

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-IV(NEW) EXAMINATION – WINTER 2022

Subject Code:3140313

Date:17-12-2022

Subject Name:Control System and Analysis

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.
4. Simple and non-programmable scientific calculators are allowed.

Q.1 (a) Which of the below system is open loop system? Justify your answer. **03**

1. Electric Hand Drier
2. Automatic washing Machine
3. Air conditioner
4. Bread Toaster
5. Missile Launcher
6. Voltage stabilizer

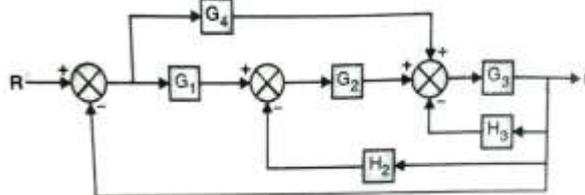
(b) 1. Obtain the Laplace transform of given $f(t)$ **04**

$$f(t) = e^{-at}$$

2. Obtain the inverse Laplace transform of given $F(s)$

$$F(s) = \frac{1}{s+3}$$

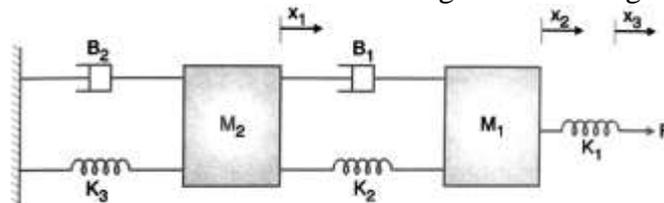
(c) Find the close loop transfer function for given system **07**



Q.2 (a) Explain different applications of Biomedical Control Systems. **03**

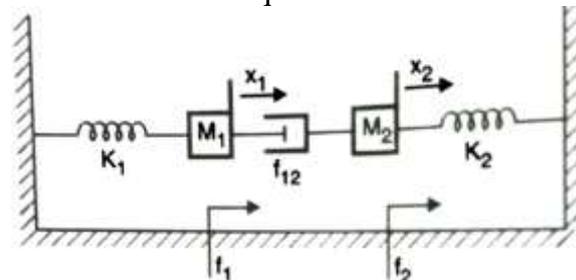
(b) Give the difference between Block diagram reduction technique and Signal flow graph? Explain Mason's Gain Equation. **04**

(c) Obtain differential equations describing mechanical system shown in figure and draw the electric network using force – voltage analogy. **07**



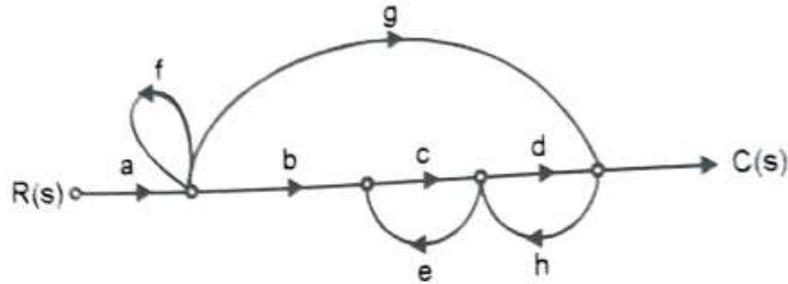
OR

(c) Obtain differential equations for mechanical system shown in figure **07**

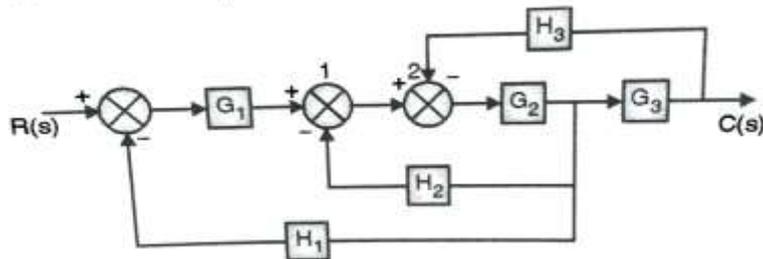


Q.3 (a) Draw and explain different standard test signals used for control system analysis. **03**

(b) Find Δ (delta) for signal flow graph given below. **04**



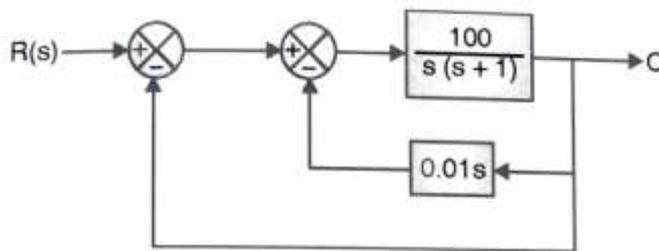
(c) Find the close loop transfer function for given system **07**



OR

Q.3 (a) Define damping ratio (zeta). Explain under damped, over damped and critically damped system with respect to zeta (ζ). **03**

(b) A system for controlling position is damped with velocity feedback as shown in figure **04**



Find out:

If input R is unit step, what is the response of the system and the steady state error?

(c) Find out Natural frequency (ω_n), Damping factor (ξ), Rise Time (T_r), Delay time (T_d), Peak Time (T_p), Peak overshoot ($\%M_p$) and T_s for **07**

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

Q.4 (a) Define State Variables, State Vectors and State Space. **03**

(b) Find the range of k for stable operation $G(s)H(s) = \frac{k}{s(s+1)(s+2)}$ using Routh's criteria. **04**

(c) Sketch the root locus for below given open loop transfer function **07**

$$G(s)H(s) = \frac{k}{s(s + 2 + 2j)(s + 2 - 2j)}$$

OR

Q.4 (a) Define below given terminologies: **03**

- Order of transfer function,
- Type of transfer function
- Transient response.

(b) Find out the stability of the system by Routh's criterion if the characteristic equation is given by, **04**

$$S^4 + s^3 + 2s^2 + 2s + 3 = 0$$

- (c) Draw the nyquist plot for, 07

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

- Q.5** (a) Describe the State model of nth order of system. 03

- (b) Draw Polar plot of 04

$$G(s)H(s) = \frac{100}{(s+2)(s+4)(s+8)}$$

- (c) Sketch the Bode plot for 07

$$G(s)H(s) = \frac{100(1 + \frac{s}{10})(1 + \frac{s}{100})}{s^2 + s + 4}$$

Find the Gain and Phase Margin.

OR

- Q.5** (a) Define and explain following terms with respect to frequency response (i) Gain Margin (ii) Phase Margin (iii) Gain cross-over frequency 03

- (b) A feedback control system has open loop transfer function 04

$$G(s)H(s) = \frac{k}{s(s+4)(s^2+4s+20)}$$

1. Find out poles and zero.
2. Draw the real axis loci.
3. Calculate number of asymptotes and angle of asymptotes.
4. Find out breakaway point.

- (c) Determine the transfer function of a system shown in figure 07

