connected induction motor has a rotor resistance and reactance per phase equal to 0.01Ω and 0.1Ω respectively. Determine :
       i) Starting torque ii) Slip at maximum torque iii) Speed at maximum torque iv) Maximum torque v) Full load torque if full load slip is 4%. Assume ratio of stator to rotor turns as 4 . **(06 Marks)**

5 a. Starting from the first principles develop the equivalent circuit of a 3-phase induction motor. **(08 Marks)**
   b. Explain with neat diagram, the no-load and blocked rotor test on an induction motor. **(06 Marks)**
   c. A 6 pole, 50Hz, 3-phase induction motor running on full load with 4% slip develops a torque of 149.3Nm at its pully rim. The friction and windage losses are 200w and the stator copper and iron losses are equal to 1620w. calculate :
       i) Output power   ii) The rotor copper loss   iii) Efficiency at full load. **(06 Marks)**

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

     b.   Write the procedure of drawing the circle diagram what information can be obtained from the circle diagram.   (08 Marks)

     c.   Explain the principle of operation of an induction generator. What are its limitations?   (06 Marks)

7   a.   Why starter is necessary for an induction motor? With neat diagram, explain the operation of a star – Delta starter.   (08 Marks)

     b.   Describe any two methods of speed control of a 3-phase induction motor.   (06 Marks)

     c.   A squirrel cage induction motor has a full load slip of 5%. The motor starting current at rated voltage is 6 times its full load current. Find the tapping on the auto transformer starter which would give. Full load torque at start. What would then be the supply starting current.   (06 Marks)

8   a.   Explain with double revolving field theory why the single phase induction motor is not self starting.   (08 Marks)

     b.   Explain with neat diagram the working principle of :
i) Shaded – pole induction motor   ii) Capacitor start induction motor.   (12 Marks)

9   a.   State the methods of starting synchronous motor explain any one in detail.   (06 Marks)

     b.   Write a note on V-curves and inverted V-curves of synchronous motor.   (06 Marks)

     c.   What is hunting? State its causes, how it can be minimized.   (08 Marks)

10   a.   Explain the construction and working of stepper motor and give some applications.   (08 Marks)

     b.   Write not on :
i) Linear induction motor
ii) AC servomotor.   (12 Marks)

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