Code No: R05220205 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2007
CONTROL SYSTEMS
(Common to Electrical & Electronic Engineering, Electronics & Communication Engineering, Electronics & Instrumentation Engineering, Electronics & Control Engineering, Electronics & Telematics and Electronics & Computer Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the classification of control systems?
   (b) Find the transfer function relating displacement 'y' and 'x' for the following system. Shown in figure 1b. [6+10]

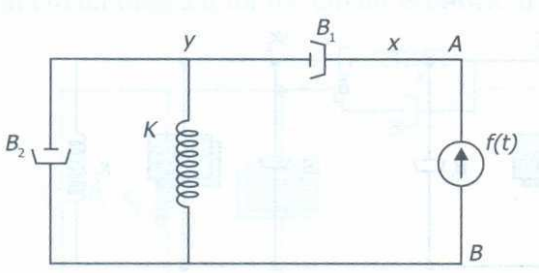

Figure 1b

2. Derive the Transfer Function for a.c. servomotor. Explain about torque-speed characteristics of a.c. servomotor. [16]

3. (a) Explain the significance of generalized error series?
   (b) For a system $G(s)H(s) = \frac{K}{s^2(s+2)(s+3)}$,. Find the value of K to limit the steady state error to 10 when the input to the system is r(t)=1+10t+40/2 t^2.[6+10]

4. The open loop T.F. of a control system is given by $G(s)H(s) = \frac{K}{s(s+6)(s^2+4s+13)}$ Sketch the root locus plot and determine
   (a) the break-away points
   (b) The angle of departure from complex poles
   (c) the stability condition. [16]

5. (a) Explain the term frequency response analysis.
   (b) Show that in Bode magnitude plot the slope corresponding to a quadratic factor is -40 dB/dec.
   (c) Explain with the help of examples
      i. Minimum phase function
      ii. Non minimum phase function
      iii. All pass function. [4+6+6]

6. (a) What is "Nyquist Contour"?

   (b) A system is given by
   $G(s) = \frac{4s+1}{s^2(s+1)(2s+1)}$ Sketch the Nyquist plot & hence determine the stability of the system. [2+14]

7. (a) What is compensation? what are the different types of compensators?

   (b) What is a lag compensator, obtain the transfer function of lag compensator and draw pole-zero plot?

   (c) Explain the different steps to be followed for the design of compensator using Bode plot? [3+3+10]

8. (a) A control system has a transfer function given by
   $G(s) = \frac{S+3}{(S+1)(S+2)^2}$. Obtain the canonical state variable representation.

   (b) A system is described by

$$\dot{x} = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} [x]$$

   Find the transfer function?. [8+8]

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Code No: R05220205 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is feedback? Explain the effects of feedback?
   (b) What is the sensitivity function and explain it with respect to open loop and closed loop systems? [8+8]

2. (a) Explain the disadvantages and advantages of block diagram reduction process over signal flow graph.
   (b) Explain the rules of block diagram reduction. [8+8]

3. (a) For an under damped second order system ,define various time domain specifications?
   (b) The forward path T.F. of a unity feed back control system is given by $G(s) = \frac{2}{s(s+3)}$. Obtain the expression for unit step response of the system? [8+8]

4. For a unity feedback system having forward path transfer function $G(S) = \frac{K}{s(1+0.6S)(1+0.4S)}$. Determine
   (a) The range of values of K
   (b) Marginal value of K
   (c) Frequency of sustained oscillations. [16]

5. (a) Write a note on determination of range of 'K' for stability using Bode plots.
   (b) Define GM & PM and explain how you can determine them from Bode plots. [8+8]

6. (a) What is "Nyquist Contour"?
   (b) A system is given by $G(s) = \frac{4s+1}{s^2(s+1)(2s+1)}$ Sketch the Nyquist plot & hence determine the stability of the system. [2+14]

7. (a) What is compensation? what are the different types of compensators?
   (b) What is a lag compensator, obtain the transfer function of lag compensator and draw pole-zero plot?

(c) Explain the different steps to be followed for the design of compensator using Bode plot? [3+3+10]

8. Find the canonical format representation and state transition matrix. [16]

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 11 \\ 1 \\ -14 \end{bmatrix} u$$

$$y = \begin{bmatrix} -3 & 5 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

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Code No: R05220205 **Set No. 3**

II B.Tech II Semester Regular Examinations, Apr/May 2007
CONTROL SYSTEMS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the transfer function for the following rotational mechanical systems. Shown in figure 1a

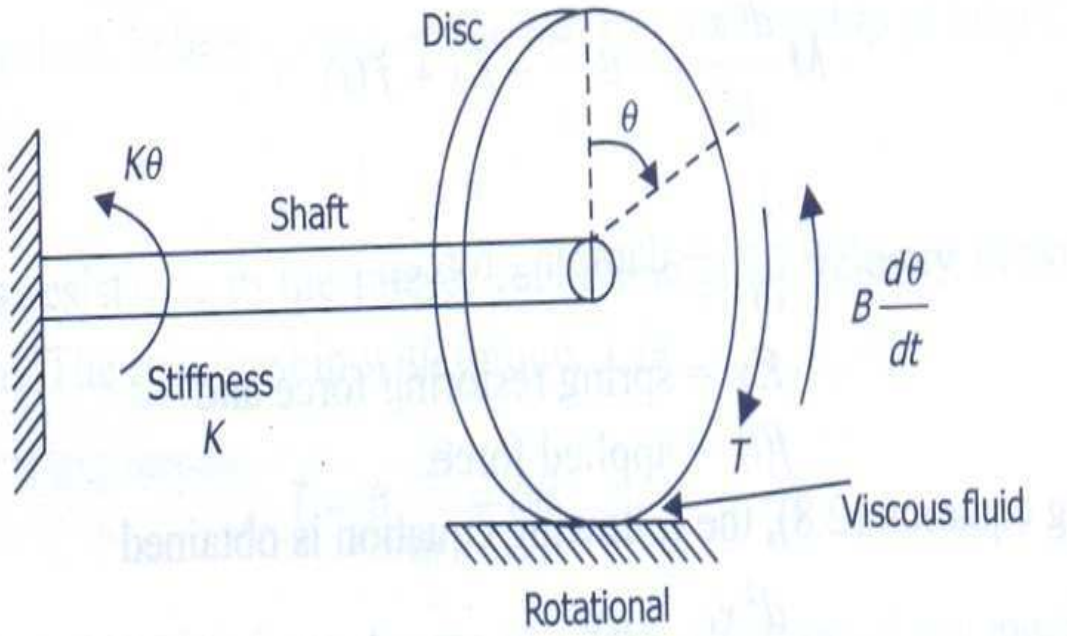

Figure 1a

(b) List out the limitation of open loop systems over closed loop systems. [10+6]

2. (a) Determine the transfer function $\frac{C(s)}{R(s)}$ for the following block diagram (figure 2a)

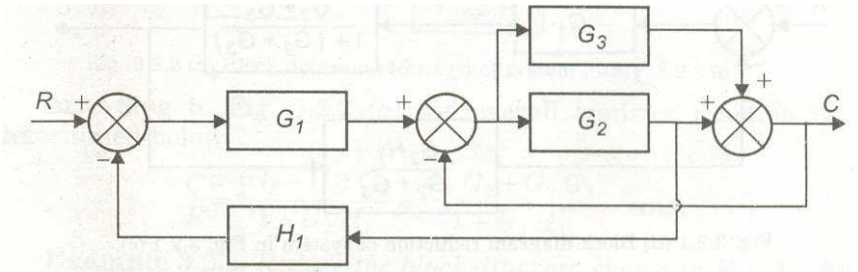

Figure 2a

(b) Define various terms involved in signal flow graphs. [10+6]

3. (a) Why derivative controller is not used in control systems? What is the effect of PI controller on the system performance?

   (b) The system shown in figure 3b uses a rate feed back controller. Determine the tachometer constant K_t so as to obtain the damping ratio as 0.5. Calculate the corresponding ω_d, T_p, T_s and M_p. [6+10]

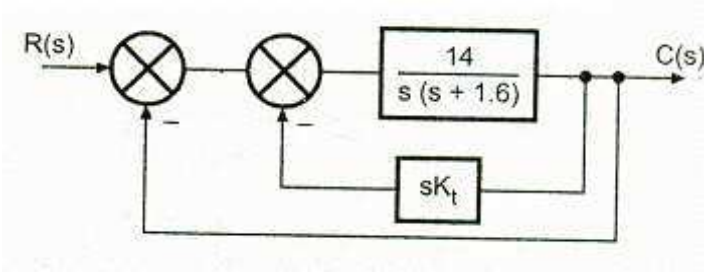

Figure 3b

4. The open loop T.F. of a control system is given by $G(s)H(s) = \frac{K}{s(s+6)(s^2+4s+13)}$ Sketch the root locus plot and determine

   (a) the break-away points

   (b) The angle of departure from complex poles

   (c) the stability condition. [16]

5. (a) Derive the expressions for resonant peak & resonant frequency and hence establish the correlation between time response & frequency response.

   (b) Given $\zeta = 0.7$ & $\omega_n = 10$ r/s find resonant peak, resonant frequency & Bandwidth. [10+6]

6. (a) A system has one open loop pole & two closed loop poles in Right Half of s-plane. Show that the Nyquist plot encircles the (-1+j0) point once in clockwise direction.

   (b) Addition of poles to the loop transfer function reduces the closed loop stability of the system. Justify by Nyquist plots. [8+8]

7. (a) What is compensation? what are the different types of compensators?

   (b) What is a lag compensator, obtain the transfer function of lag compensator and draw pole-zero plot?

   (c) Explain the different steps to be followed for the design of compensator using Bode plot? [3+3+10]

8. (a) For the given T.F
   $T(s) = \frac{b_0}{S^3+a_2S^2+a_1S+a_0}$
   Obtain the state model (phase variable form)?

   (b) Construct the state model for a system characterized by the differential equation.
   $\ddot{y} + 5\dot{y} + 6y = u$. [8+8]

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Code No: R05220205 **Set No. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2007
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Obtain the transfer function of the following system and draw its analogous electrical circuit. Figure 1a

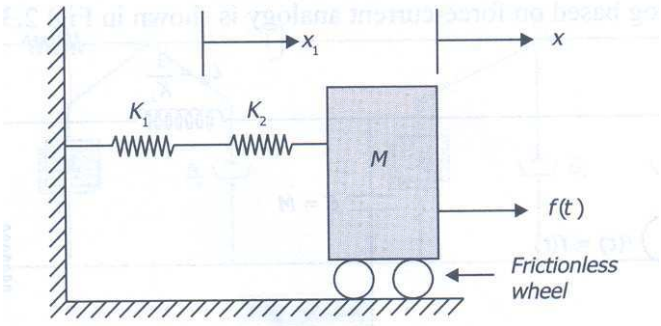

Figure 1a

(b) Explain the advantages and features of transfer function. [16]

2. (a) Explain the disadvantages and advantages of block diagram reduction process over signal flow graph.

(b) Explain the rules of block diagram reduction. [8+8]

3. (a) Define the following terms:
   i. Steady-state error
   ii. Settling time
   iii. Peak overshoot
   iv. type and order of a control system.

(b) Sketch the transient response of a second order system and derive the expression for rise time and peak overshoot? [8+8]

4. (a) Define the following terms
   i. Stable system
   ii. Critically stable system
   iii. Conditionally stable system.

(b) For the system having characteristic equation $2S^4 + 4S^2 + 1 = 0$, find the following

i. the no. of roots in the left half of s-plane
ii. the no. of roots in the right half of s-plane
iii. the no. of roots on the imaginary axis. [6+10]

Use the RH stability criterion

5. (a) Explain why it is important to conduct frequency domain analysis of linear control systems.
   (b) Sketch the Bode Magnitude plot for the transfer function $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$
   Hence find 'K' such that gain cross over freq. is 5 r/s. [6+10]

6. (a) State Nyquist Stability Criterion.
   (b) Explain the use of Nyquist Stability Criterion in the assessment of relative stability of a system.
   (c) Enlist the step-by-step procedure for the construction of Nyquist plots.[2+6+8]

7. (a) What is compensation? what are the different types of compensators?
   (b) What is a lag compensator, obtain the transfer function of lag compensator and draw pole-zero plot?
   (c) Explain the different steps to be followed for the design of compensator using Bode plot? [3+3+10]

8. (a) Discuss the significance of state Space Analysis?
   (b) Define state variables.
   (c) Obtain the state variable representation of an armature controlled D.C Servomotor? [4+4+8]

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