Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC – SEMESTER– 1st / 2nd – EXAMINATION – WINTER 2020

Subject Code: 2910904 Date: 12-03-2021

Subject Name: Control System Theory

Time: 10:30 AM to 12:30 PM Total Marks: 56

Instructions:

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

Q.1 **(a)** Compare open loop control system with closed loop control system. Also explain closed loop system with appropriate example. **07**

(b) Determine the overall transfer function of the block diagram shown in fig.1 using block diagram reduction techniques. **07**

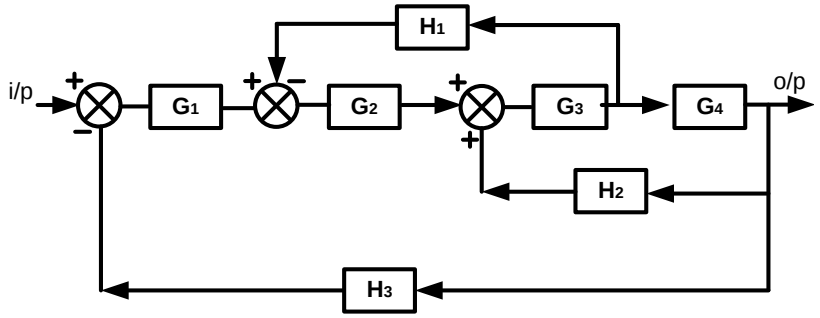

Fig.1

Q.2 **(a)** Define following terms: **07**

(1) Delay time (2) Rise Time (3) Settling time (4) Peak time
(5) Maximum overshoot (6) Steady state error (7) Damping ratio

(b) Obtain the transfer functions $X_2(s)/F(s)$ for the mechanical system shown in Fig.2. **07**

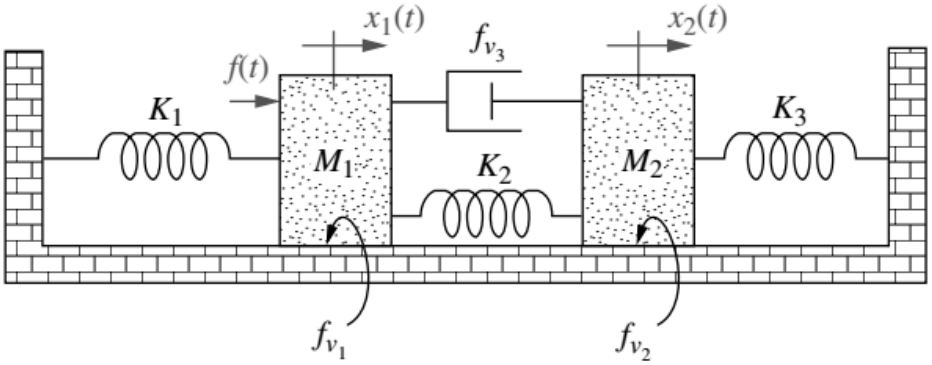

Fig.2

Q.3 **(a)** Explain standard test signals used in the control system. **07**

(b) Using Routh's Criterion determine the stability of **07**
$s^6 + 4s^5 + 12s^4 + 16s^3 + 41s^2 + 36s + 72 = 0$.

Q.4 **(a)** Explain the step by step procedure for obtaining Nyquist plot. **07**

(b) Sketch the root locus for the system with **07**

$$G(S)H(S) = \frac{K(S+3)}{S(S+1)(S+2)(S+4)}$$

Q.5 **(a)** Consider a Type-0 system with open loop transfer function G(S) = 1/(1+Ts), Where T= time constant. Obtain its polar plot. **07**

(b) A unity feedback control system has $\boldsymbol{G(S)H(S) = \frac{80}{S(S+2)(s+20)}}$ **.** Draw the bode plot and determine the value of Phase margin, Gain Margin, ω_{pc} and ω_{gc}. **07**

Q.6 **(a)** Explain lead compensator in details. Also derive the transfer function equation for lead compensator. **07**

(b) Explain Proportional Integral (PI) controller in details. Also write the characteristics of PI controller. **07**

Q.7 **(a)** Define following terms: State variables, State, state space and state vector. Explain the advantages of state variable methods over conventional one. **07**

(b) Obtain the state model of electrical system given in fig.3 **07**

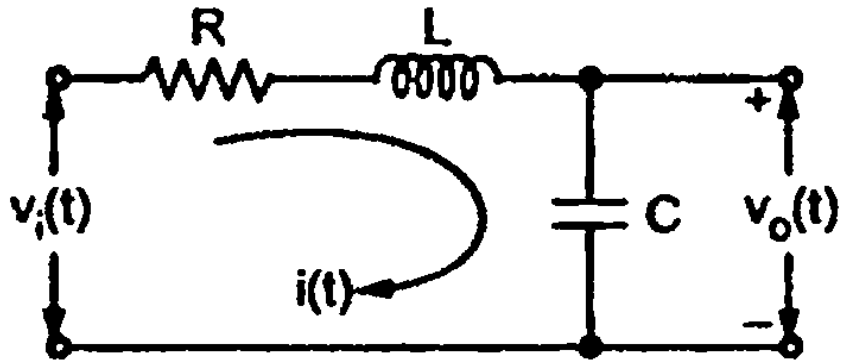

Fig.3

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