Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Final Exam 2020-2021
Date: 4-3-2021

2nd Year (Electrical Engineering)
Automatic Control (1)
Time: 180 minutes
Mark: ١٢٥
Dr. Abdel-Fattah Heliel

Answer all the following questions:

Problem 1: (٣٠ Marks)

a) Obtain the transfer functions $X_1(s)$ /U (s) and $X_2(s)/U(s)$ of the mechanical system shown in Fig. ٤. **[١٥ Marks]**

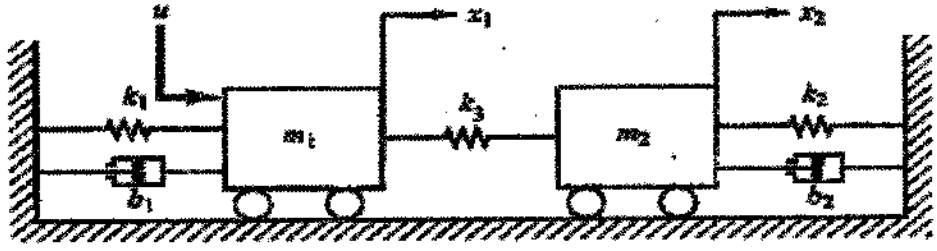

Fig. 1

b) Use block diagram reduction to simplify the block diagram below into a single block relating Y(s) to R(s), [15 Marks].

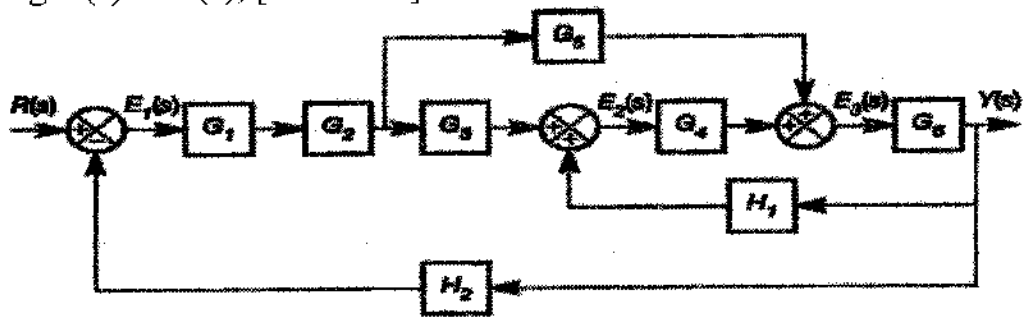

Fig. 2

Problem 2: (2٠ points)

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

b) Obtain analytically the rise time, peak time, maximum overshoot, and settling time in the unit-step response of a closed-loop system given by: $\frac{C(s)}{R(s)} = \frac{36}{s^2+2s+36}$, and show locations of poles and zeros on the pole-zero plot. **[10 Marks].**

Problem 3: (20 Marks)

a) A system with several feedback loops and forward paths is shown. Find the transfer function of the system using Mason rule. **[12 Marks]**

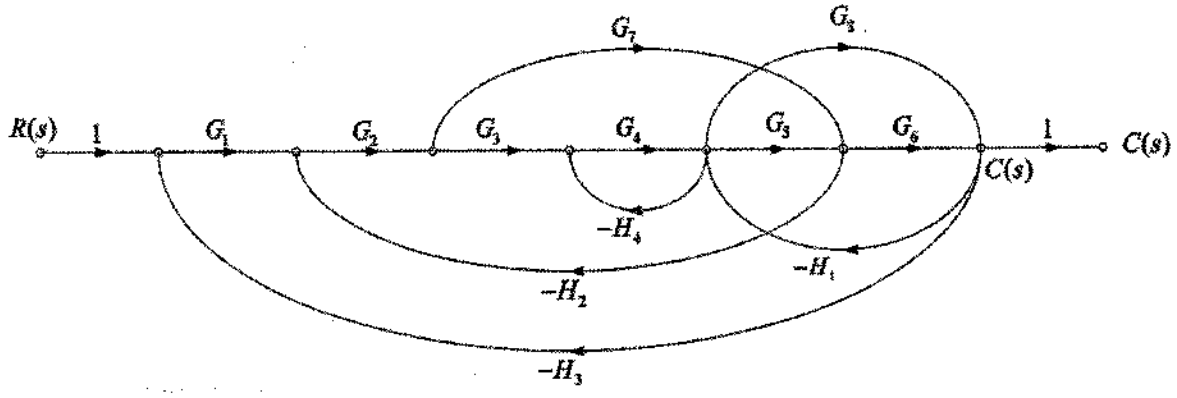

Fig. 3

b) Consider the following electrical system with the applied voltage V_i as the input and V_o as the output.

1. Write the loop equations. (2 Marks)
2. Write the node equations. (2 Marks)
3. Find the transfer function of the system. (2 Marks)
4. What is the order of this system? Notice that $V_I = V_o$ (2 Marks)

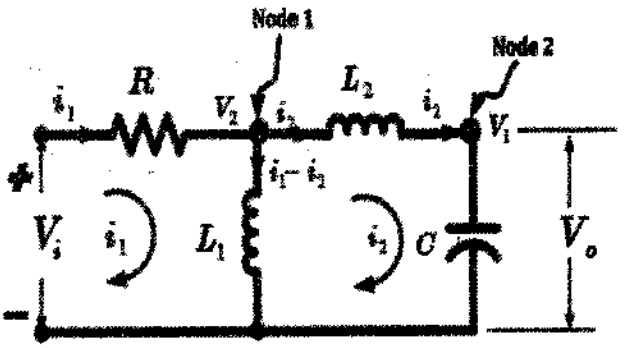

Fig. 4

Problem 4: (20 Marks)

a) Consider the following characteristic equation. Determine the range of K for stability.

$$s^4 + Ks^3 + s^2 + s + 1 = 0$$

[10 Marks].

b) Consider a unity feedback system with the open-loop transfer function as:

$G(s) = \dfrac{K}{s(s+3)(s^2+2s+2)}$, Sketch RL of the closed-loop system when K varies from 0 to ∞.

[10 Marks].

مع تمنياتي لكم بالتوفيق والنجاح،،،