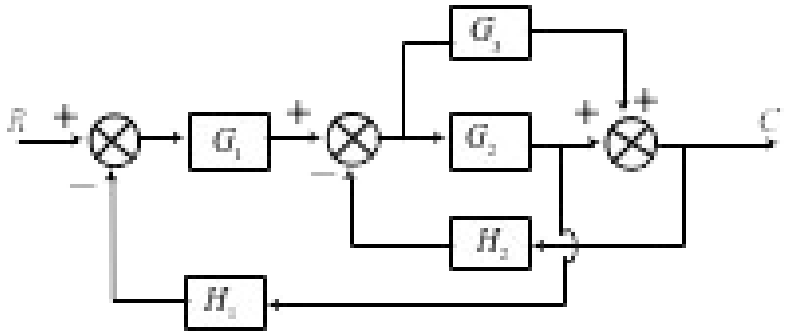
Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Instrumentation & Control **Semester: IV**
Program: B. Tech- Mechatronics **Time : 03 hrs.**
Course Code: ECEG-3011 **Max. Marks: 100**

Instructions: Attempt all the sections.

SECTION A
(5Qx4M=20Marks)

S. No.	**Attempt all the questions.**	**Marks**	**CO**
Q 1	Differentiate the open loop and closed loop system in terms of accuracy. Also explain the two industrial based realistic applications for closed loop system.	**4**	**CO1**
Q2	Obtain the mathematical model of Pneumatic system and determine the transfer function relating the output Y(s) and input pressure $P_i(s)$.	**4**	**CO2**
Q3	Determine the overall transfer function relating the output and input for a system represented by Fig (1). Use block diagram reduction method.  Fig. (1)	**4**	**CO3**
Q4	Analyze the (i) settling time (ii) steady state error for transient response of second order control system.	**4**	**CO4**
Q5	Apply Routh Hurwitz criterion (RHC) to determine the stability of the system having the characteristics equation as, $s^3 + 4\times10^2 s^2 + 5\times10^4 s + 2\times10^6 = 0$	**4**	**CO5**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Analyze and sketch the diagrams of the mechanical devices used as primary detectors as, (i) Diaphragm (ii) Bellow Also, write mathematical analysis when applied pressure to deform the original positions.	**8+2**	**CO1**

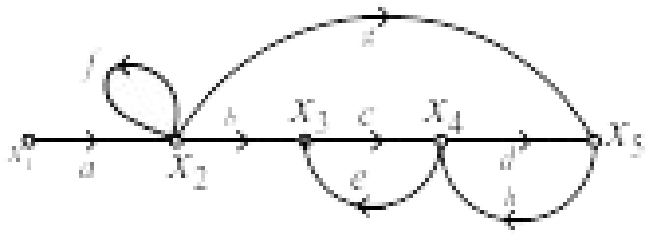
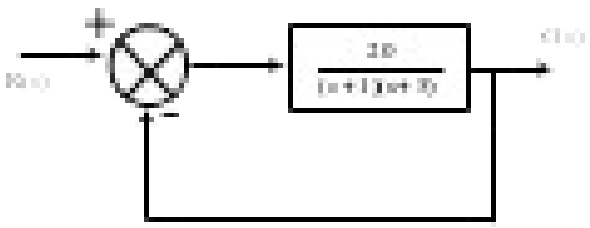
Q7	Using a neat sketch diagram, investigate the operation of a Linear Variable Differential Transformer (LVDT). Write LVDT applications for pressure measurement devices.	**8+2**	**CO2**
Q8	The signal flow graph (SFG) is shown in Fig (2). Determine the transfer function using Mason's gain method.  Fig. (2)	**10**	**CO3**
Q9	Using state equations as given below. Determine the transfer matrix of the system, $\dot{X}_1 = x_1 - 2x_2 + 2u$ $\dot{X}_2 = 4x_1 - 5x_2 + u$ $y = x_1 + x_2$ and output equation is given as, **OR** Using cascade method decompose the transfer function, $\frac{Y(s)}{U(s)} = \frac{(s+3)}{(s+1)(s+2)}$, and design the state model to represent the sate space equations.	**10**	**CO5**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	**Attempt both the parts** **(A)** The block diagram of a unity feedback control system is shown in Fig (3) as, 	**15+5**	**CO4 +CO5**

	Fig. (3) Determine the (i) Characteristics equation of the system (ii) ω_n (iii) ζ (iv) ω_d (v) t_p **(B)** In the cases of cascade decomposition, the transfer function is given in the following form $\frac{Y(s)}{U(s)} = \frac{1}{(s+2)} \cdot \frac{1}{(s+3)} \cdot \frac{1}{(s+4)}$ Design the state model (Block diagram).		
Q11	Check the controllability and observability of a system having following coefficient matrix. $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$, $B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$ **and** $C = \begin{bmatrix} 10 & 5 & 1 \end{bmatrix}$ **OR** Obtain the state transition matrix in the form of eAt and determine the time response for the system, $\dot{X} = Ax$ $A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix}$ $x_1(0) = 1,\ x_2(0) = 1$ Where and	**20**	**CO5**