SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

M.E. Control and Instrumentation Engineering

QUESTION BANK

II SEMESTER

1913201 – ADVANCED PROCESS CONTROL

Regulation – 2019

Academic Year 2019 – 20

Prepared by

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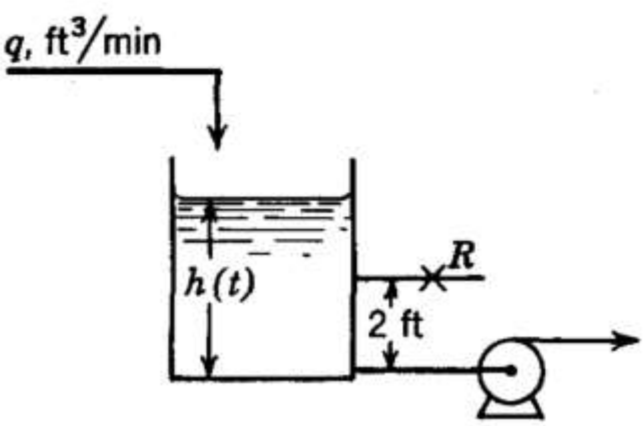
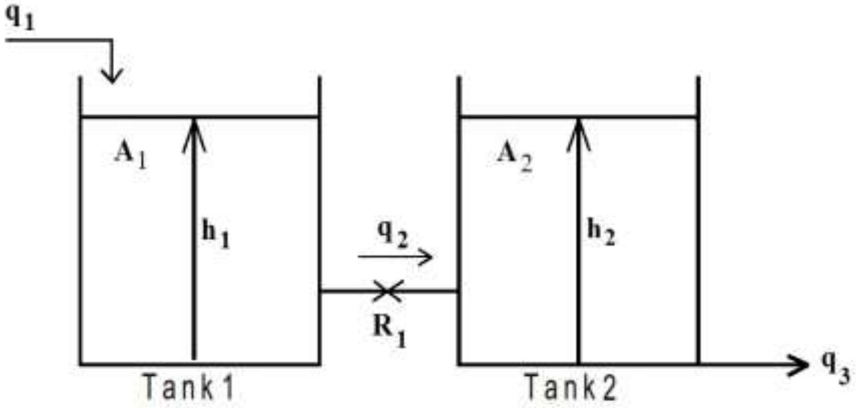
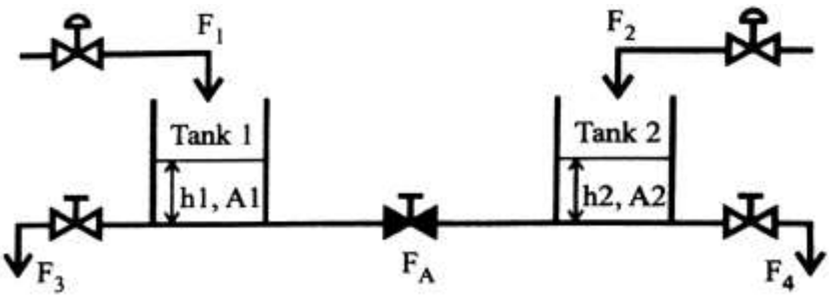
QUESTION BANK

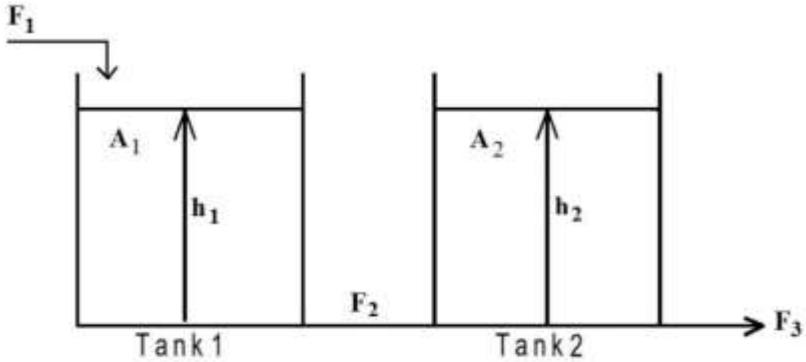
SUBJECT : 1913201 – ADVANCED PROCESS CONTROL

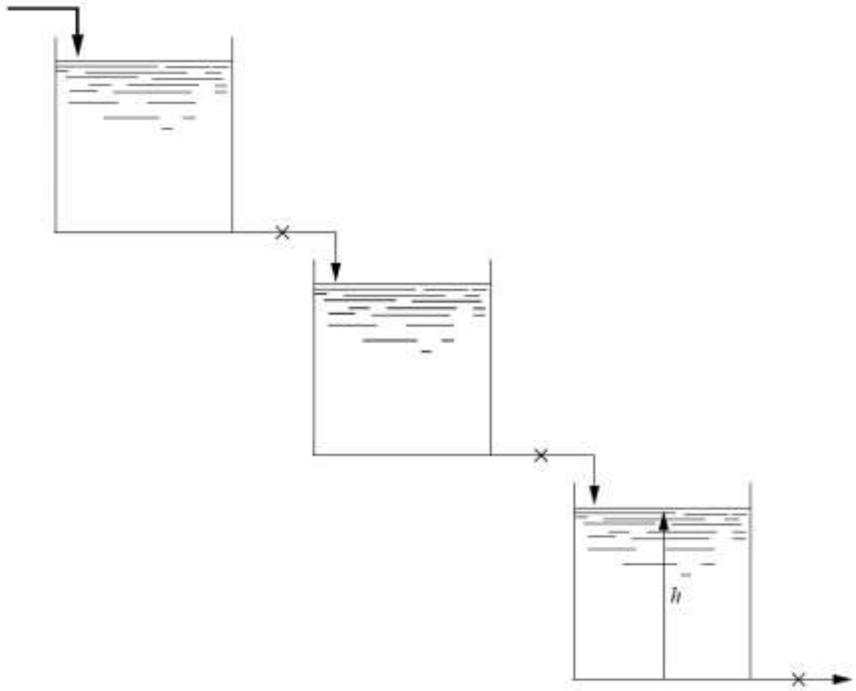
SEM / YEAR : II Semester / I Year M.E. Control and Instrumentation Engineering

UNIT I - PROCESS DYNAMICS & CONTROL ACTIONS			
Need for process control – Hierarchical decomposition of Control Functions – Continuous and batch processes – P&ID diagram - Self regulation - Interacting and noninteracting systems - Mathematical model of Level, Flow and Thermal processes – Lumped and Distributed parameter models – Linearization of nonlinear systems - Characteristic of ON-OFF, P, P+I, P+D and P+I+D control modes – Digital PID algorithm – Auto/manual transfer - Reset windup – Practical forms of PID Controller			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Give any four objectives of process control.	**BTL 2**	Understand
2.	Define process.	**BTL 1**	Remember
3.	Evaluate manipulated variable.	**BTL 5**	Evaluate
4.	Examine self-regulation.	**BTL 3**	Apply
5.	Give the need for mathematical modelling of process.	**BTL 2**	Understand
6.	Name a process giving inverse response.	**BTL 1**	Remember
7.	Define interacting system and give an example.	**BTL 1**	Remember
8.	Examine non self-regulation.	**BTL 3**	Apply
9.	Give any two characteristics of first order process modelling.	**BTL 1**	Remember
10.	Distinguish between continuous process and batch process.	**BTL 2**	Understand
11.	Explain the function of controller.	**BTL 4**	Analyze
12.	Compose the purpose of final control element?	**BTL 6**	Create
13.	.Define Process control.	**BTL 1**	Remember
14.	Classify the types of process control.	**BTL 3**	Apply
15.	Compare Servo operation and Regulatory operation.	**BTL 4**	Analyze
16.	Formulate the mathematical model of thermal process.	**BTL 6**	Create
17.	Define offset.	**BTL 1**	Remember
18.	Define integral (reset) windup?	**BTL 1**	Remember
19.	Point out the significance of Piping and Instrumentation Diagram (P&ID) in control loops?	**BTL 4**	Analyze
20.	Summarize the characteristics of On-Off and PID controllers.	**BTL 5**	Evaluate
PART – B			

1.	Derive the transfer function H(s)/Q(s) for the liquid level system shown below when (a) The tank level operates about the steady-state value of $h_s = 1$ ft. (b) The tank level operates about the steady-state value of $h_s = 3$ ft. The pump removes water at a constant rate of 10 cfm (cubic feet per minute); this rate is independent of head. The cross-sectional area of the tank is 1.0 ft^2 and the resistance R is 0.5 ft/cfm. **(13)** 	**BTL 1**	Remember
2.	Explain servo and regulatory operation with the help of suitable example. Explain with suitable examples, the difference between the interacting and non- interacting Processes. **(13)**	**BTL 1**	Remember
3.	Derive the mathematical model for the given process C_1, C_2 capacitances of the tank I and tank II respectively, h_1, h_2 and A_1, A_2 heights of liquid level and areas of the tanks tank I and tank II respectively, q_1, q_2 inflow and outflow of tank I and q_3 is the outflow of tank II. **(13)** 	**BTL 1**	Remember

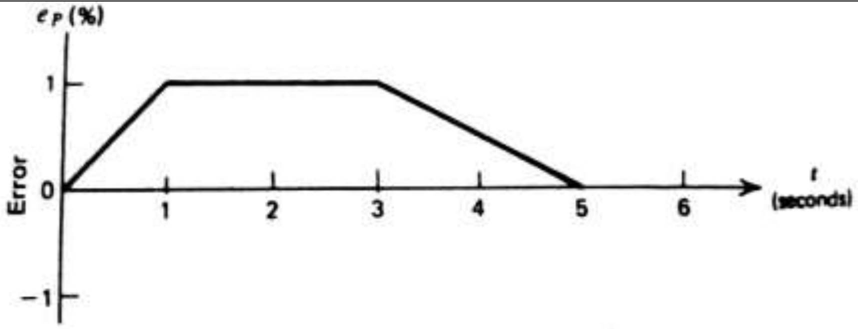
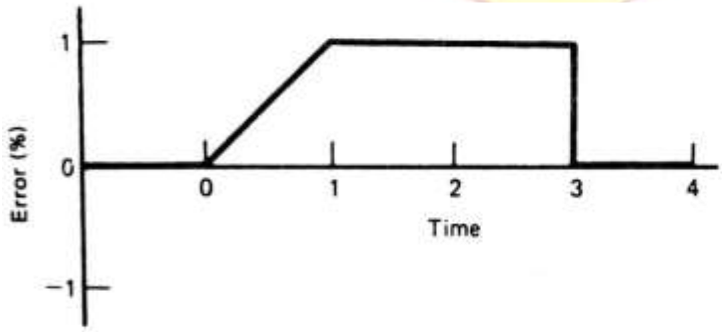
4.	Evaluate the material balance equation for the two tank hybrid system shown below and determines the transfer functions $h_1(s)$ / $F_1(s)$ and $h_2(s)$ / $F_2(s)$ **(13)**  	**BTL 5**	Evaluate
5.	(i) Obtain the difference between Servo and Regulatory operations with the help.(7) (ii) Discuss both operations with suitable examples.**(6)**	**BTL 2**	Understand
6.	Obtain the mathematical model of a process comprising two non-interacting tanks. Assume that the area of cross section of tank 1 is A_1 ft^2 and tank 2 is A_2 ft^2. The inlet flow to tank 1 and tank 2 is F_1 and F_2 ft^3/min respectively and outflow of tank 2 is F_3 ft^3/min. The level of liquid in tank 1 and tank 2 are h_1 and h_2 respectively. **(13)**	**BTL 3**	Apply
7.	(i) For the thermal process, identify the process variables, including the disturbance variable and obtain the degrees of freedom of the process. **(7)** (ii) Obtain the transfer function and State space model for the same. **(6)**	**BTL 3**	Apply
8.	Discuss about continuous and batch process with the help of neat diagram. **(13)**	**BTL 2**	Understand
9.	(i) Describe with neat diagrams the CSTR and its characteristics in detail. **(10)** (ii) Give the applications of CSTR. **(3)**	**BTL 1**	Remember
10.	(i) Explain heat exchanger and the variables associated with a neat sketch. **(7)** (ii) Obtain the transfer function and State space model for the same.	**BTL 4**	Analyze
11.	**(i)** Discuss the need for mathematical modeling. **(3)** **(ii)** Obtain the mathematical model of a first order pneumatic process. **(10)**	**BTL 2** **BTL 3**	Understand Apply

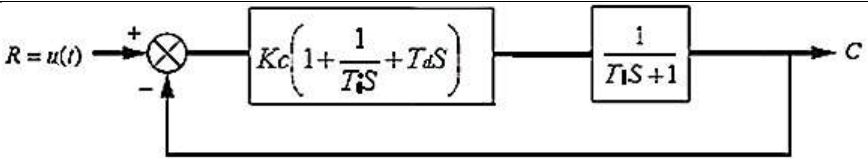
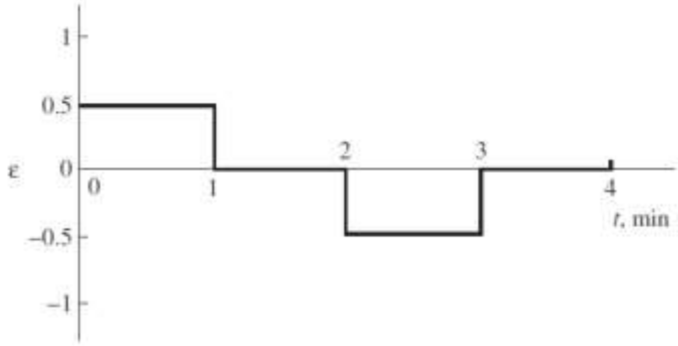
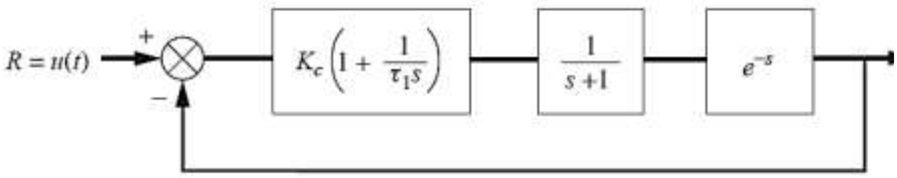
12.	**(i)** Analyze the inverse response noticed in level control of feed water in boiler. **(3)** **(ii)** Explain the self-regulation process with an example. **(10)**	**BTL 4**	Analyze
13.	Develop a mathematical model for the system shown in figure. Assume that the effluent stream from a tank is proportional to the hydrostatic liquid pressure that causes the flow of liquid. Cross-sectional area of tank 1 is A_1 (ft^2) and of tank 2 is A_2(ft^2). The flow rates F_1, F_2, $F_3$are in ft^2/min. take necessary assumptions. **(13)**  	**BTL 6**	Create
14.	Analyze any one method for linearization of non-linear system with example. **(13)**	**BTL 4**	Analyze
	PART-C		
1.	A mercury thermometer having a time constant of 0.1 min is placed in a temperature bath at 100°F and allowed to come to equilibrium with the bath. At time t =0, the temperature of the bath begins to vary sinusoidally about its average temperature of 100°F with an amplitude of 2°F. If the frequency of oscillation is 10 cycles/min, plot the ultimate response of the thermometer reading as a function of time. Analyse the phase lag. **(15)**	**BTL 5**	Evaluate
2.	Three identical tanks are operated in series in a non-interacting fashion as shown in figure. For each tank, R = 1 and t = 1. The deviation in flow rate to the first tank is an impulse function of magnitude 2. **(15)** (*a*) Determine an expression for $H(s)$ where H is the deviation in level in the third tank. (*b*) Sketch the response $H(t)$. (*c*) Design an expression for $H(t)$.	**BTL 5**	Evaluate

			
3.	A PID controller has a proportional gain of **2 %,** reset time of 4 minutes and rate time of 1 minute. At **t = 0** error starts increasing at the rate of **1.5%/min.** Develop the controller output at **t = 2** minutes. The nominal output of the controller is **50%.(15)**	**BTL 5**	Evaluate
4.	Determine the transfer function of a level process in a tank, whose area is **12 m^{2},** liquid level is maintained at **2 m** from the bottom whereas the flow is maintained at **10 m /hr**. Also design capacitance and resistance with reference to this process**(15)**	**BTL 5**	Evaluate

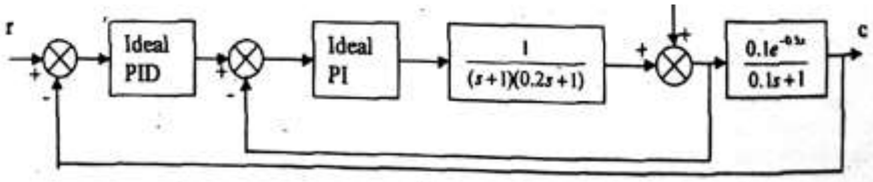
UNIT II - PID CONTROLLER TUNING – SINGLE LOOP REGULATORY CONTROL			
Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning - Process reaction curve method - Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method – optimization methods – Auto tuning.			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Formulate PI controller using Ziegler- Nicolas tuning method.	**BTL 6**	Create
2.	Define controller tuning.	**BTL 1**	Remember
3.	Examine process reaction curve.	**BTL 3**	Apply
4.	Examine the performance criterion used for the selection and tuning of controller.	**BTL 3**	Apply
5.	Define ultimate gain.	**BTL 1**	Remember
6.	Evaluate Time weighted Absolute Error (ITAE) and when to go for it?	**BTL 5**	Evaluate
7.	Analyze the parameters required to design a best controller.	**BTL 4**	Analyze
8.	Show the practical significance of the gain margin.	**BTL 3**	Apply
9.	Analyze the necessary to choose controller settings that satisfy both gain margin and Phase margin.	**BTL 4**	Analyze
10.	Give the satisfactory control for composition process& temperature process.	**BTL 2**	Understand
11.	Define Integral of Time weighted Absolute Error (ITAE)	**BTL 1**	Remember
12.	.Evaluate Integral Square Errors(ISE).	**BTL 5**	Evaluate
13.	Define Integral Absolute Errors (IAE)	**BTL 1**	Remember
14.	.Name the time integral performance criteria measures.	**BTL 1**	Remember
15.	.Define One-quarter decay rati	**BTL 1**	Remember
16.	Give the satisfactory control for gas liquid level process.	**BTL 2**	Understand
17.	Formulate PID controller using Cohen-Coon tuning method.	**BTL 6**	Create
18.	Give the satisfactory control for vapour pressure process.	**BTL 2**	Understand
19.	Analyze the tuning of controller based on quarter – decay ratio.	**BTL 4**	Analyze
20.	Give the satisfactory control for gas pressure process.	**BTL 2**	Understand
PART - B			
1.	Illustrate the process of tuning feedback controller using process reaction curve method. **(13)**	**BTL 2**	Understand

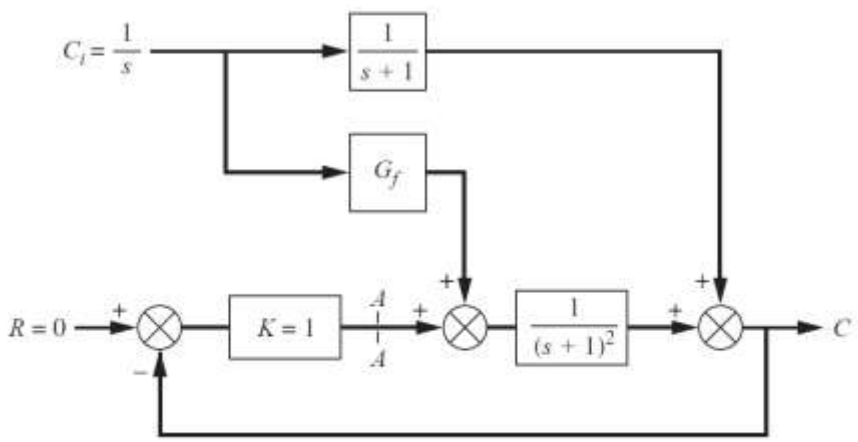
2.	Design an electronic PID controller for the following specifications: Input range: 0 to 4 V; Output range: 0 to 8 V. K_P = 4.2 %/%, K_I = 10 %(%-min), K_D = 0.6 %/ (%/min). The period of the fastest expected change is estimated to be 6 seconds. **(13)**	**BTL 4**	Analyze
3.	A PID controller has a constant input of 1 V. The proportional gain is 2, integral gain is 0.1 sec^{-1} and derivative gain is 0.1 sec. Find the output of the controller for the first 10 secs and sketch its response. **(13)**	**BTL 4**	Analyze
4.	**(i)** What are the drawbacks of process reaction curve method? How to overcome it? **(3)** **(ii)** Describe controller tuning using continuous oscillation technique. **(10)**	**BTL 1**	Remember
5.	Briefly explain the Zeigler-Nicholas closed loop method of controller tuning. **(13)**	**BTL 5**	Evaluate
6.	**(i)** Examine ¼ decay ratio criteria with example. **(7)** **(ii)** Write short notes on time response method of controller tuning. **(3)**	**BTL 3**	Apply
7.	A PI controller has proportional band of 20% and integral time of 10 seconds. For a constant error of 5%. Evaluate the controller output after 10 seconds. The controller offset is 25%. **(13)**	**BTL 1**	Remember
8.	(i) Design a PID controller using Auto tuning. **(6)** (ii) Discuss the Various tuning procedures involved in PID controller .**(7)**	**BTL 6**	Create
9.	Discuss the various tuning procedures when mathematical model of the process is available.**(13)**	**BTL 2**	Understand
10.	Design an electronic PID controller for the following specifications: Input range: 0 to 4 V; Output range: 0 to 8 V. K_P = 4.2 %/%, K_I = 10 %(%-min), K_D = 0.6 %/ (%/min). The period of the fastest expected change is estimated to be 6 seconds. **(13)**	**BTL 1**	Remember
11.	A PID controller has K_P = 5, K_I = 0.7sec^{-1}, K_D = 0.5 sec and $P_I(0)$ = 20%. Plot the controller output for an error input as shown in figure. **(13)**	**BTL 4**	Analyze

			
12.	**(i)** How is ITAE criterion different form IAE? **(3)** **(ii)** In an application of ZN method, a process begins oscillation with a 30% proportional band in an 11.5 min period. Find the nominal three mode controller settings. **(10)**	**BTL 4**	Analyze
13.	**(i)** What do mean by optimum controller setting? **(3)** **(ii)** Given the transfer function of the system C(s)/U(s) =1/6s+1 with 5 sec transportation lag. Find the optimum setting using process reaction curve for (1) P controller **(3)** (2) PI controller **(3)** (3) PID Controller. **(4)**	**BTL 3**	Apply
14.	A PI controller has $K_P = 5$, $K_I = 1 sec^{-1}$ and $P_I(0) = 20\%$. Plot the controller output for an error input as shown in figure. **(13)** 	**BTL 2**	Understand
	PART-C		
1.	The transfer function of the process, valve and the feedback are **$G_p(S) = 2/(5S+1)$, $G_v(S) = 0.5/(2S+1)$**, **$H(S) = 1/(S+1)$** respectively. Design the Zeigler-Nicholas PID controller settings. **(15)**	**BTL 5**	Evaluate
2.	For the system shown in figure evaluate the values of system gain, natural frequency of oscillations and the damping ratio in terms of the controller parameters K_c, T_i, T_d and the time constant T_l. **(15)**	**BTL 5**	Evaluate

			
3.	The input ε to a PI controller is shown in figure. Plot and analyse the output of the controller if Kc = 2 and T_I= 0.50 min. **(15)** 	**BTL 5**	Evaluate
4.	For the control system shown in figure, design the controller settings for a PI controller using the Z-N method. **(15)** 	**BTL 5**	Evaluate

UNIT III - ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL & MODEL BASED CONTROL SCHEMES			
Cascade control – Split-range - Feed-forward control – Ratio control – Inferential control — override control - Smith predictor control scheme - Internal Model Controller - IMC PID controller – Single Loop Dynamic Matrix Control – Generalized Predictive Control			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Identify the input and output variables of distillation column.	**BTL 1**	Remember
2.	What is split-range control?	**BTL 1**	Remember
3.	Develop the logic used for the implementation of ratio control.	**BTL 6**	Create
4.	Discriminate the purpose of cascade control for heat exchangers.	**BTL 5**	Evaluate
5.	What is multi variable control?	**BTL 1**	Remember
6.	Define IMC controller.	**BTL 1**	Remember
7.	Give the advantages of cascade control over conventional control.	**BTL 2**	Understand
8.	Sketch the structure of adaptive control.	**BTL 3**	Apply
9.	Give the use of feed forward controller.	**BTL 2**	Understand
10.	Differentiate split-range control and selective control.	**BTL 4**	Analyze
11.	What is ratio control? Where is it needed?	**BTL 3**	Apply
12.	Draw the split range control block diagram.	**BTL 3**	Apply
13.	Give the advantages and disadvantages of feed forward controller.	**BTL 2**	Understand
14.	What are decouplers?	**BTL 1**	Remember
15.	Differentiate feedback and feedforward controllers.	**BTL 4**	Analyze
16.	How to select secondary controller in a cascade control scheme?	**BTL 4**	Analyze
17.	Why are fuel and air sent at a specified ratio into a combustion chamber?	**BTL 5**	Evaluate
18.	Give the advantages and disadvantages of feedback controller.	**BTL 2**	Understand
19.	Develop the structure of IMC.	**BTL 6**	Create
20.	What is the need for inferential control?	**BTL 1**	Remember
PART - B			
1.	**(i)** What is split range control? Explain a simple application, where it is used?**(7)** **(ii)** Describe the implementation of ratio control for a blending process. **(6)**	**BTL 1**	Remember

2.	Explain the three element control in Boilers. **(13)**	**BTL 5**	Evaluate
3.	Explain dynamic characteristics of a cascade control system. Explain it with an example. When do you recommend such a control system? **(13)**	**BTL 4**	Analyze
4.	Examine inferential control scheme with an example. **(13)**	**BTL 1**	Remember
5.	**(i)** Discuss the control of a distillation column using complex control system. **(10)** **(ii)** Discuss the issues involved in multivariable control. **(3)**	**BTL 2**	Understand
6.	Explain the operation of adaptive control scheme with the help of a neat block diagram. **(13)**	**BTL 4**	Analyze
7.	**(i)** Illustrate Model Predictive control scheme with an example. **(10)** **(ii)** Examine the importance of Internal Model Control in process industries. **(3)**	**BTL 3**	Apply
8.	**(i)** Demonstrate the concept of feed forward control with the aid of block diagram. **(10)** **(ii)** Compare feed-forward controller with feedback controller. **(3)**	**BTL 3**	Apply
9.	**(i)** Examine the control schemes for top and bottom products in binary distillation column. **(10)** **(ii)** List the difficulties involved in controlling multivariable system from distillation column. **(3)**	**BTL 1**	Remember
10.	What are the main advantages and disadvantages of combining two controllers in series? For what kind of processes can you employ that? Explain with neat sketch. **(13)**	**BTL 2**	Understand
11.	An oil furnace is controlled by cascade control system where the inner loop regulates the flow of oil. The inner process is approximated by a first order one having a lag of 2 sec in which loop measurement lag is 0.5 sec. Assuming the lag to be zero and the outer process lag to be 5 sec, obtain the controller parameters for effectively controlling the process. The outer loop measurement lag is zero. Compare the results with the case when the cascade control is not used. **(13)** 	**BTL 6**	Create

12.	Explain the model reference adaptive control with neat sketch and appropriate example. **(13)**	**BTL 4**	Analyze
13.	Develop the estimator expression of inferential control which relates the unmeasured controlled outputs to measured quantities. **(13)**	**BTL 6**	Create
14.	Describe the functions of Internal Model Control with block diagram and appropriate example. **(13)**	**BTL 1**	Remember
	PART-C		
1.	Design a Control system with feedforward and feedback controllers.**(15)**	**BTL 6**	Create
2.	Evaluate *Gf* for the feedforward-feedback system shown in figure, so that *C* does not change when a disturbance in *Ci* occurs. **(15)** 	**BTL 5**	Evaluate
3.	Design a Single Loop and Multi Loop Dynamic Matrix Control for a system considering own example.**(15)**	**BTL 6**	Create
4.	Design an IMC controller for a process which is first-order with transport lag. **(15)** $$G = K\frac{e^{-\tau_d s}}{\tau s + 1}$$	**BTL 6**	Create

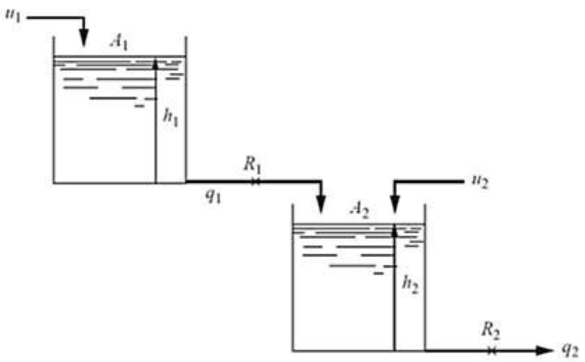
UNIT IV - MULTIVARIABLE SYSTEMS & MULTI-LOOP REGULATORY CONTROL

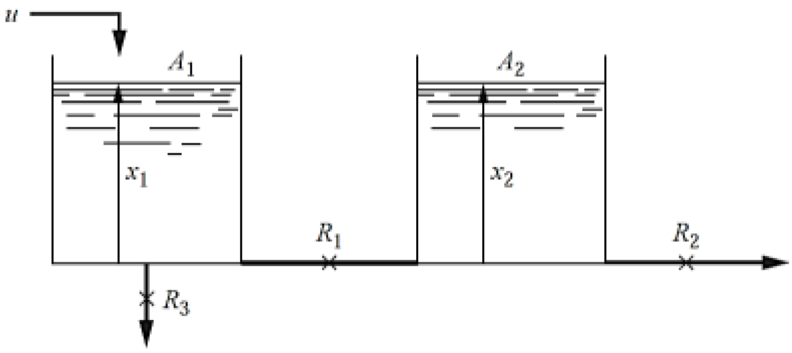
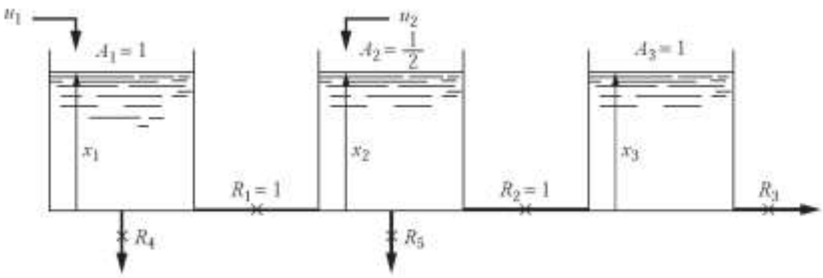
Multivariable Systems – Transfer Matrix Representation – Poles and Zeros of MIMO System - Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs-The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PIDController - Decoupling Control

PART - A

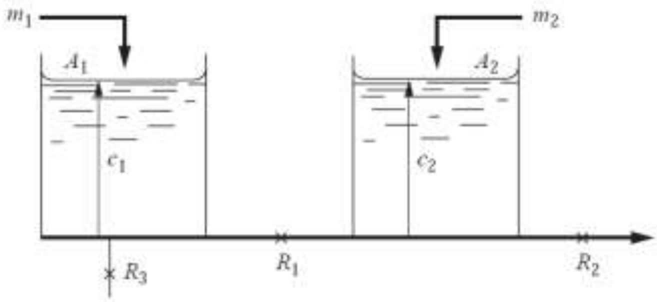
Q.No	Questions	BT Level	Competence
1.	Examine the Poles and Zeros of MIMO System.	BTL 3	Apply
2.	Analyze the need for Transfer Matrix Representation.	BTL 4	Analyze
3.	Evaluate SISO system.	BTL 5	Evaluate
4.	Discuss about multi variable control.	BTL 2	Understand
5.	Evaluate MIMO system.	BTL 5	Evaluate
6.	Define MIMO system.	BTL 1	Remember
7.	Give the properties of RGA.	BTL 2	Understand
8.	Examine how to select the loops with the help of RGA.	BTL 3	Apply
9.	Define RGA.	BTL 1	Remember
10.	List the applications of RGA.	BTL 1	Remember
11.	Give the properties of RGA.	BTL 2	Understand
12.	Examine the Process Interaction.	BTL 3	Apply
13.	Define decoupling control.	BTL 1	Remember
14.	Analyze the need of IMC controller.	BTL 4	Analyze
15.	Develop 2-input&2-output closed loop system with a neat block diagram.	BTL 6	Create
16.	Point out the merits of internal model controller.	BTL 4	Analyze
17.	Discuss about Pairing of Inputs and Outputs.	BTL 2	Understand
18.	Define dynamic matrix control.	BTL 1	Remember
19.	When IMC control is used?	BTL 1	Remember
20.	Develop 2-input&2-output open loop system with a neat block diagram.	BTL 6	Create

PART – B

1.	Calculate poles & zeros for Multi Input Multi Output system with expressions by considering an example. **(13)**	**BTL 3**	Apply
2.	Explain in detail about properties and application of Relative Gain Array for determining the best input-output pairings for multivariable process control systems. **(13)**	**BTL 4**	Analyze
3.	With schematic diagram explain multivariable system optimization in detail. **(13)**	**BTL 4**	Analyze
4.	Describe about Relative Gain Array and selection of loops. **(13)**	**BTL 1**	Remember
5.	Summarize the steps to minimize decoupling in multivariable system. **(13)**	**BTL 2**	Understand
6.	Design a multi loop Proportional Integral Derivative controller with neat diagram. **(13)**	**BTL 6**	Create
7.	Summarize the steps to minimize coupling in multivariable control process. **(13)**	**BTL 2**	Understand
8.	Describe process of interaction and decoupling of control loops**(13)**	**BTL 1**	Remember
9.	Consider a process with the following input-output relationships. Select the loops using RGA method. **(13)**	**BTL 5**	Evaluate
10.	Examine multivariable system using Transfer Matrix Representation. **(13)**	**BTL 1**	Remember
11.	Evaluate the transfer function matrix for the two-tank liquid-level system shown in figure. Given: *A*1=1, *A*2=0.5, *R*1=0.5, R2=2/3 **(13)**  	**BTL 5**	Evaluate
12.	For the system shown in figure, evaluate **A** and **b** in $\dot{\mathbf{x}} = \mathbf{Ax} + \mathbf{bu}$ The tanks are interacting. The following data apply: A1 =1, A2 =1/2, R1=1/2, R2=2, R3=1 **(13)**	**BTL 4**	Analyze

			
13.	Explain about singular value analysis in detail. **(13)**	**BTL 4**	Analyze
14.	Develop a control scheme pertaining to decoupling control system and explain about it with neat sketch. **(13)**	**BTL 6**	Create
	PART-C		
1.	Design **x**(t) for the system. **(15)** $\dot{\mathbf{x}} = \mathbf{Ax} + \mathbf{Bu}$ where $e^{\mathbf{A}t} = \begin{bmatrix} e^{-5t} & -e^{-2t} + e^{-5t} \\ 0 & e^{-2t} \end{bmatrix}$ $\mathbf{x}(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $\mathbf{u}(t) = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$ $\mathbf{B} = \begin{bmatrix} 1 & 2 \\ 0 & -4 \end{bmatrix}$	**BTL 6**	Create
2.	In the liquid-level process shown in figure, the three tanks are interacting. The process may be described by $\dot{x} = \mathbf{Ax} + \mathbf{Bu}$ where $\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ and $\mathbf{u} = \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$  $\mathbf{A} = \begin{bmatrix} 3 & 1 & 0 \\ 2 & -3 & 2 \\ 0 & 1 & -3 \end{bmatrix}$ Evaluate values of R_3, R_4, and R_5 **(15)**	**BTL 5**	Evaluate
3.	Develop multi loop control schemes for an MIMO system considering your own example. **(15)**	**BTL 6**	Create
4.	Discuss about pairing of controlled and manipulated variables in a distillation column. **(15)**	**BTL 5**	Evaluate

UNIT V - CASE –STUDIES			
Introduction to Multivariable control – Multivariable PID Controller –Predictive PID Control - Control Schemes for Distillation Column, CSTR, Four-tank system and pH			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define PH. **(BT-1)**	**BTL-1**	Remember
2.	Give the methods available for PH measurement? **(BT-2)**	**BTL-2**	Understand
3.	Summarize the design procedures followed by Multivariable control.	**BTL-5**	Evaluate
4.	Examine the configuration of the control loop used for Multivariable control. **(BT-3)**	**BTL-3**	Apply
5.	Analyze how PH control systems work for two-position control? **(BT-4)**	**BTL-4**	Analyze
6.	Define CSTR. **(BT-1)**	**BTL-1**	Remember
7.	Point out the significance of predictive controller. **(BT-4)**	**BTL-4**	Analyze
8.	Give the control scheme for predictive control. **(BT-2)**	**BTL-2**	Understand
9.	Design non-interacting control loop. **(BT-6)**	**BTL-6**	
10.	Give the control schemes for distillation column. **(BT-2)**	**BTL-2**	Understand
11.	Define binary distillation column. **(BT-1)**	**BTL-1**	Remember
12.	Name the control schemes for a CSTR process. **(BT-1)**	**BTL-1**	Remember
13.	Give the parameters to be measured and controlled in a distillation column. **(BT-2)**	**BTL-2**	Understand
14.	Examine the manipulated variables used for Multivariable control. **(BT-3)**	**BTL-3**	Apply
15.	Summarize the problems occurs in design of Multivariable control. **(BT-5)**	**BTL-5**	Evaluate
16.	Analyze the control objective of MIMO control systems. **(BT-4)**	**BTL-4**	Analyze
17.	Examine the outputs measured for system MIMO control. **(BT-3)**	**BTL-3**	Apply
18.	Develop the structure of a generalized predictive controller. **(BT-6)**	**BTL-6**	Create
19.	Define predictive control. **(BT-1)**	**BTL-1**	Remember
20.	List the control schemes for binary distillation column. **(BT-1)**	**BTL-1**	Remember

	PART – B		
1.	Evaluate the use of binary distillation column with schematic diagram. **(13)**	**BTL-5**	Evaluate
2.	Describe the predictions for MIMO models. **(13)**	**BTL-1**	Remember
3.	Summarize the various control schemes used in multi variable systems. **(13)**	**BTL-2**	Understand
4.	Describe multi variable PID controller in detail. **(13)**	**BTL-1**	Remember
5.	Summarize various control schemes used for the control for binary distillation column. **(13)**	**BTL-2**	Understand
6.	Design interacting and non-interacting control loops. **(13)**	**BTL-6**	Create
7.	Classify various control schemes used for PH measurement. **(13)**	**BTL-3**	Apply
8.	Illustrate the various control schemes used for four tank system. **(13)**	**BTL-4**	Analyze
9.	Describe predictive PID control with neat diagram. **(13)**	**BTL-1**	Remember
10.	Explain about various control schemes used for CSTR. **(13)**	**BTL-4**	Analyze
11.	For the two-tank, interacting liquid-level system shown in figure, create the block diagram for a MIMO system. **(13)**  $A_1 = 1, A_2 = \frac{1}{2}, R_1 = \frac{1}{2}, R_2 = 2, R_3 = 1.$	**BTL-6**	Create
12.	Analyze the extensions of the basic MPC model formulation. **(13)**	**BTL-4**	Analyze
13.	Design a MIMO system for two pairs of inputs and outputs**(13)**	**BTL-6**	Create
14.	With flowchart explain steps involved in MPC calculations. **(13)**	**BTL-4**	Analyze
	PART-C		
1.	Discuss about unconstrained MPC in detail. **(15)**	**BTL-5**	Evaluate

2.	Design a multi loop control system with two primary controllers and two cross controllers. **(15)**	**BTL-6**	Create
3.	Discuss about the predictions for MIMO models. **(15)**	**BTL-5**	Evaluate
4.	Design the four-tank system, and derive its overall transfer function. **(15)**	**BTL-6**	Create