6. (a) Plot the Bode diagram for the following transfer function and obtain the gain and phase crossover frequencies and margins?

$$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}. \quad (8)$$

(b) Explain what is minimum phase and non-minimum phase systems. (6)

7. (a) The open loop transfer of a feedback control system is given by $G(s)H(s) = \frac{K}{s^2 + s - 2}$, plot the Nyquist plot and show that the closed loop system is stable of $K \geq 2$. (8)

(b) State and explain Nyquist stability criterion. (6)

8. (a) A unity feedback system is characterised by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine settling time, peak overshoot and peak time for a unit step input. (8)

(b) Find the dynamic error coefficients of the unity feedback system whose forward transfer function $G(s) = \frac{10}{s(s+1)}$. Find the steady state error to the input $r(t) = P_0 + P_1 t + P_2 t^2$? (6)

[06 – 3216]

III/IV B.E. DEGREE EXAMINATION.

Second Semester

Electrical and Electronics Engineering

CONTROL SYSTEMS

(Common with Electronics and Communication Engineering)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR from the remaining

All questions carry equal marks.

1. (a) What are the characteristics of negative feedback?

(b) What is the principle of argument?

(c) Compare the AC and DC servomotor.

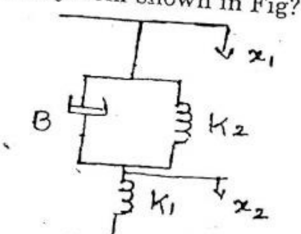
(d) What are the advantages of Bode Plot?

(e) What are the basic properties of signal flow graph?

(f) Distinguish between type and order of a system.

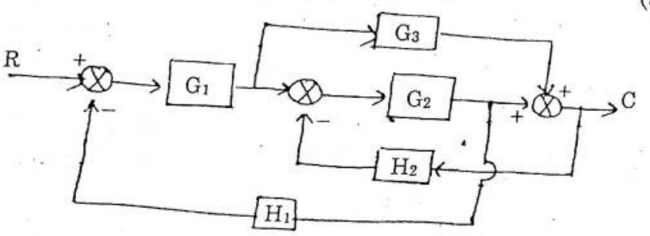
(g) Write a short note on the condition between the time and frequency response?

2. (a) Draw the electrical analogous circuit (use f-v analogs) and derive their transfer function for the system shown in Fig? (7)



(b) Write the differences between closed loop and open loop system. (7)

3. (a) Draw signal flow graph for a system whose block diagram is shown in Fig. Identify the forward paths, individual loops and determine the relation C/R? (9)



(b) The closed loop transfer function of a unity feedback control system is given below $\frac{C(s)}{R(s)} = \frac{Ks + \beta}{s^2 + 8s + \beta}$. Determine the steady state error for unit ramp input. (5)

4. (a) The overall transfer function of a control system is given by $\frac{C(s)}{R(s)} = \frac{16}{s^2 + 16s + 16}$. It is desired that the damping ratio be 0.8. Determine the derivative rate feedback constant Kt and compare rise time, peak time, maximum overshoot and steady state error for unit ramp input without and with derivative feedback control. (10

(b) For servomechanisms with open loop transfer function given below explain what type of input signal give rise to a constant steady state error and calculate their values

$$G(s) = \frac{20(s+2)}{s(s+3)(s+1)}.$$ (4)

5. (a) The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{K(s+9)}{s(s^2 + 4s + 11)}$$

Sketch the root locus of the system. (10

(b) The characteristic polynomial of a system is

$$S^7 + 5S^6 + 9S^5 + 9S^4 + 4S^3 + 20S^2 + 36S + 36 = 0$$

Determine the stability using RH criterion. (4

6. (a) Draw the polar plots for the system whose

(i) $G(s) \cdot H(s) = \dfrac{1}{S(i + TS)}$.

(ii) $G(s) \cdot H(s) = S$.

(b) Draw the Bode plots for the transfer function

$$G(s) = \frac{50}{s(1 + 0.25s)(1 + 0.1s)}.$$

From the Bode-plot, determine the values of

(i) Gain cross over frequency

(ii) Phase cross over frequency

(iii) P.M and G.M and

(iv) The stability of the system.

7. (a) Explain Nyquist stability criterion with the help of neat sketches.

(b) Using Nyquist stability criterion, find the value of k for which the closed loop system with the following characteristic equation is stable.

$$F(s) = s^3 + (k + 0.5)s^2 + 4ks + 50 = 0.$$

8. Write short notes on the following :

(a) Signal flow graphs

(b) Construction of Root loci

(c) Constant M and N circles and their use in system analysis.

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III/IV B.E. DEGREE EXAMINATION.

Second Semester

Electrical and Electronics Engineering

CONTROL SYSTEMS

(Common with ECE and Dual Degree in ECE, EEE)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR from the remaining.

All questions carry equal marks.

1. (a) Draw the block diagram of a control system.

(b) State the effect of feedback on sensitivity of a control system.

(c) Explain Routh's-Hurwitz's stability criterion.

(d) Define gain margin and phase margin of a closed-loop control system.

(e) State and explain the rules for constructing Root-locus plot of a system.

(f) State and explain Nyquist criterion.

(g) Explain the concept of controllability.

1

2. (a) Determine the transfer function $\frac{Y_2(s)}{F(s)}$ of the system shown in Fig. 1.

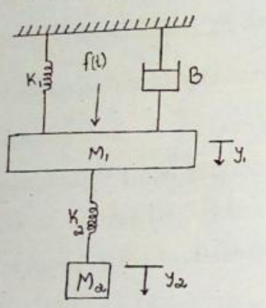

Fig. 1

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(b) Draw the block diagram representation of the network shown in Fig. 2 and find its transfer function $\frac{E_0(s)}{E_1(s)}$ using block reduction method.

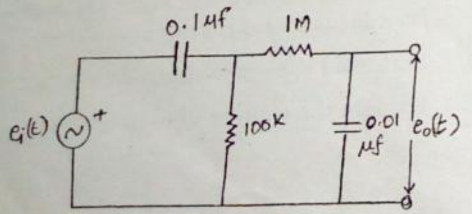

Fig. 2

3. (a) Derive the transfer function of a field controlled d.c. servomotor and develop the block diagram. Clearly state the assumptions made in the derivation.

(b) What are the effects of feedback on the performance of a system? Briefly explain.

4. (a) Determine the stability of the system that has the following characteristic equation whose function is

$$G(s)\cdot H(s) = \frac{k\,(s+3)}{s(s+2)(s+4)(s+5)}$$

(b) What are the uses of tachometers in control systems?

(c) Determine the stability of the system that has the following characteristic equation using R-H criterion

$$s^6 + 2s^5 + 8s^4 + 17s^3 + 20s^2 + 16s + 1 = 0.$$

5. (a) A unity feedback system has an open loop transfer function $G(s) = \frac{k\,(s+1)}{s\,(s-1)}$. Sketch the root locus plot with k as variable parameter. Show that the loci of complex roots are part of a circle with (–1, 0) as centre and radius $\sqrt{2}$.

(b) Define stability.

ECE

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III/IV B.E. DEGREE EXAMINATION.

Second Semester

Electrical and Electronics Engineering

CONTROL SYSTEMS

(Common with ECE and Dual Degree Program in ECE, EEE)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR from the remaining.

All questions carry equal marks.

1. (a) Explain the significance of Mason's gain formula.

   (b) Explain

      (i) marginal stability

      (ii) asymptotic stability.

(1)

(c) Explain the time response of the 1st order system for a unit impulse input.

(d) Define the time domain specifications

(i) delay time

(ii) rise time

(iii) peak time

(iv) settling time.

(e) Define the terms

(i) static position error coefficient

(ii) static velocity error coefficient

(iii) static acceleration error coefficient.

(f) What are the rules to construct the Root Locus Diagram?

(g) What is the significance of bode plot?

2. (a) Obtain the transfer functions $x_1(s)/u(s)$ and $x_2(s)/u(s)$ of the mechanical system shown in the figure below.

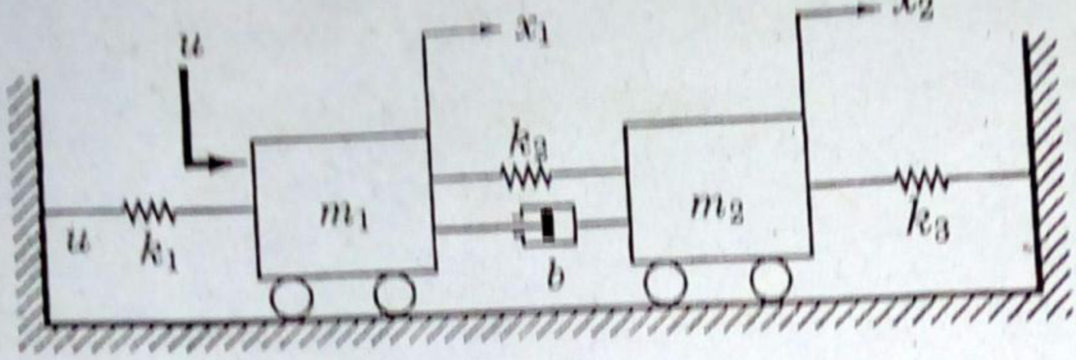

Figure 1

(b) Define the terms (i) mass (ii) linear spring (iii) frictions, for translational motion subject to mathematical modeling of mechanical systems.

3. (a) Write the various properties of a transfer function.

(b) The following differential equations represent linear time-invariant systems, where $r(t)$ denotes the input and $c(t)$ denotes the output. Find the transfer function of each of the system.

(i) $\frac{d^3c(t)}{dt^3}+3\frac{d^2c(t)}{dt^2}+4\frac{dc(t)}{dt}+c(t)=2\frac{dr(t)}{dt}+r(t)$

(ii) $\frac{d^2c(t)}{dt^2}+10\frac{dc(t)}{dt}+2c(t)=r(t-2)$.

4. (a) Define various terms related to signal flow graphs.

(b) Find the gain of the signal flow graph shown below, where a, b, c, d, e, g and l are respective gains of the branches.

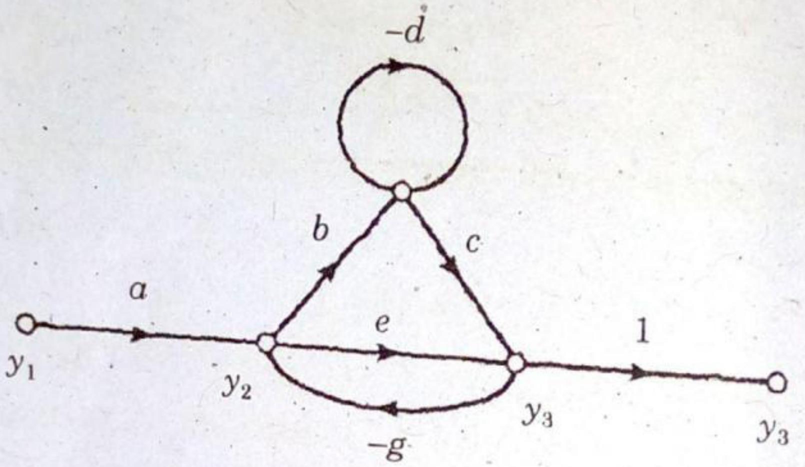

Figure 2

5. (a) For the transient-response characteristics of a control system to a unit-step input. Define

(i) Delay time

(ii) Rise time

(iii) Peak time

(iv) Maximum overshoot

(v) Settling time.

(b) Determine the position, velocity, and acceleration error constants for the control system whose open loop transfer function is as given below with unity feedback.

$$G(s)=\frac{50}{(1+0.1s)\,(1+2s)}.$$

6. The characteristic equations for certain feedback control systems are as given below. In each case determine the values of K that correspond to a stable system.

(a) $s^4+22s^3+10s^2+2s+K=0$

(b) $s^4+20Ks^3+5s^2+(10+K)s+15=0$

(c) $s^3+(K+0.5)s^2+4Ks+50=0$.

7. (a) Is a closed-loop system with the following open-loop transfer function and with $K=2$ stable?

$$G(s)H(s)=\frac{K}{s(s+1)(2s+1)}.$$

Find the critical value of the gain K for stability.

(b) Define gain margin and phase margin with necessary expressions.