SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

Minor-Exam (ODD Semester) – Sep- 2019

Entry No: 17BEC033

Total number of pages:[02]
Total number of questions: 7

B.Tech. || ECE || Sem V
Control Systems

Time allowed: 1.5 Hr. **Subject Code: ECL-3090** **Max Marks: 30**

Important Instructions: All questions are compulsory

PART A

Q1. The forward-path gain (G) of a closed-loop feedback system is $G(s)=\dfrac{10}{s(s+1)}$ and feedback transfer function $H(s) = 6$. Determine the percentage sensitivity of closed-loop transfer-function (T) w.r.t. G and H.

[4]

Q2. Calculate the value of K for which the unity-feedback control-system with $G(s)=\dfrac{K}{(s^2+2s+2)(s+2)}$ so that it produces sustained oscillations. Also calculate the frequency of oscillation. [3]

PART B

Q3. A dynamic vibration absorber is shown in figure 1 below. Draw its mechanical equivalent circuit and find the transfer function $\dfrac{Y_1(s)}{F(s)}$ and $\dfrac{Y_2(s)}{F(s)}$. [5]

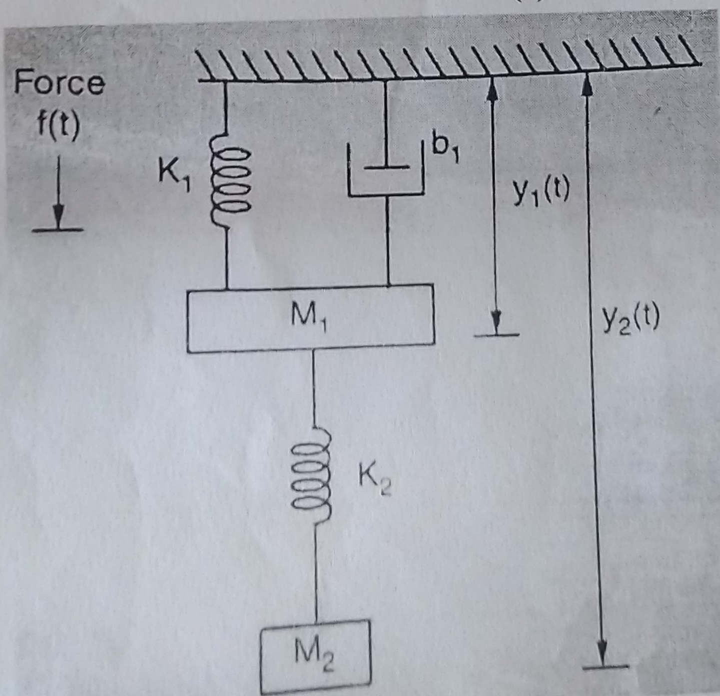

Figure 1.

Q4. Find the total output $C(s)$ for the system having two inputs R_1 and R_2 shown in figure 2, using block diagram reduction only. [5]

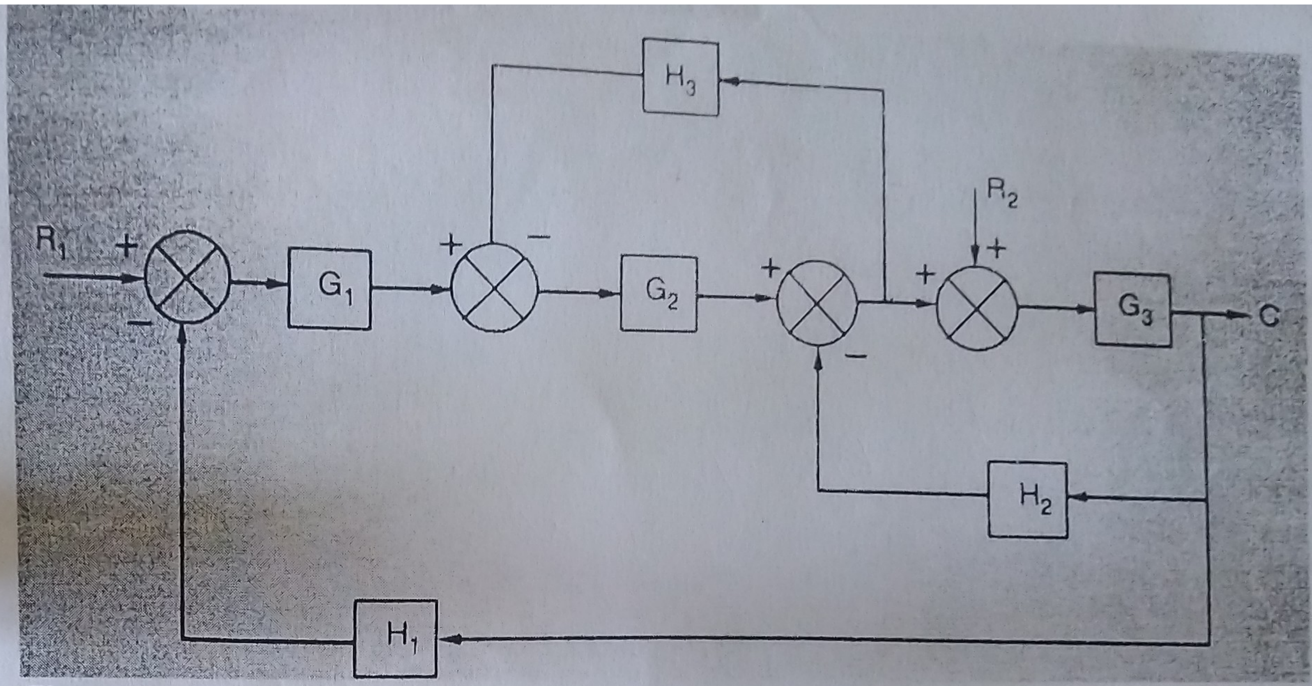

Figure 2

Q5. Determine the transfer function of the system shown in figure 3, **using Masson's Gain formula.** [5]

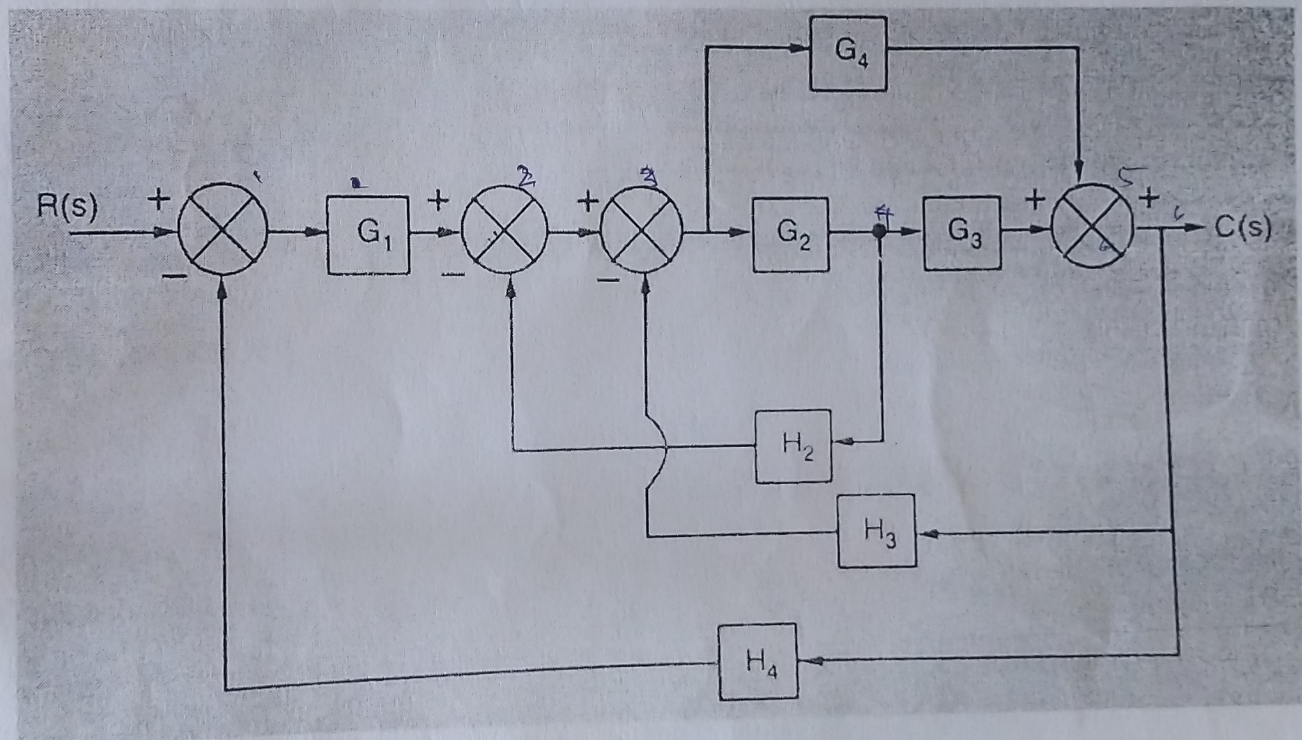

Figure 3

Q6. The percentage peak overshoot (% M_p) for a second order control system is 25.4 %, with natural frequency of oscillation is 5 rad/sec. Calculate rise-time(t_r) for 100 %, peak-time (t_p) and settling- time (t_s) for 2 % error. [3]

Q7. Construct the root-locus plot for the feedback control system with $G(s) = \dfrac{K}{(s^2+6s+10)(s+1)}$ and $H(s) = (s+2)$. Find the K for $\zeta = 0.707$ and the roots for $\zeta = 0.707$. [5]

Entry No. and Name

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
SCHOOL OF ELECTRICAL ENGINEERING
B. Tech. (ECE– 5th Sem.) **Class Test-2** (Odd Sem.), 2019-20

SET
A

Time: 45 Min. **Course Title:** Control Systems (ECL 3090) **MM: 10**

Instructions: ***All questions are compulsory.***

Q1. Drive the expression for transfer function of Lead Compensator. *(2)*

Q2. Explain the reset mode of controller with its canonical form and effect of sudden change. *(2)*

Q3. Explain composite P+I Controller with its internal diagram. Also, shows he effect on transient state of P+I controller if error, $e = Sin\omega t$. *(3)*

Q4. The following differential equations represent linear time-invariant systems. Write the dynamic equations (state equations and output equations) in vector-matrix form *(3)*

$$\frac{d^3y(t)}{dt^3} + 5\frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} + 2y(t) = u(t)$$

Entry No. and Name

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
SCHOOL OF ELECTRICAL ENGINEERING
B. Tech. (ECE- 5^{th} Sem.) **Class Test-1** (Odd Sem.), 2019-20

SET
B

Time: 45 Min.

Course Title: Control Systems (ECL 3090)

MM: 05

Instructions: *All questions are compulsory.* ***NO EXTRA SHEET WILL BE PROVIDED***

Q.1. Find the poles and zeros of the following functions (including the ones at infinity, if any). Mark the finite poles with x and the finite zeros with o in the s-plane. *(2)*

$$G(s) = \frac{10s\,(s+1)}{(s+2)(s^2+3s+2)}$$

Q.2. Find the Laplace transforms of the following functions. Use the theorems on Laplace transforms, if applicable *(1)*

$$g(t) = (t\sin 2t + e^{-2t})u_s(t)$$

Q.3. Apply the Routh-Hurwitz criterion to determine the stability of the closed-loop system as a function of K as given in equation. Determine the value of K that will cause sustained constant-amplitude oscillations in the system. Determine the frequency of oscillation. *(2)*

Characteristic equation: $s^3 + (K+2)s^2 + 30Ks + 200K = 0$

श्री माता वैष्णो देवी विश्वविद्यालय
SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
SCHOOL OF ELECTRONICS & COMMUNICATION ENGINEERING

विज्ञानं ब्रह्म

B. Tech. (ECE – 5th Sem.) **Major Examination** (Odd Sem.), 2019-20

Entry No: 1 7 B E C 0 3 3

Date:

Total Number of Pages: 02

Total Number of Questions: 05

Time: 3 Hours

Course Title: Control Systems

Course Code: ECL 3090

MM: 50

Instructions:

i. *All questions are compulsory.*

ii. ***Question 2 and 4 has choice.***

iii. *Assume any data if required and support your answer with neat freehand sketches/diagrams, wherever appropriate.*

iv. *Sharing of calculator and stationery items is not permitted.*

Q. 1. *Attempt all parts*

A) What is feedback, and what are its effects. Is feedback systems are more stable? Justify your answer. *(2)* CO1

B) Prove the convolution theorem of Laplace Transform, which is *(4)* CO1

$$L[g_1(t)g_2(t)] = G_1(s) * G_2(s)$$

C) Given the forward-path transfer function of unity-feedback control systems, *(4)* CO1

$$G(s) = \frac{K\,(s+1)}{s^3 + 2s^2 + 3s + 1}$$

Apply the Routh-Hurwitz criterion to determine

i. the stability of the closed-loop system as a function of K.

ii. the value of K that will cause sustained constant-amplitude oscillations in the system.

iii. the frequency of oscillation

Q. 2. *Attempt any two parts*

A) Fig. 2(b) shows the block diagram of the antenna control system of the solar-collector field shown in Fig. 2(a). The signal *N(s)* denotes the wind gust disturbance acted on the antenna. The feedforward transfer function $G_d(s)$ is used to eliminate the effect of *N(s)* on the output *Y(s)*. Find the transfer function $Y(s)/N(s)|_{R=0}$. Determine the expression of $G_d(s)$ so that the effect of *N(s)* is entirely eliminated. *(5)* CO2

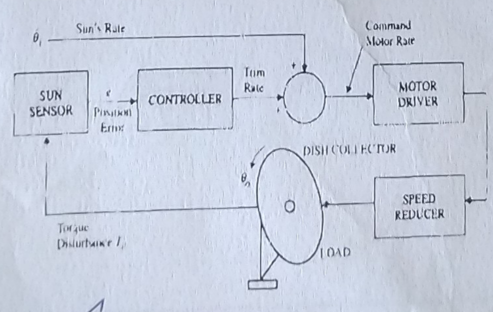

Fig. 2(a)

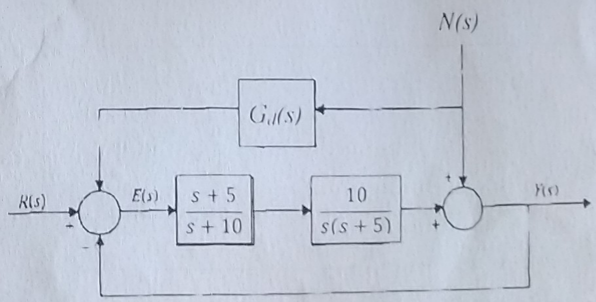

Fig. 2(b)

B) Construct the Signal-Flow Graph, by considering the following set of algebraic equations: *(5)* CO2

$$y_2 = a_{12}y_1 + a_{32}y_3$$
$$y_3 = a_{23}y_2 + a_{43}y_4$$
$$y_4 = a_{21}y_2 + a_{34}y_3 + a_{44}y_4$$
$$y_5 = a_{25}y_2 + a_{45}y_4$$

C) Write the state equations of an electric network, consider the network shown in Fig. 2(c). Where, the voltage across the capacitor, $e_c(t)$, and the currents of the inductors, $i_1(t)$ and $i_2(t)$, are assigned as state variables, as shown in Fig. 2(c). (5) CO2

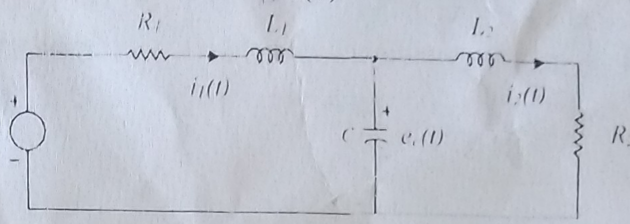

Fig. 2(c)

Q. 3. *Attempt all parts*

A) Define the expression of the transient response of second-order system. Also define the following terms with their mathematical expression for **second order system** (5) CO3

i) Natural Undamped Frequency, ii) Maximum overshoot, iii) Delay and rise time.

B) What will be effect of addition a pole to the forward-path transfer function with unity feedback and to the closed-Loop Transfer function. Also find pole and zeros, and comment on the stability of the given function (5) CO3

$$G(s) = \frac{10(s+2)}{s(s^2+2s+2)}$$

Q. 4. *Attempt any two parts*

A) Explain composite PI Controller with its internal diagram. Also, shows he effect on transient state of the controller if error, $e = Sin\omega t$. (5) CO4

B) The forward-path transfer function of a system is (5) CO4

$$G(s).H(s) = \frac{24}{s(s+1)(s+2)}$$

Design a PD controller that satisfies the following factors: The steady-state error is less than $\pi/10$ when the input is a ramp with a slope of 2π rad/sec.

C) Construct the root-locus diagram of the following control systems for which the poles and zeros of $G(s)H(s)$ are given below. The characteristic equation is obtained by equating the numerator of $1+G(s)H(s)$ to zero. (5) CO4

Poles at 0, -5, -6; zero at -8

Q. 5. *Attempt all parts*

A) Define the relationship between state equations and transfer functions. (2) CO5

B) Define the stability of state model. Also write down the condition of controllability and observability. (4) CO5

C) The following differential equation represent linear time-invariant systems. Write the dynamic equations (state equations and output equations) in vector-matrix form (4) CO5

$$2\frac{d^3y(t)}{dt^3} + 3\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 2y(t) = u(t)$$

CO	Course Outcomes	Question Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	To provide with basic knowledge of control systems and transfer function	1	10	61
CO2	To understand the methods to simplify large system and represent in a single transfer function block	2	10	
CO3	To make students familiar with system performance analysis of different order systems	3	10	
CO4	To design controllers & compensators for a particular system to meet desired response	4	10	
CO5	To understand the state space representation of systems	5	10	
		TOTAL	50	