Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Final Exam, 2017/2018
Dr. Abdel-Fattah Heliel

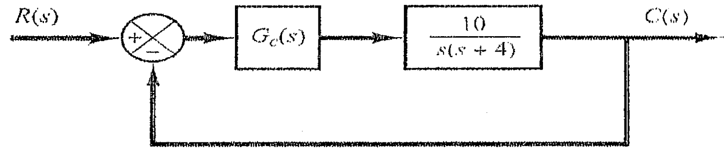
3rd Year (Electrical Engineering)
Automatic Control (2)
Time: 180 minutes
Marks= 90

Answer all the following questions:

Problem 1: (35 Marks)

a) **Construct the configuration of the electronic lag compensator using operational amplifiers and drive the transfer function of the compensator. (10 Marks)**

b) **Design a lag compensator for following unity feedback system such that the static velocity error constant is 50 sec^{-1} without appreciably changing the closed loop poles, which are at $s = -2 \pm j\sqrt{6}$. (15 Marks)**



c) **Draw the bode diagram of the following transfer function:**

$$G(j\omega) = \frac{5(1 + j0.1\omega)}{j\omega(1 + j0.5\omega)\left(1 + j0.6\frac{\omega}{50} + \left(\frac{j\omega}{50}\right)^2\right)}$$

After plotting Bode diagram evaluate the gain margin and the phase margin of the system and Comment on the stability of the system whose Bode diagram. (10 Marks)

Problem 2: (30 Marks)

a) **Define gain margin, phase margin and explain graphically. What are the gain margin and the phase margin indicate? (10 Marks)**

b) **How to select pole and zero for the lead compensator to the system: G(s)=4/(s(s+2)) based on root locus method. (10 Marks)**

c) **Consider a unity feedback system having an open-loop transfer function, (10 Marks)**

$$G(j\omega) = \frac{K}{j\omega(1 + j0.2\omega)(1 + j0.05\omega)}.$$

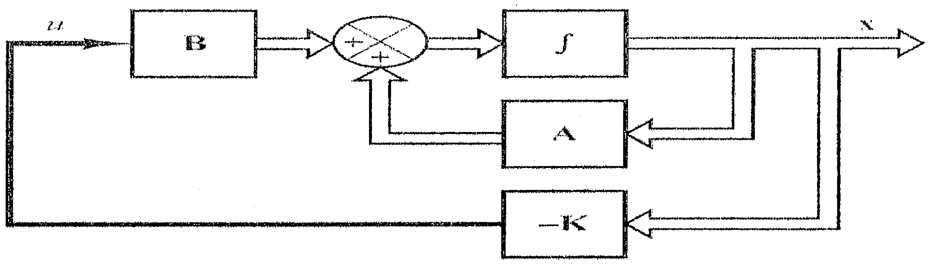
Draw the polar plot of the system and Comment on the stability of the system.

Problem 3: (25 Marks)

a) **What are controllability and observability of control systems? (10 Marks)**

b) **Consider the regulator system shown in following figure. The plant is given by: (15 Marks)**

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



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