CBCS SCHEME

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15EE44

# Fourth Semester B.E. Degree Examination, July/August 2022
## 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 significance of back e.m.f. in a d.c. motor. **(04 Marks)**
    b. With neat sketch, explain three point starter of a d.c. motor. **(07 Marks)**
    c. A 200V dc shunt motor draws 22A at rated voltage and runs at 1000rpm its field resistance is 100Ω and armature resistance including brushes is 0.1Ω. Calculate the value of additional resistance required in the armature circuit to reduce the speed to 800rpm. When the load torque is proportion to the speed? **(05 Marks)**

### OR

2   a. What are the losses in a d.c. machine and derive the expression for condition for maximum efficiency. **(08 Marks)**
    b. Explain the power flow diagram in a d.c. machine as generator and as motor. **(08 Marks)**

### Module-2

3   a. Derive the expression for efficiency of a d.c. series machine by conducting the field test. **(08 Marks)**
    b. A retardation test is carried out on a 1000rpm dc machine. The time taken for the speed to fall from 1030rpm to 970rpm is
       i)   40 seconds with no excitation.
       ii)  20 seconds with full excitation.
       iii) 9 seconds with full excitation and the armature supplying an extra load of 10A at 225V.
       Calculate: i) The moment of inertia in $kg/m^2$   ii) Iron losses    iii) The mechanical losses at the mean speed of 1000rpm. **(08 Marks)**

### OR

4   a. With neat sketch, explain the torque slip characteristic of a three phase induction motor covering motoring, generating and braking regions of operation. **(08 Marks)**
    b. A 6 pole 3 phase, 50Hz induction motor runs on full load with a slip of 4% given the rotor stand still impedance per phase as $(0.01 + j0.05)$ohm. Calculate the available maximum torque in terms of full load torque. Also determine the speed at which the maximum torque occurs. **(08 Marks)**

### Module-3

5   a. Explain the phenomenon of cogging and crawling in a three phase induction motor. **(08 Marks)**
    b. A three phase, 400V, 50Hz, 4 pole star connected induction motor has stator impedance of $Z_1 = (0.07 + j0.3)\Omega$ per phase and rotor impedance of $Z_2^1 = (0.08 + j0.3)\,\Omega$ per phase referred to stator side. The magnetizing reactance is 10Ω/phase and core loss resistance is 50Ω/phase. Under these conditions the slip is 4%. Using approximate equivalent circuit, calculate: i) Stator current and power factor    ii) Torque developed    iii) Gross efficiency. **(08 Marks)**

**OR**

6  a. With neat sketch, explain the working operation of induction generator. **(08 Marks)**
   b. Draw the equivalent circuit of a double cage induction motor. And sketch torque and current characteristics of a double cage induction motor. **(08 Marks)**

## Module-4

7  a. Explain any two methods of speed control of three phase induction motor. **(08 Marks)**
   b. With neat sketch, explain star delta starting method of a three phase induction motor. **(08 Marks)**

**OR**

8  a. With neat sketch, explain the construction and working principles of a shaded pole motor. **(08 Marks)**
   b. With neat sketch, explain the construction and working principle of split phase single phase induction motor. **(08 Marks)**

## Module-5

9  a. What are V and inverted V curves? Sketch them and explain their significance. **(08 Marks)**
   b. What are the methods for starting the synchronous motor? Explain them. **(08 Marks)**

**OR**

10 a. With neat sketch, explain the construction and working principle of linear induction motor. **(08 Marks)**
   b. With neat sketch, explain the construction and working principle of stepper motor. **(08 Marks)**

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