

GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER-IV (NEW) EXAMINATION – WINTER 2020

Subject Code:3141708

Date:11/02/2021

Subject Name:Control Theory

Time:02:30 PM TO 04:30 PM

Total Marks:56

Instructions:

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) Differentiate between open loop system and closed loop systems	03
	(b) Define Transfer function. Find the impulse response of a system whose transfer function is $G=1/(S+4)$	04
	(c) Find the overall transfer function of RLC circuit with output across capacitor.	07
Q.2	(a) Write mason's gain formula.	03
	(b) Difference between signal flow graph and block diagram representation of system	04
	(c) For the hovering systems given by $A = \begin{bmatrix} 0 & 6 \\ -1 & -5 \end{bmatrix}$ <ol style="list-style-type: none"> (a) Find the roots of the characteristic equation. (b) Find the state transition matrix $\Phi(t)$. 	07
Q.3	(a) Define 1. Source node, 2. Loop, 3. Sink node	03
	(b) Find the transfer function for the following system $\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -5 & -10 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$ $y = [0 \quad 10] \mathbf{x}$	04
	(c) Find the mathematical model of the mechanical network	07
Q.4	(a) What is analogous of all variables in mechanical network in force-current analogy?	03
	(b) Explain liquid level systems in brief	04
	(c) What is state space model? Define states. Derive the expression for converting state model to transfer function?	07

- Q.5** (a) Find the polar plot of $G=1/S$ **03**
 (b) What is Bode plot. What should be the input to the system to obtain bode plot. What are the units of scales used for plotting bode plot **04**
 (c) Sketch Bode plots of a unity feedback control system having open-loop transfer function as given below. The magnitude plot of this function should be an exact one and not an approximation. Find the GM and PM **07**
- $$G(s) = \frac{64(s+2)}{s(s+0.5)(s^2+3.2s+64)}$$
- Q.6** (a) Find the eigen values for system represented by $A = \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix}$ **03**
 (b) Write the rules for drawing root locus **04**
 (c) Sketch the root locus for an open loop transfer function **07**
- $$G(s) = k(s+2)/s(s+1)$$
- Q.7** (a) Explain standard test signals **03**
 (b) For the system $G=25/S^2+4S+25$, find the natural frequency, damping ratio. Depending on the damping ratio, describe the system **04**
 (c) A unity feedback control system's open loop transfer function is **07**
- $$G(s)H(s) = \frac{k(s+13)}{s(s+3)(s+7)}$$
- Using Routh criterion, calculate the range of k for the system to be stable. If the value of k=1, comment on stability.
- Q.8** (a) For the closed loop system $G=(S+1)(S+3)/S^3(S+1)(S+3)$, find the following 1. Order, 2. Type, 3. characteristic equation **03**
 (b) Check the system stability for system whose characteristic equation is given by $S^4+8S^3+16S+5=0$ **04**
 (c) Draw unit step response of a second order control systems. Describe all specification in detail. **07**
