SRM VALLIAMMAI ENGINEERING COLLEGE

An Autonomous Institution
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF
ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

VI SEMESTER

1907602 – PROCESS CONTROL

Regulation – 2019

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Department of Electronics and Instrumentation Engineering

SUBJECT: 1907602 PROCESS CONTROL
SEM / YEAR: VI / III

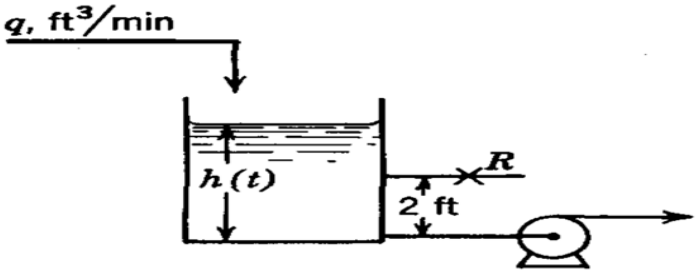
UNIT I - PROCESS MODELLING AND DYNAMICS

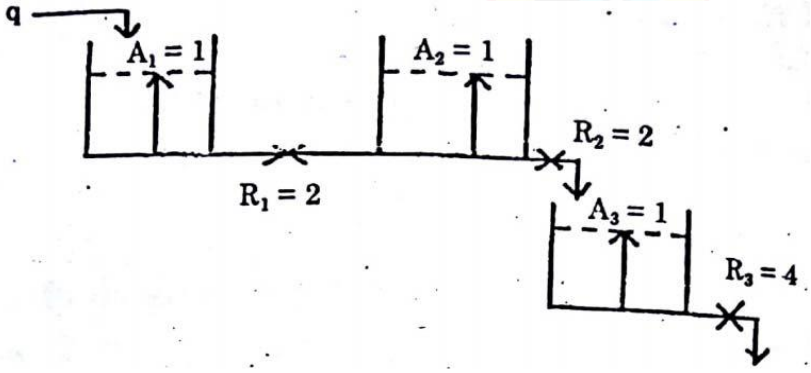
SYLLABUS

Need for process control – Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR –Linearization of nonlinear systems.

PART –A

Q.No	Questions	BT Level	Competence
1.	What is the need for mathematical model.	BTL 1	Remember
2.	Write the mathematical model representation of pressure process.	BTL 1	Remember
3.	Compare Continuous process and Batch process.	BTL 1	Remember
4.	Obtain the mathematical model of first order Thermal process system.	BTL 3	Apply
5.	Examine the need for servo operation.	BTL 1	Remember
6.	A self-regulatory system does not require a controller. True/False. Justify the answer.	BTL 4	Analyse
7.	Define controlled variable, manipulated variable and load variable in process control.	BTL 1	Remember
8.	Any process can exhibit self-regulation, Yes/No. Justify.	BTL 2	Understand
9.	What are the input and output variable for continuous and batch process?	BTL 3	Apply
10.	Compare interacting and non-interacting systems.	BTL 5	Evaluate
11.	A thermometer having a time constant of 1 min and is initially at 500C. it is immersed in a bath and maintained at 1000C at t = 0. Determine the temperature reading at t = 1.2 min.	BTL 4	Analyse
12.	List down key objectives of process control.	BTL 6	Create
13.	Write the list of control variables in Heat Exchanger and CSTR.	BTL 5	Evaluate
14.	What is non-self-regulation? Give an example.	BTL 2	Understand
15.	Define degrees of freedom.	BTL 1	Remember
16.	Differentiate servo and regulatory operations with example.	BTL 2	Understand
17.	How lumped and distributed systems are developed?	BTL 4	Analyse
18.	A tank operating at 10 ft head, 5 lpm outflow through a valve and has a cross section area of 10 sq. ft. Evaluate the time constant (τ).	BTL 6	Create
19.	Illustrate the steps involved in linearizing the nonlinear systems.	BTL 3	Apply
20.	Sketch the Heat exchanger feedback control.	BTL 2	Understand
21.	What are the four types of nonlinear functions?	BTL 2	Understand
22.	Illustrate the different methods employed in the linearization of nonlinear system.	BTL 3	Apply
23.	Define process variable.	BTL 5	Evaluate
24.	Compare controlled variable with manipulated variable.	BTL 4	Analyse

PART – B				
1.	**(i)**	Describe a simple thermal system in which incoming liquid is heated by the heater in the tank and going out with higher temperature. **(7)**	BTL 1	Remember
	(ii)	Develop first order transfer function of the thermal process. **(6)**		
2.	Discuss the laws, languages, and levels of process control and Obtain the mathematical model of a Flow process. **(13)**		BTL 5	Evaluate
3.	**(i)**	Differentiate servo and regulatory operation with the help of suitable example. **(7)**	BTL 2	Understand
	(ii)	Explain with suitable examples, the difference between the interacting and non- interacting Processes. **(6)**		
4.	**(i)**	Obtain the mathematical model of first order thermal process. **(7)**	BTL 2	Understand
	(ii)	For the above thermal process, identify the process variables, including the disturbance variable and obtain the degrees of freedom of the process. **(6)**		
5.	**(i)**	Explain the need for mathematical modeling. **(7)**	BTL 1	Remember
	(ii)	Obtain the mathematical model of a first order pneumatic process. **(6)**		
6.	**(i)**	Difference between the continuous and batch process with the help of neat diagrams. **(7)**	BTL 2	Understand
	(ii)	List the merits and demerits of the continuous and batch process. **(6)**		
7.	Derive the transfer function H(s)/Q(s) for the liquid level system shown below when **(13)** (a) The tank level operates about the steady-state value of hs =1 ft. (b) The tank level operates about the steady-state value of hs =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 ft2 and the resistance R is 0.5 ft/cfm. 		BTL 3	Apply
8.	**(i)**	Give examples for processes that exhibit self-regulation. **(7)**	BTL 4	Analyse
	(ii)	Show that a process is not self-regulating by considering its response to a step change in inlet flow rate. **(6)**		
9.	Define self-regulation. Give an example of a self-regulated process. **(13)**		BTL 3	Apply
10.	A tank operating at 3m head, 5 lpm outflow through a valve and has a cross sectional area of $2m^2$, calculate the time constant. **(13)**		BTL 3	Apply
11.	The flow rate through an exit pipe F_0 in m^3/sec is given by relation $F_0 = 0.6\sqrt{h}$ where h is the tank level in meter. Find time constant τ_p for the steady state levels of 2m and 5m cross sectional area of the tank A is $2m^2$. **(13)**		BTL 5	Evaluate

12.	A temperature having a time constant of 0.5 min is placed in a temperature bath and after thermometer is placed in the temperature bath the temperature comes to equilibrium the temperature of the bath Ti increased linearly at the rate of 10 C/ min. what is the difference between the indicated and bath temperature. **a**. 0.25 min after the changes in temperature begins. **(4)** **b**. 3 min after the changes in temperature begins. **(3)** **c**. What is the maximum deviation between the indicated and bath temperature and when does it occur. **(3)** **d**. Flow many minutes does the response lag after long enough time is elapsed? **(3)**		BTL 6	Create
13.	**(i)**	Explain heat exchanger with a neat sketch. **(7)**	BTL 1	Remember
	(ii)	Discuss on the functional and instrumentation diagram of Heat Exchanger. **(6)**		
14.	**(i)**	Explain the operation of CSTR with its characteristic curve and governing variables. **(7)**	BTL 1	Remember
	(ii)	Compare lumped and distributed systems. **(6)**		
15.	Mathematically derive servo and regulatory operation with an example for each. **(13)**		BTL 4	Analyse
16.	**(i)**	How would linearization of nonlinear system obtained in process dynamics. **(7)**	BTL 4	Analyse
	(ii)	List the nonlinearities and explain with i/o diagrams **(6)**		
17.	Explain the need of process control in process industries. **(13)**		BTL 2	Understand
	PART – C			
1.	Find the transfer function for the three tank system below. **(15)** 		BTL-5	Evaluate
2.	**(i)**	Explain the method for linearization of non-linear system with one variable. **(8)**	BTL-6	Create
	(ii)	Explain the same with many variables. **(7)**		
3.	**(i)**	With an example for each, explaIn the process and objective for continuous and batch process with the help of neat diagram. **(8)**	BTL-5	Evaluate
	(ii)	Obtain the mathematical model of tubular heat exchanger. **(7)**		
4.	**(i)**	Develop the mathematical CSTR. **(8)**	BTL-6	Create
	(ii)	Explain the CSTR with cooling socket and explain the control scheme. **(7)**		
5.	Obtain the step response of Non-interacting Multicapacity process control system. **(15)**		BTL-6	Create

UNIT II - FINAL CONTROL ELEMENTS

SYLLABUS

Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection

PART – A

Q.No.	Questions	BT Level	Competence
1.	Point out the function of Pneumatic control valve in a flow control system.	BTL 6	Create
2.	Give the functions of an actuator and list different types of actuators.	BTL 2	Understand
3.	Mention the use of electrical actuators.	BTL 1	Remember
4.	Compare pneumatic and electric actuators.	BTL 6	Create
5.	Mention the functions of valve positioner.	BTL 1	Remember
6.	State the need of valve positioner.	BTL 3	Apply
7.	Discuss “quick opening” control valve.	BTL 5	Evaluate
8.	Why an equal percentage valve is called as “equal percentage” valve?	BTL 4	Analyze
9.	Analyze why equal percentage valve is mostly used in process industries?	BTL 4	Analyze
10.	Why installed characteristics of a control valve is different from inherent characteristics?	BTL 3	Apply
11.	Draw the inherent valve characteristics of an equal percentage valve.	BTL 1	Remember
12.	Define Control Valve sizing.	BTL 2	Understand
13.	Summarize the factors to be considered in control valve sizing.	BTL 1	Remember
14.	What is range ability of a control valves?	BTL 1	Remember
15.	A valve with a C_V rating of 4.0 is used to throttle the flow of glycerine for which G = 1.26. Develop the maximum flow rate through the valve for a pressure drop of 100 psi.	BTL 1	Remember
16.	Design the size coefficient of a fully open 3 inch valve has flow rate of water is 150gpm, at a differential pressure of 6 PSI.	BTL 2	Understand
17.	What is ISA S 75.01 standard?	BTL 3	Apply
18.	Which is not covered in ISA S 75.01 standard?	BTL 3	Apply
19.	Differentiate flashing and cavitation in a control valve.	BTL 5	Evaluate
20.	Classify the different types of process parameters to be considered in selection of control valves.	BTL 4	Analyze
21.	List the parts present in basic block diagram of a process control loop.	BTL 2	Understand
22.	What are the two types of converters that are important for Final Control Elements present in process control?	BTL 3	Apply
23.	Summarize the types of seat plug in final control element.	BTL 5	Evaluate
24.	Classify the control valve based on the flow characteristics and rotor shaft.	BTL 4	Analyze

PART – B

1.	**(i)**	When and when not to use positioner. Comment it. **(7)**	BTL 1	Remember
	(ii)	Positioner is a very sensitively tuned, proportional-only controller. Justify. **(6)**		
2.	With a neat diagram explain control valve positioner and its types. Explain any one type. **(13)**		BLT-2	Understand

3.	Write a short note on			
	(i)	Spring and diaphragm motor with positioned. **(7)**	BLT-2	Understand
	(ii)	Spring less diaphragm actuator. **(6)**		
4.	Explain the diaphragm actuator with neat diagram and also give its steady state force balance equation. **(13)**		BTL 1	Remember
5.	Explain about **(a)** Double acting piston actuator. **(7)** **(b)** Rotary actuator **(6)**		BLT-2	Understand
6.	Write short notes on **(i)** Cavitation's and Flashing **(7)** **(ii)** I/P converter **(6)**		BLT-4	Analyse
7.	**(i)**	Explain the basic types of valves. Elaborate the selection of valves for different applications. **(7)**	BTL-2	Understand
	(ii)	Explain the inherent and installed characteristics of valves. **(6)**		
8.	When are single seated and double seated valves used? List and compare their advantages and disadvantages. **(13)**		BLT-4	Apply
9.	Write down the flow equation of an equal percentage valve and sketch its inherent valve characteristics. **(13)**		BLT-3	Apply
10.	Why installed characteristics of a control valve are different from inherent characteristics? **(13)**		BLT-4	Analyse
11.	Explain about Pneumatic actuators and its classification with a neat diagram. **(13)**		BTL-5	Evaluate
12.	Explain about Electro-Pneumatic Force balance type valve positioner with a neat schematic diagram. **(13)**		BLT-3	Apply
13.	**(i)**	Explain about effective valve characteristics with necessary diagram. **(7)**	BLT-2	Understand
	(ii)	Write the benefits of an equal percentage valve. **(6)**		
14.	Analyze why is equal % valve mostly used in process industries? **(13)**		BLT-4	Analyse
15.	With a neat diagram, explain the functioning of a valve positioner. What are the advantages of using the same? **(13)**		BLT-2	Understand
16.	**(i)**	With necessary diagram, analyze the characteristics of a control valve. **(7)**	BLT-3	Apply
	(ii)	List the steps to be followed for control valve sizing. **(6)**		
17.	**(i)**	What is the need of I/P converter in a control system? **(7)**	BLT-2	Understand
	(ii)	Classify and explain the different types of process parameters to be considered in selection of control Valves. **(6)**		
PART – C				
1.	**(i)**	Explain the operation of spring actuator without positioner also give its steady state force balance equation. **(7)**	BTL-5	Evaluate
	(ii)	Comment on Inertia force, Static friction force and Thrust force for the above. **(8)**		
2.	Explain the functioning of a signal conditioning circuit with a neat diagram. What is cavitation and flashing in control valves? How to avoid it? **(15)**		BTL 6	Create
3.	Evaluate about "quick opening" and "equal percentage" control valve. **(15)**		BTL 5	Evaluate
4.	Describe the function of an actuator. What are the different types of actuators? **(15)**		BTL 6	Create

5.	Tabulate the different types of control valves with their symbolic representation and its application. **(15)**	BTL-5	Evaluate

UNIT III - CONTROL ACTIONS

SYLLABUS

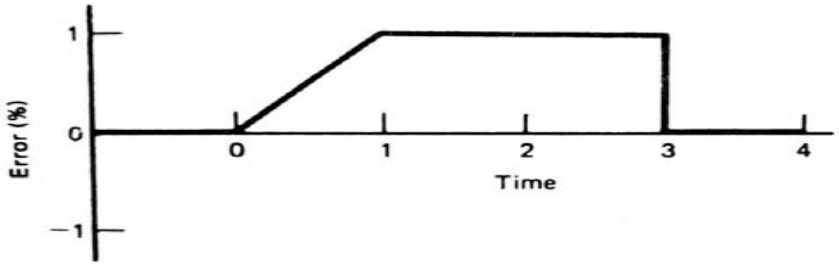
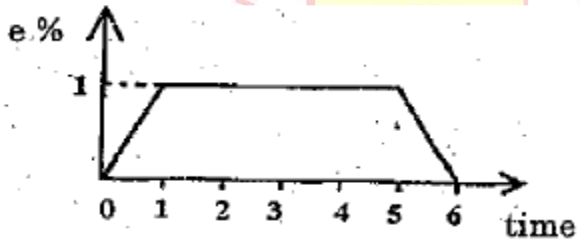
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action

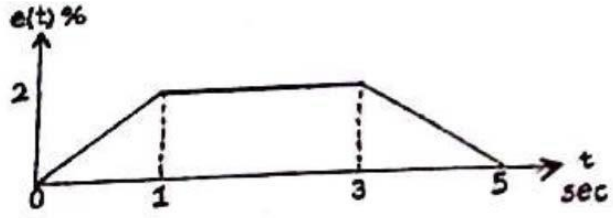
PART – A

Q.No.	Questions	BT Level	Competence
1.	What is the general guideline for specifying the controller action as direct/reverse?	BTL 5	Evaluate
2.	Examine about single speed floating control.	BTL 5	Evaluate
3.	What is meant by Neutral Zone in ON-OFF controller?	BTL 4	Analyse
4.	Develop the open loop response of an inverse response process when excited with unit step Input.	BTL 3	Apply
5.	Justify the need for auto/ manual transfer in Industrial PID controller.	BTL 6	Create
6.	Define differential gap and its need to be presented in a process.	BTL 1	Remember
7.	List the basic control actions in process control	BTL 1	Remember
8.	Write down the limitations of ON/OFF controller.	BTL 2	Understand
9.	Conclude why derivative mode of control is not recommended for a noisy process?	BTL 1	Remember
10.	What is the importance of bias term in a controller?	BTL 2	Understand
11.	What is the need for integral action in P.I controller?	BTL 2	Understand
12.	What is meant by proportional band?	BTL 3	Apply
13.	Define reset time.	BTL 6	Create
14.	Derivative controls cannot be used alone. Justify your answer.	BTL 1	Remember
15.	Distinguish between PI controller and P controller.	BTL 4	Analyse
16.	Discuss integral windup and Anti reset windup.	BTL 1	Remember
17.	Illustrate auto/ manual transfer in controller	BTL 1	Remember
18.	Illustrate the two forms of PID algorithms.	BTL 2	Understand
19.	List the various types of Anti reset windup techniques.	BTL 4	Analyse
20.	Compare P, l and D controller.	BTL 3	Apply
21.	Compare Analog Controller with Digital Controller.	BTL 4	Analyse
22.	Classify the controller types based on mode of operation.	BTL 2	Understand
23.	Classify the controller types based on the principle of operation.	BLT-5	Evaluate
24.	What is meant by error and how its related to process?	BTL 3	Apply

PART – B

1.	Discuss the working of electronic PID controller with neat diagram. **(13)**	BLT-5	Evaluate
2.	Examine when an on-off controller is recommended? How its performance affected by process dead time. **(13)**	BLT-6	Create
3.	Discuss about the characteristics of on-off control and the effect of differential gap of ON-OFF controller. **(13)**	BLT-1	Remember

4.		With neat schematic diagram describe the single speed floating control mode. **(13)**	BLT-1	Remember
5.		Compare the features of ON & OFF, P, I, D control modes and draw their characteristics. **(13)**	BLT-4	Analyse
6.		A PI controller has KP = 5, KI = 1 sec-1 and PI(0) = 20%. Plot the controller output for an error input as shown below. **(13)** 	BLT-4	Apply
7.		Obtain and comment on the response of P, PI, PID controller for a step change in input. **(13)**	BLT-3	Apply
8.		Compare the practical forms of Proportional, Integral and Derivative controllers available commercially. **(13)**	BLT-4	Analyse
9.	**(i)**	How to avoid reset windup. **(7)**	BLT-1	Remember
	(ii)	Explain why derivative and integral control is not separately recommended for any application. **(6)**		
10.		Sketch the PID controller output for the given error signal shown in the following figure. Given that KP = 5, KI = 0.7s-1, KD = 0.5 sec and PI(0) = 20%. **(13)** 	BLT-2	Understand
11.		A PI controller has proportional band of 20% and integral time of 10seconds. For a constant error of 5%. Evaluate the controller output after 10 seconds. The controller offset is 25%. **(13)**	BLT-4	Analyse
12.	**(i)**	Calculate the r1 and r2 values for an electronic P-controller with a proportional gain 5. **(7)**	BLT-3	Apply
	(ii)	Summarize the advantages and disadvantages of PI control. **(6)**		
13.		Discuss the need and benefit of each mode of composite PID controller with suitable illustration. **(13)**	BLT-2	Understand
14.		Explain the general parameters of a controller. **(13)**	BLT-3	Apply
15.	**(i)**	How to avoid bump less transfer and reset windup? **(6)**	BLT-2	Understand
	(ii)	Explain about the characteristics of two position control. **(7)**		
16.		Explain Reset action mode and anticipatory control mode in detail. **(13)**	BTL-5	Evaluate
17.	**(i)**	Discuss the need and benefits of each mode of composite PID controller with suitable illustration. **(7)**	BLT-2	Understand
	(ii)	Why is the electronic controller preferred to pneumatic controller? **(6)**		
PART – C				
1.	**(i)**	Obtain the response of P,I,D controller for a step change in input. **(11)**	BTL-5	Evaluate
	(ii)	Apply the Proportional controller for the system having changes in		

		Load. **(4)**		
2.	**(i)**	Explain the parallel-practical forms of PID controller. **(7)**	BTL-6	Create
	(ii)	Tabulate the key characteristics of commercial PID Controllers. **(8)**		
3.	Draw the plot of PID controller output for the following error pattern. (K_p =5. τ_I = 1 sec and τ_D= 0.5 sec and $P_S(0)$ = 10%). **(15)** 		BTL-5	Evaluate
4.	Compare Pneumatic Controller with Electronic Controller with a neat schematic diagram. **(15)**		BTL-5	Evaluate
5.	Explain the		BTL-6	Create
	(i)	Combined Approach of Anti-reset windup Techniques. **(10)**		
	(ii)	Automatic Reset Implementation. **(5)**		

UNIT IV - PID CONTROLLER TUNING

SYLLABUS

PID Controller Design Specifications**:** Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning**:** Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control

PART-A

Q.No	Questions	BT Level	Competence
1.	Assess the use of evaluation criteria in controller tuning.	BTL 5	Evaluate
2.	Name any two performance criteria.	BTL 1	Remember
3.	Distinguish between IAE and ISE.	BTL 2	Understand
4.	What is ITAE and when it is needed?	BTL 1	Remember
5.	Define the terms ISE and ITAE.	BTL 1	Remember
6.	Define One-quarter decay ratio.	BTL 1	Remember
7.	Write the formula for IAE and ISE.	BTL 1	Remember
8.	Analyze the need for controller tuning.	BTL 3	Apply
9.	State the Zeigler Nichols closed loop tuning formula.	BTL 4	Analyze
10.	Formulate the tuning criteria for continuous cycling method.	BTL 2	Understand
11.	Formulate the Cohen Coon controller settings for PID controller.	BTL 6	Create
12.	Write the tuning criteria for Damped Oscillation method.	BTL 6	Create
13.	Why is it necessary to choose controller settings that satisfy both gain margin and phase margin? Justify.	BTL 3	Apply
14.	Define auto tuning.	BTL 4	Analyze
15.	How secondary controller selection is made in cascade control scheme?	BTL 4	Analyze
16.	List the advantages of cascade control over conventional control.	BTL 2	Understand
17.	Give the advantages and disadvantages of cascade controller.	BTL 3	Apply
18.	Distinguish between Z-N and C-C methods of tuning.	BTL 2	Understand
19.	Differentiate feedback and feed forward controllers.	BTL 5	Evaluate
20.	List the advantages and disadvantages of feed forward control.	BTL 1	Remember

21.		Define performance indexes of a controller tuning.	BTL 4	Analyze
22.		What is meant by ON-Line tuning?	BTL 2	Understand
23.		Explain OFF-line tuning.	BTL 3	Apply
24.		State the Process Gain of the Controller.	BTL 5	Evaluate
		PART – B		
1.		How Controllers are tuned based on frequency response methods? **(13)**	BTL 4	Analyze
2.	**(i)**	Enumerate Integral of Time weighted Absolute Error for a simple system. **(7)**	BTL 1	Remember
	(ii)	Describe open loop transient response method of tuning. **(6)**		
3.		Illustrate the process of tuning feedback controller using process reaction curve method. **(13)**	BTL 4	Analyze
4.		Examine briefly Quater (¼) decay ratio criteria with example. **(13)**	BTL 3	Apply
5.	**(i)**	What are the drawbacks of process reaction curve method? How to overcome it? **(7)**	BTL 1	Remember
	(ii)	Describe controller tuning using continuous oscillation technique. **(6)**		
6.		Design and describe the process reaction curve method and explain how to arrive at optimum controller setting for P, PI and PID controllers using any one tuning criteria. **(13)**	BTL 6	Create
7.		Explain Integral of Square Error and Integral of Absolute Error. **(13)**	BTL 5	Evaluate
8.		Briefly explain the Zeigler-Nicholas closed loop method of controller tuning. **(13)**	BTL 5	Evaluate
9.		Discuss in detail the optimization methods for tuning a controller. **(13)**	BTL 2	Understand
10.		Explain how is ITAE criterion different form Integral of Absolute Error? **(13)**	BTL 4	Analyze
11.		Compare feed-forward controller with feedback controller. Also bring out its merits and demerits. **(13)**	BTL 3	Apply
12.	**(i)**	Discuss in detail about damped oscillation method. **(7)**	BTL 2	Understand
	(ii)	Explain the basis of selection of type of controller for various processes. **(6)**		
13.		Explain the cascade control scheme with a typical example and also explain when to use cascade control? **(13)**	BTL 2	Understand
14.	**(i)**	With block diagram, illustrate the superior performance of cascade control over single loop feedback control. **(7)**	BTL 3	Apply
	(ii)	Identify typical loops in distillation column that demands cascade control **(6)**		
15.		Discuss the procedure for setting controller parameters by using frequency response method. **(13)**	BTL 1	Remember
16.	**(i)**	Explain the auto tuning method with block diagram. **(6)**	BTL 1	Remember
	(ii)	Discuss the general guidelines for tuning the controller. **(7)**		
17.	**(i)**	Briefly explain about Controller tuning evaluation criteria. **(7)**	BTL 2	Understand
	(ii)	Explain about time response method of controller tuning with appropriate graph and example. **(6)**		
		PART-C		
1.	**(i)**	How the evaluation criteria is selected for a particular application. **(6)**	BTL-5	Evaluate

	(ii)	State and explain open loop tuning method with necessary diagram and equations. **(9)**		
2.	**(i)**	Write the design procedure for tuning of controller with Cohen coon parameters. **(8)**	BTL-6	Create
	(ii)	Summarize the Damped oscillation tuning method. **(7)**		
3.	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. **(15)**		BTL 5	Evaluate
4.	Develop the mathematical model of feed forward controller and explain its operation with neat diagrams. **(15)**		BTL 6	Create
5.	Compare the various Time Integral Performance criteria for a single order system and conclude the best result. **(15)**		BTL 6	Create

UNIT V - MULTIVARIABLE REGULATORY CONTROL

SYLLABUS

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three-element. Boiler drum level control - Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger - P&ID diagram.

PART – A

Q.No	Questions	BT Level	Competence
1.	Summarize the final Smith Predictor Control system diagram.	BTL 2	Understand
2.	Examine the role of boiler control.	BTL 5	Evaluate
3.	Point out the advantages of IMC.	BTL 4	Analyze
4.	Differentiate the advantage of three element control with single element control.	BTL 3	Apply
5.	List the major elements in IMC PID controller.	BTL 2	Understand
6.	Give the advantages and disadvantages of three element boiler drum level control.	BTL 2	Understand
7.	Why Smith Predictor Control scheme is recommended for dead time process?	BTL 4	Analyze
8.	What is dead time compensation?	BTL 1	Remember
9.	Write the need for the multi loop control.	BTL 6	Create
10.	Analyse the control objective of implementing feedback controllers in heat exchanger.	BTL 4	Analyze
11.	Draw any of the control scheme block diagram of CSTR.	BTL 3	Apply
12.	What is integrated approach?	BTL 1	Remember
13.	Identify the obvious advantages of introducing control schemes.	BTL 1	Remember
14.	Define IMC controller and multi variable control.	BTL 1	Remember
15.	Draw the general block diagram of Cascade Control system.	BTL 2	Understand
16.	Differentiate feed forward control system with feed back control system.	BTL 5	Evaluate
17.	Neatly sketch the feed forward control system for a heat exchanger.	BTL 4	Analyze
18.	Draw the block diagram of fuel air ratio control system for boilers.	BTL 3	Apply
19.	How the control of chemical reactors be achieved?	BTL 6	Create
20.	What is the purpose of cascade control for heat exchangers?	BTL 1	Remember

21.	Summarize the importance of model predictive controller.		BTL 5	Evaluate
22.	What is the need for adaptive control?		BTL 1	Remember
23.	Sketch any four P and ID symbols of valves.		BTL 3	Apply
24.	Give the importance of P&ID diagram.		BTL 2	Understand
	PART B			
1.	Explain the design procedure of IMC. **(13)**		BTL 1	Remember
2.	Discuss briefly and explain the Smith algorithm for dead time compensation of a process. **(13)**		BTL 3	Apply
3.	Discuss with necessary diagram a multi loop control process using distillation column. **(13)**		BTL 2	Understand
4.	Explain Feedforward -Feedback control with suitable example in CSTR process. **(13)**		BTL 5	Evaluate
5.	Explain the use of cascade and feed-forward control strategy for distillation column feed control. **(13)**		BTL 1	Remember
6.	What is IMC PID controller? Explain with a simple application, where it is used? **(13)**		BTL 1	Remember
7.	Explain how dead time compensation with feedback achieved by predictive algorithm? **(13)**		BTL 4	Analyze
8.	Discuss the effect of inverse of the process model control scheme. **(13)**		BTL 2	Understand
9.	Develop two element and three element drum level control with suitable diagrams. **(13)**		BTL 6	Create
10.	**(i)**	Discuss the dynamics of a Heat Exchanger. **(7)**	BTL 3	Apply
	(ii)	Examine the importance of Internal Model Control in process industries. **(6)**		
11.	**(i)**	How Internal Model Control is developed? **(7)**	BTL 2	Understand
	(ii)	Discuss the challenges involved in multiloop control. **(5)**		
12.	**(i)**	Enumerate various measured variables, control variables and signal used in a typical heat exchanger. **(7)**	BTL 4	Analyze
	(ii)	Elaborate the method to reduce measurement lag in a heat exchanger. **(6)**		
13.	Draw and explain the Piping and Instrumentation diagram for a Boiler. **(13)**		BTL 2	Understand
14.	What is multivariable control? Explain the three element control in Boilers. **(13)**		BTL 5	Evaluate
15.	Describe the functions of IMC with block diagram and explain in detail. **(13)**		BTL 1	Remember
16.	Draw and explain the Piping and Instrumentation diagram for a Distillation column. **(13)**		BTL 3	Apply
17.	Compare feedback + feedforward and Cascade control schemes for control of heat exchanger. Draw loop schematic and list advantages and disadvantages of each scheme. **(13)**		BTL 4	Analyze
	PART-C			
1.	Design and explain feed forward controllers and dynamic feed forward controller for a stirred Tank Heater. **(15)**		BTL 5	Evaluate

2.		With the help of necessary P and I diagrams explain any four control loops used in a boiler **(15)**	BTL-6	Create
3.		Develop a cascade control system for a Heat exchanger and process furnace. **(15)**	BTL-6	Create
4.		Explain about IMC design procedure with necessary equations. **(15)**	BTL-5	Evaluate
5.	**(i)**	Explain enhancement of multiloop control performance using decoupling. **(10)**	BTL-6	Create
	(ii)	What is an interactive? Explain its effect on stability and tuning of Multiloop control system. **(5)**