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

2nd Year (Electrical Engineering)
Automatic Control (1)
Time: 180 minutes
Mark: 90
Dr. Abdel-Fattah Heliel

Answer all the following questions:

Problem 1: (30 points)

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

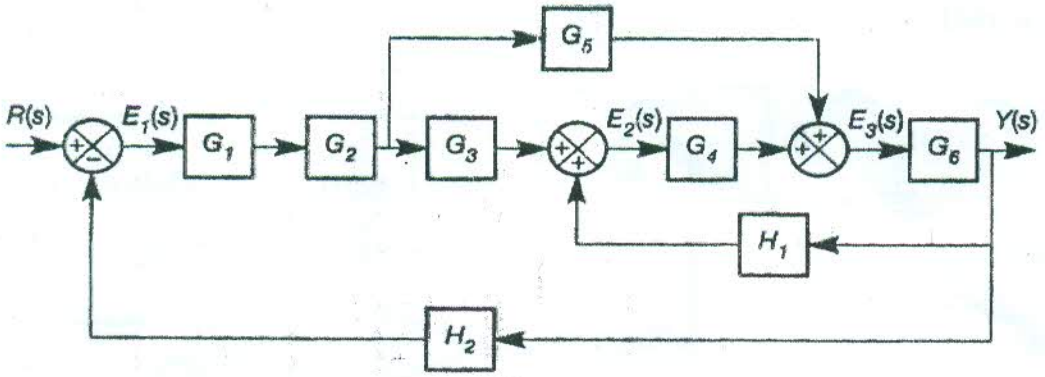


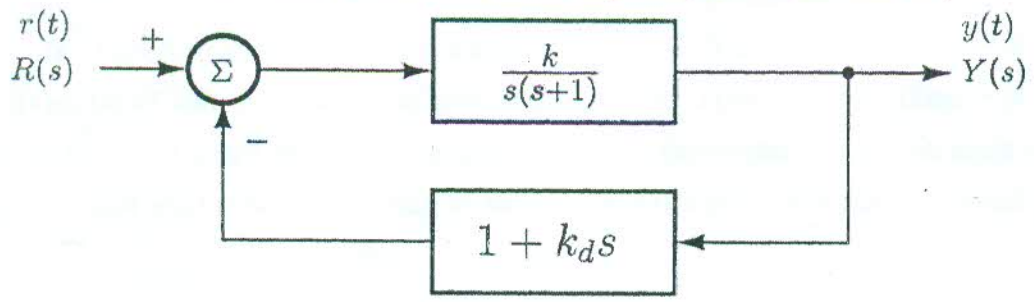
Fig. 1

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]**

$$q(s) = S^5 + 10S^4 + 45S^3 + 90S^2 + 164S + 200 = 0$$

Problem 2: (30 points)

a) Find constants k and k_d such that the step response of the system has a maximum overshoot of 20% and a peak time (t_{max}) equal to 1sec. **[10 Marks]**



b) A closed loop negative feeback system has an open loop transfer function:

$$G(s)H(s) = \frac{K(s+10)}{s(s^2+6s+13)}$$

Sketch the Root Locus for K > 0. **[20 Marks]**

Problem 3: (30 points)

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

b) We are given the control system shown below where the excitation is the voltage source $v_S(t)$ and the response is the voltage $v_C(t)$. Assume that the opamps are ideal. **[20 Marks]**

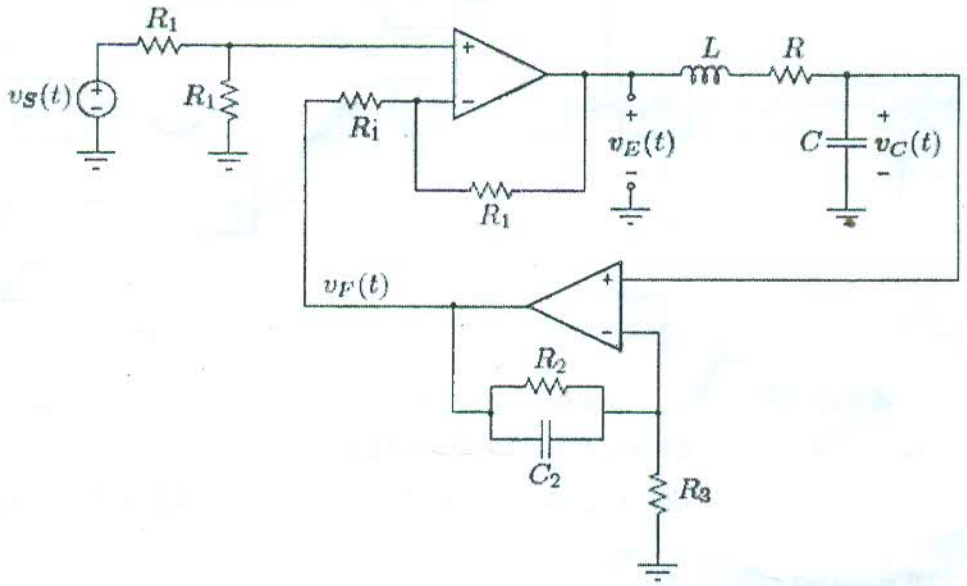


Figure 2

(a) Given that $R_1 = 10\text{k}\Omega$, determine voltage $v_E(t)$ as a function of voltages $v_S(t)$ and $v_F(t)$. Also find $V_E(s)$ as a function of voltages $V_S(s)$ and $V_F(s)$.

(b) Given that $R = 1\Omega$, $L = 100\text{mH}$ and $C = 100\text{mF}$, determine the transfer function $V_C(s)/V_E(s)$.

(c) Given that $R_2 = 10\text{k}\Omega$, $R_3 = 1\text{k}\Omega$ and $C_2 = 100\mu\text{F}$, determine the transfer function $V_F(s)/V_C(s)$.

(d) Construct a block diagram for the overall system showing voltages $V_S(s)$, $V_E(s)$, $V_C(s)$ and $V_F(s)$.

(e) Determine the transfer function $V_C(s)/V_S(s)$. What is the dc gain of the system from $V_S(s)$ to $V_C(s)$?