Paper / Subject Code: 41103 / Feedback Control System

E (Instru) sem IV choice based 03/12/18 1/2

Duration: 3 Hours **Max. Marks 80**

N.B.

1. **Q.1** is compulsory. Attempt **any three** from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1 **Attempt any four** **20**

a. For a feedback control system with forward path transfer function $G(s)$ and feedback transfer function $H(s)$, define 'Order' and 'Type' of the system.

b. Define root locus of a system? What is root locus for a system, $G(s) = \frac{K(s+1)}{s+3}$

c. For a system $\frac{Y(s)}{R(s)} = \frac{1}{(3s+1)}$, obtain unit step response $y(t)$.

d. Determine steady state error in unit step response for the system $\frac{Y(s)}{R(s)} = \frac{2(s+0.1)}{(s^2+0.8s+1)}$.

e. Write difference between open-loop and closed-loop systems.

f. Obtain the poles of the system $G(s) = \frac{1}{s^4+81}$ and comment on stability from locations of poles.

Q.2 A. For the following system, compute risetime (t_r), peak time (t_p), peak overshoot ($\%M_p$) and settling time (t_s) for 2% tolerable error in response. **10**

$$G(s) = \frac{1}{s^2 + 1.2s + 1}$$

B. Construct the signal flow graph for system in **Fig.1** and obtain the transfer function using Mason's gain formula. **10**

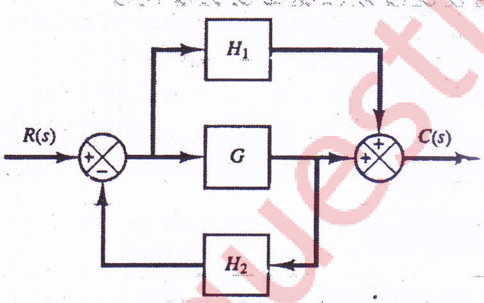

Fig.1

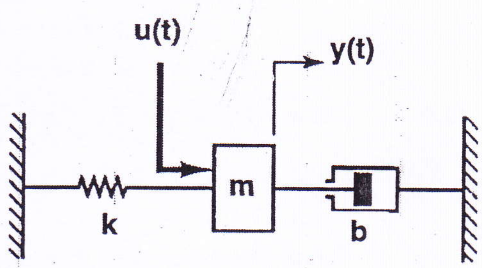

Fig.2

Q.3 A. Obtain the mathematical model of the system in **Fig.2**. What will be the transfer function of this system if $k = 2$ N/m and $b = 2.4$ N-sec/m and $m = 2$Kg? **10**

B. Determine the range of K for stability of the system having a characteristic equation **10**

$$P(s) = s^4 + 2s^3 + 2s^2 + s + K = 0$$

using Routh's criterion.

Turn Over

S.E. (Instru) sem IV choice based

Q.4 A. Determine the position, velocity and acceleration error constants for unity feedback systems with open loop transfer functions **10**

$$\text{(i) } G(s) = \frac{k}{(T_1 s + 1)(T_2 s + 1)} \qquad \text{(ii) } G(s) = \frac{1}{s(s+\alpha)}$$

Where T_1, T_2 and α are positive constants.

B. Construct the root locus for the system **10**

$$G(s) = \frac{K}{s^3 + 6s^2 + 11s + 6}$$

with feedback $H(s) = 1$.

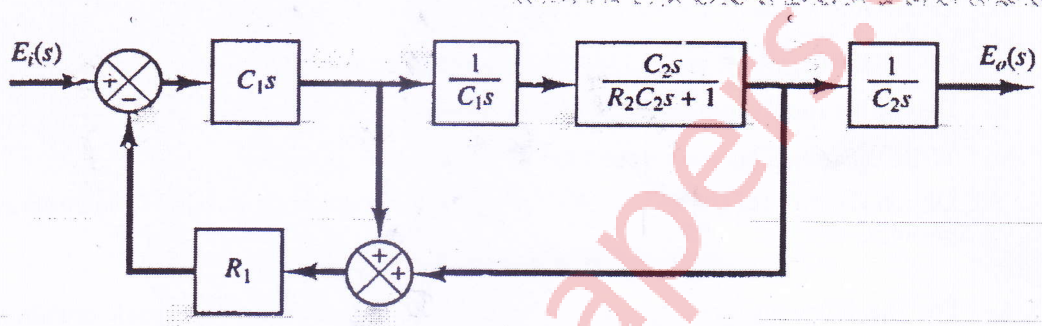

Fig.3

Q.5 A. Obtain $E_o(s)/E_i(s)$ for the system in **Fig.3** using block diagram reduction technique. **10**

B. Define stability of the system. Determine the stability of the system using Hurwitz criteria, if characteristic equation of the system is given by, **10**

$$P(s) = s^4 + 2s^3 + 49s^2 + 78s + 40 = 0$$

Q.6 A. Draw Nyquist plot for the system, **10**

$$G(s) = \frac{1}{s(0.4s + 1)(0.5s + 1)}$$

What frequency does the response will cross the real axis and what will be the magnitude at that frequency?

B. Draw Bode plot for the system, **10**

$$G(s) = \frac{15(s + 15)}{(s + 1.5)(s + 150)}$$

and obtain gain and phase margins from plot.