MODEL ANSWER

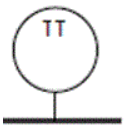
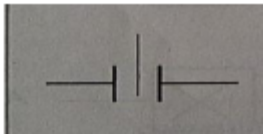
Summer – 19EXAMINATION

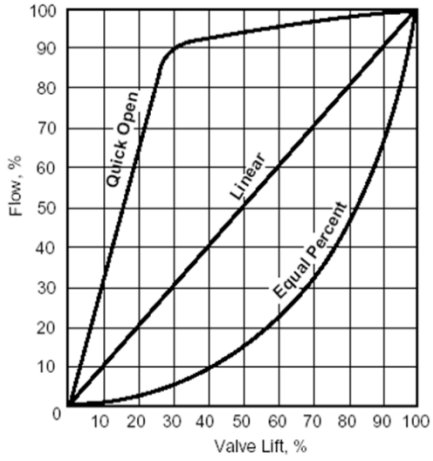
Subject Title: Process Control Systems

Subject Code:17663

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
Q1.	(A)	**Attempt any THREE:**	12 M
	a)	**Draw P & IP symbol for** **(i) Temperature transmitter** **(ii) Orifice plate** **(iii) Pneumatic signal** **(iv) Electrical signal.**	4M
	Ans.	**(i) Temperature transmitter:**  **(ii) Orifice plate:** 	1M each

		(iii) Pneumatic signal: **(iv) Electrical signal:**	
	b)	**Explain the flow characteristic of control valve.**	**4M**
	Ans.	**Diagram:**  **Explanation:** **1. Quick Opening:** This type of valve is used for full ON / OFF control operation. The valve characteristic shows that relatively small motion of valve stem results in maximum possible flow rate through the valve. It is used when maximum valve capacity must be obtained quickly. **2. Linear :**Here flow rate changes linearly with valve travel or stem position $$\frac{Q}{Q_{max}} = \frac{S}{S_{max}}$$ S is the stem position, Q is the flow rate **3.Equal Percentage:**This type of valve does not shut off the flow completely in its limit of stem travel. Thus Q_{min} represents the minimum flow when stem is at one limit of its travel. $Q_{max}$is the maximum flow rate. For this valve, Rangeability R = $\frac{Q_{max}}{Q_{min}}$	**1M** **3M**
	c)	**List four communication methods in DCS. Explain Profibus in brief.**	**4 M**

	Ans.	**Four communication methods in DCS** : Mod bus, Profibus, control net, Ethernet **Profibus:** • PROFIBUS is based on RS-485 transmission technology • Maximum distance is 400-800 m with repeaters. • Transmission speed is 9.6 Kbps to 12 Mbps. • Up to 32 stations (master or slaves) can be connected in a single segment. For connecting more than 32 stations repeaters may be used. • A maximum of 126 devices can be connected to bus. • It requires shielded twisted pair copper cable ,fibre optic cable for large distances. • The Process *Fieldbus,* PROFIBUS, is a German standard. • PROFIBUS specifies Layers 1, 2, and 7 in accordance with the OSI model. • It provides high-performance communications sys-tem for simple, inexpensive equipment. • Its functionality and data transfer capabilities ensure transparency to higher network levels. • Communication with simple field instrumentation with immediate response, master-slave access with central polling and broadcast messages • PROFIBUS uses a hybrid access method combining a centralized master-slave system with decentralized token passing.	**2M (1/2 M each)** **2M (Any 4 points)**
	d)	**Describe selective control scheme with example.**	**4 M**
	Ans.	These are the control systems that involve <u>one manipulated variable and several controlled outputs.</u> It is a control system with multiple loops. With one manipulated variable, only one output can be controlled, so the selective control systems transfer the control action from one controlled output to another according to the need. When the controlled variables are more than the manipulated variable, the system must decide how to share the manipulated variables. Switching between the controlled and manipulated variables can be easily done with selective devices called signal selectors. Signal selectors are devices that choose the lowest, highest or median signals among two or more signals. Application of signal selectors in a control strategy is called Selective control. **(Note: explanation is optional)** **Example:**	**Diagra-m 2M**

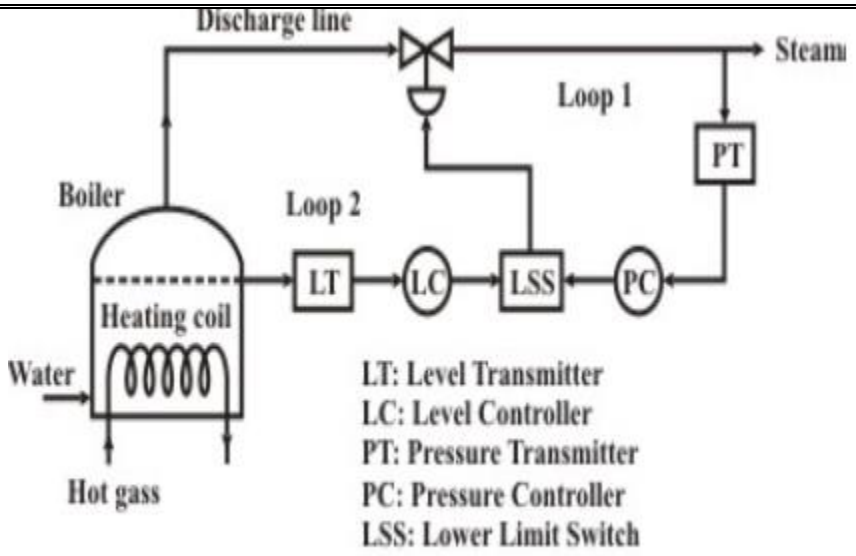
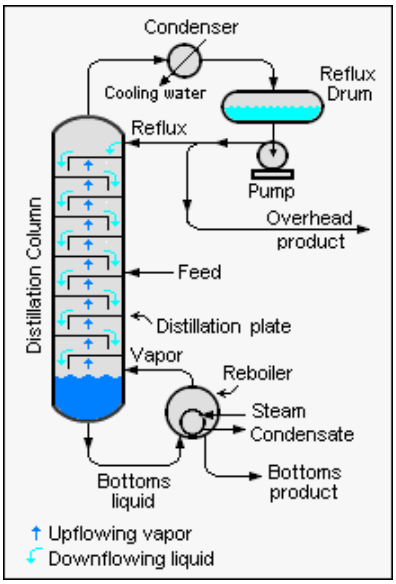


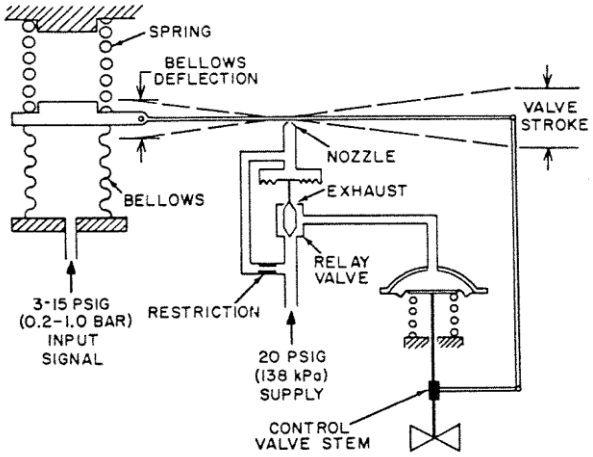
Fig. Override control to protect a boiler system

In the boiler shown above, the steam pressure is controlled through the use of a pressure control loop in the output line (loop 1).
The water level in the boiler should not fall below a lower limit which is necessary to keep the heating coil immersed in the water to prevent its burning out. Here, override control system is used with a low switch selector (LSS).
Under normal circumstances, the selector switch selects the pressure control loop for control
But as soon as the level of water falls below a set value, the selector switch LSS switches to level control mode from pressure control mode and the second loop takes over the control action and closes the valve in the output line.
(Note:Any other relevamt diagram and explanation may be considered)

Explanation 2M

(B)	**Attempt any ONE:**	**6M**
(a)	**Find the valve size in inches and centimeter for pumping the liquid flow rate of 600 gal/minwith maximum pressure difference of 55 psi. Liquid specific gravity is 1.3.**	**6M**
Ans.	**Data given:** Q = 600 gal/min, ΔP = 55 Psi, G = 1.3 Equation for flow rate, $Q = C_V\sqrt{\frac{\Delta P}{G}}$ Therefore, $C_V = Q\sqrt{\frac{G}{\Delta P}}$ Substituting we get, $C_V = 600\sqrt{\frac{1.3}{55}} = 92.24$ For a C_V of 92.24, the required valve size is 3 inches. (Refer table) The valve size in cm = 3x2.54 = 7.62 cm	**Each step 1M**
(b)	**Draw and explain the working principle of distillations column.**	**6M**

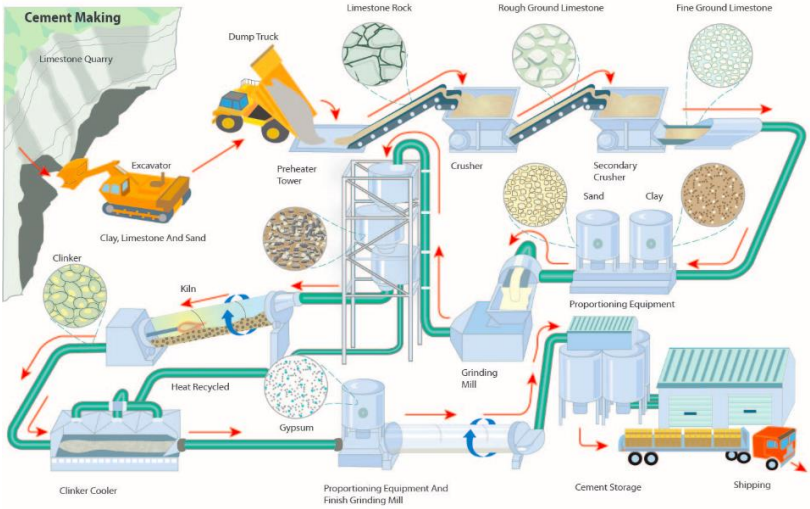
	Ans.	**Diagram:**  **Explanation:** • Distillation separates a mixture on the basis of difference in relative volatilities, or differences in boiling points, of the components to be separated. • Industrial distillation is performed in large, vertical cylindrical columns known as distillation towers or distillation columns or fractionators • The liquid leaving the column bottom is heated in a reboiler. A reboiler is a special type of heat exchanger used to provide the heat necessary for distillation. Part of this liquid is vaporized and returned into the column. The remaining liquid is taken out as a bottom product, or residue. • The overhead vapour leaving the column from top is sent to a cooler, or condenser, and is collected as a liquid in a receiver, or accumulator or reflux drum. A part of the accumulated liquid is returned to the column as reflux. The remainder is withdrawn as over-head product or distillate.	**Diagram 2M** **Explanation 4M**
Q. 2		**Attempt any TWO:**	**16 M**
	(a)	**Define valve positioner. State its types. Draw and explain pneumatic motion balance type valve positioner.**	**8M**
	Ans.	**Definition** of valve positioner: The valve positioner is a high gain proportional controller which measures the valve stem position and compares it against its set-point (controller output signal) and if there is a difference, corrects the error by adjusting stem position. **Types:** pneumatic motion balance valve positioner, pnuematic force balance valve positioner,electro- pneumatic valve positioner **Diagram:**	**Definition 1M** **Types 1M** **Diagra-**



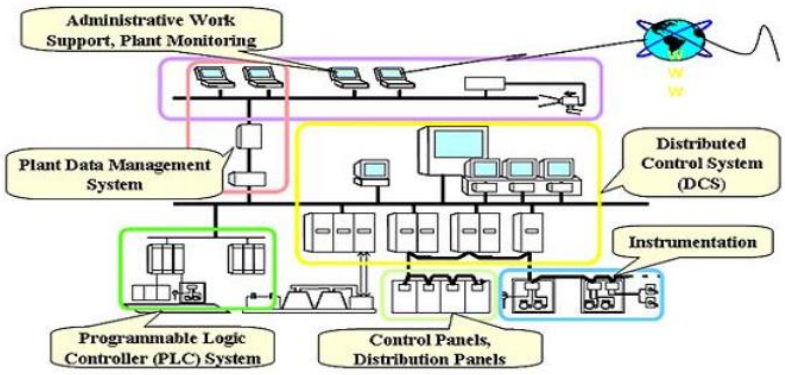
m 3M

- Motion -balance positioner has a **flapper** that compares the motion generated bythe input signal from the controller with the motion generated by the feedback through the linkage connected to the valve stem.
- One end of the flapper is connected to the bellows. The other end is connected to the valve stem through a feedback.
- The controller signal of 3-15psig acts on the bellows which creates a signal in the form of movement of the flapper which is opposed by the feedback through the linkage connected to the valve stem.
- The feedback derived from the valve position provides a force to balance the input signal.
- A relay valve is attached to the nozzle to provide the supply air to the actuator. Thus the air supply flows to the actuator.

Explanation 2M

(b)	**Draw the block diagram of DCS in cenment industry and describe its working.**	**8M**
Ans.	**Diagram:** 	**Diagram 4M**

OR



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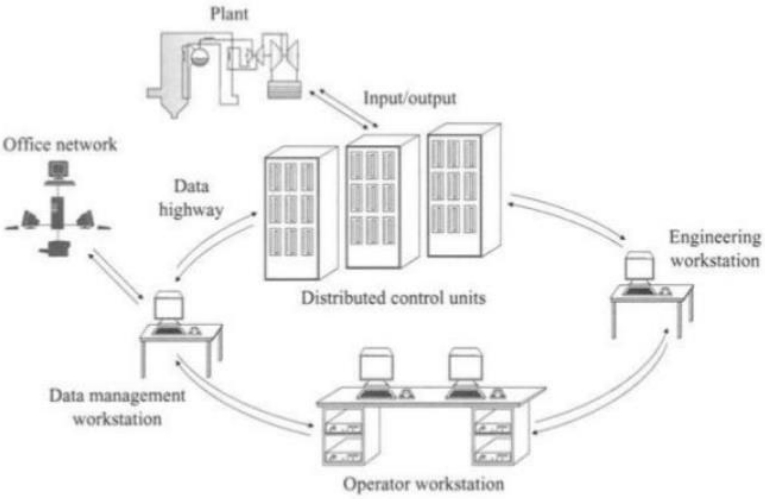
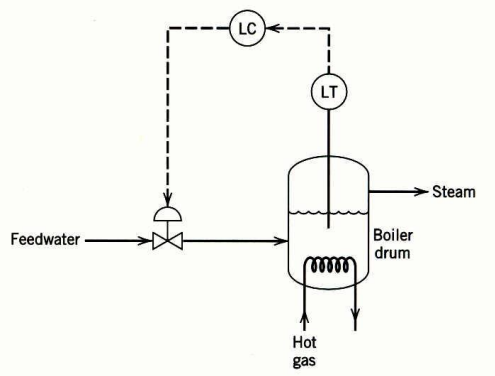


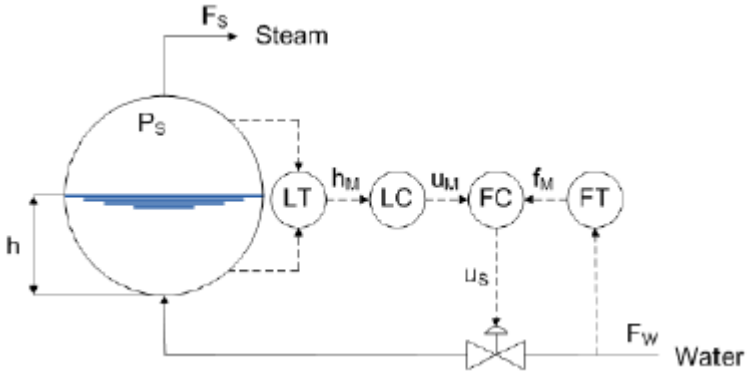
- A distributed control system (DCS) is a control system for a process where the control elements or modules are distributed throughout the system. It is a multitasking operating system which is user friendly with a data management system. The DCS has capacity for processing large number of I/O points.
- It has a modular system development capacity (expandable) which is easy to use. It has data highway, communication capability and data transmission between separate unites of the data highway which provide very wide band communication.

Explanation 4M

Crusher section:
• Raw mill section
• kiln and coal mill section
• Cement mill section
• Packing & dispatch

- Each unit will have its own local control room, which are monitored by a central

		control room. • Raw mill automation is used to control the blending system. • Kiln has optimum control to maintain kiln fuel level, kiln speed, calciner fuel, cooler speed, oxygen content and cooler fan speed. In packing and dispatch section, automatic bag filling to certain weight and automatic loading in trucks are implemented.	
	(C)	**Draw P & ID for one element, two element and three element boiler control. Describe one element control.**	**8M**
	Ans.	**One elementboiler control**: Here, only one process variable is measured which is the level of the liquid in the boiler **P & ID for one element boiler control:**  • Here, the level of the liquid in the boiler (process variable to be controlled) is measured and given to LT and LC to adjust the feed water flow rate. • If the level of the liquid in the boiler is too high, the controller will decrease the feed water flow rate entering the boiler and vice versa. • The manipulated variable is the feed water flow rate which is regulated by the control valve based on the output signal from the level controller. • Thus the level of liquid in the boiler is maintained at the desired set point **P & ID for 2 element boiler control:** • Here, two process variables are measured which are the level of the liquid in the boiler and feed water flow rate	**Diagram - 2M each** **Explanation for one element control 2M**



P & ID for 3 element boiler control:

- Here, three process variables are measured which are the level of the liquid in the boiler, feed water flow rate and outlet steam flow.

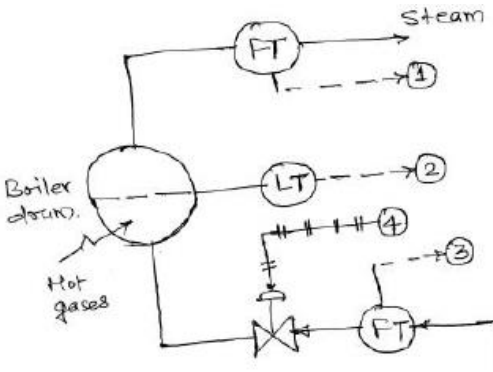
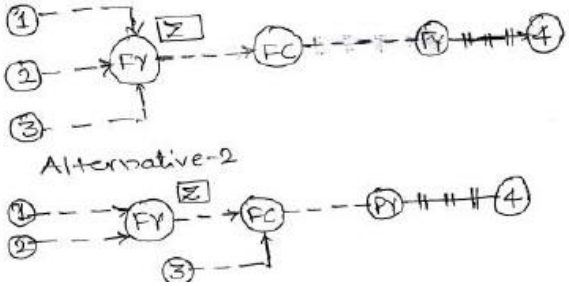


Fig:- Three element Drum level control.

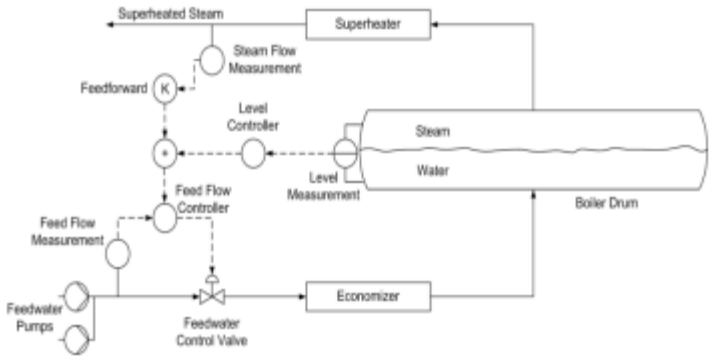
Alternative - 1



Alternative-2

OR

3 Element Boiler Drum level Control



(NOTE: Any other relevant diagram can be considered)

Q. 3 **Attempt any THREE** **16 M**

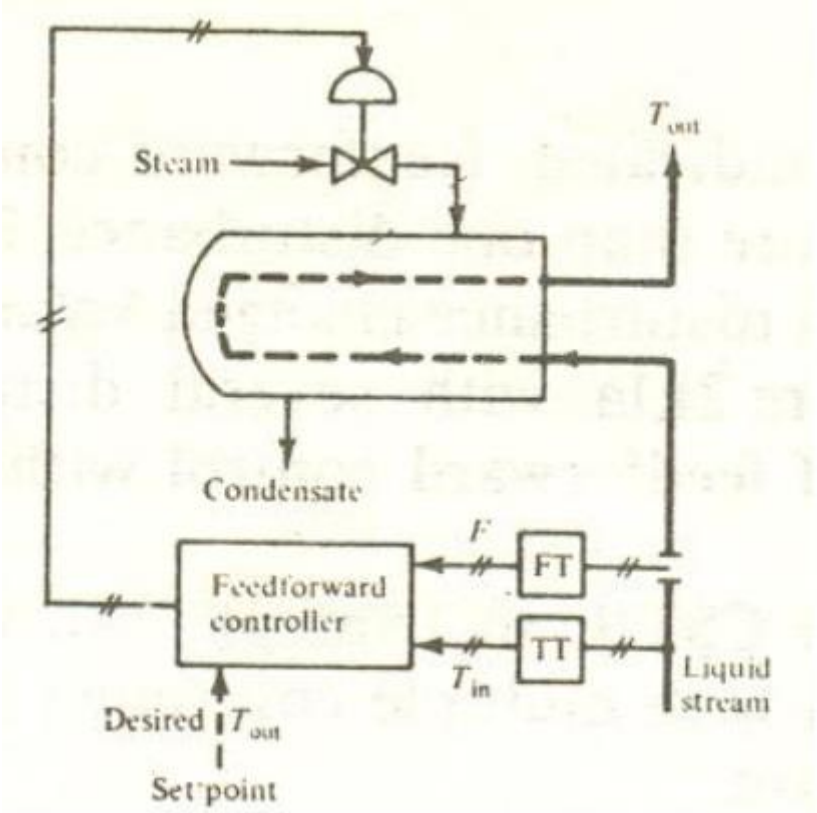
(a) **Compare feedback control scheme with feed forward control scheme.(4 points)** **4 M**

Ans. **1M for (any 4 points)**

No	Feed forward	Feedback
1	Acts before the effect of a disturbance is felt by the system, thus acts in anticipatory manner	Waits until the disturbance affects the system, thus acts in Compensatory manner.
2	Good for slow system	Not satisfactory for slow processes
3	Does not introduce instability in the closed loop response.	Create instability in the closed loop response
4	Requires identification of all possible disturbances and their direct measurement.	Does not require identification and measurement of any disturbances
5	Sensitive to modeling errors	Insensitive to modeling errors
6	Sensitive to process parameter variations	Insensitive to parameter changes

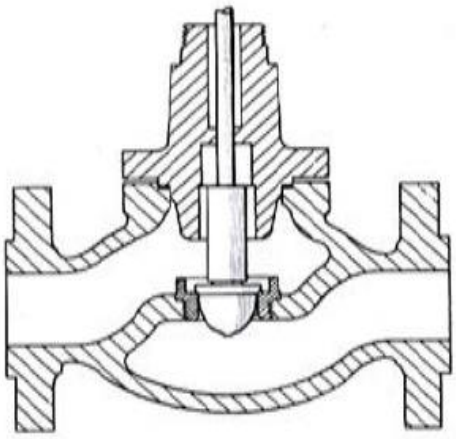
(b) **Draw feed forward contorl scheme for heat exchanger and describe it in brief** **4 M**

Ans. **Diagram:**

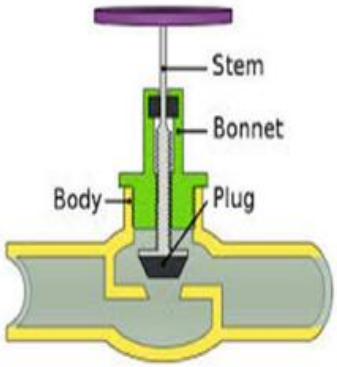


Description: The objective of a feed-forward control system is to measure disturbances and compensate for them before the controlled variable deviates from the set point.
In heat exchanger, the controlled variable is the exit temperature of the outlet liquid and manipulating variable is the steam flow.
The two principle disturbances that can affect the controlled variable are the inlet liquid flow rate and temperature (FT, TT). Therefore these two are measured and given to feed forward controller.
The feed forward controller calculates the error and sends a corrective signal to the steam flow valve.

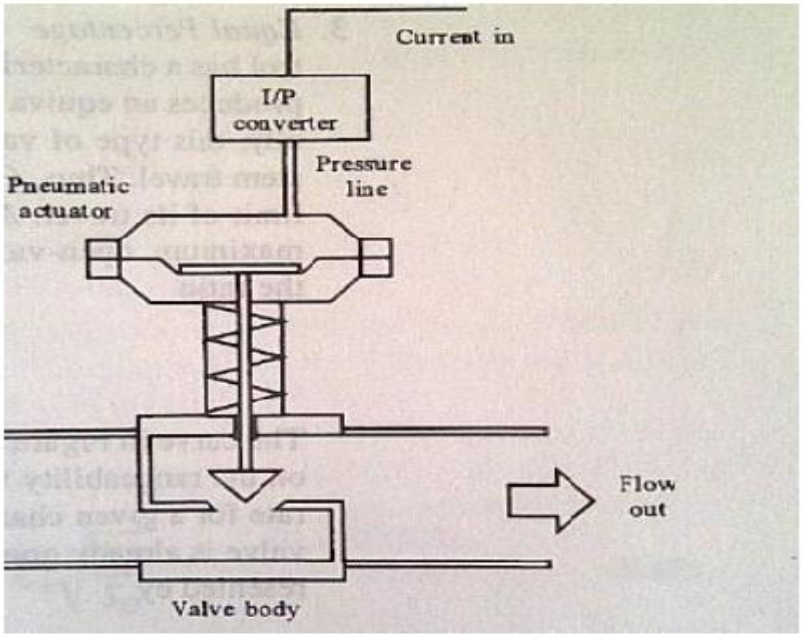
(c)	**Draw and explain the working of a globe valve.(Single seated)**	**4 M**
Ans.	**Diagram:**	**Diagram:2M**



OR



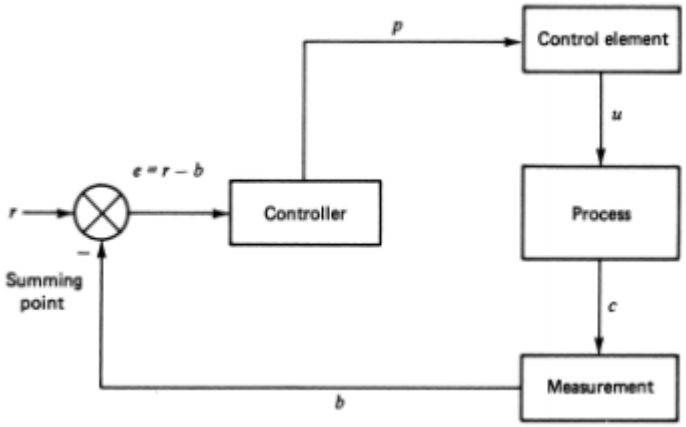
OR



Working:
The principle of operation of globe valve is the perpendicular movement of the disc away from the seat. The globe disc can be totally removed from the flow path or can completely close the flow path. This causes the annular space between the disc and seat ring to gradually close, as the valve is closed. This characteristic gives the globe valve good throttling ability which permits its use in regulating flow.

Working:2M

(d)	**State the role of instrumentation engineer in project engineering.**	**4 M**
Ans.	• Designing and developing new control systems • Testing, maintaining and modifying existing systems • Analyzing data and presenting findings in written reports • Managing operations • Working collaboratively with design engineers, operation engineers, purchasers and other internal staff • Liaising with clients, suppliers, contractors and relevant authorities (e.g. The nuclear decommissioning authority) • Project management within cost and time constrained environments • Understanding and ensuring compliance with relevant health and safety regulations and quality standards • Providing advice and consultancy support • Purchasing equipment	**1M each (Any 4 points)**

		• Writing computer software and test procedures • Developing new business proposals	
	(e)	**Draw the block diagram of process control system. Explain each block.**	**4 M**
	Ans.	**Block diagram:**  **Explanation:** **1)Process:** A process can consist of a complex assembly of phenomena that relate to some manufacturing sequence. Many variables may be involved in such a process, and it may be desirable to control all these variables at the same time. There are single variable processes, in which only one variable is to be controlled, as well as multivariable processes, in which many variables, perhaps interrelated, may require regulation. The process is often also called the plant. **2)Measurement:** a measurement refers to the conversion of the variable into some corresponding analog of the variable, such as a pneumatic pressure, an electrical voltage or current, or a digitally encoded signal. A sensor is a device that performs the initial measurement and energy conversion of a variable into analogous digital, electrical, or pneumatic information. Further transformation or signal conditioning may be required to complete the measurement function. The result of the measurement is a representation of the variable value in some form required by the other elements in the process-control operation. **3) Controller:** The next step in the process-control sequence is to examine the error and determine what action, if any, should be taken. This part of the control system has many names, such as compensator or filter, but controller is the most common. **4) Final Control element:** The final element in the process-control operation is the device that exerts a direct influence on the process; that is, it provides those required changes in the controlled variable to bring it to the set-point. This element accepts an input from the controller, which is then transformed into some proportional operation performed on the process.	**Diagram:2M** **Explanation:2M**
Q. 4)	**(A)**	**Attempt any THREE:**	**12 M**
	(a)	**Describe the working of solenoid valve with diagram.**	**4 M**
	Ans.	**Diagram:**	

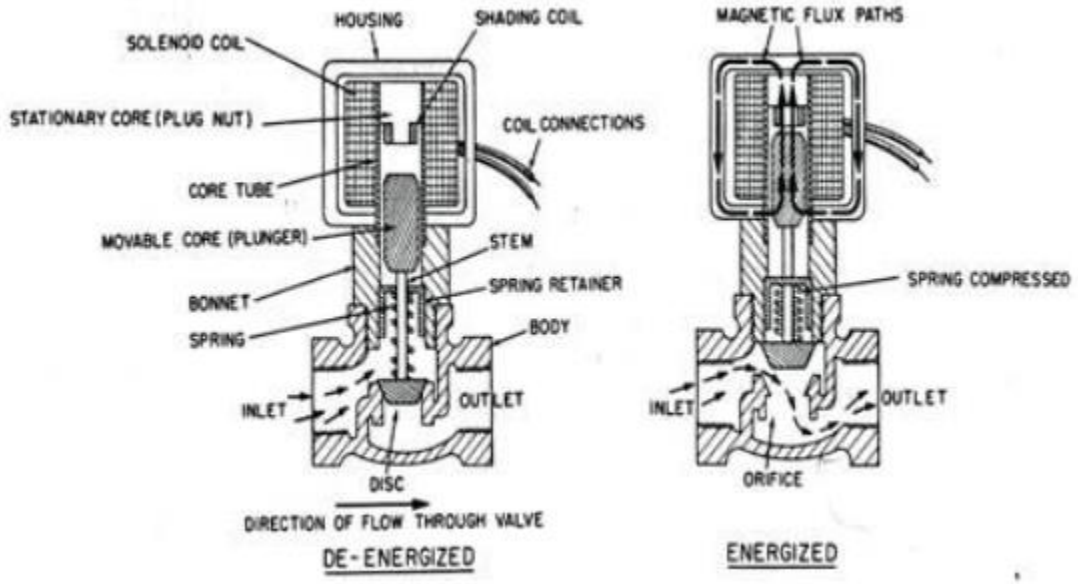


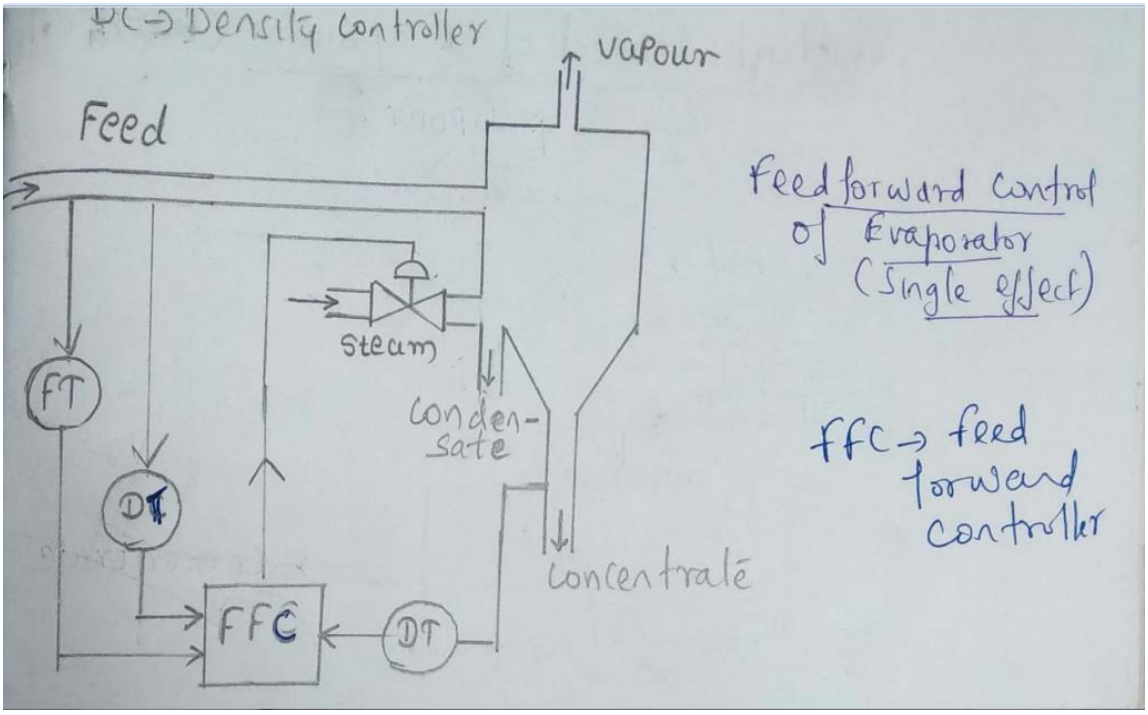
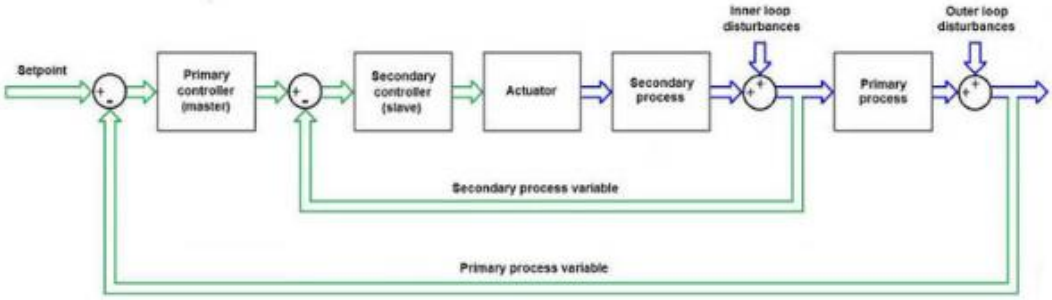
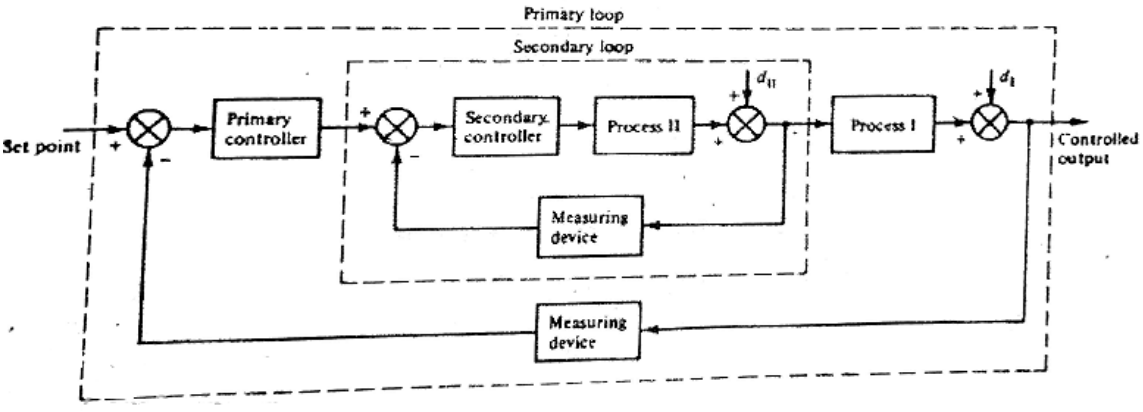
Diagram:2M

Working:

A solenoid valve is an electromechanically operated valve. The valve is controlled by electric current through a solenoid: Most solenoid valves operate on a digital principle. They therefore, possess two distinct states, which are (1) - when the coil is activated by current, and (2) - when the valve is resting (without electricity). In the case of a two-port valve the flow is switched on or off. If the valve is open, then the two ports are connected and fluid may flow between the ports; if the valve is closed, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is termed normally open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed normally closed.
This type of valve is actuated entirely by the solenoid force (produced by magnetizing the coils by passing electric current). The plunger with a seal acting as the main closure device is forced directly onto the valve seat by the fluid pressure and closing spring. The valve is opened directly by the solenoid force only.

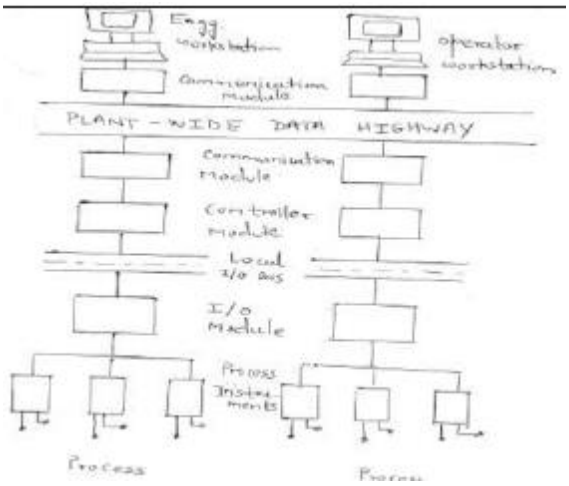
Working:2M

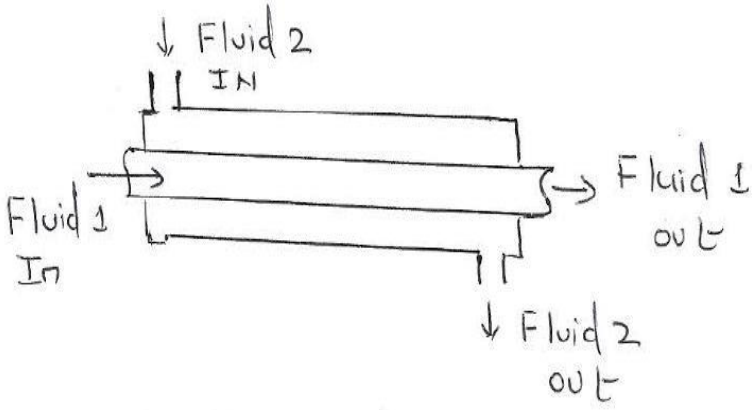
	(b)	**State the principle of evaporator. Draw feed forward control scheme for single effect evaporator.**	**4 M**
	Ans.	**Principle:** An evaporator is a device used to turn the liquid form of a chemical into its gaseous form. The liquid is evaporated, or vaporized, into a gas. Evaporation is a special case of heat transfer to a boiling liquid. It is the separation of a liquid mixture into a liquid product (concentrate or thick liquor) and a vapor byproduct. It is used to concentrate a non-volatile solute from a solvent, usually water. This is done by boiling off the solvent. Concentration by evaporation is normally stopped before the solute begins to precipitate. Otherwise the operation will become crystallization. **Diagram:**	**2M** **2M**

		Feed forward control for single effect evaporator:  **(Note: Any other relevamt diagram may be considered)**	**2M**
(c)	**Describe cascade control scheme with block diagram.**		**4 M**
Ans.	**Diagram:**  **OR**  	**Diagram:2M**

		Description: In a cascade control arrangement, there are two or more control loops in series, where one controller's output drives the set point of another controller. The cascade control has one manipulated variable and more than one measurement. The system involves two control loops that use two measurement signals to control one primary variable. There is a secondary control loop located inside a primary loop. Though two controllers are used, only one variable is manipulated. The output of the primary loop controller is used to calculate the set point for the inner(secondary) control loop. The output of the secondary controller is used to adjust the manipulated variable. Thus the primary controller maintains the primary variable at set point by adjusting the set point of secondary controller. The secondary controller, in turn responds to the output of the primary controller and to the secondary control variable. Thus the secondary controller act as defense against disturbances, and prevents it from entering the primary process.	**Description:2M**
(d)		**Explain the selection criteria of DCS system. (four points)**	**4 M**
Ans.		**Selection criteria of DCS:** **1. Nature of Manufacturing and type of product manufactured** •No. of Products manufactured : Single / Multiple • Recipe parameter : Constant or Variable • Procedure : Single or Different • Equipment Utilization : Fixed or Flexible • Frequency of changes to formula & Recipe : Never or Often • Regulatory / Analog loop control • Complex Batch Control **2. The value of the product being manufactured and the cost of downtime** •If the value of the batch is high, either in raw material cost or market value, & the downtime not only results is lost production but potentially dangerous and damaging conditions, the DCS should be selected The environment in process automation can be volatile & dangerous**.** **3. Factory environment:** •In this scenario, the HMI is a central control room console that provides the only complete "window" into the process, enabling operator to monitor & control the process which are occurring inside pipes & vessels located throughout the plant. **4. Role of operator:** • The DCS plant requires an operator to make decision and continuously interact with the process to keep it running. •Operator's process knowledge is often critical to operational excellence & keeping the process running optimally. **5. What system performance is required:** • The speed of logic execution is a key differentiator between PLC and DCS. While fast scan rates are necessary to be able to effectively control the operations involving motion control, high-speed interlocking, control of motors and drives,	**1M each point (Any 4)**

		he DCS does not have to be that quick. • Control Loops require deterministic Scan execution at speed 100-500ms • System redundancy is often required • Online configuration changes often required • Analog Control – Simple to Advanced PID up to Advanced Process Control cascade, Split range, Ratio etc. **6. Degree of customization required:** • In PLC Powerful Programming languages are typically available to facilitate the creation of custom code from scratch. DCS consists of Pre-engineered solutions consists of standards, templates & extensive libraries. • The highest priority of DCS is to deliver reliability & availability, which often results in a design which trades unlimited functionality for repeatability and dependability.	
	(B)	**Attempt any ONE:**	**6 M**
	(a)	**Enlist the documents required for instrumentation in project engineering. State the need of instrument index sheet and data sheet.**	**6 M**
	Ans.	The documents required for instrumentation in project engineering are, **1)** Instrument index: It is a document containing list of instrument devices within a plant. Instrument index shall include tag number of all physical instruments (e.g. field instrument, physical alarm and indicator) and pseudo instruments which commonly named "soft tag"(e.g. DCS indication, alarm, and controller). **2)** Datasheet: Data sheet or spec sheet is a document that summarizes the performance and other technical characteristics of a product, machine, component (e.g., an electronic component), material, a subsystem (e.g. a power supply) or software in sufficient detail to be used by a design engineer to integrate the component into a system. **3)** I/O List: It is a document containing list of instrumentation which serve as an input or output of control system. **4)** Process flow diagram: A process flow diagram (PFD) is a diagram commonly used in chemical and process engineering to indicate the general flow of plant processes and equipment. The PFD displays the relationship between major equipment of a plant facility. **Need of Instrument Index Sheet & data sheet:** **1.** The instruments index sheets provide summary of all instruments required for job, listing each number identified items of each loop. **2.** These are made near the start of job and used to check the progress in specification, writing purchasing expediting, delivery and installation. **3.** As items are added the list increase: deletion should be line out thus serving as a record of changes, even though information is not complete. **4.** The list should be issued early in the job so that project engineers and other concerned with the job may use it to gauge the job requirements.	**Documents:4M** **Need:2 M**
	(b)	**Define cavitation and flashing. Describe the remedies to avoid them.(any two each)**	**6 M**
	Ans.	**Cavitation:** It is the formation and subsequent collapse of vapour cavities or gas "bubbles" or "voids" in a flowing liquid in a region where the local static pressure of the liquid falls	**Definition:3M**

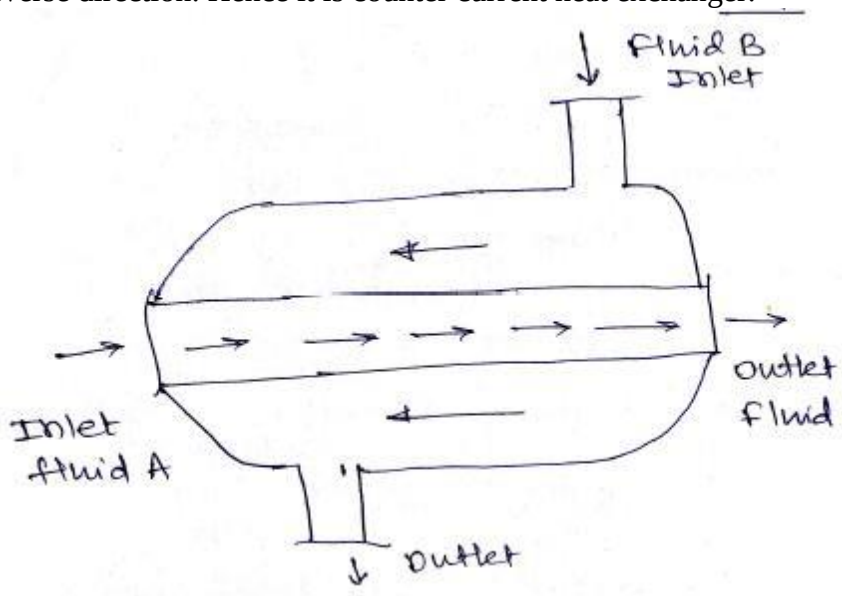
		below its vapour pressure. **Flashing:** It is the formation of vapour cavities or gas "bubbles" or "voids" in a flowing liquid in a region where the local static pressure of the liquid falls below its vapour pressure and the vapour phase continues downstream because the downstream pressure remains at or below the vapour pressure of the liquid. **Remedies to avoid the problem of cavitation:** **1.** Revised process condition: a) Reduction of operating temperature can lower vapor pressure. b) Increase in upstream and downstream pressure with Δp. unaffected. **2**. Revised valve Type of valve in terms of pressure recovery characteristics. **3.** Revised installation Two or more control valves installed in series as multistage control valve to handle huge pressure drop. **4.** Gas injections Introduction of non-condensable gas or air into the region where cavitation is anticipated **Remedies to avoid flashing:** **1.**The damage from flashing can be minimized by reducing velocity by using reduced port angle valve discharging directly into vessel or flash tank. **2.** Using erosion resistant material such as ceramic material lining provided at downstream of control valve.	**Remedies:3M**
Q. 5		**Attempt any TWO :**	**16M**
	a)	**Draw the architecture of DCS . Explain the Function of each block in detail.**	**8 M**
	Ans.	 **1. Input-output module:** All these modules are mounted in a single or multirack system connected on common communication highway. I/O module scans and digitizes the process in simple logic. It provides the main interface between DCS and process being controlled. They convert the information provided by process instruments into digital form. They also provide signal filtering **2. Local i/o bus:** It provides bridge between I/O and controller module and is restricted in terms of geographical area and data loading. It operates at slower speed than the plant wide data highway communication. **3. Controller module:**	**Diagram 4M** **Explanation of each block 1M each (Any**

		It is the brain of the DCS. It updates field data from I/O module and performs control calculation and logic to make the process changes. It also consists of memory, registers and buses, CPU, ROM and RAM. Hence it is microprocessor based device. **4. Communication module:** It provides communication between data highway and other modules such as controller module and user interfaces. Communication module manages the flow of information between the data highway, controller module and user interface **5. Data highway:** The data highway is the communication device that allows distribution of the controlling function throughout a large plant area. It is the digital data link that connects the multifunction controllers with the central operator stations. Data highway is microprocessor based module through which the messages and files are transferred. The medium can be coaxial cable or the fiber glass cable. **6. User interface:** It provides the interface between user and process. It can either operator interface or engineer interface. • **Operator Station:- It performs:** **1.** From operator station, operator can view entire plant/process and can control the process. **2.** Controlling the complete process (regulatory and supervisory control); allows configuration of all inputs **3.** Alarm display setting. • **Engineer Station:- it performs following functions:** **1.** system design and generation of system loop diagram **2.** documentation **3.** programming system maintenance **(Note: Any other relevant diagram and explanation may be considered)**	**four)**
	b)	**(i) Explain the concept of co-current and counter current heat exchanger with diagram.** **(ii) Draw the cascade control scheme of heat exchanger .Explain 'master' and 'slave' with respect to it.**	**8M**
	Ans.	**Co-Current Heat Exchanger:** Both the fluids flow parallel to each other in the same direction. Both the fluids enter the heat exchanger at their largest temperature difference. The temperature difference becomes less over the length of the heat exchanger  	**1M** **1M**

Counter current Heat Exchanger:

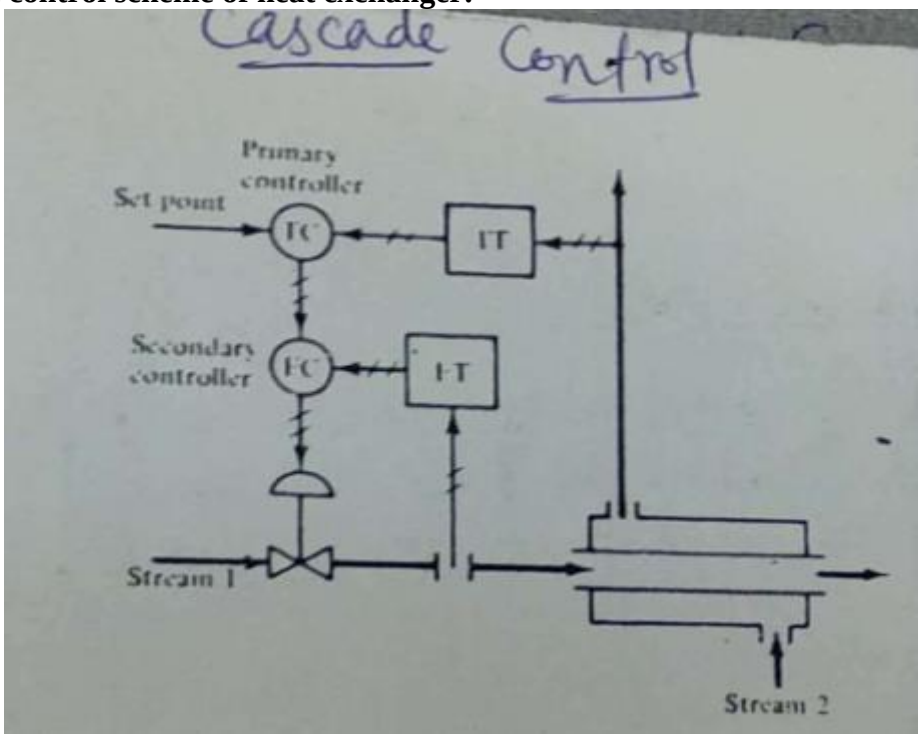
Here, both the fluids flow parallel to each other in the opposite direction.

Heat exchange equipment involves heat energy transfer either by conduction or convection. In double pipe type heat exchanger one of the fluid flow inside pipe in forward direction other fluid flows through annular space created between two concentric pipes in reverse direction. Hence it is counter current heat exchanger. **1M**



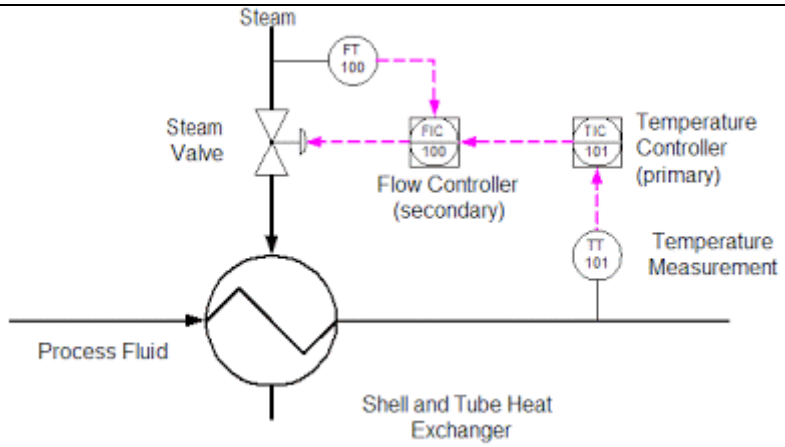
1M

Cascade control scheme of heat exchanger:



Cascade control scheme- 3 M

OR:



Concept of Master/Slave:
Temperature controller which controls the outlet flow temperature is the master or primary controller. Master controller controls the controlled variable.
Flow controller which controls the flow of steam is the slave or secondary controller. Slave controller controls the manipulated variable.
(Note:Any other relevamt diagram and explanation may be considered)

Concept of Master/ Slave -1 M

c) **State the types of dryer. Draw the schematic of feedback and feed forward control scheme of dryer with label. Explain any one type in brief.** **8 M**

Ans.

Types :-
1) Fluid- Bed Dryer
2) Spray Dryer
3) Direct Fired Rotating Kiln Dryer
4) Double Drum Dryer

Types of dryer-1 M

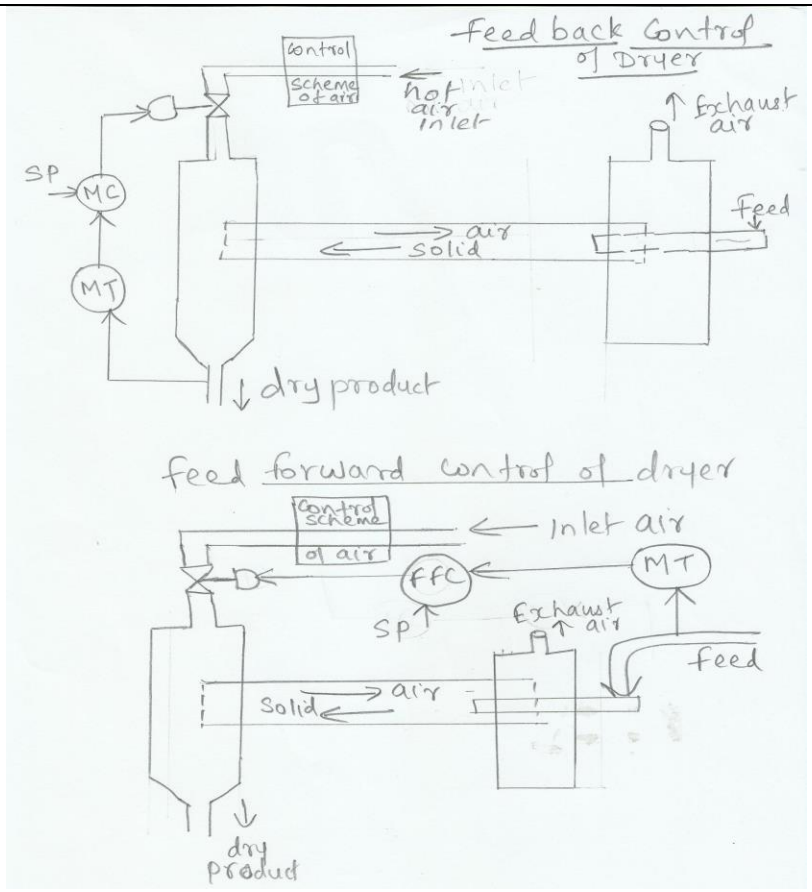
OR

1)Adiabatic and Non-adiabatic Drying
2) Continuous and Batch Drying

Schematic of feedback and feed forward control scheme of dryer:

4M

(schematic of feedback and feed forward 2 M each)



Any one Explanation 3M

Feedback control scheme of dryer:

Feedback control scheme waits until the disturbance affects the system, thus acts in Compensatory manner.

The aim of the dryer feedback control is to maintain the moisture content of the product at the set point. The controlled output of the dryer is moisture content of the product.

It uses a sensor (MT) to measure the moisture content of the product at the outlet and gives to MC. Controller (MC) compares it with the set point. After comparison of this value with the set point, the controller (MC) regulates the manipulated variables (e.g.: steam flow, the infrared irradiation or hot airflow) according to the chosen controller. Thus feedback control is achieved.

Feed forward control scheme of dryer:

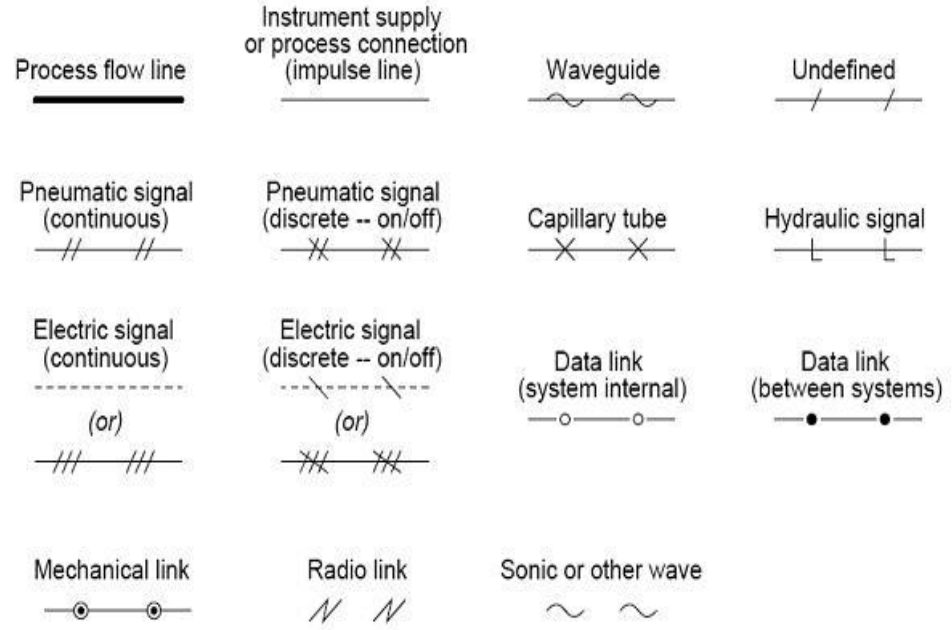
Feed forward control scheme acts before the effect of a disturbance is felt by the system, thus acts in anticipatory manner.

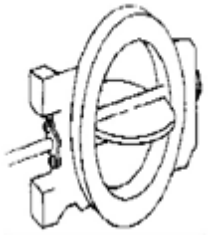
The objective is to maintain the product quality by controlling the moisture content of the product. A feed-forward control structure uses a sensor to measure an input disturbance (e.g.: the moisture content in input feed).

The controller takes corrective action before the input disturbance affects the product quality. This is done by the tuning of the manipulated variables (heating method to give heat energy. Ex. Hot air flow, Steam flow, infrared radiation etc) before it affects the controlled variable.

This is done by using MT to measure the inlet feed moisture, then its output is given to FFC whose set point is the desired moisture content of the product.

FFC output is given to control valve through which the heating method to give heat

		energy flows. Thus feed forward control is achieved. **(Note: Any other relevant diagram may be considered)**	
Q. 6		**Attempt any FOUR of the following**	**16M**
	(a)	**Draw different inter connection P& ID symbols.**	**4M**
	Ans.		
	(b)	**Draw and label the butterfly valve. Describe its operation in brief.**	**4M**
	Ans.	In this valve, the plug is in the form of a disc. The "butterfly" is the metal disc mounted on a rod. The disc is positioned in the center of the pipe. A rod connected to an actuator on the outside of the valve is passing through the disc. Rotating the actuator turns the disc either parallel or perpendicular to the flow. • The disc is always present within the flow, therefore a pressure drop is always induced in the flow, regardless of valve position. A butterfly valve is from a family of valves called quarter-turn valves. In operation, the valve is fully open or closed when the disc is rotated a quarter turn. When the valve is closed, the disc is turned so that it completely blocks off the passageway. When the valve is fully open, the disc is rotated a quarter turn for the passage of the fluid. • Butterfly valves are less costly and lighter in weight, therefore less support is required. It is used for isolating or regulating flow.	**2M** **2M**

			
	(c)	**List any four features of DCS.**	**4M**
	Ans.	a) CRT-based operator consoles and keyboards which are used by plant operator or engineers to monitor and control the process b) Controllers, multifunction control modules, and PLCs which provide the basic control computation or operation c) A communication network which is used to transfer the information between control modules and operator consoles across the node on the network d) I/O (Input/output) modules which are used to convert the field instrumentation signals from analog to digital and digital to analog form for controller modules and console displays e) Fieldbus communication links which are used for communication between remote I/O devices and control modules f) Historical module which is used for data storage for control data and for on-line data retrieval or archiving g) Computer interface which is used for communication between the nodes on the DCS network and the supervisory computer **OR** **1.** Modular system development capability **2.** Build schematic display develop control program **3.** Interoperability. **4.** Support for standards. **5.** Location independence **6.** Increased service reliability and support for Fallback. **7.** Optimized throughput. **8.** Monitoring and Instrumentation capability. **9.** Redundancy and other fail safe techniques **10.** Data highway and transmission, communication capability	**1M each, any 4**
	(d)	**Compare human aided and automatic control system.(4 points)**	**4M**

Ans.

Human aided control:	Automatic process control:
Human being are required in control operation	No human being is required in control operation
Human cant not work beyond certain time if efficiency is less	Efficiency is excellent in this sysytem
More errors occurs.Hence accuracy is less.	Less error exist.Hence accuracy is more.
They are easy to install	They are difficult to install
They cannot be used in hazzardous	It is used in hazzardous area.
Safety of human is major concern	Machine can work safely.
Quality of product is not good.	Quality of product is good.

1M each

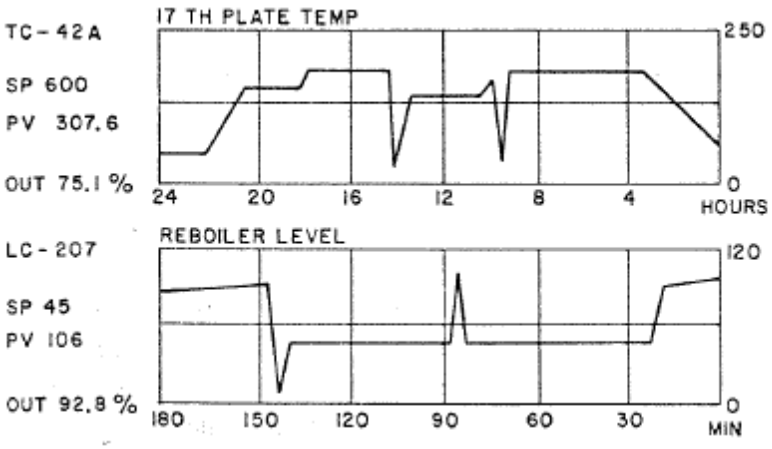
(e) **Enlist different process displays. Draw any two types.** **4M**

Ans. **2M**

Types of process displays:

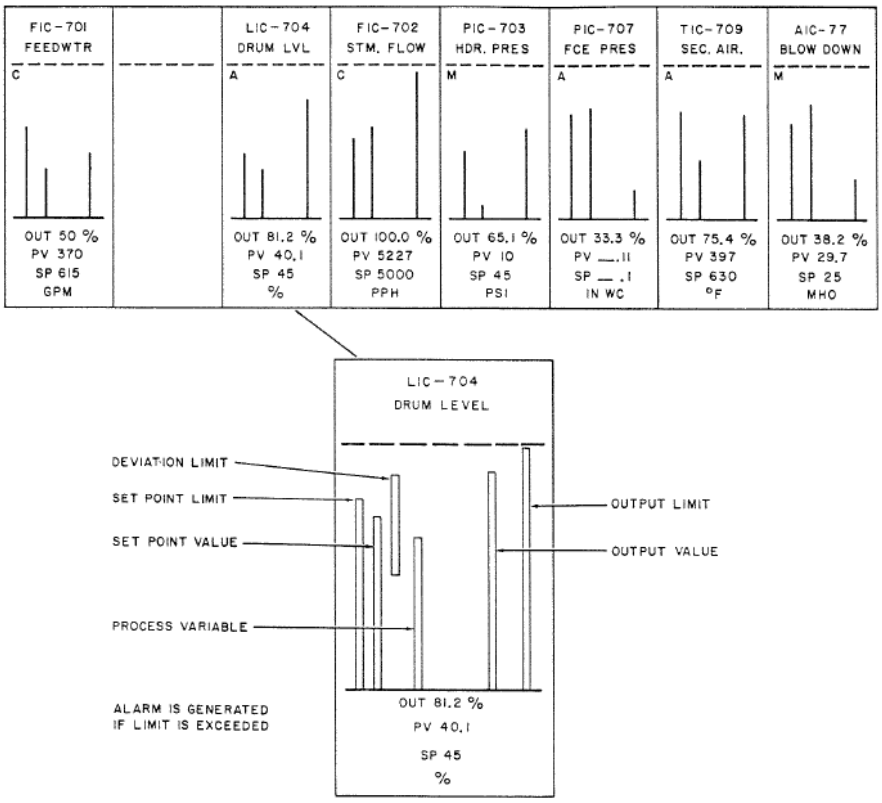
1.Group display
2.Overview display
3.Alarm Display
4.Graphic display
5. Trend display

Trend display:

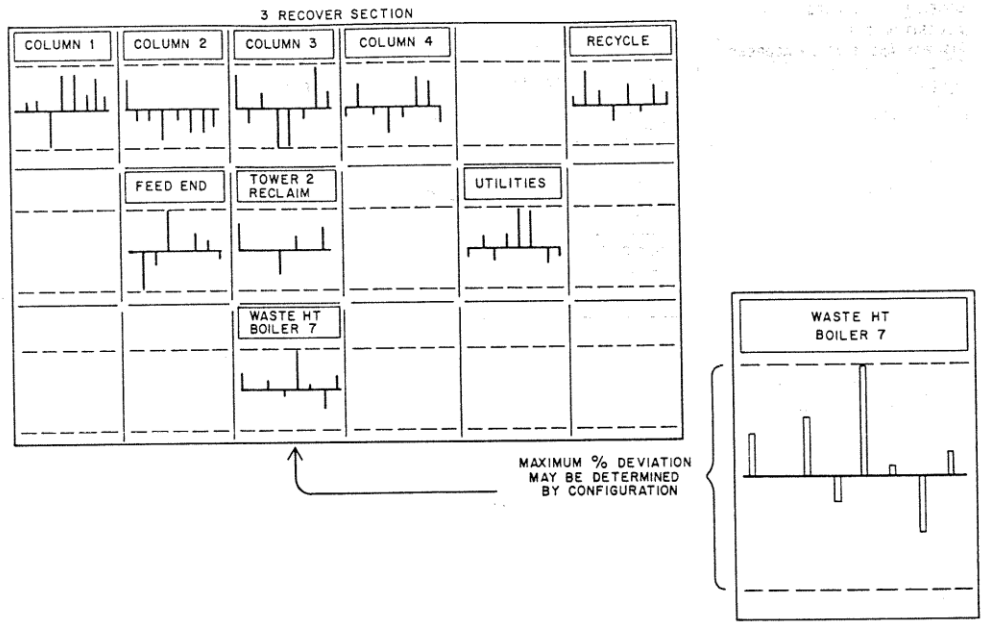


Any two, 1M each

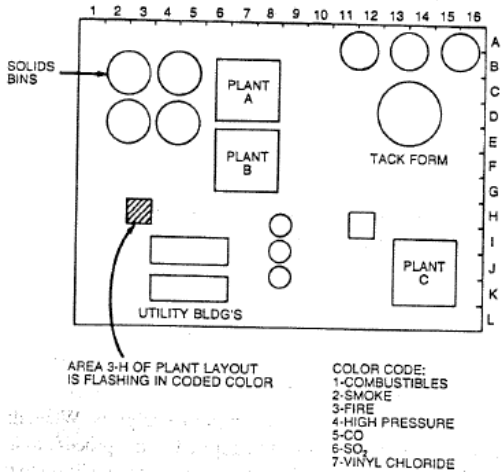
Group display:



Overview display:



Alarm Display:



Graphic display: