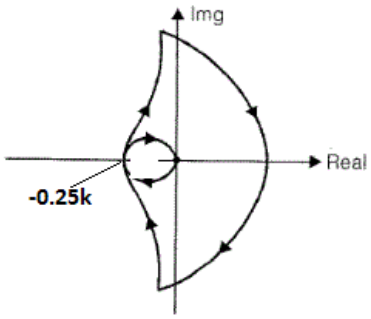
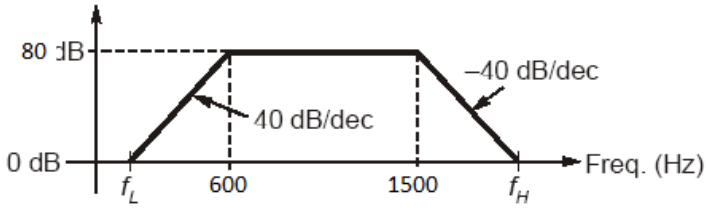
**Name:**

**Enrolment No:**

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, May 2019**

**Course: Control System Engineering** — **Semester: VI**
**Programme: B.Tech EE and B.Tech EE spz BCT** — **Time: 03 hrs.**
**Course Code:ELEG383** — **Max. Marks: 100**
**Instructions:**

## SECTION A

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Comment on the stability and location of poles of the given characteristic equation, 1+G(s)H(s)= $\mathbf{5s^5+3s^4+6s^3+5s^2+6s+5.}$ | **5** | **CO1,CO3** |
| Q 2 | The open loop transfer function of H(s) = 1 is given by G(s) = K/s(s+3)($s^2$+s+2). Determine the value of K that will cause sustained oscillations in the closed loop system. Also, find the natural frequency of oscillation? | **5** | **CO1 CO3** |
| Q 3 | If out of 3 open loop poles No open loop poles lies at right hand side of Imaginary axis. Consider the Nyquist Plot given and Find the range of variable parameter k for which system is stable ?   | **5** | **CO3** |
| Q 4 | Evaluate the bandwidth ($f_H$ - $f_L$)of the bode plot given in the figure below?   | **5** | **CO3 CO2** |

## SECTION B

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| Q 5 | Evaluate the open loop transfer function G(s) of the signal flow graph given below using mason's gain formula. Assume unity gain feedback for the system | **10** | **CO4** |

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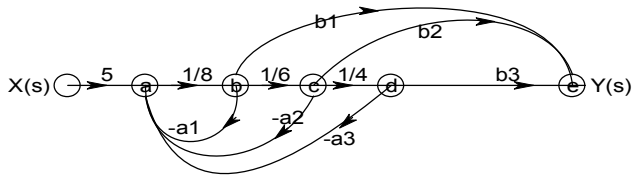
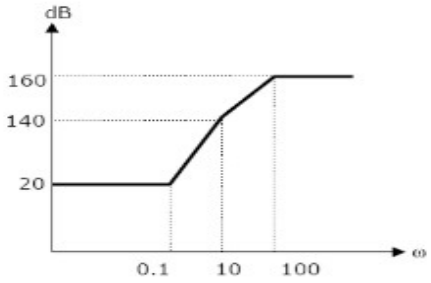
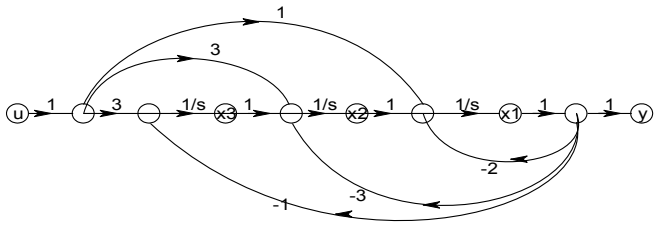
|---|---|---|---|
| |  | | |
| Q6 | Evaluate the Transfer Function T (s) from the given bode plot and define the term Crossover frequency.<br>  | **10** | **CO3,CO1** |
| Q7 | Consider the unity feed-back control system is given by G(s) = 50/s(1+0.2s)(1+0.02s), H(s)=1, Determine the followings:<br>(1)Gain crossover and phase crossover frequencies.<br>(2)Gain margin and phase margin<br>(3)The stability of the closed loop system<br>(4) Draw the magnitude bode plot on semi log paper | **10** | **CO3** |
| Q8 | Determine the effect of proportional controller over the output response of the second order system for Kp = 10. Compare the response with the standard 2nd order system. | **10** | **CO4** |
| | **SECTION-C** | | |
| Q 9 | (a)Design the control system for the given signal flow graph and compute the controllability and observability of the system<br>(b)Write the state space equations for the system given below?<br>  | **20** | **CO1 CO3** |
| Q10 | Illustrate the root locus for the given G(s)H(s) = K/s(s+5)($s^2$ + 4s + 13) and mention all the following: | **20** | **CO4CO2** |

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|---|---|---|---|
| | (a) Centroid<br>(b) Break away point<br>(c) Angle of departure and angle of asymptotes<br>(d) Find the value of K for which root locus lies at imaginary axis and in that case what will be the frequency of oscillations. | | |

| Name:<br>Enrolment No: | UPES |
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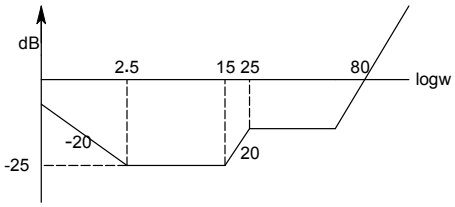
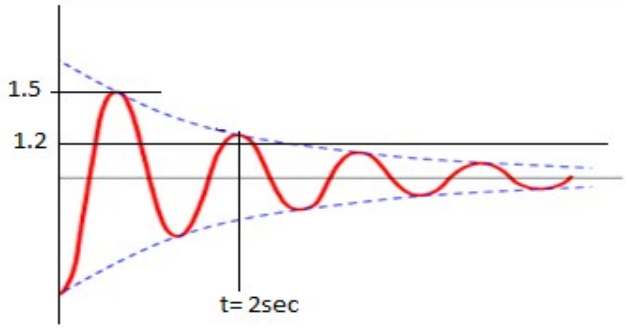
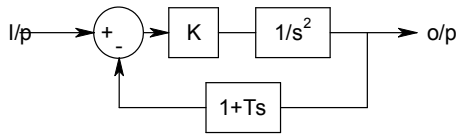
**SECTION A**

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Evaluate the Closed loop transfer function from the given bode plots. Consider the unity feedback system.<br>  <br> | 5 | CO1,CO3 |
| Q 2 | Determine the closed loop stability of the given open loop system of unity feedback with the Nyquist stability criterion<br>$G(s) = \frac{s+0.25}{s^2(s+1)(s+0.5)}$ | 5 | CO1<br>CO3 |
| Q 3 | | 5 | CO3 |
| Q 4 | Elaborate the Type of output responses on the basis of damping ratio and sketch the response with settling time with location of closed loop poles for standard second order function. | 5 | CO3<br>CO2 |
| | | | |
| Q 5 | (a) Find the response equation for the figure given below and Find the transfer function ?<br>(b) Find the Tr, Tp , damped frequency and settling time**?( input is 1.2 u(t))**<br>(c) Evaluate the forward gain of the system? | 10 | CO4 |

| | | | |
|---|---|---|---|
| |  | | |
| Q6 | For the closed loop system whose block diagram is shown below, determine the value of K and T such that the maximum overshoot to the unit step input is 25% and time to peak is 2 secs.<br>  | **10** | **CO3,CO1** |
| Q7 | The open loop transfer G(s)H(s)function is given below. Determine the error coefficient and steady state errors due to following inputs? (K= 10, T= 4)<br>$\frac{K(s+1)}{s(1+Ts)(1+2s)}$<br>(a)R(t)= 2u(t)<br>(b) R(t)= 3t u(t)<br>(c)R(t)= $4t^2$ | **10** | **CO3** |
| Q8 | A person try to measure the voltage across the two nodes using the analog voltmeter. In His experiment, he found that the pointer crosses the desired value in 10sec and maximum pointer deflection was 7.5 V and after some time it settled at its certain final value. His friend gave him the location of imaginary poles as ± 5j. Find the natural frequency and output response of the system? Plot the ouput response of the system. | **10** | **CO4CO1** |
| | | | |
| Q 9 | The open loop transfer system function of a unity feedback system is G(s)= K/s(1+Ts).<br>(a) Find by what factor the gain K changes so that the overshoot is increase by 40% to 60%.<br>(b) Find by what factor the gain K be reduced so that the damping ratio is increased from 0.2 to 0.5 | **20** | **CO1 CO3** |
| Q10 | Illustrate the root locus for the given G(s)H(s) = K/s(s+10)($s^2$ + 4s + 13) and mention all the following:<br>(a) Centroid<br>(b) Break away point | **20** | **CO4CO2** |

| | | | |
|---|---|---|---|
| | (c) Angle of departure and angle of asymptotes<br>(d) Find the value of K for which root locus lies at imaginary axis and in that case what will be the frequency of oscillations. | | |