(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 2289454 Roll No. | | | | | | | | | |

B.TECH.

Regular Theory Examination (Odd Sem-V) 2016-17

CONTROL SYSTEMS - I

Time : 3 Hours *Max. Marks : 100*

Section - A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)

a) Distinguish between open loop and closed loop control system.

b) Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system.

c) Derive the step response of a first order system.

d) Why negative feedback is invariably preferred in closed loop system?

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

f) What is a polar plot?

g) What do you understand by type and order of a system?

h) What is servomechanism?

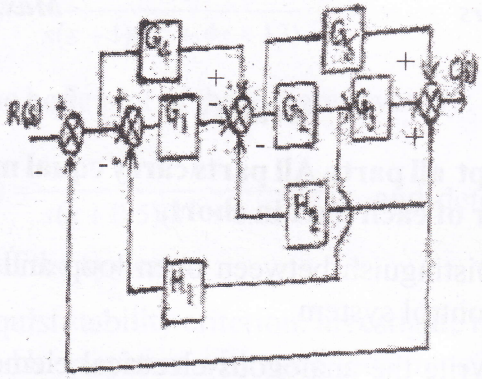
i) State angle and magnitude criteria in root locus.

j) Define state, State Variable State Space State Vector.

Section - B

2. Attempt any five parts from this section. (5×10=50)

a) Determine the transfer function C(s)/R(s) for the block diagram shown in figure given below by using Block Diagram Reduction Method.



b) Construct the state model for a system characterized by differential equation:-

$$\frac{d^3y}{dt^3} = 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u$$

Give block diagram and signal flow graph representation of the state model.

c) A unity feedback control system is characterized by an open-loop transfer function

$$G(s)H(s) = \frac{K}{s(s+10)}$$

Determine the system gain K, so that the system will have a damping ratio of 0.5. For this value of K, find the rise time, peak time, settling time and peak overshoot.

d) i) Explain the correlation between Transfer function and state space equations.

ii) Derive the transfer function for Armature controlled DC Servo motor.

e) Obtain the time response of the following system:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

where u(t) is a unit step occurring at t = 0 and $X^T(0) = [1 \ 0]$

f) i) Draw the response of second order system for critically damped case and when input is unit step.

ii) Derive the expressions for Rise time, Peak time, and peak overshoot.

g) The open loop transfer function of a system is $G(s)H(s) = k(s+1)/(s^3+bs^2+3s+1)$. Determine the values of 'k' & 'b' so that system will oscillate at frequency of 2rad/sec by using R-H criteria.

h) What is the role of sensors and encoders in control system? Explain the construction and principle of potentiometer.

Section - C

Note: Attempt any two questions from this section. **(2×15=30)**

3. Sketch the root loci for the open loop transfer function given below (The gain K is assumed to be positive) and determine whether a system is stable or not:

$$G(s)H(s) = \frac{k}{s(s+1)(s^2+4s+13)}$$

4. Sketch the bode plot of the system given by:

$$G(s)H(s) = \frac{k}{s(s+0.5)(s^2+0.6s+10)}$$ and determine the stability of the system.

5. State Nyquist stability criterion. Investigate the stability of a closed loop system with open loop transfer function given by:

$$G(s)H(s) = \frac{K(s+3}{s(s-1)}$$

by using Nyquist plot. Also find the value of Gain margin.
