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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Derive an expression for the armature torque of D.C. motor. **(06 Marks)**
   b. With a neat circuit diagram, explain the methods of speed control for D.C. shunt motor. **(07 Marks)**
   c. A 200V DC shunt motor takes 22A at rated voltage and runs at 1000rpm. Its field resistance is 100Ω and armature circuit resistance is 0.1Ω compute the additional resistance required in the armature circuit to reduce the speed to 800rpm, when i) the load torque is proportional to the speed   ii) the load torque varies as the square of the speed. **(07 Marks)**

OR

2 a. Draw the power flow diagram for D.C. motor. Also explain the various losses which occur in D.C. motor. **(06 Marks)**
   b. With a neat sketch, describe the working of three point starter. What are its limitations and necessity of starter? **(08 Marks)**
   c. A 4 pole 230V series motor runs at 1000rpm, when the load current is 12A, the series field resistance is 0.8Ω and the armature resistance is 1Ω. The series field coils are now regrouped from all in series to two in series with two parallel paths. The line current is now 20A if the corresponding weakening of field is 15%. Calculate the speed of the motor. **(06 Marks)**

Module-2

3 a. With a neat circuit diagram, explain the importance and procedure of conducting Swinburner's test on DC motor. Show the efficiency as a motor can be predetermined and list the advantage of this test. **(10 Marks)**
   b. Two identical DC shunt machine, when tested by Hopkinson's method gave the following data line voltage = 230V, line current excluding the field current = 30A, motor armature current = 230A, field currents 5A and 4A (generator and motor respectively), the armature resistance of each machine is 0.025Ω, calculate the efficiency of both the machines. **(10 Marks)**

OR

4 a. Discuss the torque – slip characteristics of a three phase induction motor including motoring generating and braking regions and obtain torque ratio $\dfrac{T_{FL}}{T_m}$ in terms of slip and rotor parameters. **(10 Marks)**
   b. A 3-phase induction motor having 6-poles, stator winding is star connected runs on 240V, 50Hz supply. The rotor resistance and stand still reactance are 0.12Ω and 0.85Ω per phase. The ratio of stator to rotor turns is 1.8 and full load slip is 4%. Calculate the developed torque at full load, maximum torque and the speed at maximum torque. **(10 Marks)**

Module-3

5 a. Draw the phasor diagram of induction motor "on load" condition. Write steps involved in drawing it. **(10 Marks)**

   b. Draw the circle diagram from no load and blocked rotor test of a 3 phase 14.92kW, 400V, 6 pole IM from the following test results:

   No load test : 400V, 11A, p.f = 0.2

   Blocked rotor test : 100V, 25A, p.f = 0.4

   Rotor cu lose at standstill is half the total cu loss.

   From the diagram, find line current, slip, efficiency, maximum torque and power factor.

   (10 Marks)

OR

6 a. Explain the construction and working of double cage induction motor and also draw an equivalent circuit. **(08 Marks)**

   b. Explain the working of induction motor working as a generator. **(06 Marks)**

   c. Explain the grid connected operation of the induction generator. **(06 Marks)**

Module-4

7 a. What is the necessity of starter? Explain the auto transformer method of starting a three phase induction motor. **(10 Marks)**

   b. List and explain the different methods of speed control of 3ϕ induction motor. **(10 Marks)**

OR

8 a. Explain double field revolving theory as applied to single phase induction motor and prove that it cannot produce any starting torque. **(10 Marks)**

   b. Explain the construction and working of capacitor start capacitor run single phase induction motor. Mention its applications. **(10 Marks)**

Module-5

9 a. Explain the operation of synchronous motor at constant load variable excitation. **(10 Marks)**

   b. Explain with a neat diagram, the construction and working of linear induction motor and state its applications. **(10 Marks)**

OR

10 a. Explain in detail the various methods of starting synchronous motor. **(10 Marks)**

   b. Explain the construction and working principle of universal motor also mention applications of the universal motor. **(10 Marks)**

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