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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV EXAMINATION – SUMMER 2020

Subject Code: 2141004 Date:29/10/2020

Subject Name: CONTROL SYSTEM ENGINEERING

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. Draw the equivalent mechanical system for the system shown in figure 1. Also write the set of equilibrium equations for it. 3

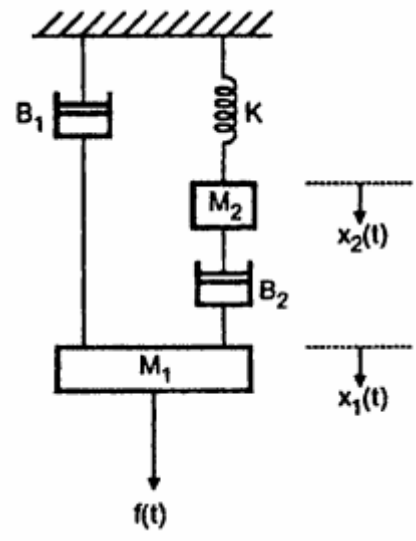

Figure 1

b. Define the following terms: 4
1. Transfer function.
2. Characteristic equation.
3. Order of the system.
4. Type of the system.

c. Discuss open loop control system and closed loop control system with suitable examples. 7

Q.2 a. In F-V analogy 3
1. Mass is analogous to_____.
2. Friction is analogous to _____.
3. Spring of constant k is analogous to _____.

b. Explain Mason's Gain Formula. 4

c. Determine the transfer function for the system shown in figure 2. 7

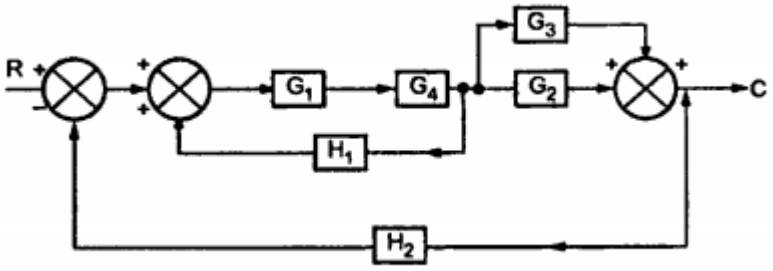

Figure 2

OR

c. Obtain the block diagram for the electrical network shown in figure 3. 7

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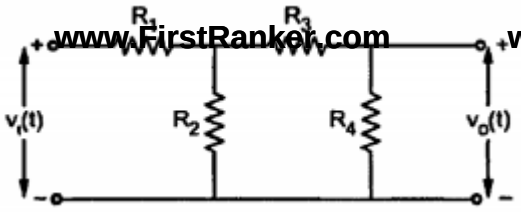

Figure 3

Q.3	a.	Define the following test signals. 1. Unit Impulse 2. Unit Step 3. Unit Ramp	3
	b.	Discuss the effect of feedback on system gain and stability.	4
	c.	Derive the expression of a second order control system subjected to unit step signal.	7

OR

Q.3	a.	Define the following terms with respect to a second order system subjected to unit step signal. 1. Rise time 2. Peak time 3. Settling time	3
	b.	Discuss the effect of adding a pole to a closed loop transfer function.	4
	c.	Derive the expressions for error constants K_p , K_v and K_a corresponding to step, ramp and parabolic input respectively.	7
Q.4	a.	1. In a system, for a bounded input output is also bounded. The system is said to be _____. 2. In a system, two poles are on the negative real axis and one pair of poles lies on jω axis. The system is said to be_____. 3. In a system, repeated roots are placed on imaginary axis. The system is said to be _____.	3
	b.	State advantages and limitations of Routh's stability criterion	4
	c.	For a unity feedback system $G(s) = \frac{4}{s(s^2+qs+2k)}$,the system is marginally stable and oscillates with frequency 4 rad/sec. Find k_{mar} and q.	7

OR

Q.4	a.	Define the following terms: 1. Stable system 2. Unstable system 3. Marginally stable system	3
	b.	Discuss Hurwitz's stability criteria.	4
	c.	Explain the rules for the construction of Root Locus.	7
Q.5	a.	Discuss briefly PID controller.	3
	b.	Discuss Nyquist criteria for stability.	4
	c.	A second order system has overshoot of 50% and period of oscillations 0.2 second in step response. Determine resonant peak and resonant frequency.	7

OR

Q.5	a.	Compare time response and phase response of the system.	3
	b.	Define the following with respect to Bode Plot: 1. Gain cross over frequency 2. Phase cross over frequency 3. Gain Margin 4. Phase Margin	4
	c.	Write a short note on state space representation of a control system.	7

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