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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Prepared by

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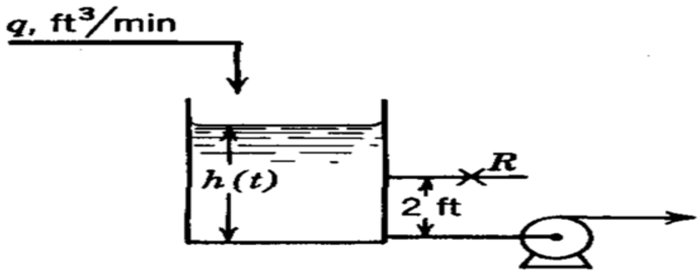
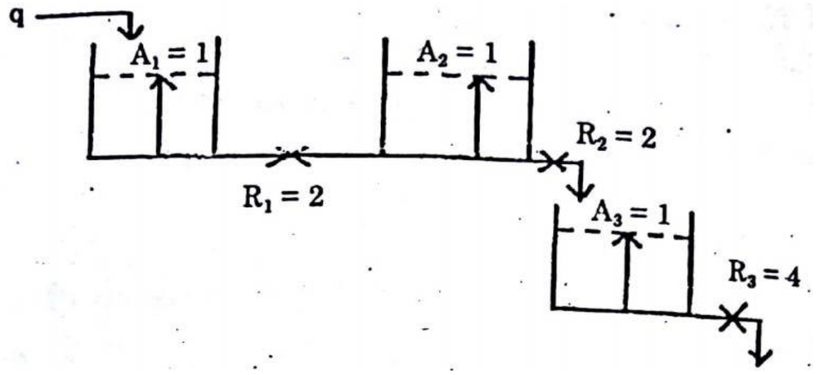
Department of Electronics and Instrumentation Engineering

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	COs	BT Level	Competence
1.	What is the need for mathematical model.	CO1	BTL 1	Remember
2.	Write the mathematical model representation of pressure process.	CO1	BTL 1	Remember
3.	Compare Continuous process and Batch process.	CO1	BTL 1	Remember
4.	Obtain the mathematical model of first order Thermal process system.	CO1	BTL 2	Understand
5.	Examine the need for servo operation.	CO1	BTL 1	Remember
6.	A self-regulatory system does not require a controller. True/False. Justify the answer.	CO1	BTL 2	Understand
7.	Define controlled variable, manipulated variable and load variable in process control.	CO1	BTL 1	Remember
8.	Any process can exhibit self-regulation, Yes/No. Justify.	CO1	BTL 2	Understand
9.	What are the input and output variable for continuous and batch process?	CO1	BTL 2	Understand
10.	Compare interacting and non-interacting systems.	CO1	BTL 2	Understand
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.	CO1	BTL 2	Understand
12.	List down key objectives of process control.	CO1	BTL 2	Understand
13.	Write the list of control variables in Heat Exchanger and CSTR.	CO1	BTL 2	Understand
14.	What is non-self-regulation? Give an example.	CO1	BTL 2	Understand
15.	Define degrees of freedom.	CO1	BTL 1	Remember
16.	Differentiate servo and regulatory operations with example.	CO1	BTL 2	Understand
17.	How lumped and distributed systems are developed?	CO1	BTL 2	Understand
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).	CO1	BTL 2	Understand
19.	Illustrate the steps involved in linearizing the nonlinear systems.	CO1	BTL 2	Understand
20.	Sketch the Heat exchanger feedback control.	CO1	BTL 2	Understand
21.	What are the four types of nonlinear functions?	CO1	BTL 2	Understand
22.	Illustrate the different methods employed in the linearization of nonlinear system.	CO1	BTL 2	Understand
23.	Define process variable.	CO1	BTL 2	Understand

24.		Compare controlled variable with manipulated variable.	CO1	BTL 2	Understand
		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)**	CO1	BTL 3	Apply
	(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)**	CO1	BTL 3	Apply
3.	**(i)**	Differentiate servo and regulatory operation with the help of suitable example. **(7)**	CO1	BTL 3	Apply
	(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)**	CO1	BTL4	Analyse
	(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)**	CO1	BTL4	Analyse
	(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)**	CO1	BTL4	Analyse
	(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 (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. **(13)** 	CO1	BTL 3	Apply
8.	**(i)**	Give examples for processes that exhibit self-regulation. **(7)**	CO1	BTL 4	Analyze
	(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)**	CO1	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)**	CO1	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)**	CO1	BTL4	Analyse
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)**	CO1	BTL4	Analyse
13.	**(i)** Explain heat exchanger with a neat sketch. **(7)** **(ii)** Discuss on the functional and instrumentation diagram of Heat Exchanger. **(6)**	CO1	BTL 3	Apply
14.	**(i)** Explain the operation of CSTR with its characteristic curve and governing variables. **(7)** **(ii)** Compare lumped and distributed systems. **(6)**	CO1	BTL 3	Apply
15.	Mathematically derive servo and regulatory operation with an example for each. **(13)**	CO1	BTL 4	Analyse
16.	**(i)** How would linearization of nonlinear system have obtained in process dynamics. **(7)** **(ii)** List the nonlinearities and explain with i/o diagrams **(6)**	CO1	BTL 4	Analyse
17.	Explain the need of process control in process industries. **(13)**	CO1	BTL 3	Apply
	PART – C			
1.	Find the transfer function for the three tank system below. **(15)** 	CO1	BTL 4	Analyse
2.	**(i)** Explain the method for linearization of non-linear system with one variable. **(8)**	CO1	BTL 4	Analyse

	(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)**	CO1	BTL5	Evaluate
	(ii)	Obtain the mathematical model of tubular heat exchanger. **(7)**			
4.	**(i)**	Develop the mathematical CSTR. **(8)**	CO1	BTL 4	Analyse
	(ii)	Explain the CSTR with cooling socket and explain the control scheme. **(7)**			
5.		Obtain the step response of Non-interacting Multi capacity process control system. **(15)**	CO1	BTL 4	Analyse

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**	**COs**	**BT Level**	**Competence**
1.	Point out the function of Pneumatic control valve in a flow control system.	CO2	BTL2	Understand
2.	Give the functions of an actuator and list different types of actuators.	CO2	BTL2	Understand
3.	Mention the use of electrical actuators.	CO2	BTL1	Remember
4.	Compare pneumatic and electric actuators.	CO2	BTL2	Understand
5.	Mention the functions of valve positioner.	CO2	BTL1	Remember
6.	State the need of valve positioner.	CO2	BTL2	Understand
7.	Discuss “quick opening” control valve.	CO2	BTL2	Understand
8.	Why an equal percentage valve is called as “equal percentage” valve?	CO2	BTL2	Understand
9.	Analyze why equal percentage valve is mostly used in process industries?	CO2	BTL2	Understand
10.	Why installed characteristics of a control valve is different from inherent characteristics?	CO2	BTL2	Understand
11.	Draw the inherent valve characteristics of an equal percentage valve.	CO2	BTL1	Remember
12.	Define Control Valve sizing.	CO2	BTL2	Understand
13.	Summarize the factors to be considered in control valve sizing.	CO2	BTL1	Remember
14.	What is range ability of a control valves?	CO2	BTL1	Remember
15.	A valve with a C_V rating of 4.0 is used to throttle the flow of glycerin for which G = 1.26. Develop the maximum flow rate through the valve for a pressure drop of 100 psi.	CO2	BTL1	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.	CO2	BTL2	Understand

17.	What is ISA S 75.01 standard?	CO2	BTL2	Understand
18.	Which is not covered in ISA S 75.01 standard?	CO2	BTL2	Understand
19.	Differentiate flashing and cavitation in a control valve.	CO2	BTL2	Understand
20.	Classify the different types of process parameters to be considered in selection of control valves.	CO2	BTL2	Understand
21.	List the parts present in basic block diagram of a process control loop.	CO2	BTL2	Understand
22.	What are the two types of converters that are important for Final Control Elements present in process control?	CO2	BTL2	Understand
23.	Summarize the types of seat plug in final control element.	CO2	BTL2	Understand
24.	Classify the control valve based on the flow characteristics and rotor shaft.	CO2	BTL2	Understand
	PART – B			
1.	**(i)** When and when not to use positioner. Comment it. **(7)** **(ii)** Positioner is a very sensitively tuned, proportional-only controller. Justify. **(6)**	CO2	BTL3	Apply
2.	With a neat diagram explain control valve positioner and its types. Explain any one type. **(13)**	CO2	BTL3	Apply
3.	Write a short note on **(i)** Spring and diaphragm motor with positioned. **(7)** **(ii)** Spring less diaphragm actuator. **(6)**	CO2	BTL3	Apply
4.	Explain the diaphragm actuator with neat diagram and also give its steady state force balance equation. **(13)**	CO2	BTL4	Analyze
5.	Explain about **(a)** Double acting piston actuator. **(7)** **(b)** Rotary actuator. **(6)**	CO2	BTL4	Analyze
6.	Write short notes on **(i)** Cavitation's and Flashing. **(7)** **(ii)** I/P converter. **(6)**	CO2	BTL4	Analyze
7.	**(i)** Explain the basic types of valves. Elaborate the selection of valves for different applications. **(7)** **(ii)** Explain the inherent and installed characteristics of valves. **(6)**	CO2	BTL4	Analyze
8.	When are single seated and double seated valves used? List and compare their advantages and disadvantages. **(13)**	CO2	BTL4	Apply
9.	Write down the flow equation of an equal percentage valve and sketch its inherent valve characteristics. **(13)**	CO2	BTL3	Apply
10.	Why installed characteristics of a control valve are different from inherent characteristics? **(13)**	CO2	BTL4	Analyse
11.	Explain about Pneumatic actuators and its classification with a neat diagram. **(13)**	CO2	BTL4	Analyze
12.	Explain about Electro-Pneumatic Force balance type valve positioner with a neat schematic diagram. **(13)**	CO2	BTL3	Apply
13.	**(i)** Explain about effective valve characteristics with necessary diagram. **(7)** **(ii)** Write the benefits of an equal percentage valve. **(6)**	CO2	BTL4	Analyze

14.		Analyze why is equal % valve mostly used in process industries? **(13)**	CO2	BTL4	Analyze
15.		With a neat diagram, explain the functioning of a valve positioner. What are the advantages of using the same? **(13)**	CO2	BTL4	Analyze
16.	**(i)**	With necessary diagram, analyze the characteristics of a control valve. **(7)**	CO2	BTL3	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)**	CO2	BTL4	Analyze
	(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)**	CO 2	BTL4	Analyze
	(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)**	CO 2	BTL5	Evaluate
3.		Evaluate about “quick opening” and “equal percentage” control valve. **(15)**	CO 2	BTL5	Evaluate
4.		Describe the function of an actuator. What are the different types of actuators? **(15)**	CO 2	BTL3	Apply
5.		Tabulate the different types of control valves with their symbolic representation and its application. **(15)**	CO 2	BTL3	Apply

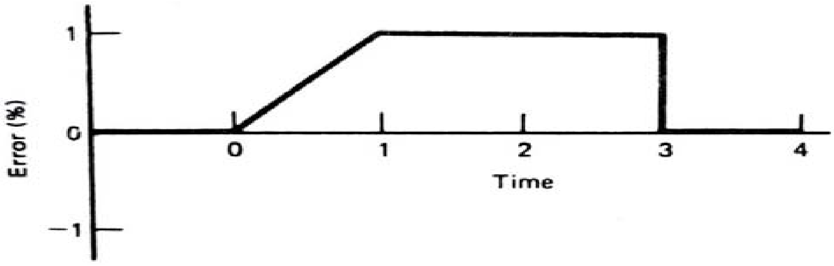
UNIT III - CONTROL ACTIONS

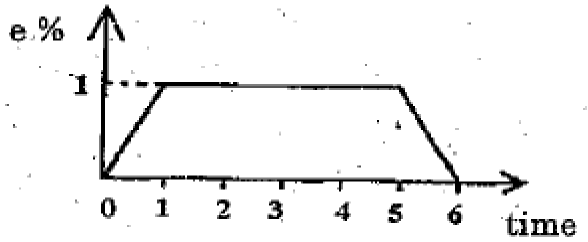
SYLLABUS

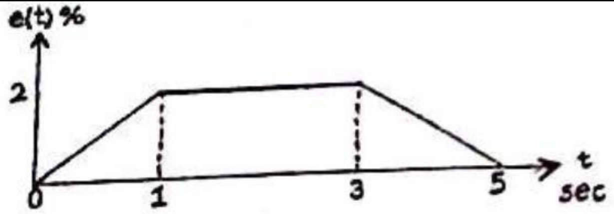
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action

PART – A

Q.No	**Questions**		**BT Level**	**Competence**
1.	What is the general guideline for specifying the controller action as direct/reverse?	CO3	BTL2	Understand
2.	Examine about single speed floating control.	CO3	BTL2	Understand
3.	What is meant by Neutral Zone in ON-OFF controller?	CO3	BTL2	Understand
4.	Develop the open loop response of an inverse response process when excited with unit step Input.	CO3	BTL2	Understand
5.	Justify the need for auto/ manual transfer in Industrial PID controller.	CO3	BTL2	Understand
6.	Define differential gap and its need to be presented in a process.	CO3	BTL1	Remember
7.	List the basic control actions in process control	CO3	BTL1	Remember
8.	Write down the limitations of ON/OFF controller.	CO3	BTL2	Understand

9.	Conclude why derivative mode of control is not recommended for a noisy process?	CO3	BTL1	Remember
10.	What is the importance of bias term in a controller?	CO3	BTL2	Understand
11.	What is the need for integral action in P.I controller?	CO3	BTL2	Understand
12.	What is meant by proportional band?	CO3	BTL1	Remember
13.	Define reset time.	CO3	BTL1	Remember
14.	Derivative controls cannot be used alone. Justify your answer.	CO3	BTL1	Remember
15.	Distinguish between PI controller and P controller.	CO3	BTL2	Understand
16.	Discuss integral windup and Anti reset windup.	CO3	BTL1	Remember
17.	Illustrate auto/ manual transfer in controller	CO3	BTL1	Remember
18.	Illustrate the two forms of PID algorithms.	CO3	BTL2	Understand
19.	List the various types of Anti reset windup techniques.	CO3	BTL2	Understand
20.	Compare P, l and D controller.	CO3	BTL2	Understand
21.	Compare Analog Controller with Digital Controller.	CO3	BTL2	Understand
22.	Classify the controller types based on mode of operation.	CO3	BTL2	Understand
23.	Classify the controller types based on the principle of operation.	CO3	BTL2	Understand
24.	What is meant by error and how its related to process?	CO3	BTL2	Understand
	PART – B			
1.	Discuss the working of electronic PID controller with neat diagram. **(13)**	CO3	BTL3	Apply
2.	Examine when an on-off controller is recommended? How its performance affected by process dead time. **(13)**	CO3	BTL4	Analyse
3.	Discuss about the characteristics of on-off control and the effect of differential gap of ON-OFF controller. **(13)**	CO3	BTL3	Apply
4.	With neat schematic diagram describe the single speed floating control mode. **(13)**	CO3	BTL3	Apply
5.	Compare the features of ON & OFF, P, I, D control modes and draw their characteristics. **(13)**	CO3	BTL4	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)** 	CO3	BTL4	Analyse
7.	Obtain and comment on the response of P, PI, PID controller for a step change in input. **(13)**	CO3	BTL3	Apply
8.	Compare the practical forms of Proportional, Integral and Derivative controllers available commercially. **(13)**	CO3	BTL4	Analyse
9.	**(i)** How to avoid reset windup. **(7)** **(ii)** Explain why derivative and integral control is not separately recommended for any application. **(6)**	CO3	BTL3	Apply

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)** 	CO3	BTL4	Analyse
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)**	CO3	BTL4	Analyse
12.	**(i)** Calculate the r1 and r2 values for an electronic P-controller with a proportional gain 5. **(7)**	CO3	BTL3	Apply
	(ii) Summarize the advantages and disadvantages of PI control. **(6)**			Apply
13.	Discuss the need and benefit of each mode of composite PID controller with suitable illustration. **(13)**	CO3	BTL2	Understand
14.	Explain the general parameters of a controller. **(13)**	CO3	BTL3	Apply
15.	**(i)** How to avoid bump less transfer and reset windup? **(6)**	CO3	BTL3	Apply
	(ii) Explain about the characteristics of two position control. **(7)**			
16.	Explain Reset action mode and anticipatory control mode in detail. **(13)**	CO3	BTL4	Analyse
17.	**(i)** Discuss the need and benefits of each mode of composite PID controller with suitable illustration. **(7)**	CO3	BTL3	Apply
	(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)**	CO3	BTL3	Apply
	(ii) Apply the Proportional controller for the system having changes in Load. **(4)**			
2.	**(i)** Explain the parallel-practical forms of PID controller. **(7)**	CO3	BTL4	Analyse
	(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)**	CO3	BTL5	Evaluate

				
4.	Compare Pneumatic Controller with Electronic Controller with a neat schematic diagram. **(15)**	CO3	BTL5	Evaluate
5.	Explain the	CO3	BTL3	Apply
	(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	COs	BT Level	Competence
1.	Assess the use of evaluation criteria in controller tuning.	CO4	BTL2	Understand
2.	Name any two performance criteria.	CO4	BTL1	Remember
3.	Distinguish between IAE and ISE.	CO4	BTL2	Understand
4.	What is ITAE and when it is needed?	CO4	BTL1	Remember
5.	Define the terms ISE and ITAE.	CO4	BTL1	Remember
6.	Define One-quarter decay ratio.	CO4	BTL1	Remember
7.	Write the formula for IAE and ISE.	CO4	BTL1	Remember
8.	Analyze the need for controller tuning.	CO4	BTL2	Understand
9.	State the Zeigler Nichols closed loop tuning formula.	CO4	BTL2	Understand
10.	Formulate the tuning criteria for continuous cycling method.	CO4	BTL2	Understand
11.	Formulate the Cohen Coon controller settings for PID controller.	CO4	BTL2	Understand
12.	Write the tuning criteria for Damped Oscillation method.	CO4	BTL2	Understand
13.	Why is it necessary to choose controller settings that satisfy both gain margin and phase margin? Justify.	CO4	BTL2	Understand
14.	Define auto tuning.	CO4	BTL2	Understand
15.	How secondary controller selection is made in cascade control scheme?	CO4	BTL2	Understand
16.	List the advantages of cascade control over conventional control.	CO4	BTL2	Understand
17.	Give the advantages and disadvantages of cascade controller.	CO4	BTL2	Understand
18.	Distinguish between Z-N and C-C methods of tuning.	CO4	BTL2	Understand

19.	Differentiate feedback and feed forward controllers.	CO4	BTL2	Understand
20.	List the advantages and disadvantages of feed forward control.	CO4	BTL1	Remember
21.	Define performance indexes of a controller tuning.	CO4	BTL2	Understand
22.	What is meant by ON-Line tuning?	CO4	BTL2	Understand
23.	Explain OFF-line tuning.	CO4	BTL2	Understand
24.	State the Process Gain of the Controller.	CO4	BTL2	Understand
	PART – B			
1.	How Controllers are tuned based on frequency response methods? **(13)**	CO4	BTL4	Analyze
2.	**(i)** Enumerate Integral of Time weighted Absolute Error for a simple system. **(7)** **(ii)** Describe open loop transient response method of tuning. **(6)**	CO4	BTL1	Remember
3.	Illustrate the process of tuning feedback controller using process reaction curve method. **(13)**	CO4	BTL4	Analyze
4.	Examine briefly Quarter (¼) decay ratio criteria with example. **(13)**	CO4	BTL3	Apply
5.	**(i)** What are the drawbacks of process reaction curve method? How to overcome it? **(7)** **(ii)** Describe controller tuning using continuous oscillation technique. **(6)**	CO4	BTL3	Apply
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)**	CO4	BTL4	Analyze
7.	Explain Integral of Square Error and Integral of Absolute Error. **(13)**	CO4	BTL4	Analyze
8.	Briefly explain the Zeigler-Nicholas closed loop method of controller tuning. **(13)**	CO4	BTL4	Analyze
9.	Discuss in detail the optimization methods for tuning a controller. **(13)**	CO4	BTL3	Apply
10.	Explain how is ITAE criterion different form Integral of Absolute Error? **(13)**	CO4	BTL4	Analyze
11.	Compare feed-forward controller with feedback controller. Also bring out its merits and demerits. **(13)**	CO4	BTL3	Apply
12.	**(i)** Discuss in detail about damped oscillation method. **(7)** **(ii)** Explain the basis of selection of type of controller for various processes. **(6)**	CO4	BTL4	Analyze
13.	Explain the cascade control scheme with a typical example and also explain when to use cascade control? **(13)**	CO4	BTL4	Analyze
14.	**(i)** With block diagram, illustrate the superior performance of cascade control over single loop feedback control. **(7)** **(ii)** Identify typical loops in distillation column that demands cascade control. **(6)**	CO4	BTL3	Apply
15.	Discuss the procedure for setting controller parameters by using frequency response method. **(13)**	CO4	BTL3	Apply

16.	**(i)**	Explain the auto tuning method with block diagram. **(6)**	CO4	BTL4	Analyze
	(ii)	Discuss the general guidelines for tuning the controller. **(7)**			
17.	**(i)**	Briefly explain about Controller tuning evaluation criteria. **(7)**	CO4	BTL4	Analyze
	(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)**	CO4	BTL4	Analyze
	(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)**	CO4	BTL3	Apply
	(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)**		CO4	BTL3	Apply
4.	Develop the mathematical model of feed forward controller and explain its operation with neat diagrams. **(15)**		CO4	BTL3	Apply
5.	Compare the various Time Integral Performance criteria for a single order system and conclude the best result. **(15)**		CO4	BTL3	Apply

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**	**COs**	**BT Level**	**Competence**
1.	Summarize the final Smith Predictor Control system diagram.	CO5	BTL2	Understand
2.	Examine the role of boiler control.	CO5	BTL2	Understand
3.	Point out the advantages of IMC.	CO5	BTL1	Remember
4.	Differentiate the advantage of three element control with single element control.	CO5	BTL1	Remember
5.	List the major elements in IMC PID controller.	CO5	BTL2	Understand
6.	Give the advantages and disadvantages of three element boiler drum level control.	CO5	BTL2	Understand
7.	Why Smith Predictor Control scheme is recommended for dead time process?	CO5	BTL2	Understand
8.	What is dead time compensation?	CO5	BTL1	Remember
9.	Write the need for the multi loop control.	CO5	BTL2	Understand

10.	Analyse the control objective of implementing feedback controllers in heat exchanger.	CO5	BTL2	Understand
11.	Draw any of the control scheme block diagram of CSTR.	CO5	BTL2	Understand
12.	What is integrated approach?	CO5	BTL1	Remember
13.	Identify the obvious advantages of introducing control schemes.	CO5	BTL1	Remember
14.	Define IMC controller and multi variable control.	CO5	BTL1	Remember
15.	Draw the general block diagram of Cascade Control system.	CO5	BTL2	Understand
16.	Differentiate feed forward control system with feed back control system.	CO5	BTL2	Understand
17.	Neatly sketch the feed forward control system for a heat exchanger.	CO5	BTL2	Understand
18.	Draw the block diagram of fuel air ratio control system for boilers.	CO5	BTL2	Understand
19.	How the control of chemical reactors be achieved?	CO5	BTL2	Understand
20.	What is the purpose of cascade control for heat exchangers?	CO5	BTL1	Remember
21.	Summarize the importance of model predictive controller.	CO5	BTL2	Understand
22.	What is the need for adaptive control?	CO5	BTL1	Remember
23.	Sketch any four P and ID symbols of valves.	CO5	BTL2	Understand
24.	Give the importance of P&ID diagram.	CO5	BTL2	Understand
PART B				
1.	Explain the design procedure of IMC. **(13)**	CO5	BTL4	Analyze
2.	Discuss briefly and explain the Smith algorithm for dead time compensation of a process. **(13)**	CO5	BTL3	Apply
3.	Discuss with necessary diagram a multi loop control process using distillation column. **(13)**	CO5	BTL3	Apply
4.	Explain Feedforward -Feedback control with suitable example in CSTR process. **(13)**	CO5	BTL4	Analyze
5.	Explain the use of cascade and feed-forward control strategy for distillation column feed control. **(13)**	CO5	BTL4	Analyze
6.	What is IMC PID controller? Explain with a simple application, where it is used? **(13)**	CO5	BTL3	Apply
7.	Explain how dead time compensation with feedback achieved by predictive algorithm? **(13)**	CO5	BTL4	Analyze
8.	Discuss the effect of inverse of the process model control scheme. **(13)**	CO5	BTL2	Understand
9.	Develop two element and three element drum level control with suitable diagrams. **(13)**	CO5	BTL3	Apply
10.	**(i)** Discuss the dynamics of a Heat Exchanger. **(7)** **(ii)** Examine the importance of Internal Model Control in process industries. **(6)**	CO5	BTL3	Apply
11.	**(i)** How Internal Model Control is developed? **(7)** **(ii)** Discuss the challenges involved in multiloop control. **(6)**	CO5	BTL3	Apply
12.	**(i)** Enumerate various measured variables, control variables and signal used in a typical heat exchanger. **(7)** **(ii)** Elaborate the method to reduce measurement lag in a heat	CO5	BTL4	Analyze

	exchanger. **(6)**			
13.	Draw and explain the Piping and Instrumentation diagram for a Boiler. **(13)**	CO5	BTL3	Apply
14.	What is multivariable control? Explain the three element control in Boilers. **(13)**	CO5	BTL3	Apply
15.	Describe the functions of IMC with block diagram and explain in detail. **(13)**	CO5	BTL3	Apply
16.	Draw and explain the Piping and Instrumentation diagram for a Distillation column. **(13)**	CO5	BTL3	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)**	CO5	BTL4	Analyze
PART-C				
1.	Design and explain feed forward controllers and dynamic feed forward controller for a stirred Tank Heater. **(15)**	CO5	BTL5	Evaluate
2.	With the help of necessary P and I diagrams explain any four control loops used in a boiler. **(15)**	CO5	BTL3	Apply
3.	Develop a cascade control system for a Heat exchanger and process furnace. **(15)**	CO5	BTL5	Evaluate
4.	Explain about IMC design procedure with necessary equations. **(15)**	CO5	BTL3	Apply
5.	**(i)** Explain enhancement of multiloop control performance using decoupling. **(10)** **(ii)** What is an interactive? Explain its effect on stability and tuning of Multiloop control system. **(5)**	CO5	BTL4	Analyze