Total No. of Printed Pages:03

SUBJECT CODE NO:- H-545
FACULTY OF SCIENCE AND TECHNOLOGY
T.E.(EEP/EE/EEE)
Control System Engineering
(REVISED)

[Time: Three Hours] **[Max.Marks:80]**

Please check whether you have got the right question paper.

N.B
1) Q.No.1 and Q.No.6 are compulsory.
2) Solve any two from remaining questions from each section.
3) Use suitable data if necessary.

Section A

Q.1 Solve any five questions. 10

a) Define transfer function.
b) What is feedback? Give the types of feedback.
c) What is block diagram?
d) Define damping and damping ratio.
e) Define Rise time and settling time.
f) What is acceleration error coefficient?

Q.2 a) For the mechanical system shown in fig.1. Draw the force-voltage and force-current analogous circuits. 08

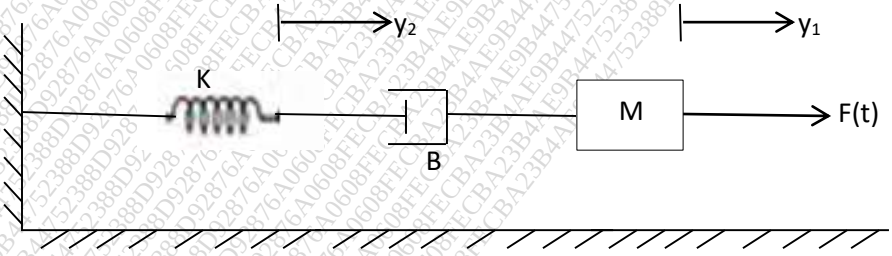

Fig. (1)

b) Write steps for solving signal flow graph using Mason's gain formula. 07

Q.3 a) Derive the expression for time response of second order system for step input. 08

b) The open loop transfer function of a servo system with a unity feedback is given by. 07

$$G(S) = \frac{10}{(S+3)(S+6)}$$

Determine the damping ratio, undamped natural frequency of oscillation. What is the percentage over shoot of the response to a unit step input.

Q.4 a) Explain steady state and static error constant. 07

b) For servo mechanisms with open loop transfer function $(S) = \frac{20(S+2)}{S(S+1)(S+3)}$, Explain what type of input signal give rise to a constant steady state error and calculate their values. 08

Q.5 a) What are the difficulty arises in the Routh's Array? Explain in detail. 07

b) Determine range of values of 'K' for the system $S^3 + 3KS^2 + (K+2)S + 4 = 0$ to be stable. 08

Section B

Q.6 Answer any five:- 10

a) What is centroid? How the centroid is calculated?
b) Define roof locus.
c) Define gain margin?
d) What do you mean by angle of departure?
e) Define the term state, state variable.
f) Define the term controllability and observability.

Q.7 The open loop transfer function of a unity feedback system is given by, 15

$G(S) = \frac{K(S+9)}{S(S^2+4S+11))}$, Sketch the roof locus of the system.

Q.8 Sketch Bode plot for the following transfer function and determine the system gain 'K' for the gain cross over frequency to be 5 rad/sec. 15

$G(S) = \frac{KS^2}{(1+0.2s)(1+0.02s)}$

Q.9 a) Determine the state transition matrix for the system. 07

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \quad \text{where u>0}$$

b) Construct a state model of a system whose transfer function is given as 08

$\frac{y(S)}{U(S)} = \frac{10}{S^3+4S^2+2S+1}$

Q.10 a) Explain the effect of addition of poles and zeros on roof locus. 08

b) Test the observability of the system described by 07

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -3 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$