Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER • 2014

Subject Code: 160104 **Date: 05-12-2014**

Subject Name: Basic Control Theory

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

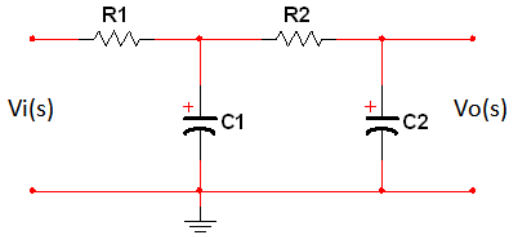
Instructions:

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

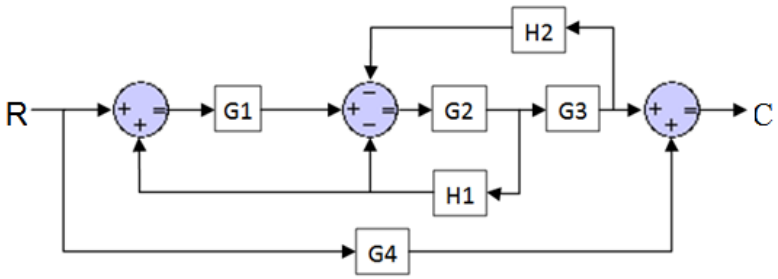
Q.1 **(a)** Explain following terms. **07**

1. Controlled Variable 2. Disturbance 3. Time Invariant System
4. Continuous Time System 5. Poles 6. Translation Motion
7. Summing Point

(b) What is Transfer Function? Derive the transfer function for electrical network shown in figure. Deduce the result when $R_1=R_2=R$ and $C_1=C_2=C$. **07**



Q.2 **(a)** Evaluate the closed loop transfer function C/R of system represented by block diagram. **07**

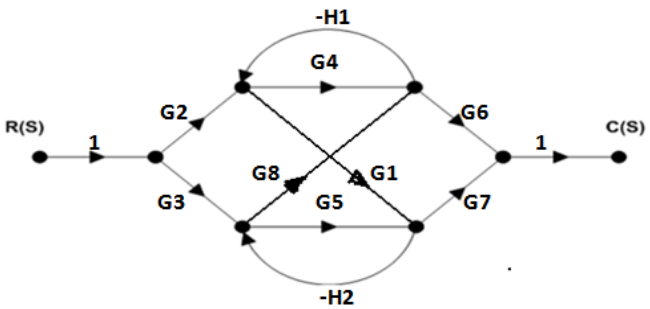


(b) Compare following **07**

1. Open loop System and Closed loop system
2. Block diagram method and Signal flow graph

OR

(b) Obtain the transfer function C/R from the signal flow graph as shown in below figure. **07**



Q.3 **(a)** What do you mean by Time response Analysis? Explain the standard Test signal in brief with equation of signal and waveform. Derive Unit Step response for first order system. **07**

(b) Unity gain system having Open loop transfer function **07**

$$G(S) = \frac{K}{S\,(S+5)}$$

Determine the gain K, so that system has damping ratio £ = 0.5 for same value of K find Rise time, Settling time, % peak overshoot for unit step input.

OR

Q.3 **(a)** Derive the expression for Static error constants. Show that how the type of system effects the steady state error. **07**

(b) What do you mean by stability? Ascertain stability of the system whose characteristic equation is **07**

$$S^5 + 2S^4 + 24S^3 + 48S^2 - 25S - 50 = 0$$

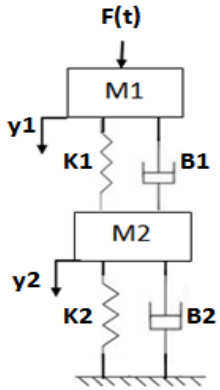
Also find the roots of this equation.

Q.4 **(a)** A feedback system has open loop transfer function **07**

$$G(s)H(s) = \frac{K}{S\,(S+3)\,(S^2+2S+2)}$$

Find Root locus as K varied from 0 to ∞. Also obtain limiting value of K for stability and corresponding frequency.

(b) Consider the mechanical system consisting of two platforms coupled to each other and to ground via spring and dashpot dampers. Choosing suitable state variables, construct a state model. **07**



OR

Q.4 **(a)** Explain following terms: 1. State 2. State Variables 3. State Model 4. State Vector 5. State Space. List advantage of state variable analysis. **07**

(b) Draw bode plot for the system using **07**

$$G(s)H(s) = \frac{100}{S(S+1)(S+2)}$$

Find 1. Gain Margin 2. Phase Margin 3. Gain Cross over Frequency 4. Phase Cross over Frequency from bode plot.

Q.5 **(a)** Draw polar plot of transfer function **07**

$$G(s) = \frac{1}{(S^2)(1+S)(1+2S)}$$

(b) Explain Nyquist stability criteria. Explain generalized Nyquist path and its mapping. Write steps to solve problems by Nyquist criteria. **07**

OR

Q.5 **(a)** Using Nyquist criteria, explain closed loop stability of a system whose open loop transfer function is given by **07**

$$G(s)H(s) = \frac{50}{(S+1)(S+2)}$$

(b) Explain Frequency domain specification. **07**

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