Code No: 134AM **R16**

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]

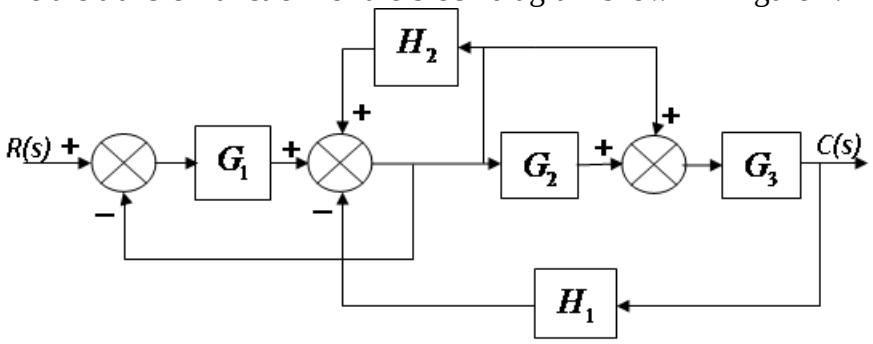

Figure: 1

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 = 1×10^{-5} 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]

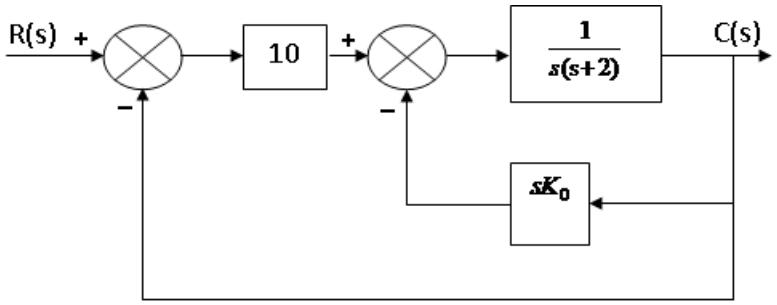

Figure: 2

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, $\phi_{pm}=30^0$. [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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