Code: 20A02502T

R20

B.Tech III Year I Semester (R20) Supplementary Examinations August 2023

CONTROL SYSTEMS

(Electrical & Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

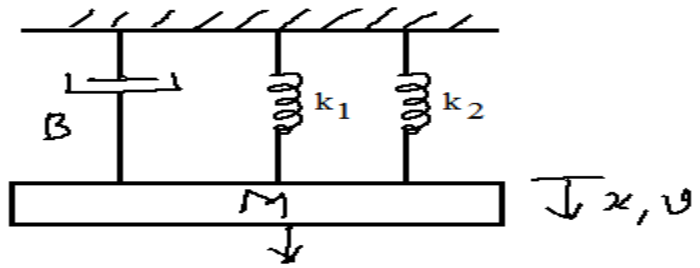
(a)	What is negative feedback?	2M
(b)	What is an open loop system?	2M
(c)	What is a step input?	2M
(d)	Define error constant.	2M
(e)	Define stability.	2M
(f)	What is a Centroid?	2M
(g)	Define resonant peak.	2M
(h)	Define phase margin.	2M
(i)	Define state variable.	2M
(j)	With a suitable example define duality.	2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2 (a) Explain the differences between open and closed loop systems in detail. 5M

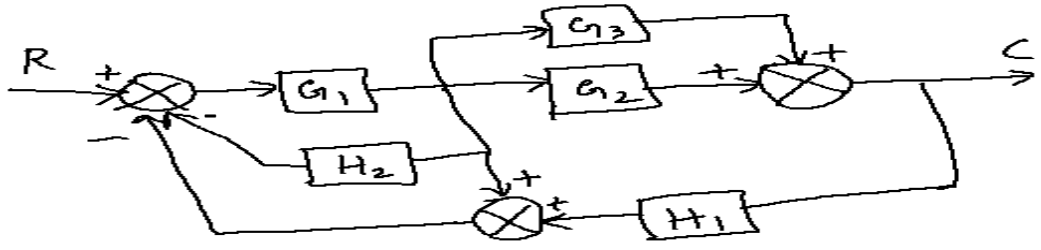
(b) For the mechanical system below, derive the transfer function. 5M



OR

3 (a) Derive the differential equations for the basic rotational system components. 5M

(b) Draw the signal flow graph of the following block diagram and obtain the transfer function C/R using Mason's gain formula. 5M



4 (a) Derive the time response of a first order system for impulse input. 5M

(b) A unity feedback system has an open loop transfer function 5M

$$G(s) = \frac{5}{s(s+1)}$$

Find the rise time, peak overshoot and peak time for a step input of 10 units.

OR

Contd. in Page 2

5	(a)	Explain the working of a PID controller in detail.	5M
	(b)	A unity-feedback system is characterized by the open loop transfer function below. Determine the steady state errors to unit step, unit-ramp and unit parabolic inputs. $G(s) = \frac{1}{s(0.3s+1)(0.1s+1)}$.	5M
6	(a)	What are the limitations of Routh's stability? Explain.	5M
	(b)	Draw the root locus diagram of a system whose open loop transfer function given by; $G(s)H(s) = \frac{K(s+1)}{s^2}$.	5M
		OR	
7	(a)	What are the steps involved in the construction of Root locus? Explain.	5M
	(b)	Using Routh criterion, determine the stability of the system whose characteristic equation is given by; $2s^4 + 5s^3 + 9s^2 + 8s + 5 = 0$.	5M
8	(a)	How to draw Nyquist plot? Explain.	5M
	(b)	Sketch the bode plot of the following open loop transfer function; $G(s) = \frac{30(1+0.2s)}{(1+0.02s)(0.5+s)}$.	5M
		OR	
9	(a)	Discuss in detail about lag compensating technique.	5M
	(b)	Sketch the polar plot of the following transfer function; $G(s) = \frac{5(2+s)}{(1+s)(3+s)}$.	5M
10	(a)	What is Observability? Explain in detail.	5M
	(b)	How to derive transfer function from state model? Explain.	5M
		OR	
11	(a)	What is Diagonalization? Explain in detail.	5M
	(b)	Explain the duality between controllability and observability.	5M

*****

Code: 20A02502T

R20

B.Tech III Year I Semester (R20) Regular & Supplementary Examinations January 2024

CONTROL SYSTEMS

(Electrical & Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) Define causal system with a statement and an equation. 2M

(b) State the analogous quantities for mechanical rotational system and electrical systems in torque-current analogy. 2M

(c) Why D controller cannot alone used? 2M

(d) The unit step response of a particular control system is given by $c(t) = 1 - e^{-t}$. Determine the transfer function of the system. 2M

(e) Differentiate between Hurwitz stability criterion and Routh stability criterion? 2M

(f) What is the limitation of Hurwitz criteria? 2M

(g) What is the slope change at ω=10 of the magnitude vs frequency characteristic of a unity feedback system with the following open loop transfer function? Justify answer. 2M

$$G(JW) = \frac{5(1+J0.1W)}{JW\,(1+J0.5W)\left[1+J0.6\left(\frac{W}{50}\right)-\left(\frac{W}{50}\right)^2\right]}.$$

(h) Explain how the Nyquist criterion for stability based on the principle of argument in complex theory. 2M

(i) How a general state space model is transformed into a Jordan canonical model? Explain in short? 2M

(j) If the Eigen values of a 3×3 matrix A are 1, -2 and 4. What are the Eigen values of $P^{-1}AP$, where P is a linear transformation ? 2M

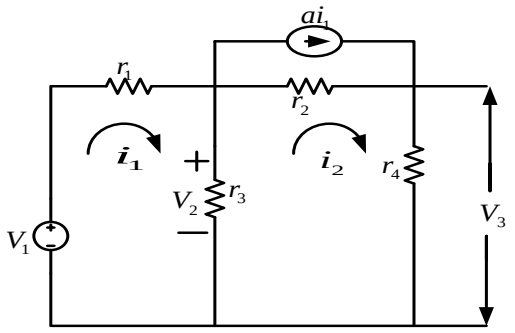
PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2 How AC servomotor is different from normal induction motor. Derive the incremental transfer function of AC servomotor with neat sketch, proper block diagram and torque-speed characteristics. 10M

OR

3 Draw the SFG of electrical network and find $\frac{V_3(s)}{V_1(s)}$. 10M



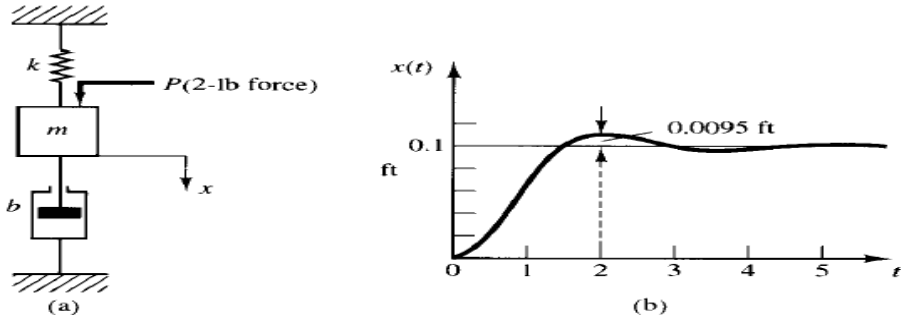
Contd. in Page 2

4 (a) The open loop transfer function of a servo system with unity feedback is $G(S) = \frac{200}{S(S+5)}$. Using error series obtain the steady state error of the system when subjected to an input $r(t) = 3t + 4t^2$ 5M

(b) Derive the expression for generalized error series. 5M

OR

5 Below figure shows a mechanical vibratory system. When 2lb of force (step input) is applied to the system, the mass oscillates as shown in figure. Determine m, b, k of the system from this response curve. The displacement x is measured from this equilibrium point. 10M



6 (a) What is BIBO stability of a system? State the condition and derive it? 5M

(b) A unity feedback control system is characterized by the open loop transfer function $G(s) = \frac{K(s+17)}{s(s+6)(s+9)}$. What should be the upper limit of K if all the roots of the characteristics equation are required to lie on the left of the line $\sigma = -1$. 5M

OR

7 Sketch the root locus of the system whose $G(s)H(s) = \frac{Ke^{-s}}{s(s+2)}$. When K varies from 0 to infinite? 10M

8 Sketch the bode plot for a feedback system which has the open loop transfer function $G(s)H(s) = \frac{1200(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0..005s)}$. Find GM and PM? 10M

OR

9 Sketch the nyquist plot for the system with loop transfer function $G(s)H(s) = \frac{K(1+0.5s)(s+1)}{(10s+1)(s-1)}$. Determine the range of K for system is stable. 10M

10 (a) A control system is found to be Un-controllable. Discuss the conditions how it can be made controllable? 5M

(b) Is the following system completely controllable and observable? 5M

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}-2 & 0\\ 3 & -5\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix}u; y = [1 \quad -1]\begin{bmatrix}X_1\\ X_2\end{bmatrix}$$

OR

11 (a) For closed loop system characterized by the transfer function $T(s) = \frac{s^2+3s+3}{s^3+2s^2+3s+1}$. Draw the signal flow graph and construct the state model. 5M

(b) Consider the state equation of the system matrix A=$\begin{bmatrix}0 & 1\\ 2 & 3\end{bmatrix}$, B=$\begin{bmatrix}0\\ 1\end{bmatrix}$. Determine solution of this equation when input is unit step for $t \geq 0$. 5M

*****