Code No: R050212203 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
CONTROL SYSTEMS
(Instrumentation & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the following terms:
   (a) Linear systems and nonlinear systems
   (b) Continuous systems and discrete systems
   (c) Single input-single output systems (SISO) and multiple input - multiple output systems (MIMO)
   (d) Static systems and dynamic systems. [16]

2. (a) Reduce the given block diagram (figure 2a) and hence obtain the transfer function $\frac{C(s)}{R(s)}$.

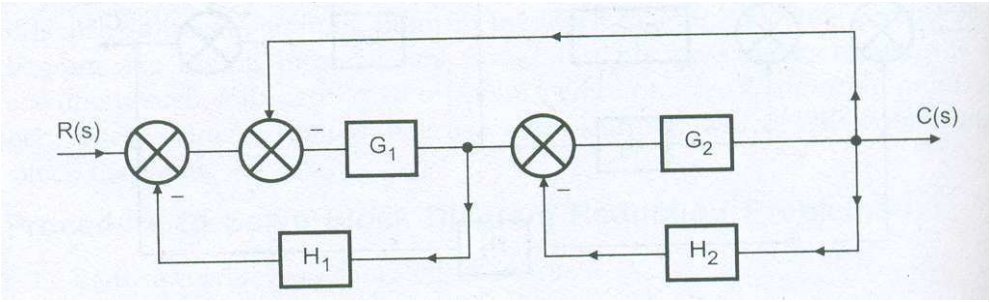

Figure 2a

   (b) Explain synchro receiver. [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. A given system oscillates with frequency 2 rad / sec .Find the values of K_{mar} and P. No poles are in right hand side. Shown in figure 4. [16]

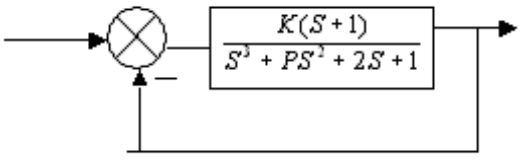

Figure 4

5. Sketch the Bode plots for a system
   $G(s) = \frac{15(s+5)}{s(s^2+16s+100)}$
   Hence determine the stability of the system. [16]

6. (a) Explain the effect of addition of a pole at the origin on the polar plot of a given system.
   (b) Sketch the polar plot & hence find the frequency at which the plot intersects the +ve imaginary axis for the system
   $G(s) = \frac{0.1}{s^2(1+s)(1+0.1s)}$
   Also find the corresponding magnitude. [6+10]

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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Code No: R050212203 **Set No. 2**

II B.Tech I Semester Regular Examinations, November 2006
CONTROL SYSTEMS
(Instrumentation & Control Engineering)

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

Answer any FIVE Questions
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1. (a) Explain the linearizing effect of feedback.
   (b) The dynamic behaviour of the system is described by the equation, $\frac{dC}{dt} + 10C = 40e$, where 'e' is the input and 'C' is the output. Determine the transfer function of the system. [10+6]

2. Explain the rules of signal flow graph reduction and block diagram reduction techniques. [16]

3. (a) Derive the expression for % M_p of a second order system subjected to unit step input?
   (b) A system has the following transfer function $\frac{C(s)}{R(s)} = \frac{20}{s+10}$. Determine its unit impulse, step and ramp responses with zero initial conditions? [3+13]

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. Sketch the Bode plots for a system
   $G(s) = \frac{15(s+5)}{s(s^2+16s+100)}$
   Hence determine the stability of the system. [16]

6. (a) State & explain "principle of argument"
   (b) Given
   $G(s) = \frac{K}{s(s+2)(s+10)}$
   Sketch Nyquist plot & find range of ?K? for stability. [8+8]

7. The open loop transfer function of certain unity feedback control system is given by G(S) = K/S (S+4) (S+80). It is desired to have the phase margin to be at least 33^0 and velocity error constant $K_V = 30\ Sec^{-1}$. Design a phase lag series compensator?

   [16]

8. (a) Obtain the state model of the system shown in figure 8a.

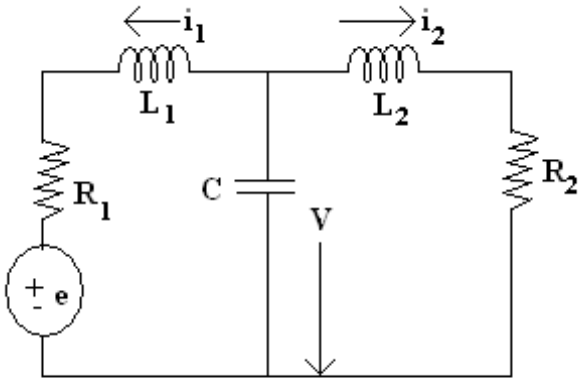

Figure 8a

Consider the state variables as i_1, i_2, v

(b) Obtain the state model of a field controlled motor? [8+8]

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Code No: R050212203 **Set No. 3**

II B.Tech I Semester Regular Examinations, November 2006
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(Instrumentation & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the transfer function of the network given figure 1a

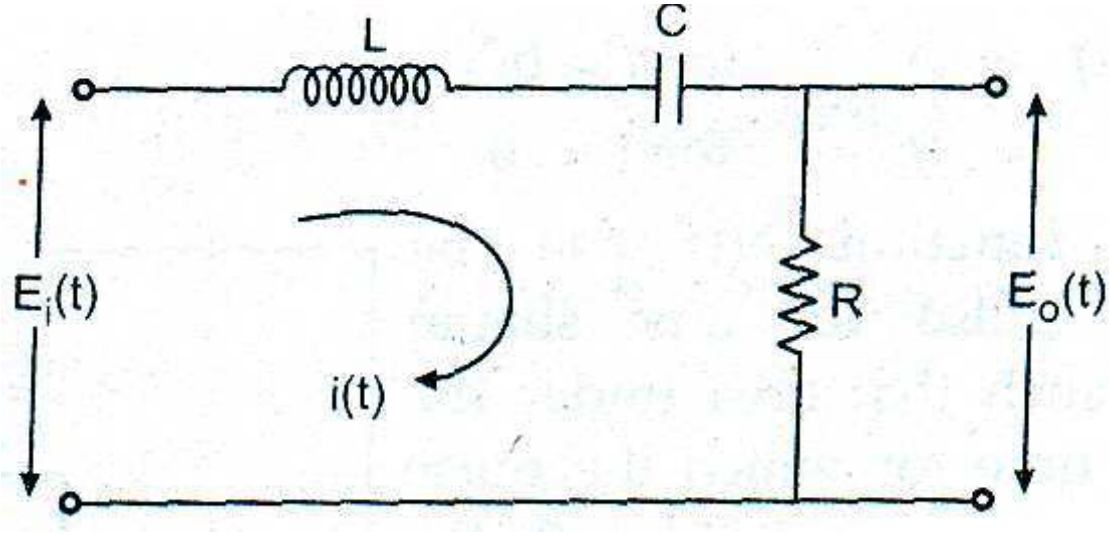

Figure 1a

(b) Explain the basic elements of control systems. [8+8]

2. Write notes on the following:

(a) Field controlled d.c. motor

(b) Armature controlled d.c. motor. [16]

3. (a) Draw the transient response of a second order system and define all the specifications for under damped case?

(b) A closed loop system has two complex conjugate poles at $s_1, s_2 = -2 \pm j1$. Determine the form of T.F. and the values of ω_n, T_p, T_r, T_s and M_p assuming standard second order system? [6+10]

4. (a) Explain the RH stability Criterion ?

(b) The open loop transfer function of a unity feed back control system is given by $G(s) = \frac{K}{s(1+sT_1)(1+sT_2)}$. Apply RH stability criterion, determine the value of K in terms of T_1 and T_2 for the system to be stable? [6+10]

5. Write short notes

(a) Frequency domain specifications

(b) Stability analysis from Bode plots. [8+8]

6. (a) Explain how the type of a system determines the shape of polar plot
   (b) Write a note on Nyquist criterion for minimum phase & non minimum phase transfer functions. [8+8]

7. The open loop transfer function of certain unity feedback control system is given by G(S) = K/S (S+4) (S+80). It is desired to have the phase margin to be at least 33^0 and velocity error constant $K_V = 30\ Sec^{-1}$. Design a phase lag series compensator?

   [16]

8. (a) Solve the following differential equation by converting it into state variable form $\frac{d^2y}{dt^2} + \frac{dy}{dt} - 2y = u\,(t)\,e^{-t}$ Where y(0)=0, $\dot{y}\,(0) = 0$; u(t)=unit step input
   (b) The state equation of a linear time invariant system is given by
   $$\begin{bmatrix} x_1\,(t) \\ x_2\,(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} x_1\,(t) \\ x_2\,(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r\,(t)$$
   Find the state transistion matrix ϕf(t). [10+6]

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Code No: R050212203 **Set No. 4**

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CONTROL SYSTEMS
(Instrumentation & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the transfer function of the network given figure 1a

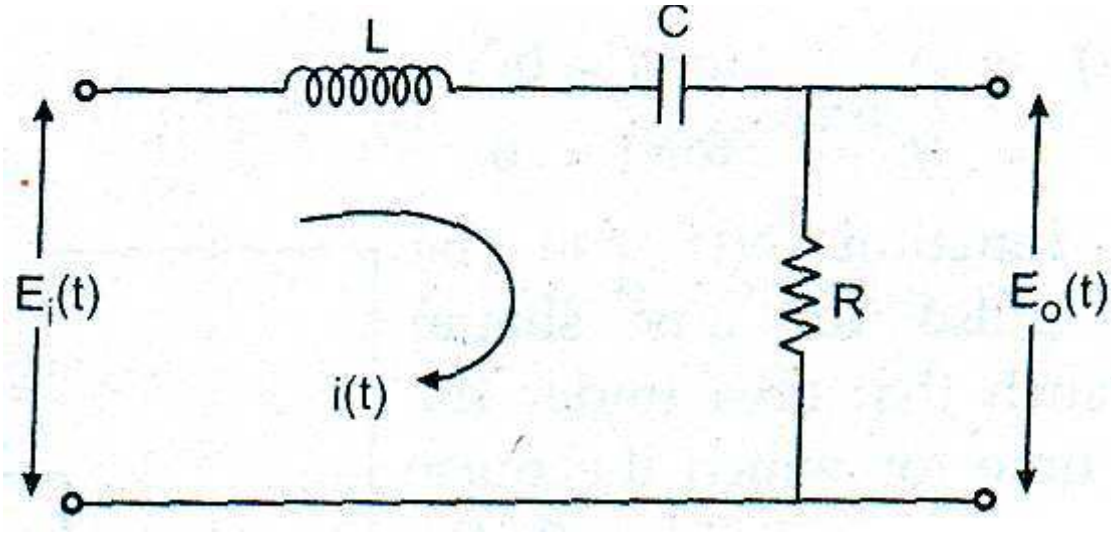

Figure 1a

(b) Explain the basic elements of control systems. [8+8]

2. Derive the transfer function for the field controlled d.c. motor with neat sketch and explain the advantages of field controlled d.c. motor over armature controlled d.c. motor. [16]

3. (a) State how the type of a control system is determined? How it effects the steady-state error of the system?

(b) A unity feed-back system has $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$. Determine

i. Type of the system?
ii. All the error coefficient?
iii. Error for ramp input with magnitude. [6+10]

4. (a) Write a short note on angle and magnitude condition of root locus

(b) Explain the terms

i. asymptotes
ii. centroid
iii. Break away points
iv. angle of departure. [8+8]

5. (a) Bandwidth is directly proportional to ω_n. Justify

(b) The forward path transfer function of a unity feed back system is $G(s) = \frac{K}{s(s+6.54)}$. Find the resonant peak, resonant frequency & Bandwidth of closed loop system for

i. K = 5

ii. K = 21.39

iii. K = 100.

Comment on the result. [6+10]

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 unity feedback system has an open loop transfer function G(S) =K/S(1+2S). Design a suitable lag compensator so that phase margin is 40^0 and the steady state error for ramp input is less than or equal to 0.2 [16]

8. Obtain the two differential state representation for the system with transfer function.
$\frac{y(s)}{u(s)} = \frac{2}{S^3+6S^2+11S+6}$. [16]

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