
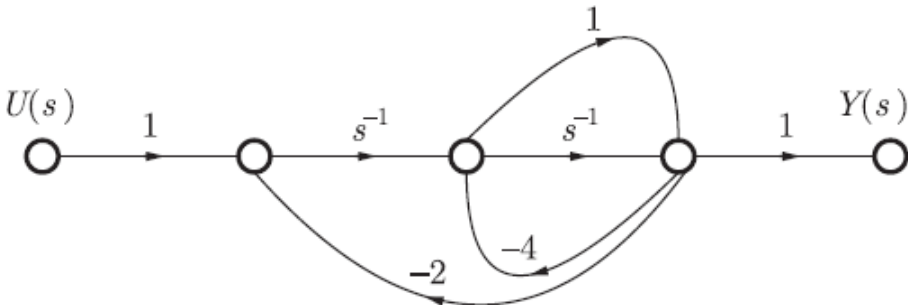
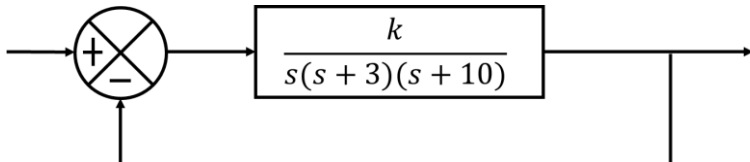
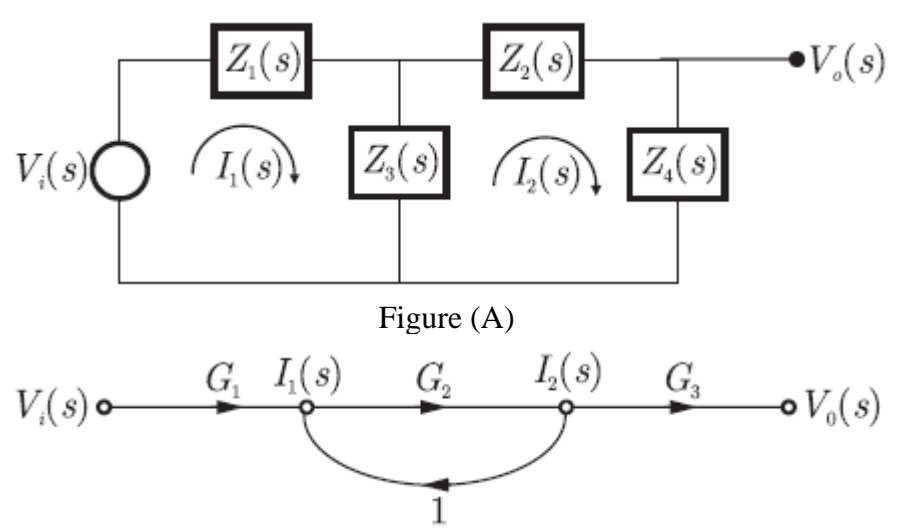
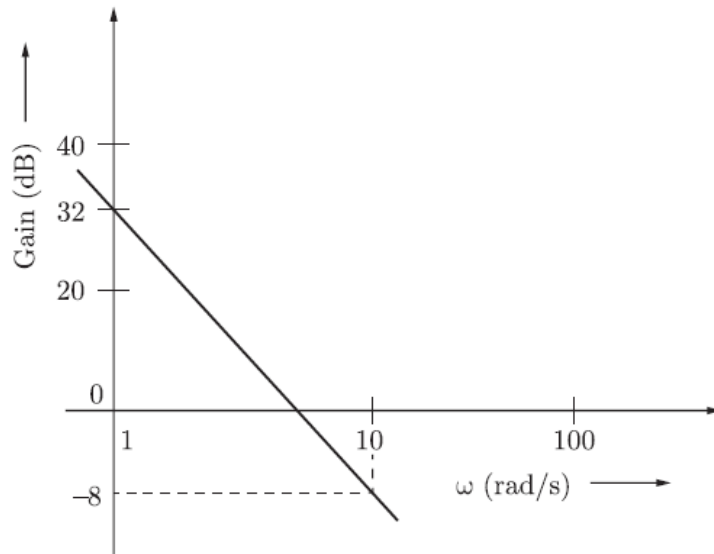


Name:			
Enrolment No:			
<div>UPES</div> <div>End Semester Examination, May 2025</div> <div><div>Course: Control System Engineering</div><div>Program: B.Tech Electrical Engineering</div><div>Course Code: ECEG2068</div></div> <div><div>Semester: IV</div><div>Time : 03 hrs.</div><div>Max. Marks: 100</div></div>			
Instructions: Use of Calculator is permitted. Assume any missing values.			
SECTION A (5Qx4M=20Marks)			
S. No.		Marks	CO
Q 1	<p>The signal flow graph for a system is given below. Determine the transfer function $\frac{Y(s)}{U(s)}$ for the system.</p> 	4	CO1
Q 2	<p>A second order real system has the following properties:</p> <p>(a) The damping ratio $\zeta = 0.5$ and undamped natural frequency $\omega_n = 10$ rad/s</p> <p>(b) The steady-state value of the output to a unit step input is 1.02.</p> <p>Determine the transfer function of the system.</p>	4	CO2
Q 3	<p>An open loop transfer function $G(s)$ of a system is</p> $G(s) = \frac{K}{s(s + 1)(s + 2) + K}$ <p>For a unity feedback system. Determine the breakaway point of the root loci on the real axis.</p>	4	CO3
Q 4	<p>Determine the range of k where $k > 0$ for which the system given below is stable.</p> 	4	CO2

Q 5	If $x = \text{Re}\{G(j\omega)\}$ and $y = \text{Im}\{G(j\omega)\}$ then for $\omega \rightarrow 0^+$, determine the value of x from the Nyquist plot for $G(s) = \frac{1}{s(s+1)(s+2)}$.	4	CO4
SECTION B (4Qx10M= 40 Marks)			
Q 6	<p>An electrical system and its signal-flow graph representations are shown in Figure (A) and (B) respectively. Find out the values of G_2 and H.</p>  <p>Figure (A) is a circuit diagram. It consists of an input voltage source $V_i(s)$ in series with a block $Z_1(s)$. After $Z_1(s)$, the circuit splits into two parallel branches. The first branch contains a block $Z_3(s)$ in series with a block $Z_4(s)$. The second branch contains a block $Z_2(s)$. The output voltage $V_o(s)$ is taken across $Z_2(s)$. Currents $I_1(s)$ and $I_2(s)$ are indicated with arrows pointing downwards through $Z_3(s)$ and $Z_4(s)$ respectively.</p> <p>Figure (B) is a signal-flow graph. It has an input node $V_i(s)$ and an output node $V_o(s)$. The signal path consists of three forward blocks: G_1, G_2, and G_3. There are two nodes between G_1 and G_2, and between G_2 and G_3. The signal between the first two nodes is labeled $I_1(s)$, and the signal between the second two nodes is labeled $I_2(s)$. A feedback path with a gain of 1 connects the node after G_2 back to the node before G_1.</p>	10	CO1
Q 7	<p>For a second order system with the closed-loop transfer function</p> $T(s) = \frac{9}{s^2 + 4s + 9}$ <p>Evaluate the settling time for 2-percent band.</p>	10	CO2
Q 8	<p>A system with transfer function $\frac{Y(s)}{X(s)} = \frac{s}{s+p}$ has an output $y(t) = \cos(2t - \frac{\pi}{3})$ for the input signal $x(t) = p \cos(2t - \frac{\pi}{2})$. Determine, the system parameter p.</p>	10	CO3
Q 9	The Bode plot of a transfer function $G(s)$ is shown in the figure below.	10	CO4



The gain ($20\log|G(s)|$) is 32 dB and -8 dB at 1 rad/s and 10 rad/s, respectively. The phase is negative for all ω . Determine the transfer function $G(s)$.

OR

The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{3e^{-2s}}{s(s+2)}$$

Determine the gain and phase crossover frequencies in rad/sec.

SECTION-C (2Qx20M=40 Marks)

Q 10	<p>(a) Find the number of right-hand, left-hand and imaginary axis poles for the following characteristic equations.</p> <p>(i) $1 + G(s)H(s) = s^4 + s^3 - s - 1$</p> <p>(ii) $1 + G(s)H(s) = s^3 + s^2 + s + 1$</p> <p>(iii) $1 + G(s)H(s) = s^3 - s^2 + s - 1$</p> <p>(b) The open loop transfer function of a unity negative feedback system is given by $\frac{k(s+1)(s+2)}{(s+3)}$. Draw the root locus as the value of k varies from zero to infinity.</p>	20	CO3
Q 11	<p>(a) Consider the following transfer function:</p> $G(s) = \frac{200}{s^3 + 11s^2 + 38s + 4}$ <p>If the frequency response, is represented by $G(j\omega)$, Develop its rectangular and polar forms for $\omega = 1$ rad/sec.</p> <p>(b) Draw the Root Locus for the open loop transfer function given below.</p> $G(s)H(s) = \frac{K(s+0.1)}{s^2(s+1)}$ <p>OR</p> <p>(a) A process transfer function is described as follows:</p>	20	CO4

$$G(s) = \frac{10}{s^3 + 4s^2 + 6s + 8}$$

Sketch the polar plot for $G(s)$ by properly labelling the key frequencies in $G(j\omega)$ plane.

(b) Draw the Root Locus for the closed loop system given below, where a is the gain of the open loop transfer function, having a range $0 < a < \infty$.

