Minoufia University
Faculty of Engineering
Production Eng. & Mech. Design. Dept.
Time: 180 min.

Final Automatic Control Exam.

Academic year: 2014-20
Academic term: 2nd Term
Academic level: 4th PROD.
Date: /06/2015
Code: PRE 422

Answer the following questions:

Q1:(20 marks)

Find out the transfer functions $\left[\frac{C(s)}{R(s)}\right]$ for the control system block diagram given in Fig. 1:

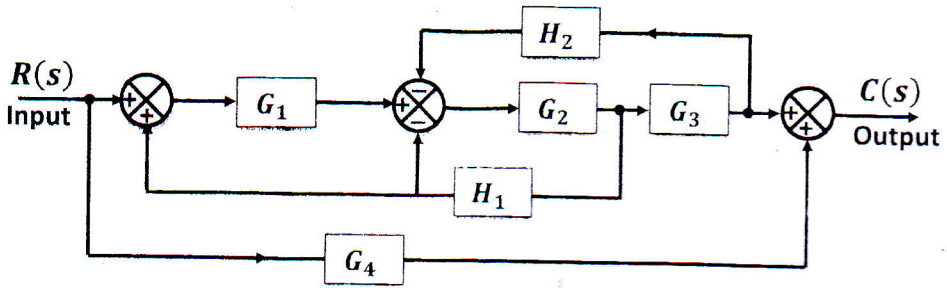

Fig. 1: Block diagram.

Q2: (15 marks)

Draw the block diagram of the closed-loop control system shown in Fig. 2. The input linear displacement x_i and the output force F are converted to electrical signal throughout the potentiometer with constant Kp and the force transducer with constant K_f. The controller amplification factor is ka and the ***D.C-Servo motor*** has the following specifications: resistance R, inductance L and capacitance C, torque constant kt ***(N.m/A)*** back emf constant Kv***(Vs/rad)***, and equivalent mass m, ***(kg)***, the motion is transmitted from the motor to the mas trough the gearing system *1* and *2* with angular displacement θ_1, θ_2 and radius R_1, R_2, rack and pinion with radius R_o is converted the angular displacement $\theta_2$of the output of gearing system to linear displacement X of the output of the mass.

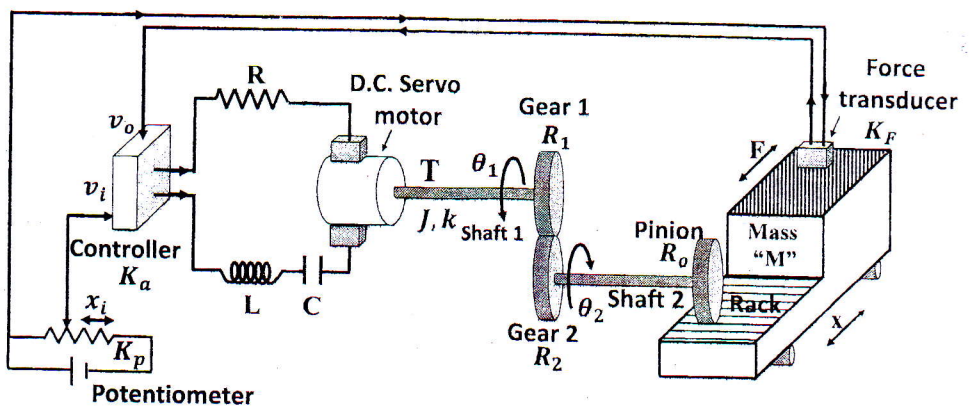

Fig. 2: Force control system.

Q3: (20 marks)

Consider the closed-loop control system shown in the figure (3).

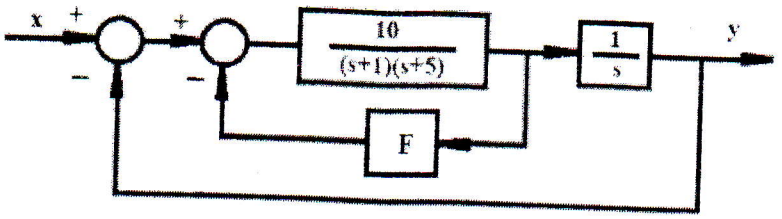

Fig. (3) Closed-loop control system.

1. Calculate the value of the feedback block (F) to get critically stable system.
2. Determine the stability of the system with value of F = 0.2.
3. Find out the Gain and Phase Margins with value of F = 0.2.

Q4: (5+10) marks

i- Find the inverse Laplace transform of

$$F(s)= (2*S + 12)/(S^2 +2*S +5)$$

ii- The forward path function for a closed loop control system has the following form:

$$G(s) = K/S^2$$

And the feedback function has the form:

$$H(s) = 1+k*S$$

Calculate the value of K and k for transient response has a maximum overshoot = 25% and peak time = 2 sec.

Q5: (20 marks)

Consider the system shown in Figure (4). Sketch the root loci for the system. Observe that for small or large values of K the system is underdamped and for medium values of K it is overdamped.

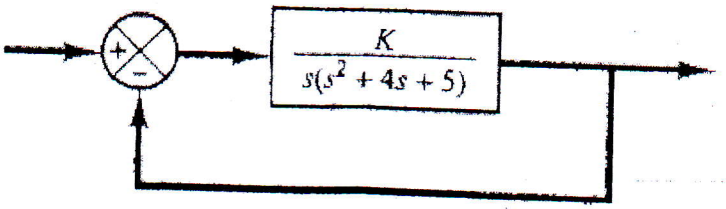

Fig. (4)

Best Wishes