

R16

Code No: 134AM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, May - 2019
CONTROL SYSTEMS
(Common to EEE, ECE, EIE, ETM)
Time: 3 Hours
Max. Marks: 75
Note: This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A.

Part B consists of 5 Units. Answer any one full question from each unit.

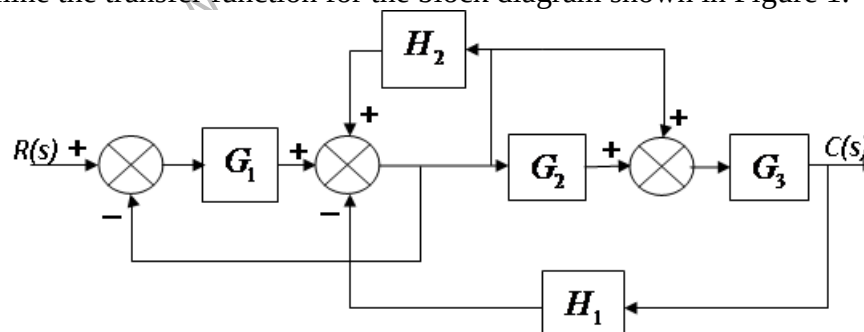
Each question carries 10 marks and may have a, b as sub questions.

PART – A
(25 Marks)

- 1.a) Classify the following as open or closed loop system with valid reasons (i) An electrical On-Off switch, (ii) Room air-conditioner. [2]
- b) Why do you need a feedback controller? Justify your answer with an example. [3]
- c) What are the effects of integral control action? [2]
- d) Find the peak overshoot for unit step response of the system described by closed loop transfer function, $G(s) = \frac{64}{s^2 + 16s + 64}$. [3]
- e) Outline the Bode plot for a Proportional Integral controller. [2]
- f) Compare between absolute stability, conditional stability and relative stability. [3]
- g) Draw the polar plot for $G(s)H(s) = \frac{1+2s}{1+3s}$. [2]
- h) What is a Phase Lag compensator and why is it used? [3]
- i) What are the advantages of State variable model of dynamic system? [2]
- j) How do you determine the system eigen values and what is its role in the system response? [3]

PART – B
(50 Marks)

2. Determine the transfer function for the block diagram shown in Figure 1. [10]


Figure: 1
OR

- 3.a) Distinguish between Open loop control system and closed loop control system.
 b) A two phase AC servo motor has the following parameters:
 Starting torque = 0.166 N-m
 Inertia = $1 \times 10^{-5} \text{ kg-m}^2$
 Supply voltage = 115 V
 No load angular velocity = 304 rad/sec
 Assuming torque – speed curve to be linear and zero viscous friction, derive the transfer function. [4+6]

4. The open loop transfer function of an unity feedback control system is given as

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

 Determine the factor by which the gain 'K' should be multiplied so that the overshoot of the unity step response be reduced from 80% to 25%? [10]

OR

- 5.a) Determine the damping ratio and natural frequency of the system if the derivative feedback is absent ($K_0=0$) in the closed loop system shown in Figure 2. What is the steady state error resulting from unit ramp input?
 b) Determine the derivative feedback constant ' K_0 ' which will increase the damping ratio of the system to 0.5. What is the steady state error resulting from unit ramp input with this setting of the derivative feedback constant? [5+5]

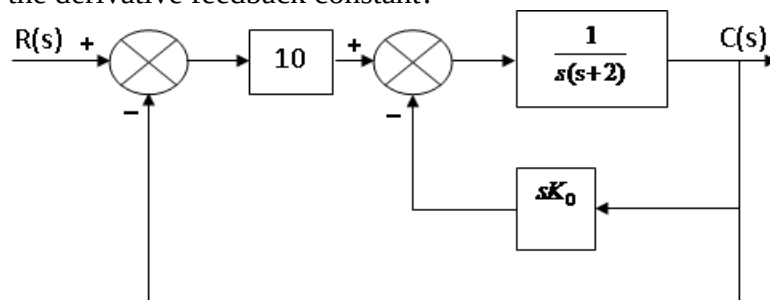


Figure: 2

6. Determine the values of K and β , so that the system whose open loop transfer function is

$$G(s) = \frac{K(s+1)}{s^3 + \beta s^2 + 5s + 1}$$

 oscillates at a frequency of oscillations of 2 rad/sec. Assume unity feedback. [10]

OR

7. Sketch the root locus of the unity feedback system having $G(s) = \frac{K}{s^2 + 2s + 2}$ for positive values of K. Sketch the new root locus when a simple pole at $s = -5$ is added to the system loop transfer function. Hence indicate the effect of adding this pole on the root locus of the system. [10]

8. Investigate closed loop stability of a system having $G(s)H(s) = \frac{K(s+4)}{s(s-2)}$ using Nyquist criterion. Determine the limiting value of 'K' for stability. [10]

OR

9. Design a lead compensator for the system with an open-loop transfer function $G(s) = \frac{K}{s^2(1+0.1s)}$ for the specifications of acceleration error constant, $K_a = 10$ and phase margin, $\phi_{pm} = 30^\circ$. [10]

10. For the system given below, obtain:

- a) Zero input response
 b) Zero state response
 c) Total response.

[10]

$$A = \begin{bmatrix} 1 & 4 \\ -2 & -5 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, u = 1 \text{ and } \begin{matrix} x_1(0) = 1 \\ x_2(0) = 0 \end{matrix}$$

OR

- 11.a) Distinguish between Transfer function model and State Space model.
 b) Diagonalize the system matrix given below.

[4+6]

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -4 \end{bmatrix}$$

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