COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering
Lecturer : Dr. Rania Assem
Course : Electrical Drives 1
Course Code : EE 424 Ni Marks : 40
Date : 04/06/2014 Time : 2 hour

Final Exam

Answer all the following questions

Q1 [10 marks] (A-28)

a- Explain briefly why:

i. Large DC motors cannot normally be started by applying full voltage;
ii. The no-load speed of a permanent-magnet motor is almost proportional to the armature voltage;
iii. The field windings of a DC motor consume energy continuously even though they do not contribute to the mechanical output power;
iv. The field poles of a DC machine are not always laminated.

(4 marks)

b- A dc, separately excited motor has the following parameters and ratings:

$$k\varphi = 3Vsec, \qquad R_a = 2\Omega$$

Terminal voltage = 600V, Full load torque = 21 Nm

Calculate:

i. The armature current at full load torque
ii. The starting current. Show how can you reduce the starting current by 80%

(6 marks)

Q2 [10 marks] (A-29)

a- Discuss the main disadvantages of a rectifier fed dc drive system. Will the system performance be enhanced in case of use of a chopper drive system? Give reasons for your answer (4 marks)

b- A DC motor is supplied from a three-phase power system at 415 V r.m.s, line-to-line via a dual fully controlled bridge converter system which has 4V device voltage drop. The motor armature resistance is 0.2 Ω and supply inductance may be neglected. Find the firing angles and DC machine e.m.f.s for the following conditions:

i. Machine motoring from converter 1 at 100A and a terminal voltage of 500V.
ii. Machine regenerating through converter 2 at 100A and the same terminal voltage.

(6 marks)

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Q3 [10 marks] (A-4)

a- Explain briefly why:

i- Induction motors are often described as 'constant speed' machines.

ii- Large induction motors sometimes cause a dip in the supply system voltage when they are switched direct-on-line **(4 marks)**

b- An induction motor has a stator resistance of 3Ω, and the rotor resistance referred to the stator is 2Ω. The equivalent inductive reactance X_{eq}=10Ω. Calculate the change in the starting torque if the voltage is reduced by 10%. Also, compute the resistance that should be inserted to the rotor circuit to achieve maximum torque at starting. **(6 marks)**

Q4 [10 marks] (A-28), (B-2)

a- The block diagram in figure 1 is a closed loop control for an induction motor. Answer the following questions:

i. What is the main control function of the control system in terms of control variables

ii. What is the purpose of the following blocks:

a) PI speed and current controller

b) Filter

iii. Draw the expected torque-speed characteristics that your expect for the induction motor operating with this drive system. Show the expected speed operating range if a fan load is applied on the motor

iv. Draw the power circuit diagram for this drive.

v. Can this drive system operate in regenerative mode? Justify your answer

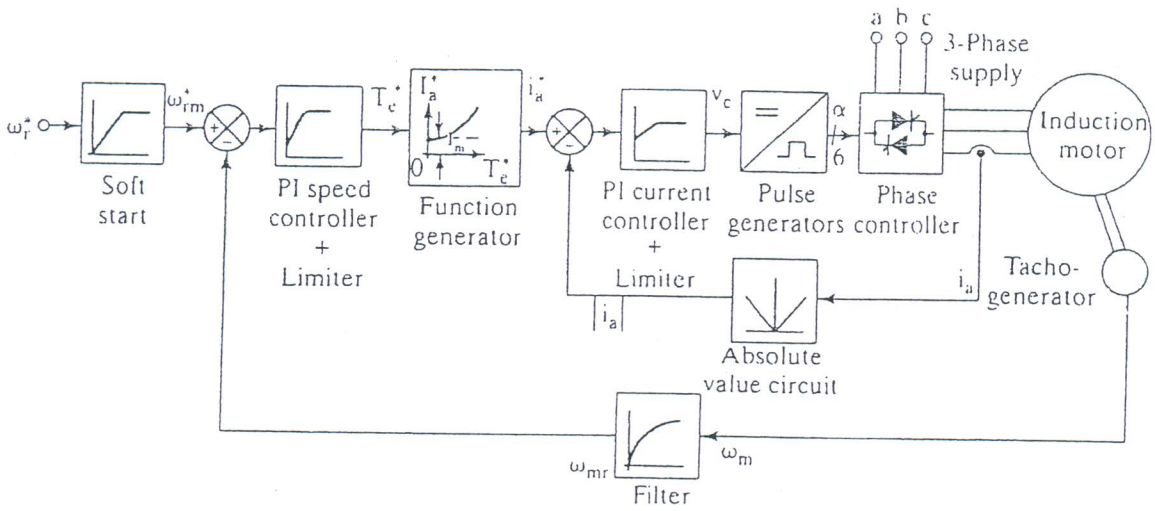

Figure 1: Closed loop control of induction motor

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