[Total No. of Printed Pages:2] **CODE NO:- Z-86**

FACULTY OF ENGINEERING

T.E (EEP/EE/EEE) - Year Examination June – 2015

Control System Engineering

(Revised)

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

"Please check whether you have got the right question paper."

i) Attempt any three questions from each section
ii) Q.No.1 and Q.No.6 are compulsory
iii) Solve any two from remaining questions from each section.

SECTION A

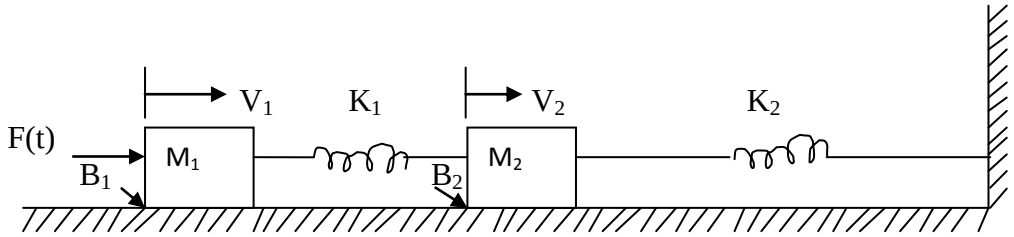
Q.1 Attempt any five from the following 10

a. Define open loop and closed loop control system
b. What is signal flow graph?
c. What is transmittance?
d. Write the mason's gain formula
e. What is time response?
f. Define damping ratio
g. List the time domain specifications
h. What is steady state error?

Q.2 a) Derive an expression for undamped second order system for unit step input 07

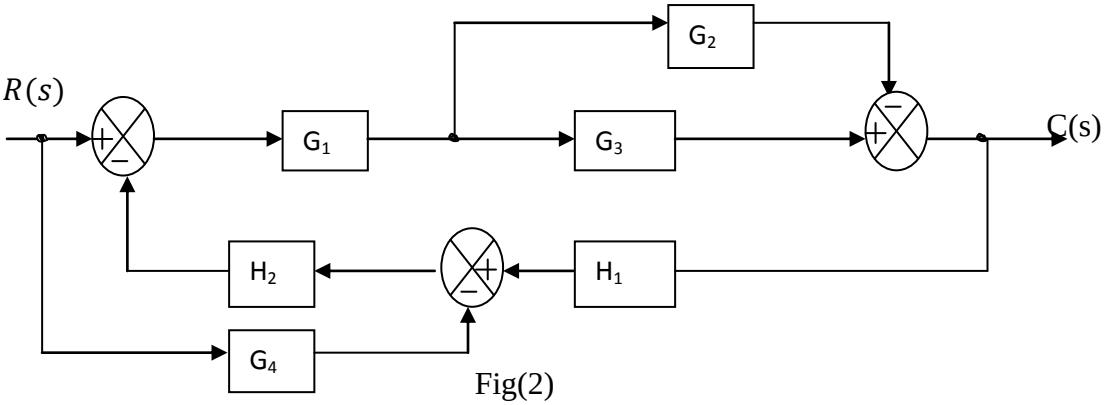
b) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$ 08
determine the gain K, so that the system will have a damping ratio of 0.5 for this value of k.
determine setting time, peak, overshoot and time to peak overshoot for a unit step input

Q.3 a) For the mechanical system shown in fig.(1), draw the force- voltage and force – current analogous circuits 08



Fig(1)

b) Draw a signal flow graph and evaluate the closed loop transfer function of a system whose block diagram is shown in fig (2) 07



Fig(2)

Q.4 a) Explain in detail, the various block reduction rules 08

b) Find k_v, k_p, k_q *and* less for open loop transfer function. $G(s) = \frac{10}{s(0.1s+1)}$ 07

Q.5 a) If $G(s) = \frac{20}{s(1+4s)(1+s)}$ determine; 08

1. Different static error coefficients
2. Steady state error if $r(t) = 2 + 4t + \frac{t^2}{2}$

b) For a system $s^4 + 2s^3 + (4+k)s^2 + 9s + 25 = 0$. find range of k using Routh's Hurwitz criterion 07

SECTION B

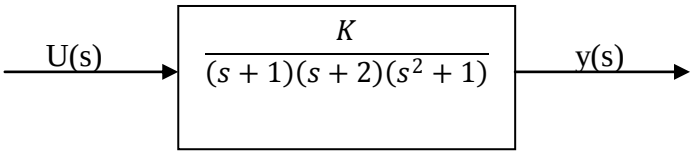
Q.6 Attempt <u>any five</u> 10

a. Define BIBO stability
b. What is the necessary condition for stability
c. How will you find the gain k at a point on root locus?
d. How will you find root locus on real axis
e. What are asymptotes? How will you find the angle of asymptotes?
f. Define i) state vector ii) state space
g. What is phase and gain cross – over frequency
h. What is bode plot?

Q.7 Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+2)(s+4)}$ find the value of 'K' so that the damping ratio of the closed loop system is 0.5 15

Q.8 Sketch the bode plot for the following transfer function and determine the system gain for the gain cross over frequency is be 5 red/sec. $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$ 15

Q.9 a) Represent following transfer function in state space form 08



b) Find state transition matrix $\emptyset(t)$ of following system 07

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Q.10 a) Test the controllability and observability of the system whose state space representation is given as, 08

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

b) Explain the effect of addition of poles and zeros on root locus 07