

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI • EXAMINATION – SUMMER 2013

Subject Code: 160104

Date: 03-06-2013

Subject Name: Basic Control Theory

Time: 10.30 am - 01.00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain Open loop control system and closed loop control system with block diagram. List two advantages, disadvantages and examples of both control system. **07**
- (b) Using Mason's Gain Formula, Find the transfer function $C(S)/R(S)$ for the Signal Flow Graph shown in Figure (a). **07**

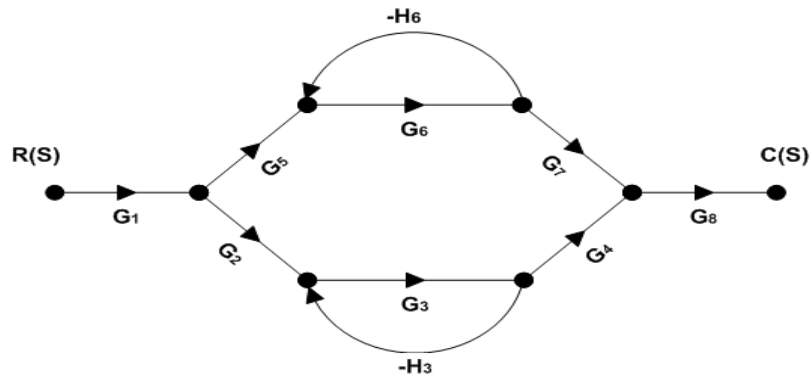


Figure (a).

- Q.2** (a) For the mechanical system shown in figure (b), (1) Draw the node diagram **07**
(2) Write System equations of performance (3) Draw Force to Voltage analogous circuit.

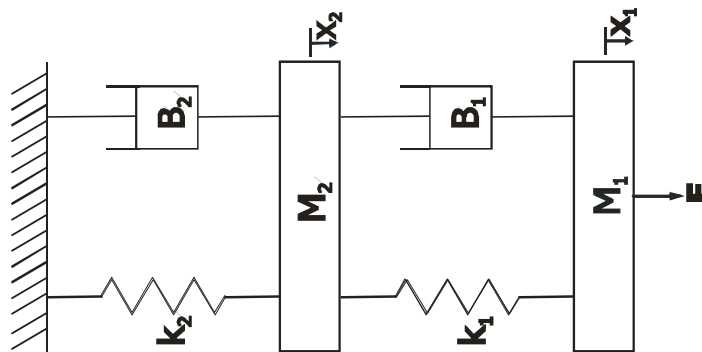


Figure (b).

- (b) Reduce the Block Diagram to its Simple Form and obtain $C(S)/R(S)$ (Refer Fig.(c)). 07

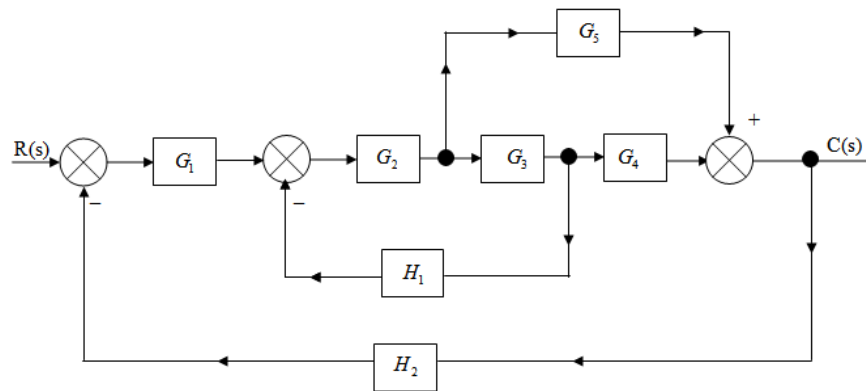


Figure (c).

OR

- (b) Explain Force to Voltage and Force to Current Analogies System. 07
- Q.3 (a) Explain Transient Response Specification with diagram and write its equation. 07
- (b) For a unity feedback system $G(s) = \frac{800(s+2)}{s^2(s+10)(s+40)}$. Sketch the Bode plot and find Gain cross over frequency, Phase cross over frequency, Gain Margin, Phase Margin. Comment on stability. 07

OR

- Q.3 (a) Define the following frequency response specifications: (1) Bandwidth (2) Cutoff frequency (3) Cutoff rate (4) Phase Margin (5) Gain cross over frequency (6) Phase cross over frequency (7) Gain Margin. 07
- (b) For a system $G(s)H(s) = \frac{K}{s^2(s+2)(s+3)}$. Find the value of K to limit steady state error to 10 when input to system is $1 + 10t + \frac{40}{2}t^2$. 07
- Q.4 (a) A unity feedback control system has $G(s) = \frac{10}{s(s+1)(s+2)}$. Draw Nyquist plot and comment on closed loop stability. (Consider point Q is intersection of polar plot with negative real axis is $-1.66 + j0$). 07
- (b) Draw the Root Locus diagram for a closed loop system whose loop transfer function is given by, $G(s)H(s) = \frac{K}{s(s+5)(s+10)}$. Comment on the stability. 07

OR

- Q.4 (a) Comparison between Modern Control Theory and Conventional Control Theory. 07

- (b) Write advantages of Root Locus method. Write Matlab program to draw pole zero map, nyquist plot and bode plot for $G(S) = \frac{s+2}{s^2+3s+4}$. 07

Q.5 (a) For system $s^4 + 22s^3 + 10s^2 + s + k = 0$, find K_{mar} and ω at K_{mar} . 07

- (b) Definition (1) Time variant system (2) Time in-variant system (3) Man Made System (4) State Variable (5) Transfer Function (6) Stable System (7) Unstable System. 07

OR

Q.5 (a) A second order system has a natural frequency of oscillation $\omega_n = 2.5$ rad/sec and undamped frequency of oscillation $\omega_d = 2.0$ rad/sec. (1) Calculate its percentage overshoot, when it is subjected to a step input (2) Calculate the resonant peak, if it is subjected to sinusoidal input. 07

- (b) Write Mathematical expression for P,I,D,PI,PD,PID Controller and show the response of these controller to unit step load changes. 07
