Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

Subject Code:2142003 **Date:01/12/2018**

Subject Name:Control Theory

Time: 02:30 PM TO 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)** Describe any three block diagram reduction techniques. **03**

(b) Explain Mason's gain formula. **04**

(c) Using Routh's criterion check the stability of a system whose characteristic equation is given by $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$. **07**

Q.2 **(a)** Explain, How the gain and phase margin are obtained from Nyquist plots? **03**

(b) Explain force voltage analogy with proper example. **04**

(c) Explain standard Test signals & derive equation of steady state error. **07**

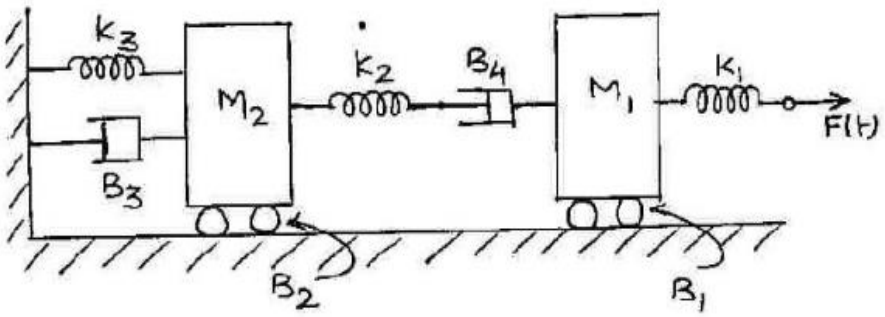
OR

(c) Explain following terms with necessary diagrams. (1) Delay Time (2) Rise Time (3) Peak Time (4) Steady state error (5) Settling Time. **07**

Q.3 **(a)** Derive Correlation Between Transfer Functions and State-Space Equations. **03**

(b) Determine the transfer function of system if impulse response of system is $e^{-2t}\sin 3t$ **04**

(c) For the given mechanical system Write down differential equations, mechanical circuit diagram and obtain force-voltage analogy. **07**



OR

Q.3 **(a)** Define thermal resistance and thermal capacitance. Also derive the transfer function of Thermometer placed in water bath as a Thermal system. **03**

(b) Write short notes on open loop control systems and closed loop control systems. Discuss their advantages and disadvantages. **04**

(c) Obtain a state space and out-put equation for the system defined by **07**

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

Q.4 **(a)** Derive the expression for time response of first order control system subjected to unit step input. **03**

(b) Using suitable diagram derive the transfer function of liquid level system with interaction. **04**

(c) Sketch the root locus for the given open loop transfer function and determine the stability. Also write the matlab code for the same. **07**

$$G(s)H(s) = \frac{K(s+0.1)}{s(s-0.2)(s^2+s+0.6)}$$

OR

Q.4 **(a)** What do you understand by absolute stability and relative stability? Which method indicates what type of stability? **03**

(b) Comment on the effect of derivative control on damping ratio, rise time, peak time and maximum overshoot. **04**

(c) A second order system is represented by the transfer function given below **07**

$$\frac{C(s)}{R(s)} = \frac{1}{Js^2+Fs+K}$$

A step input of 10Nm is applied to the system and the test results are:

a) Maximum overshoot =6%
b) Time at peak overshoot = 1 sec
c) The steady value of the output is 0.5 radians

Determine the values of J,F,K

Q.5 **(a)** Mention the advantages of frequency domain analysis. **03**

(b) Determine the relation between the phase margin and damping ratio for an underdamped second-order system. **04**

(c) Using Nyquist plot, comment on the stability of the following system. **07**

$$G(s)H(s) = \frac{2.2}{s(s+1)(s^2+2s+2)}$$

OR

Q.5 **(a)** How will you obtain the transfer function from Bode magnitude plot? **03**

(b) State space and out-put equation for the system defined by **04**

$$A = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 3 \\ 5 \end{bmatrix} \quad C = [1 \;\; 0] \quad D = [0]$$

Obtain the transfer function of the system.

(c) Sketch the Bode plot and determine the gain margin and phase margin for the given unity feedback control system. **07**

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

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