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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. What is meant by back emf? Explain the significance of back emf. **(06 Marks)**
   b. State the applications of various types of DC motor. **(04 Marks)**
   c. A 200 V dc shunt motor takes 22 A and runs at 1000 rpm. Its field and armature resistance are 100 Ω and 0.1 Ω respectively. Determine the valve of additional resistance required in the armature circuit to reduce the speed to 800 rpm, when:
   (i) The torque proportional to the speed
   (ii) The torque varies as the square of the speed **(10 Marks)**

OR

2 a. Explain the characteristics of DC shunt motor. **(06 Marks)**
   b. Derive the condition for maximum efficiency of a DC machine. **(04 Marks)**
   c. With a neat sketch, explain the Ward-Leonard method of speed control of DC motor. **(10 Marks)**

Module-2

3 a. Describe the field test applied to two similar DC series motor. **(06 Marks)**
   b. Derive an expression for running torque of an induction motor and obtain the condition for maximum torque while running. **(08 Marks)**
   c. A 4-pole, 50 Hz, induction motor at rated voltage and frequency has a starting torque of 160% and maximum torque of 200% of full load torque. Determine:
   (i) Full load speed
   (ii) Speed at maximum torque **(06 Marks)**

OR

4 a. Discuss the torque-slip characteristics of a 3-ϕ induction motor indicating motoring, generating and braking regions on diagram. **(10 Marks)**
   b. The Hopkinson's test on two shunt machines gave the following test results for full load:
   Line voltage = 250 V
   Current taken from supply excluding field current = 50 A
   Motor armature current = 380 A
   Field currents = 5A and 4.2 A
   Calculate the efficiency of the motor and generator. Assume resistance of each machine is 0.02 Ω (Ra). **(10 Marks)**

Module-3

5 a. In a 3 ϕ IM show that rotor input: rotor cu loss : mechanical power developed is 1:5:1 − 5. **(06 Marks)**
   b. Explain cogging and crawling phenomenon in 3-ϕ induction motor. **(04 Marks)**

c. The power input to a 500 V, 50 Hz, 6-pole, 3ϕ induction motor at 975 rpm is 40 KW. The stator losses total 1 KW and the friction and windage losses total 2 KW. Calculate:
   (i) Slip
   (ii) The rotor copper loss
   (iii) Mechanical power developed in the rotor
   (iv) Efficiency   (10 Marks)

OR

6 a. Draw the circle diagram from no load and short circuit test of a 3-ϕ, 14.92 KW, 400 V, 6 pole induction motor with the following test data:
   No load : 400 V, 11 A, cos ϕ = 0.2
   SC load : 100 V, 25 A , cos ϕ = 0.4
   The stator and rotor copper losses are equal. Determine from circle diagram:
   (i) The line current   (ii) Slip   (iii) Power factor
   (iv) Maximum output   (v) Efficiency   (10 Marks)

   b. Explain the construction of deep bar rotor induction motor.   (06 Marks)

   c. Explain the principle of operation of an induction generator. What are its limitations?   (04 Marks)

Module-4

7 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. Mention the different methods of speed control of 3ϕ induction motor. Describe any two methods.   (10 Marks)

OR

8 a. Explain why single phase induction motor is not self starting.   (06 Marks)

   b. Briefly explain torque-speed characteristics of capacitor split phase motor. Mention the application of capacitor split phase method.   (06 Marks)

   c. With neat sketches, explain the construction and operation of capacitor start 1-ϕ induction motor.   (08 Marks)

Module-5

9 a. Explain the operation of synchronous motor at constant load and variable excitation with phasor diagrams.   (08 Marks)

   b. Describe the different starting methods of synchronous motor.   (06 Marks)

   c. Describe the operation of linear induction motor. List the application.   (06 Marks)

OR

10 a. Explain the construction and working of universal motor.   (06 Marks)

   b. Write a short note on stepper motor.   (06 Marks)

   c. Describe a phenomenon of hunting in synchronous machine, what are the methods to overcome this.   (08 Marks)

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