Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2015

Subject Code: 2140307 Date: 03/06/2015

Subject Name: CONTROL SYSTEM AND ANALYSIS

Time:10:30am-1.00pm 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 and closed loop control system with suitable example & gives its advantages and disadvantages. **07**

(b) (i) For the electrical network of Fig.1 Find the transfer function $\frac{Vo(s)}{Vi(s)}$ **07**

(ii) Find the Inverse Laplace transform of the given function.

$$F(s) = \frac{5}{s(s^2 + 4s + 5)}$$

Q.2 **(a)** Write the differential equations for the mechanical system shown in Fig.2. Also obtain an analogous electrical circuit based on force-current analogy. **07**

(b) Draw a basic Thermal system and determine its transfer function. **07**

OR

(b) Find-out transfer function for Signal flow diagram as shown in Fig.3, using Mason's gains Formula. **07**

Q.3 **(a)** Explain Linear model of Physiological system. **07**

(b) Obtain transfer function for the system given in state model form as **07**

$$A = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 1 \end{bmatrix}, \quad D = [0]$$

OR

Q.3 **(a)** State the advantage and Limitation of state variable approach. **07**

(b) Explain Root Locus Technique Rules. **07**

Q.4 **(a)** Determine the stability of a system having following characteristic equation using Routh Criterion **07**

$s^5+s^4+2s^3+2s^2+3s+15=0$

(b) Find the response of step input on first order system. **07**

OR

Q.4 **(a)** The close loop transfer function of a position control system is given by **07**

$$\frac{C(s)}{R(s)} = \frac{K}{(s^4 + 6s^3 + 30s^2 + 60s + K)}$$

(i) By applying the Routh criterion discuss the stability of the closed loop system as a function of K.

(ii) What should be the upper limit on K if all the closed loop poles are required to be to the left of the line

(b) The open loop transfer function of a unity feedback control system given by **07**

$$G(s) = \frac{20}{(s+1)(s+5)}$$

Determine the Characteristic equation of the system,natural frequency of oscillations(ω_n), damping frequency of oscillations(ω_d),damping ratio (ζ), and the maximum overshoot of a unit step input(Mp).

Q.5 **(a)** Find Polar Plots of G(s) = 1/ (1+T_1S) (1+T_2S) **07**

(b) Draw the Bode plot for the open loop T.F **07**

$$G(s)H(s) = \frac{25(s+4)}{s(s+1)(s+10)}$$

Find (a) Gain Margin, (b) Phase Margin (c) Gain Crossover frequency (d) Phase Crossover frequency

OR

Q.5 **(a)** Define and explain following terms with respect to frequency response **07**
(i) Gain Margin (ii) Phase Margin (iii) Gain cross-over frequency (iv)Phase cross-over Frequency

(b) A unity feedback control system has **07**

$$G(s) = \frac{10}{s(s+1)(s+2)}$$

Draw Nyquist Plot and using Nyquist criterion investigate the closed loop stability of the system.

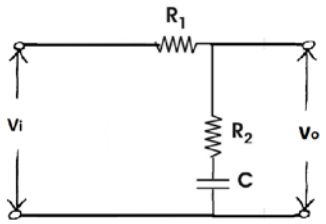

Fig.1

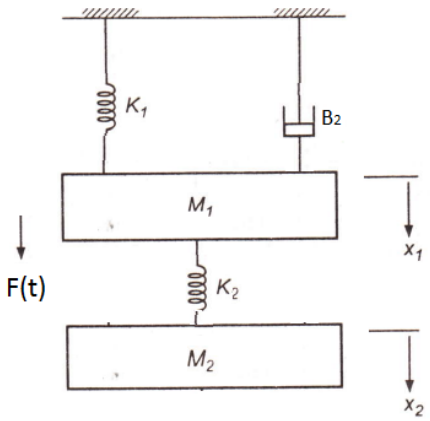

Fig.2

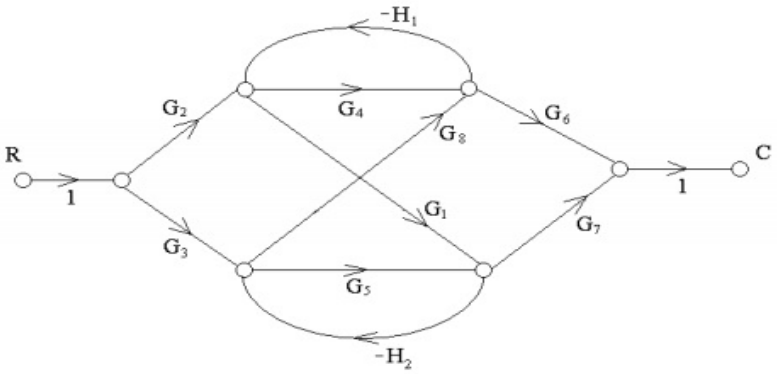

Fig.3

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