Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2142003 **Date:22/05/2018**

Subject Name:Control Theory

Time:10:30 AM to 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 the advantages of state space approach over classical methods for obtaining the transfer function of system. **03**

(b) Explain following terms with necessary diagrams. **04**
(1) Delay Time (2) Rise Time (3) Peak Time (4) Steady state error

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

Q.2 **(a)** The closed loop transfer function of a second order system is given by **03**

$$\frac{200}{S^2 + 20S + 200}$$

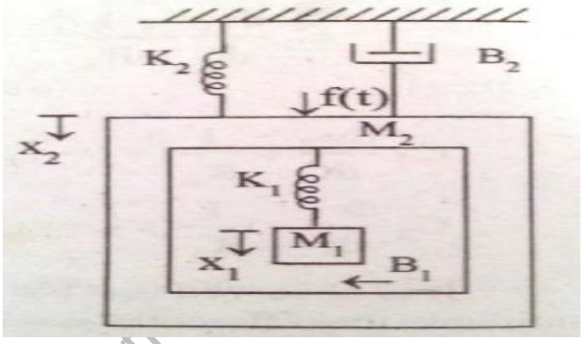
Determine the damping ratio and natural frequency of oscillation.

(b) State the points of difference between open loop and closed loop control system **04**

(c) Explain force voltage and force current analogy with proper example. **07**

OR

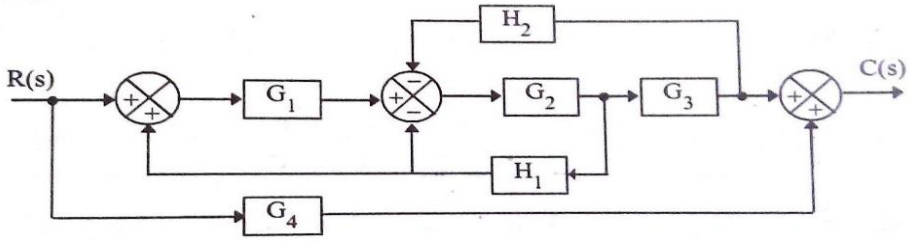
(b) For the given mechanical system as shown in Figure. Write down differential equations, represents in Force-Voltage analogy. **07**



Q.3 **(a)** Define transfer function and Explain importance of Laplace transform in control system. **03**

(b) Define thermal resistance and thermal capacitance. Also derive the transfer function of Thermometer placed in water bath as a Thermal system. **04**

(c) A linear feedback control system has the block diagram shown in Figure. Using block diagram reduction rules, obtain overall transfer function C(S)/R (S). **07**

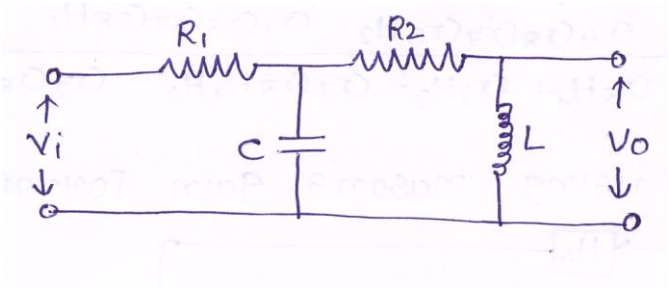


OR

Q.3 **(a)** Derive transfer function of Field controlled D.C. Motor **03**

(b) Explain with suitable example, one method for linearization of nonlinear mathematical model. **04**

(c) Determine the transfer function Vo(S)/Vi(S) for the given network using Masson's gain formula **07**



Q.4 **(a)** Explain with example first order control system. **03**

(b) A unity feedback system is characterized by open loop transfer function **04**

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

Determine gain 'K' so that the system will have a damping ratio of 0.5

(c) For the unity feedback system having **07**

$$G(S) = \frac{K}{S(S^2+S+1)(S+4)}$$

Find the range of 'K' for the stability of the system.

OR

Q.4 **(a)** For the second order control system show the location of the poles in S-plane for the different value of damping ratio. Also show the time response of the same if unit step is provided as input. **03**

(b) Write the MATLAB CODE to obtain the Nyquist plot for the given system **04**

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

(c) By means of Routh criterion, determine the stability of the system described by characteristic equations. **07**

(1) $S^4+2\,S^3+8\,S^2+4S+3 = 0$

(2) $3S^4+10S^3+5S^2+5S+2 = 0$

Q.5 **(a)** State the limitation of Routh criterion and how this limitations are overcome by Root Locus. **03**

(b) Define and explain following terms with respect to frequency response **04**

(i) Gain Margin (ii) Phase Margin (iii) Gain cross over frequency (iv) Phase cross over frequency

(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.5 **(a)** With example explain the location of the roots of characteristics equation for the stable control system . **03**

(b) State and explain the Nyquist stability criterion use to determine system stability. **04**

(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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