Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Final Exam, 2015/2016

3rd Year (Electrical Engineering)
Automatic Control (2)
Time: 180 minutes
Dr. Abdel-Fattah Heliel

Problem 1: (30 points)

a) Define gain margin and phase margin and explain graphically. What do the gain margin and the phase margin indicate? **(10 points)**

b) A simplified diagram of the closed-loop system for controlling the yaw of a fighter jet is given in Figure 1, where the aircraft is approximated by a fourth-order system. When gain K=80, Draw the bode plot. Determine the gain margin and phase margin . Also determine gain crossover frequency and phase crossover frequency. Comment on the system stability using bode plot. **(20 points)**

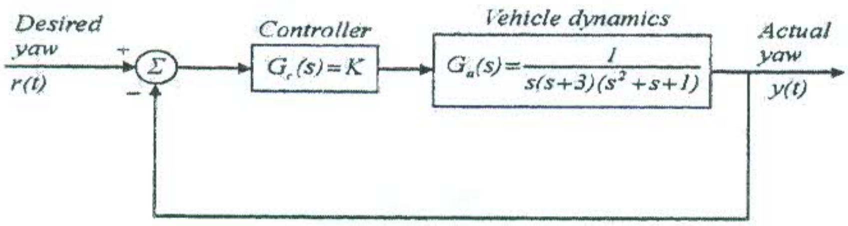


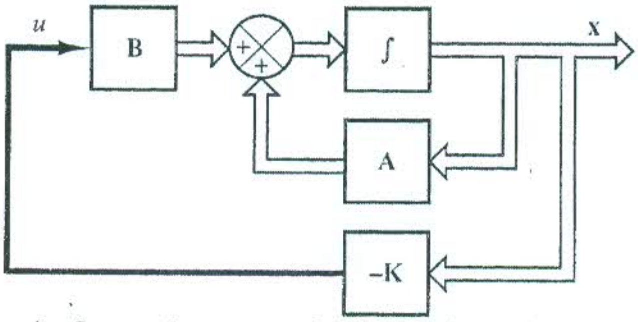
Fig.1

Problem 2: (20 points)

a) Sketch the polar plot for G(s)=20/s(s+1)(s+2). **(5 points)**

b) Consider the regulator system shown in following figure. The plant is given by

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

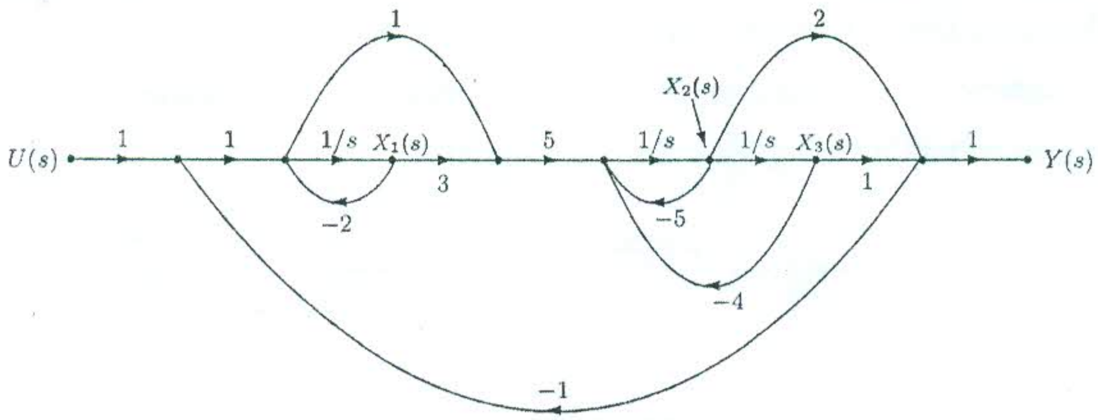


Determine the state feedback gain for each state variable to place the poles at -1+j, -1-j,-3.

<u>(Apply any method)</u> **(15 points)**

Problem 3 (40 points)

We are given the signal flow graph shown below where the excitation is $U(s)$ and the response is $Y(s)$. The signals $U(s)$ and $Y(s)$ are the Laplace transformed versions of time signals $u(t)$ and $y(t)$, respectively. The signals $X_1(s)$, $X_2(s)$ and $X_3(s)$ are the Laplace transformed versions of the state variables $x_1(t)$, $x_2(t)$ and $x_3(t)$, respectively



(a) Write the state equations for the system using state variables $x_1(t)$, $x_2(t)$ and $x_3(t)$. Put the equations in standard form $\dot{x}(t) = Ax(t) + Bu(t)$. Clearly identify matrices A and B.

(b) Write the output response $y(t)$ as a function of the state variables.

(c) Find the transfer function $Y(s)/U(s)$.

< Good luck >

Kafrelsheakh university
Faculty of engineering
Physics & engineering mathematics dept.
Year: 3rd year electrical eng.

Time: 3 h
Total mark: 70 marks
Subject: engineering mathematics (3)
Final 1st term exam (13/1/2016)

Answer the following questions:

[1] a- If A, B are two independent events, show that : $P(A^C \cap B^C) = p(A^C)p(B^C)$.

b- Let A, B be events with $p(A) = \frac{3}{8}$, $p(B) = \frac{1}{2}$ and $p(A \cap B) = \frac{1}{4}$, find $p(A \cup B)$, $p(A^C)$, $P(A^C \cup B^C)$.

c- Find the expectation μ, variance σ^2 and standard deviation σ of the following distribution

x_i	-1	0	1	2	3
$f(x_i)$	0.3	0.1	0.1	0.3	0.2

[2] a- Define probability function (p)?

b- For each $A, B \subseteq S$, prove that :

1- $p(A) = 1 - p(A^c)$.
2- $p(A \cap B) = p(A) + P(B) - p(A \cup B)$.
3- $p(A - B) = p(A) - p(A \cap B)$.

c- Let $S = \{a, b, c, d, e, f\}$ and $p(a) = \frac{1}{16}$, $p(b) = \frac{1}{16}$, $p(c) = \frac{1}{8}$, $p(d) = \frac{3}{16}$, $p(e) = \frac{1}{4}$, $p(f) = \frac{5}{16}$. And let $A = \{a, c, e\}$, $B = \{c, d, e, f\}$, $C = \{b, c, f\}$. Find $p(A|B)$, $p(A^c|C)$ and $p(C|A^c)$?

[3] a- If X is a random variable has probability density function

$$f(x) = \begin{cases} c(1-x), & -1 < x < 1 \\ 0, & othrwise \end{cases}$$

i) Find the constant c .
ii) The value of $p(0 < X < 0.75)$.

b- A pair of fair dice is thrown. Let X be the random variable which denotes the minimum of the two numbers which appear. Find the distribution, mean, variance and standard deviation of X,

With my best wishes

Prof.Dr. Arafa Nasef