Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End-Sem Examination, Dec. 2020

Course: Control System Engineering **Semester: V**
Program: B.Tech. ECE **Time 03 hrs.**
Course Code: ECEG 4007 **Max. Marks: 100**

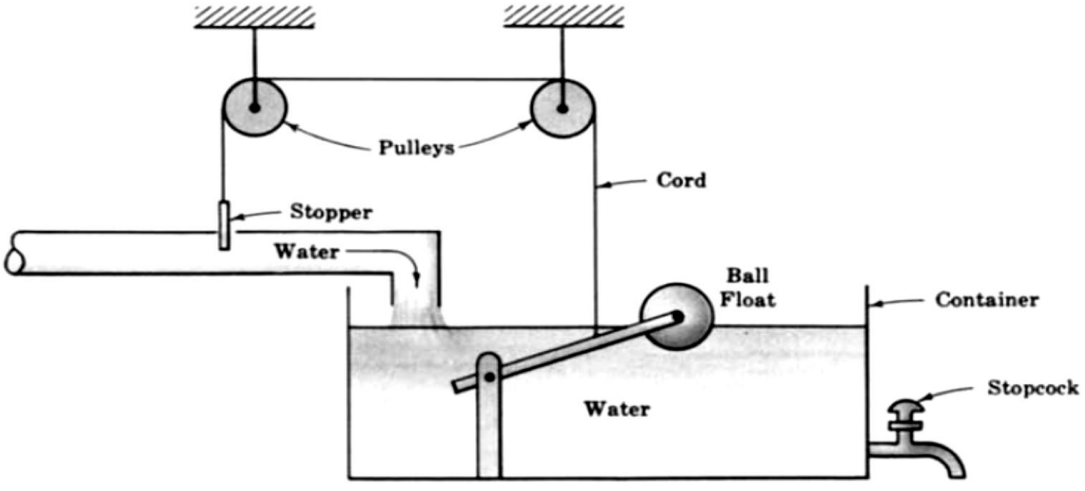
Instructions:

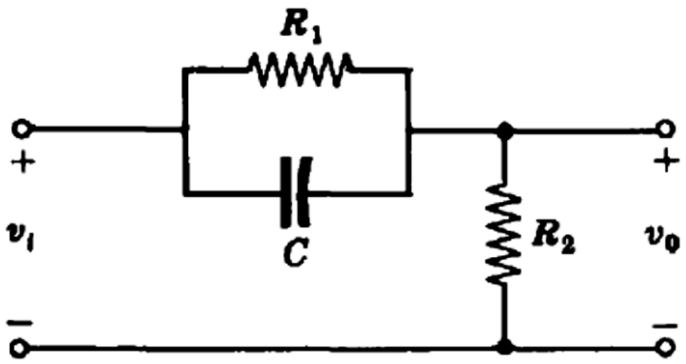
1. **Attempt Section A by typing in your answers in the relevant text box.**
2. **Attempt section B and Section C on A4 size blank sheets. Use graph paper wherever necessary.**
3. **Answer should be neat and clean. Draw a free hand sketch for circuits/tables/schematics wherever required.**

SECTION A [Type the answer] 30 Marks

S. No.		Marks	CO
Q 1	State the advantages of a F**eedback** control system.	5	CO1
Q 2	Explain the significance of **State Variable** with respect to a control system.	5	CO1
Q 3	What is the significance of mathematical modeling in **Controller Design**?	5	CO2
Q 4	Why do **RHP** poles and zeros aid **instability** to a system?	5	CO3
Q 5	Explain the significance of the term **Root Locus** in control system design.	5	CO4
Q 6	Why we cannot use a **Differential** controller in standalone mode.	5	CO4

SECTION B [Scan and upload] 50 Marks

Q 7	Figure 1 shows a simple automatic control system using mechanical components (for water level control); the objective of the system is to fill a container with water if it is emptied through a stopcock at the bottom, which is operated manually. The "ball float" floats on the water and as the ball gets closer to the top of the container, the stopper decreases the flow of water. When the container is filled completely, the stopper shuts off the flow of water. In this system identify (a) system, (b) set-point, (c) controller, (d) Actuator, and (e) the feedback element. Also draw the block diagram for the system.  Figure 1. Water level Control System for Q7	10	CO1

Q 8	Determine the transfer function of the R-C network mechanization of the **lead compensator** shown in figure 2.  Fig 2 R-C lead compensator network for Q8	10	CO2
Q 9	Consider a simple pendulum system expressed by the following model: $$\ddot{\theta} = -\frac{g}{l} sin\theta + ucos\theta$$  **Linearize** the above model and express the system in **state space** model.	10	CO4
Q 10	Consider a system expressed by: $$\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} x$$ Comment on the **stability** of the system.	10	CO4
Q 11	Write the working equation of a **PID** controller. What is the primary role of **Integral** controller? Why is it better to use a PI controller instead of a standalone P controller?	10	CO4
SECTION C [Scan and upload] 20 Marks			
Q 12	Consider a system having transfer function as: $$G(s) = \frac{(s+3)}{s(s+1)(s+2)}$$ Sketch a **bode plot** for the above system and determine: a) Gain cross over frequency b) Phase cross over frequency c) Gain margin d) Phase margin **OR** Consider a system having transfer function as: $$F(s) = \frac{k}{s(s+1)(s+3)(s+4)}$$ Sketch a **root locus** for the above system and comment on the stability.	20	CO3