Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Final Exam, 2020/2021
Dr. Abdel-Fattah Heliel

3rd Year (Electrical Engineering)
Automatic Control Engineering
Time: 180 minutes
Marks = 90
Date: 17-3-2021

Answer all the following questions:

Problem 1: (30 Marks)

a) Compare between lead and lag compensators? **(10 Marks)**

b) Consider the control system shown in following figure

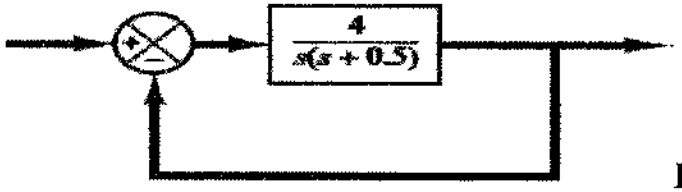

Figure 1

The damping ratio is 0.125, the undamped natural frequency is 2 rad/sec, and the static velocity error constant is 8 sec^{-1}. It is desired to make the damping ratio of the dominant closed-loop poles equal to 0.5 and to increase the undamped natural frequency to 5 rad/sec and the static velocity error constant to 80 sec^{-1}. Design an appropriate compensator to meet all the performance specifications. **(20 Marks)**

Problem 2: (30 Marks)

a) Define gain margin, phase margin and explain graphically. What are the gain margin and the phase margin indicate? **(12 Marks)**

b) Construct the polar plot for the function GH(S) =2(S+1)/ S^2. Find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. **(18 Marks).**

Problem 3: (30 Marks)

a) Draw the bode plot of the system and Comment on the stability of the system. **(10 Marks)**

$$G(s) = \frac{K(s+3)}{s(s+1)(s+2)}$$

b) For the following transfer function: $G(s) = \frac{Y(s)}{U(s)} = \frac{S^2+7S+2}{S^3+9S^2+26S+24}$. Draw the simulation diagram and find the state space representation for the above transfer function.**(10 Marks)**

c) Consider the regulator system shown in following Figure 2. The plant is given by: **(10 Marks)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} u(t)$$

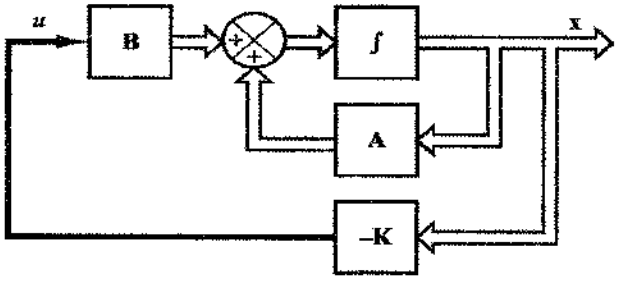

Figure 2

Determine the state feedback gain for each state variable to place the poles at -1+j, -1-j,-3.