Printed Pages : 7 TEC504

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3088 Roll No.

B.Tech

(SEM V) ODD SEMESTER THEORY EXAMINATION 2009-10

AUTOMATIC CONTROL SYSTEM

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt all questions.*

1 Attempt any **two** of the following : **10×2=20**

(a) Define control system. Explain closed loop control system and open loop control system with examples.

(b) (i) Write the differential equations governing the behaviour of the mechanical system shown in **Fig. 1** and draw its mechanical network.

(ii) Obtain the analogous electrical ckt. based on force voltage (f-v) analogy :

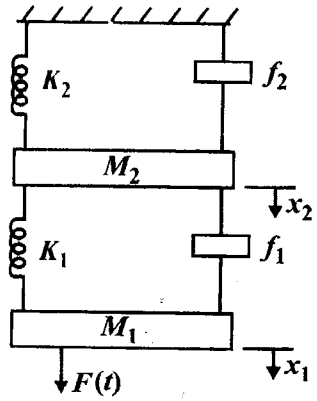


Fig. 1

(c) Determine the overall transfer function GR from the signal flow graph shown in **Fig. 2** using the Maron's gain formula

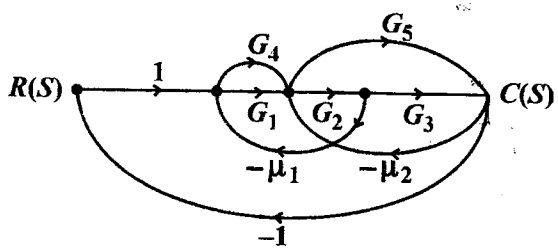


Fig. 2

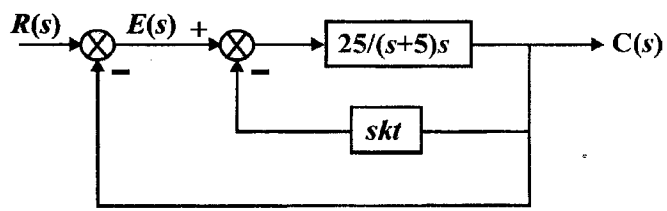
2 Attempt any **two** parts of the following : **10×2=20**

(a) The open loop transfer function of a unity feedback control system is given by

$$G(s)=\frac{25}{s(s+5)}$$

(i) Calculate the natural frequency of oscillation, damped frequency of oscillations, damping factor, damping ratio and the max. overshoot of a units step input.

(ii) If the damping ratio is to be made 0.75 using a technometer of gain skt, calculate the techometer constant (kt) and determine the maximum over shoot, peak time and settling time :



Block diagram Incorporating techometer feedback

(b) The closed loop transfer function of fourth order system is $\frac{\left(s+\frac{1}{2}\right)}{s^4+10s^3+35s^2+50s+24}$

Determine the response of the system when a step input of 10 is applied to the input. Hence calculate the steady state o/p of the system.

(c) Consider a unity feedback system having transfer function $\frac{G(s)}{R(s)}=\frac{a}{s^2+ksea}$.

Determine the open loop transfer function and steady state error coefficients.

Attempt any **two** of the following : **10×2=20**

(a) Sketch the root locii for $G(s)=\frac{k(s+1)}{s^2(s+3.6)}$

and $H(s)=1$.

(b) Sketch the Nyquist plot for the system having

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

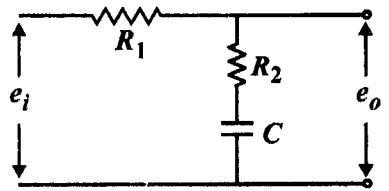
Using Nyquist criterion, determine wheather the closed loop system having the following open loop transfer function is stable or not.

(c) (i) Explain nonminimum phase function, minimum phase function and all pass function using pole-zero pattern.

(ii) Explain the terms phase margin and gain margin.

4 Attempt any **two** of the following : **10×2=20**

(a) Discuss the electrical network realization of lag compensator and its frequency characteristic using Bode plot. Mention its effects on phase margin, response, bandwidth, rise time and settling time.



(b) Obtain the transfer function for lag compensator for a system whose open loop transfer function is $G(s)=\dfrac{k}{s(s+1)(s+4)}$ to meet the following specifications. Damping ratio = 0.5, settling time $(ts)=10\text{sec}$ velocity error const. $kv\geq 5$.

(c) Describe the steps for designing the phase lead compensation using Bode plot.

5 Attempt any **two** of the following : **10×2=20**

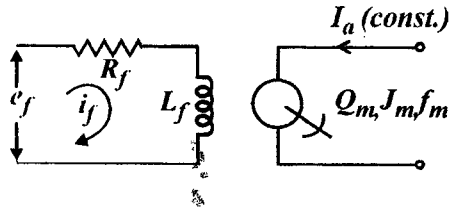
(a) (i) Obtain the transfer function if

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-5 & -1\\ 3 & -1\end{bmatrix}\begin{bmatrix}x_4\\ x_2\end{bmatrix}+\begin{bmatrix}2\\ 5\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

(ii) Give the basic introduction of fuzzy logic control.

(b) Obtain the state equations for the field controlled DC motor



(c) Check the state controllability and obse the system described by

$$\dot{x}=\begin{bmatrix}-3 & 1 & 1\\ -1 & 0 & 0\\ 0 & 0 & 1\end{bmatrix}x+\begin{bmatrix}0 & 1\\ 0 & 0\\ 2 & 1\end{bmatrix}u$$

$$y=\begin{bmatrix}0 & 0 & 1\\ 1 & 1 & 0\end{bmatrix}u$$