Code No: 07A5EC16 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
CONTROL SYSTEMS
Common to Aeronautical Engineering, Electronics And Instrumentation Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain about the effect of feedback on:
   i. Time constant of a control system,
   ii. Overall Gain,
   iii. Stability,
   iv. Disturbance.

   (b) The forward path T.F. of a unity feed back control system is given by $G(s) = \frac{9}{s(s+3)}$. Obtain the expression for unit step response of the system? [8+8]

2. (a) Explain the working of an Amplidyne and derive its transfer function.

   (b) Derive the transfer functions of AC servomotor and A.C. tachometer. [8+8]

3. (a) Explain the need of lead compensator and obtain the transfer function of lead-lag compensator.

   (b) Explain the significance of compensation? [10+6]

4. (a) Reduce the matrix A to diagonal matrix. A = $\begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$.

   (b) Derive the state models for the system described by the differential equation in phase variable form $\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = 2\ddot{u}(t) + 5\dot{u}(t) + 5u$. [8+8]

5. (a) The open loop Transfer function of unity feedback system is given by $G(s) = \frac{K}{s(s^2+8s+T)}$
   Using Routh's Criterion, determine the conditions to be satisfied by K and T, if it is required that all the roots of the characteristic equation lie in the region to the left of a line s = -1

   (b) Give the steps followed for construction of Root locus. [8+8]

6. (a) Indicate various terms used in a generalized feedback control system.

   (b) Obtain the transfer function $X_1(s)/F(s)$ for the mechanical system as shown in figure 1. [8+8]

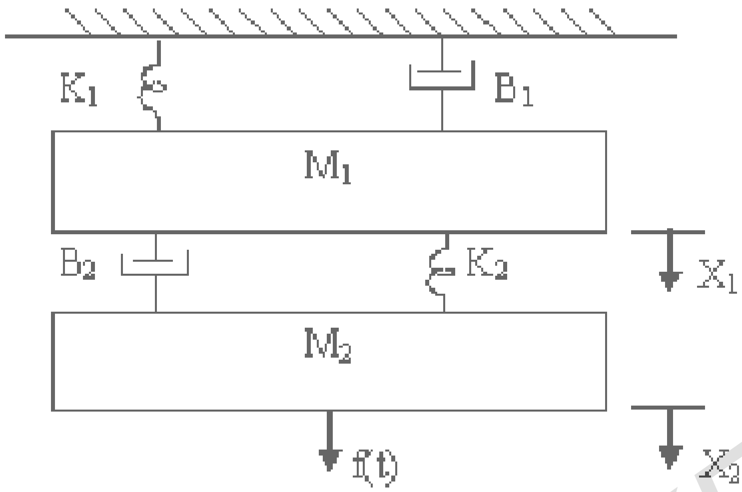

Figure -1

7.(a) Explain how exact Bode plot is obtained from asymptotic plot with figure.

(b) The open loop transfer function of a unity feed back system is

$$G(s) = \frac{50K}{s(s+10)(s+5)(s+1)}$$

i) Gain margin and phase margin

ii. The value of steady state error coefficient for a gain of 10 db and the value which will make the closed loop system marginally stable. [6+10]

8. (a) State & explain Nyquist stability criteria.

(b) Check stability of system by Nyquist Criteria $G(s) = \frac{10}{s^2+(1+0.2s)(1+0.5s)}$. [4+12]

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Code No: 07A5EC16 **R07** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
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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) Explain the principle of operation of the Amplidyne.
   (b) A unity feedback system has forward path transfer function
   $G(s) = \frac{20}{(s+1)}$
   Determine and compare the response of open-loop and closed-loop systems for a unit step input. [8+8]

2. (a) Define the following terms:
   i. System
   ii. Control system
   iii. Input
   iv. Output
   v. Disturbance.
   (b) Explain why it is necessary to employ feedback in control systems and discuss the effect of feedback on various aspects regarding the performance of the system. [8+8]

3. (a) Derive the expressions for resonant peak & resonant frequency and hence establish the correlation between time response & frequency response.
   (b) Given $\zeta = 0.7$ & $\omega_n = 10$ rad/s find resonant peak, resonant frequency & Bandwidth. [10+6]

4. (a) Given $\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -2 & 3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = Ax(t)$
   Find the eigen values, eigen vectors and response when
   $x(0) = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$
   (b) For the given system obtain the phase variable form of state model
   $\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 10y = 8u(t)$. [10+6]

5. (a) A feedback system has an open-loop transfer function of $G(s)H(s) = \frac{K}{s(s^2+5s+9)}$
   Determine the maximum value of K for the closed-loop system to be stable.
   (b) Determine the steady state error, if the input to the system is a unit ramp. [8+8]

6. The open loop transfer function of the given system is G(s) = $\frac{K}{s(2s+1)(0.5s+1)}$. It is desired to design a compensator to obtain a phase margin of 35^0 and velocity error constant of 10sec^{-1}. [16]

7. (a) Briefly discuss the merits and demerits of R-H stability criterion. Determine the value of K such that the system is stable for the open-loop transfer function of a control system which is given by $G(s)\,H(s) = \frac{K}{s(s+2)(s+4)}$

   (b) A unity feedback system has an open-loop transfer function $G(s) = \frac{K}{s(1+0.02s)(1+0.01s)}$. Sketch the root-locus of the system. [8+8]

8. (a) Explain about the Polar Plots.

   (b) The open loop transfer function of a unity feed back control system is given by G(s)H(s)= $\frac{K(s+5)(s+40)}{s^3(s+200)(s+1000)}$. Discuss the stability of a closed loop system as a function of k. Determine values of K which will cause sustained oscillations in the closed loop system. What are the frequencies of oscillations? Use Nyquist approach. [6+10]

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Code No: 07A5EC16 **R07** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. The system has the following transfer function $\frac{C(s)}{R(s)} = \frac{20}{(s+10)}$
   Determine its unit impulse, step and ramp response with zero initial conditions. Sketch the responses. [16]

2. (a) Explain the term frequency response analysis.
   (b) Sketch the Bode Plot for the Transfer function G(s) $= \frac{Ke^{-0.5s}}{s(2+s)(1+0.3s)}$ and determine the system gain 'K' for the gain crossover frequency ω_0 to be 5 rad/sec. [8+8]

3. (a) Draw & explain polar plots for type-0, type-1 & type-2 systems.
   (b) Write a note on relation between root loci & Nyquist plots. [12+4]

4. (a) For the given transfer function, T(s) $=\frac{(b_0 s^3)}{s^3+a_2s^2+a_1s+a_0}$, obtain the state model of the system.
   (b) Obtain the state transition matrix for the system matrix: [10+6]
   $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$

5. Open loop T.F. of a unity feedback system is $G(s) = \frac{K(s+a)}{s(s+b)}$
   (a) Prove that break-away and break-in points will exist only when $|a| > |b|$
   (b) Prove that the complex points on the root locus form a circle with center (-a,0) and radius $\sqrt{a^2 - ab}$. [8+8]

6. (a) Obtain the transfer function of the mechanical system shown in figure 1 and draw the force-voltage analogy circuit.
   (b) What do you understand by Analogous systems? Explain its significance.[8+8]

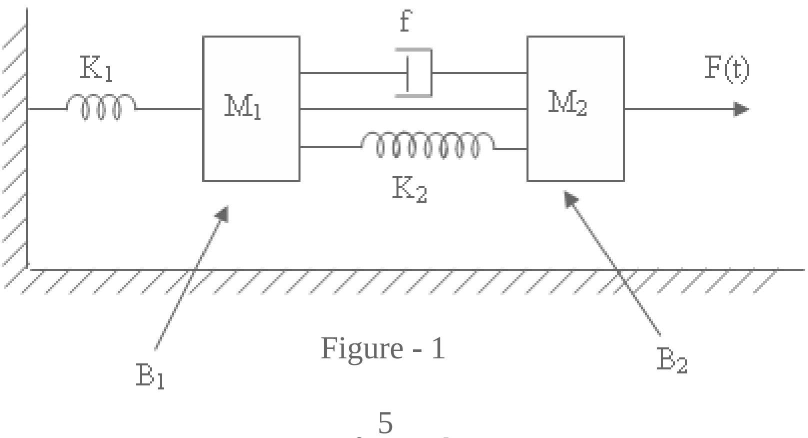

Figure - 1

7.(a) What are the characteristics of a lag-lead compensator? Explain.

(b) Open loop transfer function of the uncompensated system is $G(s) = \frac{1}{s(s+1)(s+2)}$. Compensate the system by cascading suitable lead – lag compensator so that the compensated system has the static velocity error constant of 10 sec^{-1}, the phase margin 45^0 and gain margin of 10dB or more [6+10]

8.a) Describe tachometer and derive its transfer function with its constant.

(b) With the help of a schematic diagram, explain the principle and operation of synchro error detector. [8+8]

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Code No: 07A5EC16 **R07** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. The open loop transfer function of a unity feedback control system is G(s) = $\frac{10}{s(s+1)(s+5)}$. Draw its polar plot and hence determine its phase margin and gain margin. [16]

2. (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. [8+8]

3. (a) Sketch the complete root locus of system having $G(s)\,H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$.
   (b) Give the steps followed. [8+8]

4. The open loop transfer function of a certain unity feedback control system is given by G(s) = $\frac{K}{s(s+1)}$. It is desired to have the velocity error constant, $K_V = 10$ and the phase margin to be at least 60^0. Design a phase lag series compensator. [16]

5. (a) Sketch the mechanical components in:
      i. series and
      ii. parallel
   (b) For the mechanical system shown in figure 3, determine the transfer function $\frac{Y_1(s)}{F(s)}$ and $\frac{Y_2(s)}{F(s)}$ [8+8]

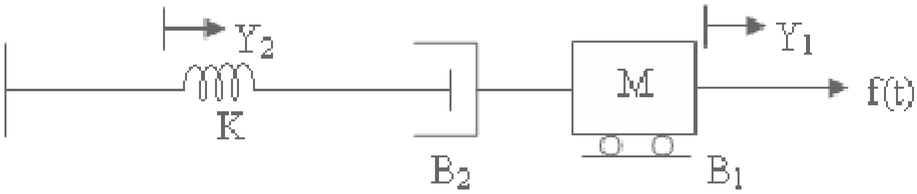

Figure 3:

6. Given the open loop transfer function G(s) = $\frac{30(s+1)}{s(s+5)(s^2+2s+10)}$. Draw the Bode plot and hence the phase and gain margins. [16]

7. (a) Obtain the solution of a system whose state model is given by
   X = A X(t) + B U(t) ; X(0) =X_0 and hence define State Transition Matrix.

(b) Obtain the transfer function of a control system whose state model is

$\dot{x}(t) = A\,x(t) + B\,u(t)$

$y(t) = C\,x(t)$

where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix}$ $C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$.

[8+8]

8. (a) Derive the time response specifications for unit step response for a second order system for underdamped case.

(b) With a neat sketch, explain about PD type of controller. [8+8]

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