

Set-A

Name:

Enrolment No:



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

Course: Process Control – ICEG 341**Semester: VI****Program: B.Tech. Electronics Engineering with Spz. In IoT based Instrumentation****Time: 03 hrs.****Max. Marks: 100**

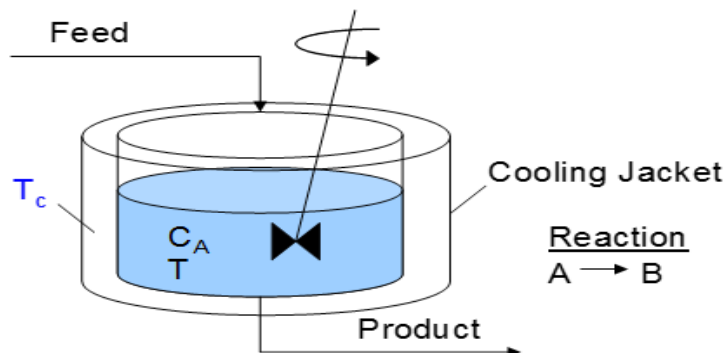
Instructions: 1) Answers should be brief and concise.
 2) Assume any missing data.

SECTION A (20 marks) All question of section A are compulsory

| S. No. | | Marks | CO |
|--------|--|-------|-----|
| Q 1 | Elucidate the working of a “PID” controller. Also draw the block diagram for a process with PID controller. | 5 | CO1 |
| Q 2 | Explain in detail the working of a CSTR. Draw a neat sketch of the process and label various input and output variables. | 5 | CO2 |
| Q 3 | Differentiate between a 1 st and a 2 nd order system based on the dynamic response. | 5 | CO2 |
| Q 4 | Elucidate the difference between a “feedback” and “feedforward” control system design. | 5 | CO3 |

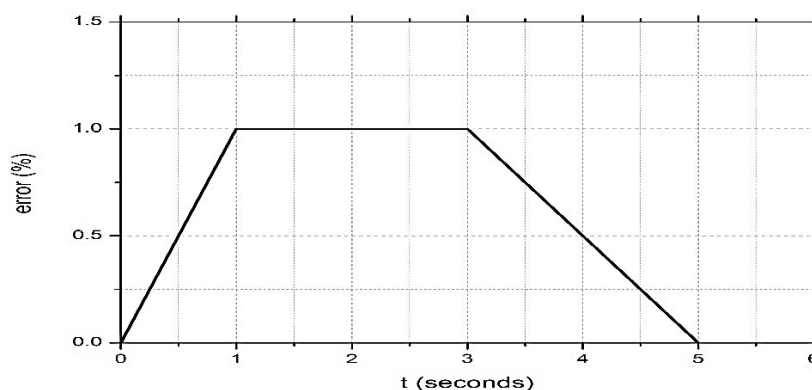
SECTION B (40 marks) Question 8 consist of an internal choice

| | | | |
|-----|---|--------|-----|
| Q 5 | Elucidate the block diagram of a Feedback Control System . Label various signals and briefly explain the functioning of each block and give description of various signals. | 10 | CO1 |
| Q 6 | A. Obtain the mathematical model for a Surge Vessel . B. Plot the dynamic response for a first order Capacitive Process . How does it differ from a standard first order lag system? | 4 6 | CO2 |
| Q 7 | Explain the principle of Selective Control System . Design a boiler protection system using Override Control . | 10 | CO3 |
| Q 8 | A JCSTR system as depicted in figure below: Identify the feedback control loop for temperature control of the product. Design a Cascade Control loops for the same. | | |



OR

Compute and plot the output for a **PD controller** for the error signal given in figure below: Consider the controller parameters as: $K_p=5, K_D=0.5 \wedge p_0=20\%$

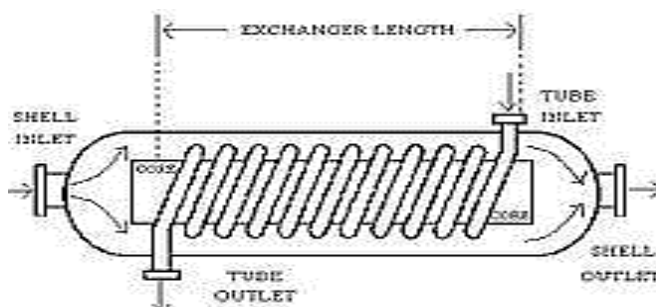


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CO4

SECTION-C (40 marks) Internal choice available in Question 10

Q 9 A. Design an “**Auctioneering Control System**” for a shell heat exchanger. The control objective is to maintain the temperature of the heated stream coming out of heat exchanger at a desired set-point. For this purpose, superheated steam is fed through tube.



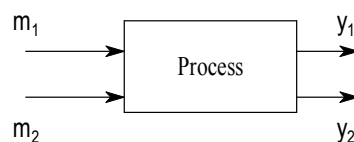
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CO4

B. Design a **Gain Scheduling Adaptive Controller** for a standard first order process control system. Determine the gain of adaption mechanism for a non-linear Valve.

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Q 10 For a MIMO process given in figure below:



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Determine the interaction of loops under the following conditions:

- a. One loop closed and another loop open
- b. Both loops are closed

OR

A. For a process with mathematical models unknown for actuator and process, which adaptive control scheme will provide “best” parameter control for the process. Justify your answer and draw the corresponding block diagram.

OR

CO3

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B. If in a certain process control application, the controlled variable cannot be measured. Which controller is applicable for such systems; draw the corresponding block diagram.

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Set-B

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|---------------|--|
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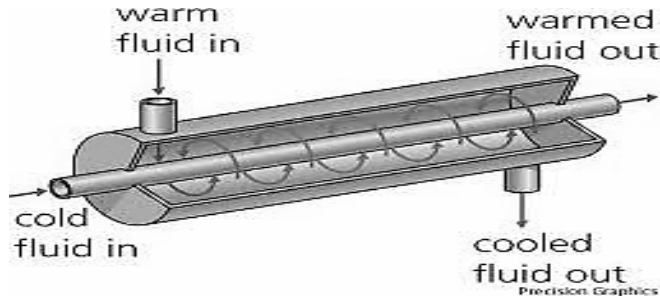
SECTION A (20 marks) All question of section A are compulsory

| S. No. | | Marks | CO |
|--------|---|-------|-----|
| Q 1 | What is the role of Actuator in control system? Give example of any 3 actuators used in process industries. | 5 | CO1 |
| Q 2 | A 1st Order System does not depict overshoot in its dynamic response. Is the statement true? Justify your answer. | 5 | CO2 |
| Q 3 | Briefly explain the working of a Jacketed CSTR . Draw a neat sketch of the process and label various input and output variables. | 5 | CO2 |
| Q 4 | Proportional controller exhibits offset error. Is the statement true? Justify your answer. | 5 | CO3 |

SECTION B (40 marks) Question 8 consist of an internal choice

| | | | |
|-----|---|----|-----|
| Q 5 | Plot the dynamic response for a 2nd Order System . Enumerate the effect of damping ratio (ζ) on the dynamic response of the system. | 10 | CO1 |
| Q 6 | Obtain the mathematical model for a Gas Surge Drum . Also determine the equation at steady-state conditions. | 10 | CO2 |
| Q 7 | Explain the principle of Ratio Control System . Design a ratio controller for a 2-input stream chemical reaction-based process system. | 10 | CO3 |

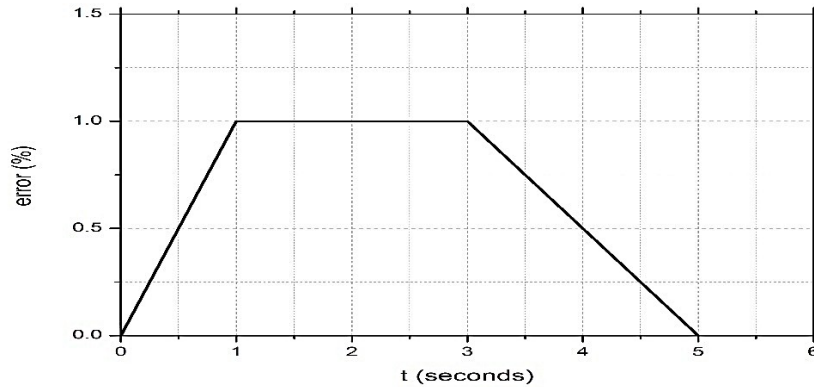
Q 8 For the **Heat Exchanger** system as depicted in figure below: Identify the control loops for controlled variables specified above. Design a **Cascade Control** loops for these controlled variables.



OR

Compute and plot the output for a **PI controller** for the error signal given in figure below:

OR
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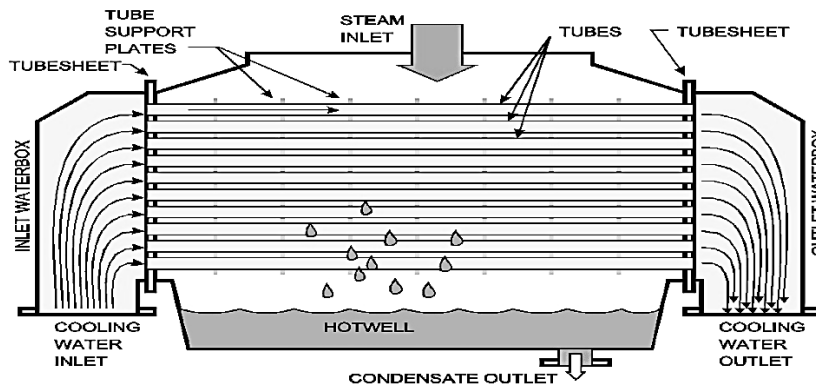


Consider the controller parameters as: $K_p=5, K_I=1.0 \wedge p_1(0)=20\%$

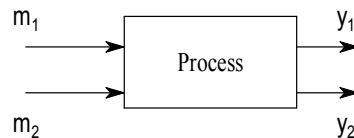
SECTION-C (40 marks) Internal choice available in Question 10

- Q 9 Figure below shows a condenser used in coal based power generation plant. The objective of condenser is to convert the inlet steam into liquid water (obtained at condensate outlet) with the help of coolant (cooling water) circulation.
- A. Design a **Cascade Control Sytem** for the same.
 - B. Design an **Auctioneering Control System** for the same.

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- Q 10 For a MIMO process given in figure below:



Obtain the transfer function for the MIMO model, also draw the block diagram for the same.

OR

- A. For a process with mathematical models unknown for actuator and process, which adaptive control scheme will provide “best” parameter control for the process. Justify your answer and draw the corresponding block diagram.
- B. If in a certain process control application, the controlled variable cannot be measured. Which controller is applicable for such systems; draw the corresponding block diagram.

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OR

10

10

CO3