CBCS SCHEME

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15EE44

# Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## 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 emf in DC motors. **(04 Marks)**

b. Describe with a neat sketch the working of 3-point starter. **(06 Marks)**

c. A 250 V DC shunt motor on no load runs at 1000 rpm and takes 5A. The total armature circuit and shunt field resistance are 0.2Ω and 250Ω respectively. Calculate the speed when loaded and taking a current of 50A, if armature reaction weakens the field by 3%. Assume a brush contact drop of 1V at each brush. **(06 Marks)**

**OR**

2 a. Derive the torque equation of DC motor. **(05 Marks)**

b. Explain briefly the losses in DC motor. **(05 Marks)**

c. A 60 KW, 500 V DC shunt motor has a lap connected armature with 492 conductors. Flux/pole is 0.05 wb and full load efficiency is 90%. Its armature resistance is 0.1Ω and shunt field resistance is 250Ω. Find for full load (i) speed (ii) useful torque, if 6% of the torque is lost in friction. **(06 Marks)**

### Module-2

3 a. Discuss in detail the Swinburn's test conducted on DC machine for predetermination of efficiency. **(05 Marks)**

b. Derive an expression for the torque of an induction motor and obtain the condition for maximum torque. **(05 Marks)**

c. A Retardation test is carried out on a 1000 rpm DC machine. The time taken for the speed to fall from 1030 rpm to 970 rpm is,

1) 40 seconds with no excitation
2) 20 seconds with full excitation
3) 9 seconds with full excitation and the armature supplying an extra load of 10 A at 225 V. Calculate:

i) The moment of inertia of the armature in kg-$m^2$.
ii) Iron losses
iii) The mechanical losses at the mean speed of 1000 rpm. **(06 Marks)**



**OR**

4 a. Describe the field test applied to two similar DC series motors. **(05 Marks)**

b. The following results were obtained during Hopkinson's test on two similar 230 V machines, armature currents 37A and 30A; filed currents of 0.85 A and 0.8A. Calculate the efficiencies of machines if each has armature resistance of 0.33Ω. **(06 Marks)**

c. Calculate the torque exerted by an 8-pole, 50 Hz, 3-phase induction motor operating with a 4% slip which develops a maximum torque of 150 kg-m at a speed of 660 rpm. The resistance per phase of the rotor is 0.5Ω. **(05 Marks)**

## Module-3

5 a. Discuss the various losses that take place in 3-phase induction motor. Explain briefly. **(05 Marks)**

b. Explain no load and blocked rotor tests conducted on 3-phase induction motors to construct circle diagram. **(06 Marks)**

c. Draw a neat sketch and explain the working of double cage induction motor. **(05 Marks)**

**OR**

6 a. Write a brief note on induction generator. **(04 Marks)**

b. Draw the circle diagram for a 20 HP, 50 Hz, 3-phase star connected induction motor with the following data:
No load test: 400 V, 9A, 0.2 PF
Blocked rotor test: 200 V, 50A, 0.4PF
Determine the line current and efficiency for full load condition. **(08 Marks)**

c. A 5 HP, 400V, 6-pole, 50 Hz, 3-phase induction motor operating at full load draws a line current of 7A at 0.866 PF with 2% slip. Find the rotor speed and efficiency of the motor. **(04 Marks)**

## Module-4

7 a. Justify the necessity of starter for 3-phase induction motor. Explain star-delta starter with neat sketch. **(08 Marks)**

b. Explain with a neat sketch the construction and working principle of split phase induction motor. **(04 Marks)**

c. A 250 W, 230 V, 50 Hz single phase capacitor start induction motor has the following constants for the main and auxiliary windings. Main winding $Z_m = (4.5 + j3.7)\Omega$, auxiliary winding $Z_a = (9.5 + j3.5)\Omega$. Determine the value of the capacitor that will place the main and auxiliary winding currents in quadrature at starting. **(04 Marks)**

**OR**

8 a. Describe the different methods of speed control of three phase induction motors. **(06 Marks)**

b. Discuss with a neat sketch the working of DOL starter. **(05 Marks)**

c. Explain with a neat sketch the construction and working principle of capacitor start induction motor. **(05 Marks)**

## Module-5

9 a. Write a brief note on V and inverted V curves of synchronous motor. **(06 Marks)**

b. List the applications of linear induction motor. **(04 Marks)**

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



**OR**

10 a. Explain briefly why synchronous motors are not self starting. **(06 Marks)**

b. Write a brief note on AC series motor. **(04 Marks)**

c. Describe the phenomenon of hunting in synchronous machine. **(06 Marks)**

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