CBCS SCHEME

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15EE44

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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. Explain the speed-current, torque-current and speed torque characteristics of DC shunt motor. **(06 Marks)**

b. Derive the expression for the torque developed in a DC motor. **(04 Marks)**

c. A 200V shunt motor has $R_a = 0.1\Omega$, $R_f = 240\Omega$ and rotational loss 236watt. On full load, the line current is 9.8A with the motor running at 1450 rpm. Determine:
i) The mechanical power developed
ii) The load torque
iii) The full load efficiency **(06 Marks)**

OR

2 a. Explain with a neat diagram the operation of a 3 point starter. **(07 Marks)**

b. What are the different losses in dc shunt motor? how do they vary with the load. **(04 Marks)**

c. A 230V DC shunt motor runs at 800rpm and takes an armature current of 50A. Find the resistance to be added to the field circuit to increase the speed from 800rpm to 1000rpm at an armature current of 80A. Assume that flux is proportional to field current. Take $R_a = 0.15\Omega$ and $R_{sh} = 250\Omega$. **(05 Marks)**

Module-2

3 a. Explain with a neat circuit Field's test conducted on two similar DC series motor. **(06 Marks)**

b. Sketch the torque-slip characteristic of a 3 phase Induction motor indicating herein the starting torque, maximum torque and operating region. **(04 Marks)**

c. Derive the expression for the torque of an Induction motor and obtain the condition for maximum torque. **(06 Marks)**

OR

4 a. A retardation test in performed on a separately excited DC motor. The induced voltage falls from 240V to 220V in 25 secs, on opening the armature circuit and in 6 seconds on suddenly changing the armature connection from supply to a load resistance, which takes an average current of 10A. Find the efficiency of the machine running as a motor taking a current of 25A from 250V supply. Take $R_a = 0.3\Omega$ and $R_{sh} = 200\Omega$. **(06 Marks)**

b. An 8 pole, 50Hz, 3 phase Induction motor develops a maximum torque of 150Nm at 650rpm. The rotor resistance is 0.6Ω/ph. Find torque at 4% slip. Neglect stator impedance. **(04 Marks)**

c. Describe the relative merits and demerits of Swinburne's test. Why this test cannot be performed on DC series motor. **(06 Marks)**

Module-3

5 a. Draw and explain the phasor diagram and equivalent circuit of a 3 phase Induction motor. **(08 Marks)**

b. A 6 pole, 50Hz, 3 phase Induction motor running on full load with 4% slip develops a torque of 149.3Nm, at its pulley rim. The friction and windage losses are 200W and stator copper and iron losses equal to 1620watts. Calculate:

i) Output power
ii) Gross torque
iii) The rotor copper losses
iv) The efficiency at full load. **(08 Marks)**

OR

6 a. A 400V, 3 phase, 50Hz, star connected Induction motor has the following test results:
No-load test : 400V, 8.5A, 1100W
Blocked rotor test : 180V, 45A, 5700W
Calculate the line current and power factor when operating at 4% slip by drawing circle diagram. The stator resistance/ph is 0.5Ω. **(10 Marks)**

b. Explain how voltage is induced in Induction generator. **(06 Marks)**

Module-4

7 a. With the help of a neat sketch explain the working of star-delta starter. **(06 Marks)**

b. With connection diagram, explain working of single phase capacitor start Induction motor. **(06 Marks)**

c. Explain rotor resistance control method of 3 phase induction motor speed control with a suitable diagram. **(04 Marks)**

OR

8 a. Why single phase Induction motor is not self starting? Explain the double revolving field theory. **(08 Marks)**

b. Why starters are required for 3ph Induction motor? Explain with necessary circuit direct on-line starter. **(08 Marks)**

Module-5

9 a. Why the synchronous motor is not self starting? Explain the following starting methods.

i) Auxiliary motor starting
ii) Induction motor starting. **(08 Marks)**

b. List out the reasons why AC servomotors are best suited for low power applications. **(04 Marks)**

c. A 400V, 10HP, 3 phase synchronous motor has negligible armature resistance and synchronous reactance of 10Ω/phase. Determine the minimum current and the corresponding induced EMF for full load condition. Assume an efficiency of 85%. **(04 Marks)**

OR

10 a. Explain the effect of varying excitation on armature current and p.f. of synchronous motor. **(08 Marks)**

b. Explain with a neat diagram principle of operation of stepper motor. **(08 Marks)**

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