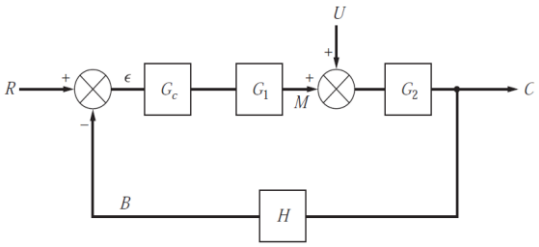
**Name:**

**Enrolment No:**

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, May 2018**

**Course: B. Tech CERP** **Semester: VI**
**Subject: Process Dynamics Instrumentation and Control**
**Time: 03 hrs.** **Max. Marks: 100**
**Instructions: Assume the appropriate value of missing data if any.**

**SECTION A (4×5=20 M)**
**All the questions are compulsory**

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Draw a response curve for a unit step change across a simple first order system. The thermometer initially at $100^0$C is dipped at t = 10 into oil bath, maintained at $150^0$C. If the recorded temperature is $130^0$C after 1 min, then calculate the time constant of thermometer (in min). | **4** | **CO1** |
| Q 2 | What will be the values of τ and ξ for the transfer function $\frac{1}{s^2+2s+3}$ ? Draw the response of a unit step change across a system for the above transfer function. | **4** | **CO2** |
| Q 3 |   Calculate the closed loop transfer function for servo and regulatory problem for the given figure. | **4** | **CO3** |
| Q 4 | What is the advantage and disadvantage of proportional controller? How can you avoid the disadvantage in two following different cases, (a) when you have to use the same controller but can tune some parameter value and (b) when can you change the controller type? | **4** | **CO4** |
| Q 5 | Define stability of a control system. How do you determine the stability from the characteristic equation? | **4** | **CO5** |

**SECTION B (10×4= 40 M)**
**Answer all the questions. Q 8 has an internal choice**

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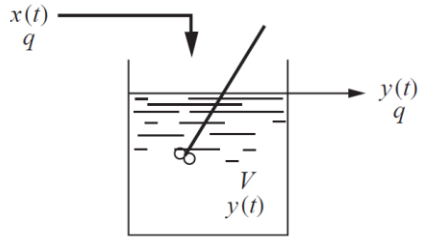
| Q 6 |   Find out the transfer function (Y(s)/X(s)) for the mixing process shown in the figure. If V = 10 $m^3$, q = 1 $m^3$/s and there is a unit step change in the input concentration, then what will be the concentration in the outlet stream after 10 seconds? | **10** | **CO1** |

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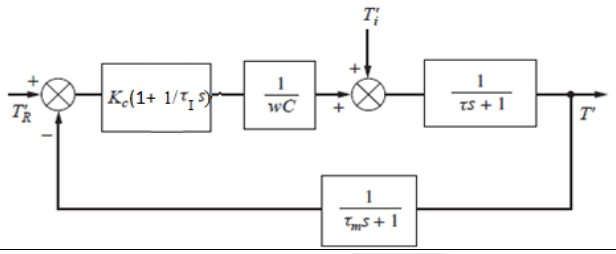
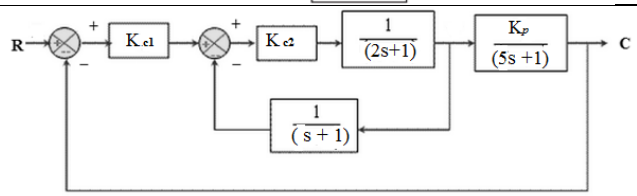
| Q 8 | If $T_i' = 0$ and $T_R' = u(t)$; $K_C = 2$; $1/wC = 1$ ; $\tau = \tau_I = 1$ and $\tau_m << \tau$. Identify if the response (T') of the system is underdamped/critically-damped/over-damped.   | **10** | **CO2** |
| Q 7 |   (a) Find the transfer function (C/R) (b) Calculate the offset in C due to a unit step change in the set point R<br><br>OR<br>A proportional controller is used for the control of a first order process. If the dynamics of all other units in the control loop are negligible and their steady state gains are all equal to unity, show that **(a)** the response of controlled process is faster than that of the uncontrolled process **(b)** the offset, for change in set point, decreases as the parameter of the controller is increased. | **10** | **CO3** |
| Q 9 | What do you understand by direct and indirect measurement (with an example)? (b) What is static error and explain how do you calculate the true value when you know the static error? (c) Which static characteristic is defined by hysteresis it? (d) How do you calculate the least accuracy and root square accuracy, explain using an error curve for an instrument. (e) Name the dynamic characteristics of a measuring instrument? | **10** | **CO5** |
| **SECTION-C (20×2= 40 M)**<br>**Answer any two questions** | | | |
| Q 10 | What do you understand by zeros and poles of a close loop transfer function? Explain, why is it necessary to have all the poles to be negative? Draw all the possibilities for the poles and draw the responses of a unit step change for the different possibilities of the poles? In a root locus method how do we find out the poles at $K_C = 0$. The roots moves as $K_C$ values are increased. What information can one draw from the root locus? (2+2+2+9+5) | **20** | **CO4** |

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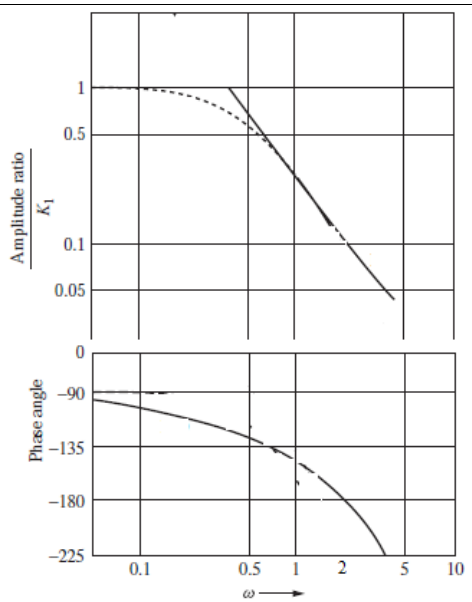
| Q 11 |  | Calculate the cutoff frequency, Phase Margin, Gain Margin for the bode plot is given in the figure. The value of $K_I$ = 2 (1+5+4)<br><br>Design the controllers using Ziegler Nichols method for the controllers<br><br>(i) P ($K_C$) (2)<br>(ii) PI ($K_C$, $\tau_I$) (4)<br>(iii) PID ($K_C$ $\tau_I$ $\tau_D$) (4)<br><br>OR<br><br>As a design engineers if you have to choose P/PI/PID controllers then what conditions will decide your choice? What are simple criteria looked for while tuning the control parameters? What problem one faces while choosing different criteria? How can one find out one single criteria for tuning of control parameters? What variations in formulation of this criteria will you make so that you can handle the situation when (i) error is significant (ii) error is very small (iii) error is persistent for significant of time. | **20** | **CO4**<br>**CO5** |