Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech. / M. Tech. / Ph.D.

End-Semester Examination March, 2019

Branch : ECE **Semester** : 4th

Title of the Course : Control Theory **Course Code** : ECL 251

Time: 3 Hours **Maximum Marks: 50**

Section-1

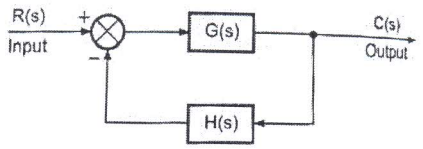
Note: Attempt all questions **[2×5=10]**

Q.1 Represent the following set of equations by a signal flow graph and determine the overall transfer function.

$X_2= ax_1+cx_3$ $X_3=bx_2$ $X_4=dx_3+fx_5$

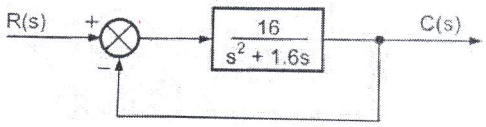
$X_5=ex_4$ $X_6=gx_5$

Q.2 Determine the sensitivity of overall transfer function M(s) with respect to feedback path transfer function H(s).



Q.3 Consider a unity feedback control system with a closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$. Determine the open loop transfer function G(s), and find the steady state error with unit ramp input.

Q.4 A unity feedback control system is shown in figure below. By using derivative control the damping ratio is made to be 0.8. Determine the value of constant T_d.



Q.5 Find the valid breakaway point of the given system.

$$G(s)H(s) = \frac{K}{S(S+2)(S+3)}$$

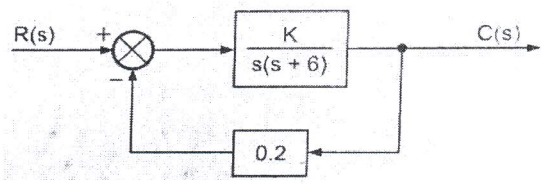
Section-2

Note: Attempt any four questions **[4×5=20]**

Q.1 Determine $|G(j\omega)H(j\omega)|$ at $\omega=\sqrt{2}$ rad/sec. Calculate the gain margin and gain cross over frequency and comment on stability of the system.

$$G(s)H(s) = \frac{32}{s(s+\sqrt{6})^3}$$

Q.2 A closed loop control system is shown in figure below. The system is to have a damping ratio of 0.7. Determine the value of K to satisfy this condition and calculate the settling time, peak time and maximum overshoot for the value of K thus determined.

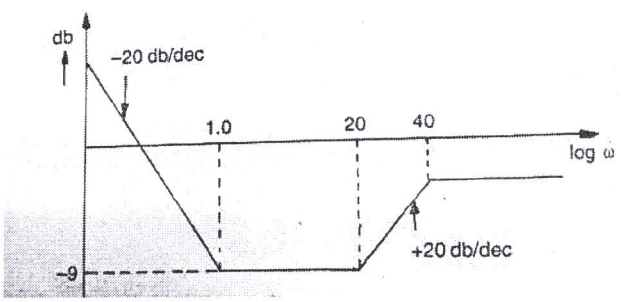


Q.3 Using Nyquist criterion investigation the closed loop stability of the system whose open loop transfer function is given by

$$G(s)H(s) = \frac{K(s+1)}{(s+0.5)(s-2)}$$

Consider (i) K=1.25 (ii) K=0.25

Q.4 Find the transfer function of the system whose Bode plot is given below.



Q.5 Using the Nyquist criterion investigates the stability of a closed loop control system whose open loop transfer function is given below.

$$G(s)H(s) = \frac{K}{s(sT_1+1)(sT_2+1)}$$

Section-3

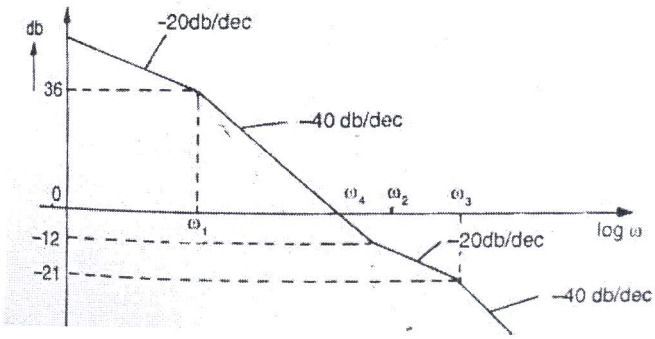
Note: Attempt all questions **[10×2=20]**

Q.1 (a) Draw the root locus of the given system and find the values of K for which the system is over damped, critically damped and under damped. [10]

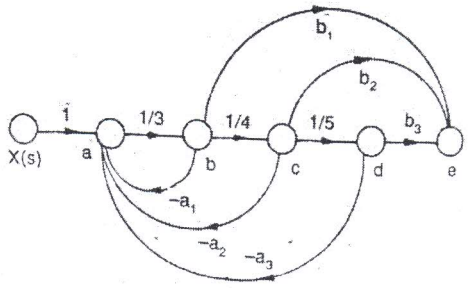
$$G(s)H(s) = \frac{K(S+2)}{S(S+1)}$$

OR

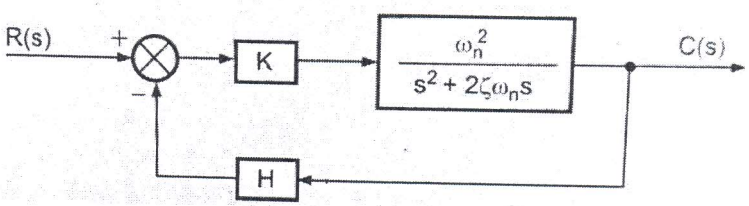
Q.2 (a) Derive the transfer function of the system from the given data on the Bode plot diagram.



(b) Derive the transfer function Y(s)/X(s) for the system shown in figure below.



Q.3 (a) Determine the sensitivity of the overall transfer function for the system with respect to change in parameter K.



(b) Find the Bode magnitude plot of $GH(j\omega) = \frac{10^4(1+s)}{(10+j\omega)(100+j\omega)^2}$