Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech 2nd year

Branch : ECE

Semester: 4th

Title of the Course : Control Theory

Course Code: ECL-251

Time: 2 Hours

Maximum Marks: 25

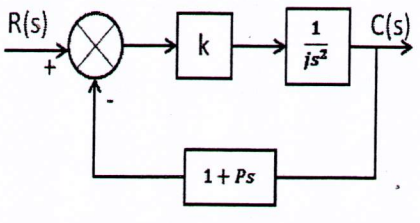
Note: Attempt all questions

Q.1 A unity feedback system has $G(s) = \frac{k}{s(s+1)(0.1s+1)}$ and r(t)= 10t

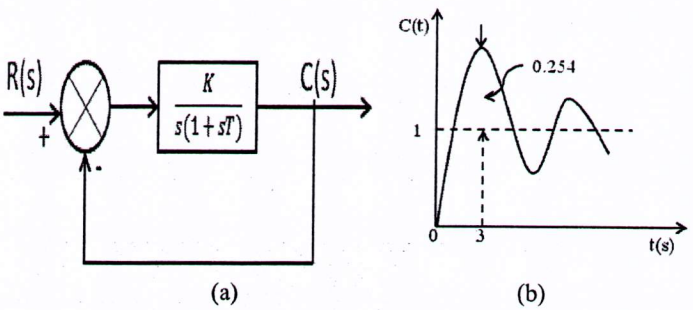
(a) If k=2, determine $e_{ss}(t)$.

(b) Find the minimum value of k for $e_{ss}(t) < 0.1$, for a unit ramp input. [3]

Q.2 Determine the values of K and P of the closed loop system shown in figure below, so that the maximum overshoot in the unit step response is 25% and the peak time is 2 second. Assume that J= 1kg-m^2. [3]



Q.3 The system shown in Fig. (a) when subjected to a unit step input gives the output response shown in Fig. (b). Determine the value of K and T from the response curve. [3]



(a) (b)

Q.4 A system is described by the following set of equations

$$x_2 = a_{12}x_1 + a_{22}x_2 + a_{32}x_3$$

$$x_3 = a_{23}x_2 + a_{43}x_4$$

$$x_4 = a_{24}x_2 + a_{34}x_3 + a_{44}x_4$$

$$x_5 = a_{25}x_2 + a_{45}x_4$$

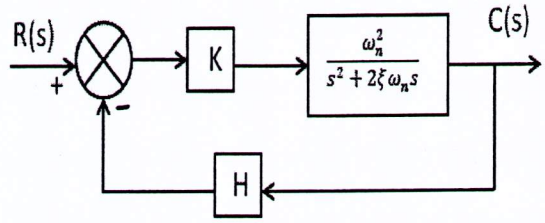
Draw the signal flow graph and obtain the transfer function of the system using Mason's gain formula. [3]

Q.5 The characteristic equation of a system in differential equation form is

$$\ddot{x} - (K+2)\dot{x} + (2K+10)x = 0$$

Find the values of K for which the system is (i) stable, (ii) limitedly stable and (iii) unstable. [3]

Q.6 Determine the sensitivity of overall transfer function for the system shown in figure below with respect to change in parameter (a) K and (b) H. [5]



Q.7 A closed loop control system with unity feedback is shown in figure below. By using derivative control, the damping ratio is to be made 0.75. Determine the value of T_d. Also determine the rise time with and without derivative control. The input to the system is a unit step. [5]