Kafrelsheikh University
Faculty of Engineering
Mechanical Engineering Dept.
Final Exam, 2015-2016

3rd Year (Mechanical Engineering)
Automatic Control Engineering
Time: 180 minutes
Mark: 90
Dr. Abdel-Fattah Heliel

Answer all the following questions:

Problem 1: (20 Marks)

a) What is PID control? Explain the control effects by P, I, and D, respectively. [8 Marks]

b) Obtain the transfer functions X1(s) / U (s) and X2(s)/U(s) of the mechanical system shown in Fig. 1. [12 Marks]

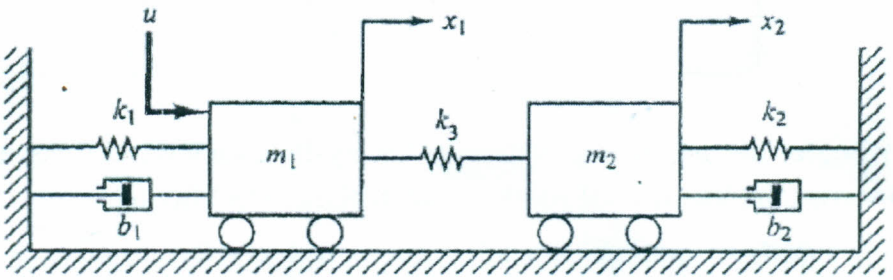


Figure 1

Problem 2: (25 Marks)

a) What are the advantages and disadvantages of open-loop and closed-loop control systems? [10 Marks]

b) For the system shown in Figure 2, determine the values of gain K and velocity-feedback constant K_h so that the maximum overshoot in the unit-step response is 0.2 and the peak time is 1 sec. With these values of K and K_h, obtain the rise time and settling time. Assume that J=1 kg-m^2 and B=1 N-m/rad/sec. [15 Marks]

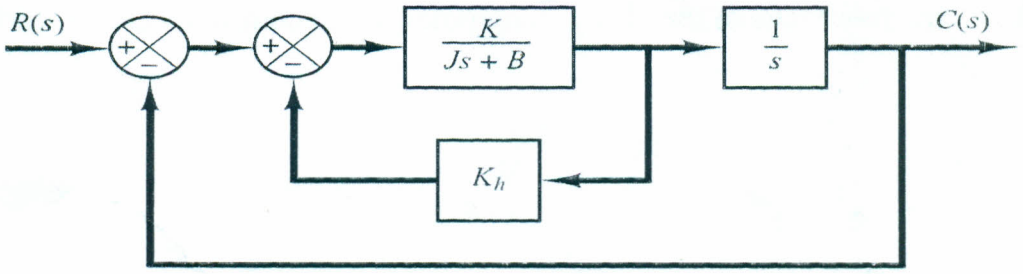


Figure 2

Problem 3: (25 Marks)

a) Reduce the block diagram shown below to a single block representing the transfer function, $T(s) = C(s)/R(s)$. [10 Marks]

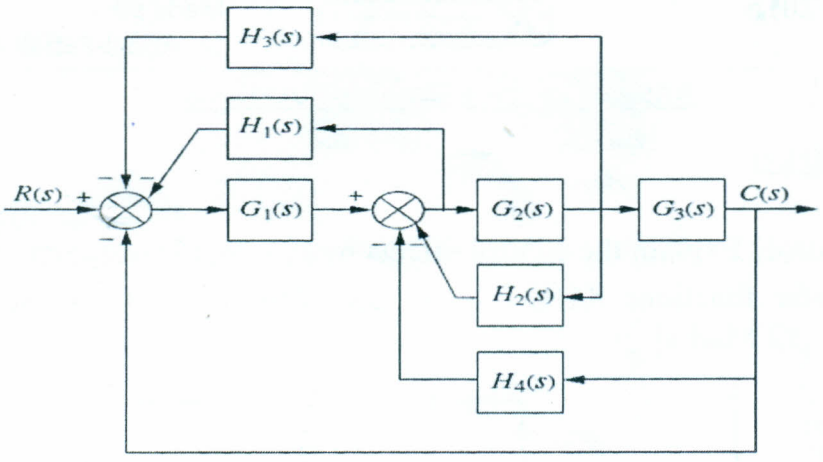


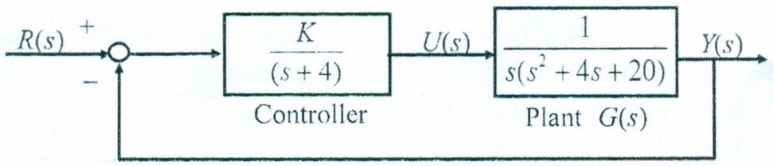
Figure 3

b) Check whether the following system given by its characteristic equation is stable or not and shows the location of roots on the s-plane. **[15 Marks]**

$$q(s) = S^5 + S^4 + 2S^3 + 2S^2 + S + 1 = 0$$

Problem 4: (20 Marks)

A feedback control system is proposed. The corresponding block diagram is:



Sketch the root locus of the closed-loop poles as the controller gain K varies from 0 to ∞.