



COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering

Lecturers : Dr. Rania Assem

Course : Electrical Machines I

Course Code: EE 321

Date : 26 / 5 / 2015

Marks: 40

Time : 2 hours

Final Exam

Answer The Following Questions:

Q1 [10 marks] (C-3)

- a- Describe the types of magnetic (core losses) and how can you minimize their effect. (2 marks)
- b- What is meant by energy and co-energy? (2 marks)
- c- A rotating reluctance machine of the form shown has a coil inductance that can be approximated by:

$$L(\theta) = 0.02 - 0.04 \cos 2\theta \text{ H.}$$

A current of 5A (rms) at 60 Hz is passed through the coil. And the rotor is driven at a speed, which can be controlled, of ω_m rad/sec.

- Sketch the function of L versus θ
- Find the values of ω_m at which the machine can develop average torque.
- At each of the speeds obtained in part (a), determine the maximum value of the average torque and the maximum mechanical power output. (6 marks)

Q2 [10 marks] (A-28)

- a- Discuss briefly how to control the speed of a DC shunt motor. (5 marks)
- b- A 10 kW, 200 V series motor has an armature circuit resistance of 0.02Ω and a series field resistance of 0.04Ω . The speed at full load is 1200 rpm. Find the new speed if a diverter resistance of 0.04Ω was connected in parallel to the series field while the total torque was unchanged. Assume that the magnetic flux is directly proportional to the field current over the given operating range.

(5 marks)

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Q3 [10 marks] (C-3)

a- Explain what is meant by “armature reaction” and how does it affect the performance of DC machines?

Suggest methods to improve the machine performance to overcome its effects. (5 marks)

b- The open circuit characteristics of a 1200 rpm DC generator is given by:

| | | | | | | |
|-------------------|---|-----|-----|-----|-----|-----|
| Field current (A) | 0 | 1.5 | 2.0 | 2.5 | 3.5 | 4.0 |
| E.M.F (V) | 0 | 118 | 138 | 150 | 160 | 162 |

If this machine was connected as a shunt excited generator with a total field circuit resistance of 50 Ω . Find the following, assuming that the magnetic flux is proportional to the field current over the operating range:

- The no-load voltage at the given speed and the field circuit resistance.
- The values of the critical field circuit resistance and critical speed at the given conditions
- The field circuit resistance for a no-load voltage of 135V.
- The voltage if the speed dropped to 900 rpm with a total field circuit resistance of 50 Ω .

(5 marks)

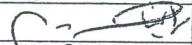


Q4 [10 marks] (A-28)

a- What are the types of braking techniques used with DC motors? Demonstrate the differences between each method showing the advantages and disadvantages of each technique (4 marks)

b- A belt driven 100 KW shunt wound generator running at 450 rpm is supplying full load to a bus bar at 230 V. At what speed will it run if the belt breaks and the machine continue to run taking 7.5 KW from the bus bars? The armature and the field resistances are 0.04 Ω and 50 Ω respectively. The brush contacts drop is 1V per brush. Neglect armature reaction.

(6 marks)

With Our Best Wishes

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