**Printed pages: 03** **Sub Code: EIC 501**

**Paper Id:** | 3 | 0 | 3 | 7 | **Roll No.** | | | | | | | | | | |

**B.TECH**
**(SEM V) THEORY EXAMINATION 2017-18**
# CONTROL SYSTEM-I

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

**Note:**Attempt all Sections. If require any missing data; then choose suitably.

## SECTION-A

**1. Attempt *all* questions in brief:** **2 x 10 = 20**

a).Distinguish between open loop system & closed loop system.

b). The breakaway points on the root locus occurs at
(i)Imaginary axis
(ii) real axis
(iii)Multiple roots of characteristics equation
(iv) either (i) and (ii)

c). If the characteristics equation of a closed loop system is

$$1+\frac{k}{s(s+1)(s+2)}=0\ ,$$

the centroid of the root locus will be at……

d). BIBO means…….

e) . The condition of a system to be controllable is …….

f). Routh Hurwitz criterion is valid only for real coefficients of the characteristics of the characteristic equation. (True/ False)

g). What are the limitations of Routh Hurwitz criterion?

h). Explain Nyquist stability criterion.

i). Explain the following (i) Gain Margin (ii) Phase Margin.

j).Explain the following (i) Rise time (ii) settling time.

## SECTION - B

**2. Attempt any *three* of the following:** **10 x 3 = 30**

a.) Design SFG for the following equation:

$$(i)Y_2=a_1\frac{dY_1}{dt},(ii)Y_3=\frac{d^2Y_2}{dt^2}+\frac{dY_1}{dt}-Y_1,(iii)\frac{d^2Y}{dt^2}+\frac{2}{3}\frac{dY}{dt}+\frac{11}{2}Y=X$$

b. Construct the polar plat for the following transfer function.

$$(i)G(s)=\frac{10(s+2)(s+4)}{s(s^2-3s+10)}\quad (ii)G(s)=\frac{2(s+1)}{s^2}$$

c. Sketch the Nyquist plot for a unity feedback system having open loop transfer function given by

$$(i)G(s)=\frac{k}{s(1+s)(1+2s)(1+3s)}$$ Determine the range of value of k for which the system is stable

d. The closed loop transfer function of unity feedback control system is given by:

$\frac{C(s)}{R(s)} = \frac{10}{10(s^2+4s+5)}$ Determine (i) damping ratio (ii) natural undammed frequency (iii) percentage peak overshoot (iv) Expression for error.

e. For the unity feedback system whose open loop transfers function is:

$(i)G(s) = \frac{50}{(1+0.1s)(1+2s)}$ Find the position velocity and acceleration error constant

## SECTION - C

**3. Attempt any one part of the following: 10 x 1 = 10**

a.Find the equivalent transfer function of three parallel blocks $G_1(s) = 1/s+1$
$G_2(s) = 1/s+4$ and $G_3(s) = s+4/s+5$

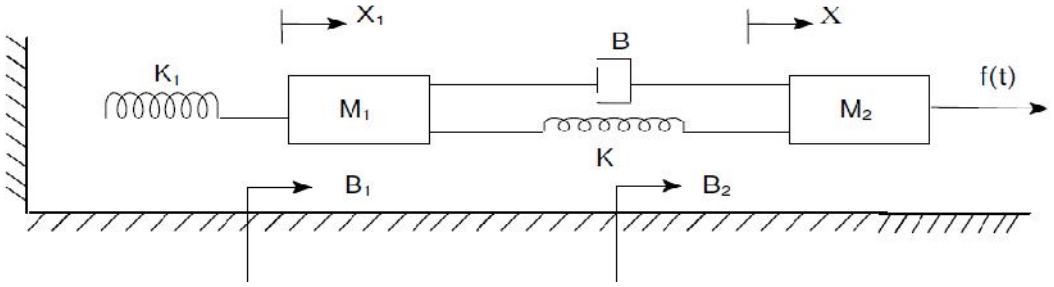
b. a unity feedback control system has an open loop transfer function $(i)G(s) = \frac{10}{s(s+2)}$ , find the rise time percentage overshoot and peak time. Also find the steady state error when

$(i)R(s) = \frac{9s^3}{(s-2)(s^2+1)}$ $H(s) = 1$

**4. Attempt any one part of the following: 10 x 1 = 10**

a. The open loop transfer function of a unity feedback system is given by $(i)G(s) = \frac{k}{s(sT+1)}$ where k and T are positive. By what factor should the gain k the reduced so that peak overshoot of unit step response of the system is reduced from 75% to 25%.

b. Write the differential equations governing the Mechanical system shown in fig and determine the transfer function.




**5. Attempt any one part of the following: 10 x 1 = 10**

a. Obtain state space model for the transfer functions given below:
(i)Y(s)/U(s) =1/ (s+1) (s+2) (s+3) (cascade decomposition)
(ii)Y(s)/U(s) =s2 +s+2/s 3 +9s2 +26s+24 (direct decomposition)

b. Establish correlation between frequency domain response & time domain response. A unit step input is applied to a unity feedback control system having open loop Transfer Function G(S)H(S) =k/s

(1+sT). Determine the values of K and T to have peak overshoot =26% and resonant frequency =8 rad /sec. Also calculate the resonant peak.

**6. Attempt any one part of the following:** **10 x 1 = 10**

a. Construct the Bode plot for unit feedback control system having G(s) = 2(s+0.25)/s2 (s+1) (s+0.5) From the plot obtain Gain Margin, Phase Margin, Gain crossover frequency and Phase crossover frequency. Also comments on stability of closed loop system.

b. A system is described by the following differential equation. Represent the system in the state space.

$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t)$ and outputs are

$Y_1 = 4\frac{dx}{dt} + 3u_1, \quad Y_2 = \frac{d^2x}{dt_2} + 4u_2 + u_3$

**7. Attempt any one part of the following:** **10 x 1 = 10**

a. A linear time invariant system is characterized by the state variable model. Examine the controllability and observability of the system

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}$$

$$B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} \; ; \; C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

b. Consider a unity feedback system with a forward path transfer function,

$$G(s) = \frac{k(s+4)}{(s+2)(s-1)}$$

Draw the root locus.