Handout

Subject Name: Control System

Prepared by (Faculty (s) Name):

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Year and Sem, Department:II Year II Sem,EEE

Unit-I: (Introduction to Control Problem)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- The output of the system does not vary linearly with input called as Non Linear System. Example: Diode
- Static Signal is an unwanted input signal that affects the output signal.
- Resistor: It is an element which resists the flow of current in an electrical system.Capacitor: It is an element that stores electrical energy in a electric field. Inductor: It is an element that stores electrical energy in a magnetic field
- The control signal or manipulated variable is the quantity or condition that is varied by the controller so as to affect the value of the controlled variable
- An unwanted input signal that affects the output signal is called as Noise
- The Control unit that reacts to an actuating signal to produce a desired output. This unit does the work of controlling the output and thus may be a power amplifier
- The Actuating signal that is difference between the reference input and the feedback signal if actuates the control unit in order to maintain the output of the desired value
- A Synchro is a device used to convert an angular motion to an electrical signal or vice versa
- The motors used in automatic control systems or in servomechanism are called servomotors. They are used to convert electrical signal into angular motion.
- The function of a linear time invariant differential equation system is defined as the ratio of Laplace transform of the output(response function) to the Laplace transform of the input(drive function) under the assumption that all initial conditions are zero called as Transfer Function

Short Questions (Minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain how feedback effects overall gain of the system (Dec 2018)
2. Classify the following as open or closed loop system with valid reasons (i) An electrical On-Off switch, (ii) Room air-conditioner (May 2019)
3. Give two examples for open loop and closed loop control systems(June 2019)
4. What are the advantages of block diagram reduction technique?(June 2019)
5. Why is negative feedback invariably preferred in a closed loop system (Nov 2017)
6. Distinguish between open loop and closed loop system.(Nov 2017)
7. List out the classification of control systems (Nov 2016)
8. Define transfer function. What are its limitations (March 2017)

9. Give classification of control systems. (March 2017)
10. Define Transfer Function (Feb 2016)
11. Describe Feedback Characteristics(Feb 2016)
12. Discuss the effect of Feedback on Overall Gain?(Nov 2015)

Long Questions (Minimum 10 previous JNTUH Questions – Year to be mentioned)

1 .

For the system represented by the block diagram shown in figure 1. Find $\frac{C}{R}$.

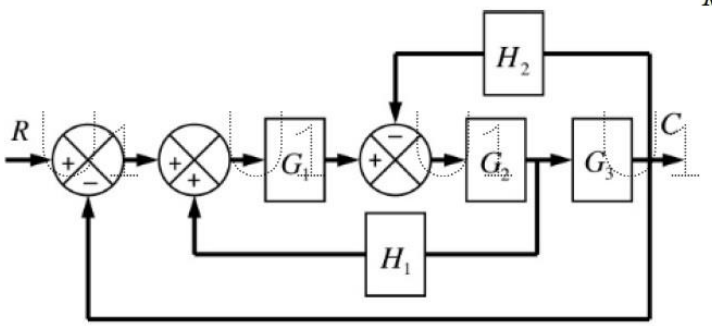


Figure: 1

(Apr-2018)

2.

What is feed back? Explain the effects of feedback.

Obtain the transfer function $X_1(s)/F(s)$ for the mechanical system shown figure 2. [5+5]

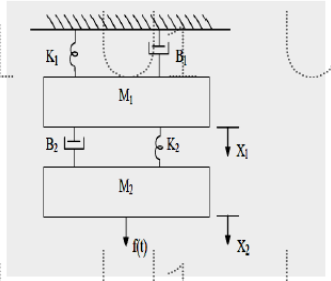


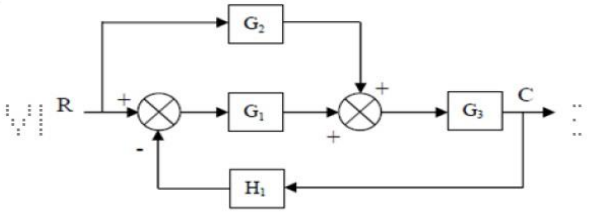
Figure 2

(Nov-2017)

3. Discuss the characteristics of feedback in closed loop control system(Nov 2016)
4. What is feedback? Explain the effects of feedback.
   b) What are differences between block diagram reduction and signal flow graph reduction?(March -2016)
5. Obtain the transfer function of RLC Circuit(March -2016)
6. Explain the rules for block diagram algebra in evaluating the transfer function of a system (Nov-2017)

7.

Illustrate at least two applications of feedback control systems.
Determine the transfer function C(S)/R(S) for the following block diagram.



8. Obtain the transfer function $\frac{Y(s)}{R(s)}$ for the flowing block diagram (figure 1):

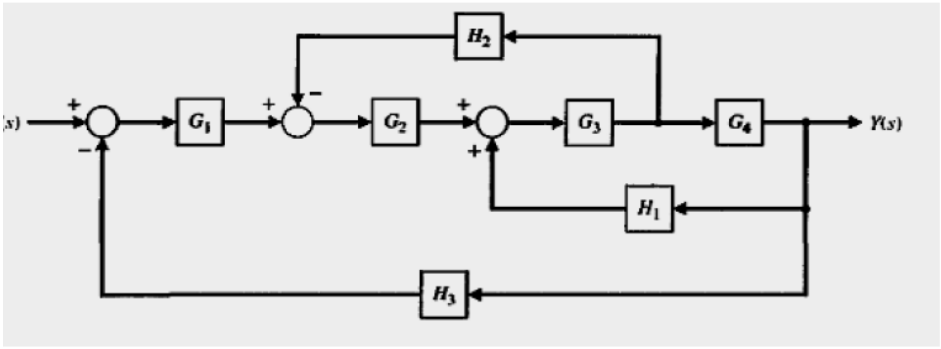


Figure 1

(Nov-2016)

9. Discuss about the effects of feedback on systems. (Nov 2016)

10. Distinguish between Open loop control system and closed loop control system(May-2019)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. A system in which the output quantity is Controlled by Varying input quantity is known as Control System
2. In Control System Negative Feedback reduces the disturbances and noise signals in Forward path.
3. The Input Quantity is also Known as ExcitationSignal and output Quantity is also Known as Response
4. The ratio of laplace transform of output to Laplace transform of Input is Known as Transfer function
5. Block diagram is used for both Linear & Non Linear Systems
6. The basic elements used in Mechanical Translation System are Mass,Spring Constant & DashPot
7. A signal flow graph is applicable only to Linear Systems
8. A node which has both Incoming & Outgoing Branches is called as Mixed Node
9. The basic elements used in Mechanical rotational System are Moment of inertia,Spring Constant & DashPot
10. In Mechanical Translational System Motion takes place along a straight line

Unit-II: (Time Response Analysis of Standard Test Signals)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- An LTI system is stable if and only if its natural response approaches zero as time → ∞.
- The natural response of a system is the response which is not due to any input, but only that which is due to initial conditions
- The poles are lying on imaginary axis of s plane then the system is called marginally stable system

- The characteristic equations having negative or zero coefficients then the system is unstable system
- The Hurwitz stability test is most useful for testing the stability of large order stability systems
- The root location can be plotted in the s plane by varying system parameter over the complete range of values
- A linear relaxed system is said to have BIBIO stability if every bounded input results in a bounded output.
- The addition of poles to the transfer function has the effect of pulling the root locus to the right, making the system less stable. Addition of zeros to the transfer function has the effect of pulling the root locus to the left, making the system more stable
- The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to 1 are called root loci.

- At break away point the root locus breaks from the real axis to enter into the complex plane. At break in point the root locus enters the real axis from the complex plane. To find the break away or break in points, form a equation for K from the characteristic equation and differentiate the equation of K with respect to s. Then find the roots of the equation dK/dS = 0. The roots of dK/dS = 0 are break away or break in points provided for this value of root the gain K should be positive and real.

Short Questions (Minimum 10 previous JNTUH Questions – Year to be mentioned)

1. What is meant by characteristic equation? (December 2018)
2. What are the standard test signals? (December 2018)
3. What is damping ratio? Differentiate second order system based on damping ratio (May 2019)
4. Distinguish between type and order of a system (April 2018)
5. What is break away and break in points? What is the procedure to determine them(May 2018)
6. What is meant by un-damped response (Nov 2016)
7. Write the remedies if an entire row is zero while computing elements in R-H array(Nov 2016)
8. Define a stable system (April 2018)
9. Write the drawbacks of RH criteria (Nov 2017)
10. What is need of Angle of Aysmptote in Root Locus(Nov 2016)

Long Questions (Minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Write the equations for time domain specifications of a standard second order system with unit step input(Dec 2018)

2. The Open Loop transfer function of unity feedback control system is given by $G(S)=\frac{9}{S(S+3)}$ find the Natural Frequency of Response ,Damping ratio,damped Frequency & Time Constant? (April 2018)

3. Determine the factor by which the gain 'K' should be multiplied so that the overshoot of the unity step response be reduced from 80% to 25%? (May 2019)

4. Derive the time response of second order over damped system due to unit step input (May 2019)

5. A unity feedback system has an open loop function G (s) = $\frac{k}{s(s2+3s+10)}$ make a rough sketch of root locus plot by determining the following (a) Centroid, number and angle of asymptotes (b) angle of departure of root loci from the poles (c) Breakaway points if any (Dec 2018)

6. A) Determine the RH stability of given characteristic equation, $S^4 + 8S^3 + 18S^2 + 16S + 5 = 0$

   b) Sketch the root locus of the system, whose open loop transfer function is $\frac{K(s+15)}{s(s+1)(s+5)}$=G(S) (Apr-2018)

7. The open loop transfer function of a unity feedback system is given by ,G(S)= $\frac{K}{S(1+ST)}$ where K and T are constants having positive values. By what factor the gain K be reduced so that (a) the peak overshoot of unit step response is reduced from 80% to 20%. (b) the damping ratio increases from 0.1 to 0.5. (May 2018)
8. Define root Locus? Explain the Procedure of Sketch of Root locus for a Given Transfer Function?(Nov 2016)
9. **OR**

   The characteristic equations of two systems are given below

   a) $S^4 + 21S^3 + 21S^2 + 36S + 20 = 0$

   b) $S^5 + 6S^4 + 3S^3 + 2S^2 + S + 1 = 0$

   Find whether the systems are stable or not using RH Criterion.

   (May 2017)

10. A)Sketch the root Locus of Function G(S)H(S)=$\frac{K}{(S+1)(S+3)}$

    B)Write the effect of adding Poles /Zeros to G(S)H(S) (Nov 2015)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The Standard Test signals are Unit Step,Ramp,Impulse,Parabolic& Sinusoidal
2. The Zero Input Stability is also known as Asymptotic Stability
3. The Root locus is Symmetrical about the real axis
4. The root locus techniques was introduced by W.R Evans
5. A Straight line travels along the axis to meet Zero at Infinity is known as Asymptote
6. The break away can be either Real or Complex
7. Unity is the area under unit impulse function
8. If the damped factor is unity then the response is called as Critically damped Function
9. The polynomial whose coefficients are the elements of row just below the row of zeros in Routh array is known as Auxillary Polynomial
10. The transient response of the system is also called as Dynamic response