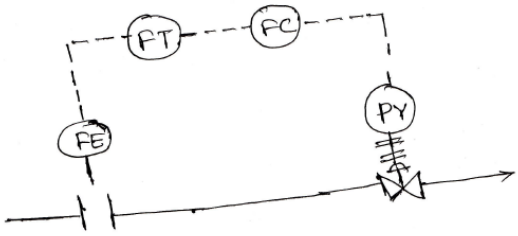
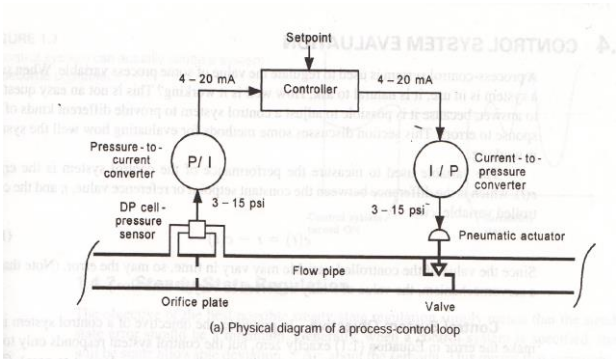
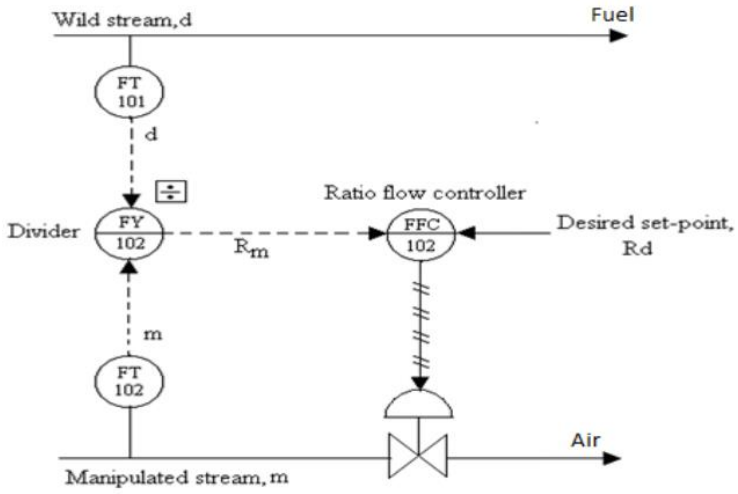
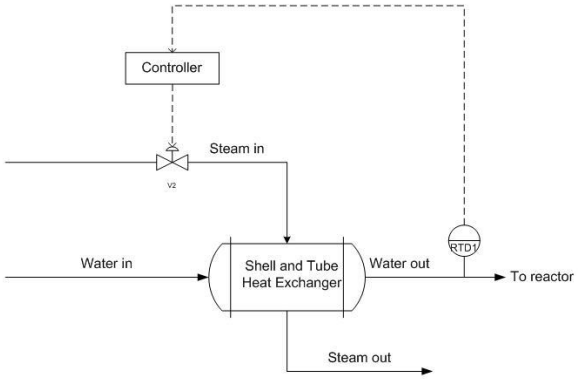
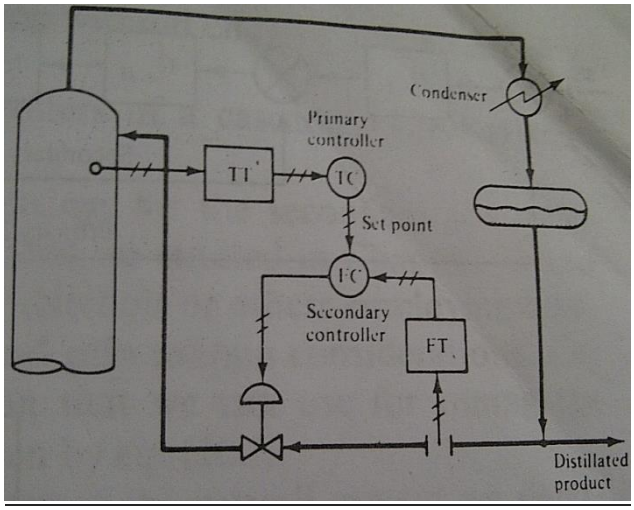
Important Instructions to examiners:

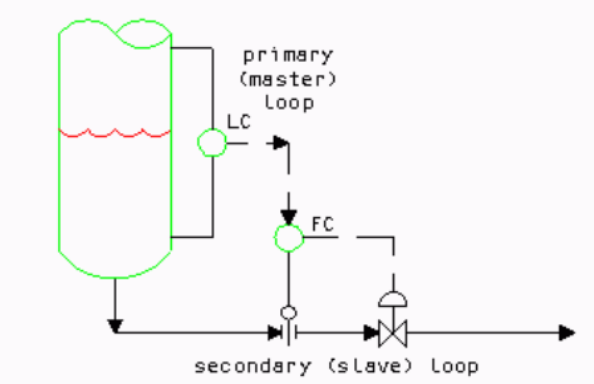
1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 any equivalent 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	Question & its answer	Remark	Total marks
01 A)	**Attempt any THREE**		12
a)	**Draw P and ID diagram for flow control system**	04	
Ans.	 P&ID of flow control system  Physical diagram of flow control system **(Any other relevant diagram can be considered)**	**04 marks**	

b)	**Explain the method of ratio control with a neat diagram**	**04**	
Ans.	Ratio control is a special type of feed-forward control. The objective of a ratio control scheme is to keep the ratio of two process variables at a specified value. The two process variables are usually flow rates of a manipulated stream(m) and a disturbance stream(d). Here, the disturbance stream is also referred to as wild or load stream. Thus, the ratio (R) of two variables (m& d),**R = m / d** is controlled rather than controlling the individual variables. There are two ways to implement ratio control scheme. i) Ratio control scheme using Divider ii) Ratio control scheme using Multiplier  **Diagram for Ratio control scheme using Divider**. Here the manipulated stream (m) is under standard feedback control. The flow of the wild stream(d) is measured using flow transmitter(FT-101) and sent to a 'multiplier' (FY-102) which multiplies the signal by the desired ratio(Rd) yielding the set-pointfor the flow controller(FC-102).The flow controller then adjusts the flow rate of manipulated stream(m).The main advantage of this method is that the process gain remains constant because divider is not used. **(Any other relevant diagram can be considered)**	**02 marks For description** **02 marks for diagram**	
c)	**List the features of a typical DCS**	**04**	
Ans.	1. Modular system development capability 2. Build schematic display develop control program 3. Interoperability. 4. Support for standards.	**01 mark for each point(Any four points)**	

	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		
d)	**Draw and explain feedback control system, to control the temperature of heat exchanger.**	**04**	
Ans.	 In the feedback control system, the temperature of the variable to be controlled is measured directly. If the exiting outlet water temperature is too high, the controller will decrease the amount of steam entering the inlet side of the heat exchanger. Likewise, if the exiting outlet water temperature is too low, the controller will increase the amount of steam entering the inlet side of the heat exchanger.	**02 marks for diagram** **02 marks for description**	
01 B)	**Attempt any ONE**		**06**
a)	**Explain in brief the documents required for the successful completion of an instrumentation project.**	**06**	
Ans.	Instrument index sheet, Data sheet, I/O list, Process flow diagram 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). 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. I/O List: It is a document containing list of instrumentation which serve as an input or output of control system. Process flow diagram: A process flow diagram (PFD) is a diagram	**1 ½ marks for each point(any four points)**	

	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. **(Any other point can be considered)**		
b)	**Draw and explain the cascade control loop for distillation column.**	**06**	
Ans.	Cascade control of distillate composition (top product):  It is used to regulate the temperature at the top or bottom of the distillation column. For regulating the temperature of the top of the column, temperature of the overhead output is measured and controlled by TT and TC. This is the primary loop. Output of TC (primary controller) is given as the setpoint of the FC. The flow rate of the distilled product is measured and controlled by FC (secondary controller), whose setpoint is set by TC. Thus the secondary loop consists of FT, FC and control valve. This is given back as the reflux flow input to the column. Thus the temperature of the top of the distillation column is regulated. **OR**	**03 marks for diagram** **03 marks for description**	

	 Here, level of the feed is measured and controlled, which forms the primary loop. Flow of the distillate product is measured, and controlled with FC, whose setpoint is the output of LC. Thus the primary loop consists of LC and secondary loop consists of FT and FC with control valve. **(Any other relevant diagram can be considered)**		
02	**Attempt any TWO**		**16**
a)	**State the need of valve positioner. Explain any one type of valve positioner with a neat diagram.**	**08**	
Ans.	Need of Valve Positioner: 1. To overcome friction on valve stem through high open loop gain. 2. To increase speed of response when the distance between controller and valve is large by dead end controller. 3. To achieve faster response speed. 4. To provide reverse action of signal pressure. 5. To provide heat range application. 6. Delaying or slowing valve action. 7. Reduces valve hysteresis. 8. Large varying fluid pressures. 9. It can modify valve characteristics. **Types of Valve Positioners:** 1) Electro-pneumatic positioner. 2) The motion-balance Positioner. 3) Force balance positioner	**02 marks (½ mark for each point)** **(any four points)**	

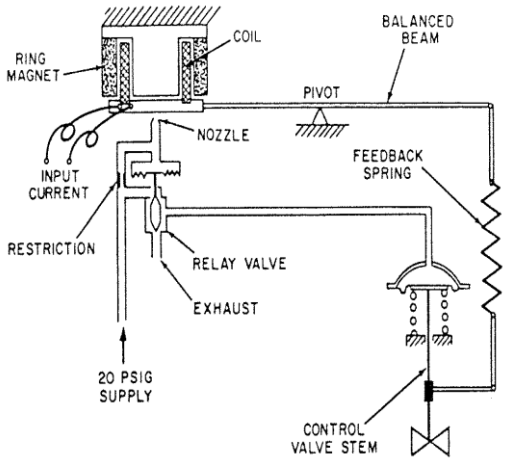


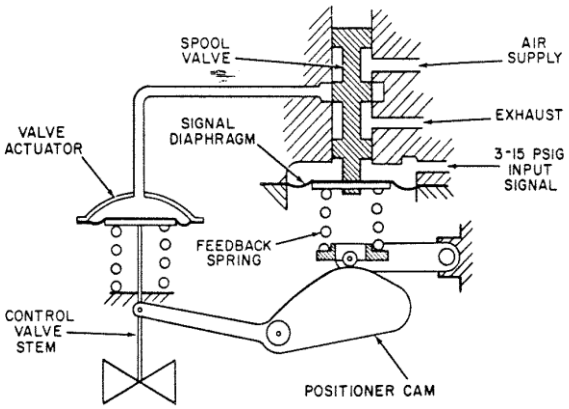
Diagram of Electro-pneumatic positioned

03 marks for diagram

Working: It has a force balance mechanism consisting of electromagnetic coil, flapper-nozzle system, relay, balanced beam, and feedback spring. As an electrical control signal is applied to the coil placed in a ring magnet changes its position. Higher the electrical signal more is the repulsive force between the magnet and the coil. This causes the nozzle back pressure to increase and is applied to the actuator through the relay valve. The change in stem position causes change in the position of the balance beam, which thereby increases the nozzle back pressure and consequently more control signal is supplied to the control valve. This process is continued until the opposite force across the pivot is balanced.

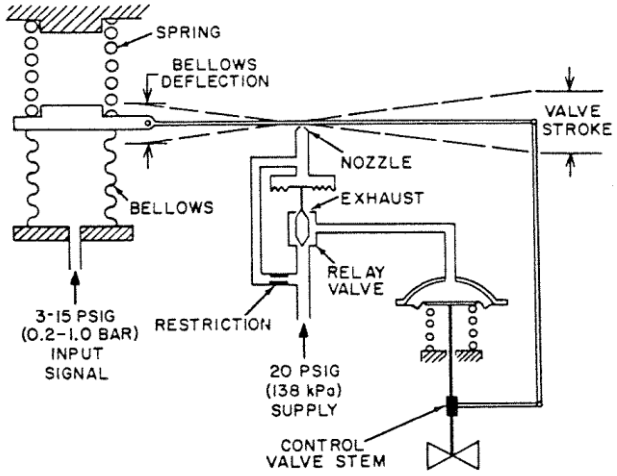
03 marks for description

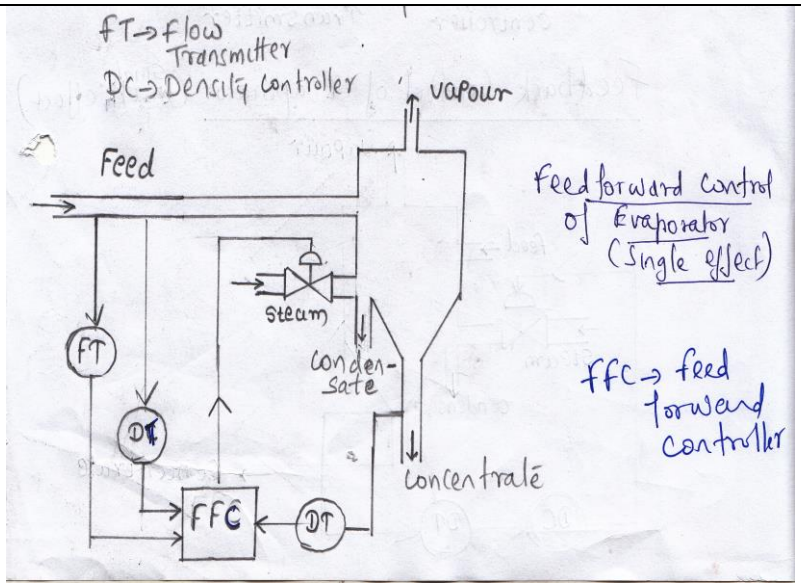
OR



Valve positioner- pneumatic force balance type

Force-balance positioner has an element that compare the force generated by

	the input signal from the controller with the force generated by the feedback spring connected to the valve stem. The feedback derived from the valve position provides a force to balance the input signal. The controller signal acts on a diaphragm which creates a signal force that is opposed by a feedback spring. A spool valve is attached to the other side of diaphragm to provide the supply air to the actuator. A temporary offset in diaphragm position moves the spool valve. Thus the air supply flows to the actuator. The resultant stem motion is sensed by a lever that rotates a cam. **OR**  **Valve positioner-pneumatic motion balance type** It compares the motion of the input bellows with that of stem to which a beam or linkage is attached. The input signal, in pneumatic form, from the controller is given to the bellows. A beam is fixed to one end of the bellows. The other end of the beam is connected to the stem. A relay valve forms flapper-nozzle arrangement with beam. As the bellows moves in response to a changed control signal, the flapper-nozzle arrangement moves the diaphragm actuator until the stem position corresponds to input air signal. Thus equilibrium is attained. **(Any one type with diagram & description can be considered)**		
b)	**i) Draw and explain feed forward control loop for single effect evaporator.** **ii) Explain the term batch process.**	**06** **02**	
Ans.	**i) <u>Feed forward control of evaporator:</u>**		



03 marks for diagram

In the evaporator applications, the control of product density is affected by variations in feed rate and feed density to the evaporator. In order to overcome these load variations, the manipulated variable (steam flow) must be regulated.

The feed forward control system is used to take the corrective action before the error takes place. Thus it reacts to the variations of feed rate and feed density before they affect the product density by controlling the steam flow. Thus the corrective action takes place before the error.

03 marks for description

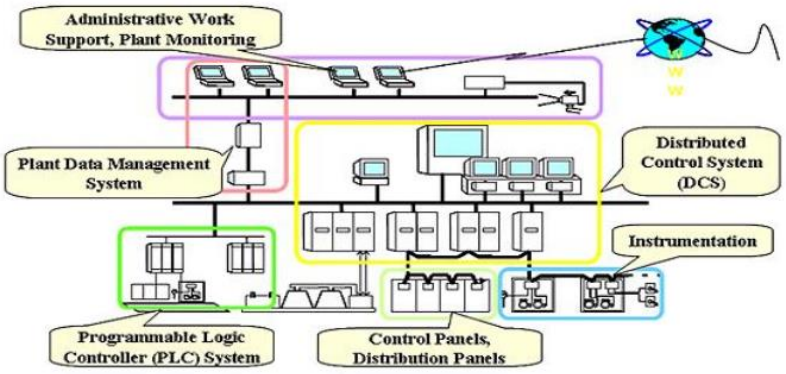
ii) Explain the term batch process:

BATCH PROCESS: it is a process that manufactures a finite quantity of material by subjecting measured quantities of raw materials to a sequential order of processing actions using one or more pieces of equipment.

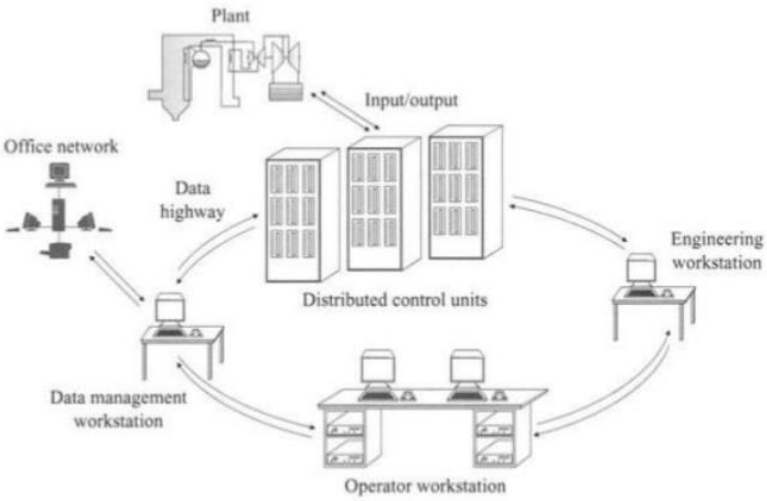
02 marks for batch process description

In batch processes, used in the food, pharmaceutical and fine chemicals industries, products are manufactured in batches. Batch processes are sequential, where the control actions, such as charging, mixing, heating, cooling, and testing are performed in an ordered fashion. Each control action may require many process steps, such as the opening and closing of valves, starting and stopping of pumps, and setting and resetting of control loops. In addition to the normal step-by-step control actions, batch process control requires many other functions: for example, responding to abnormal or failure conditions, keeping batch records, maintaining recipes, and scheduling batches.

c)	**i) Enlist the advantages of DCS.** **ii) Draw the schematic diagram of DCS for thermal power plant.**	**04** **04**	
Ans.	**i) Advantages of DCS**: 1. Overall cost of the installation is lower. 2. Less wiring required due to serial communication. 3. Panel space is reduced. 4. Allows inter-controller communication. Hence programming can be done from any location. 5. Flexible and relatively easy to expand. 6. It allows duplicate storage of data. 7. High reliability. 8. Application program can be easily developed. 9. Interface with the process is improved. 10. Advanced control technique. 11. Provision of redundancy. 12. Optimum utilization of available man-power. 13. Minimum data losses & errors. 14. Reduces manpower requirement. **ii) Draw the schematic diagram of DCS for thermal power plant**	**01 Mark Each (any four Points)** **04 marks for diagram**	



OR



(Any other relevant diagram can be considered)

03	**Attempt any FOUR**		**16**
a)	**Draw and explain feed forward concept of drum boiler.**	**04**	
Ans.	**Feed forward control of drum boiler(Two element control):** The term 'two-element' is derived from measurement of two variables: steam flow and drum level that influence on the feed water valve position. It is sometimes referred as a combination 'feed-forward-feedback' system because the steam flow demand is fed forward and the drum level signal becomes the feedback for controlling/manipulating feed water to boiler drum. The two-element drum level control shown in following figure. Steam flow is measured by the steam flow transmitter (FT-1), its signal is fed to the feed water flow computer (FC-1) after processing through the square root	**02 marks for diagram**	

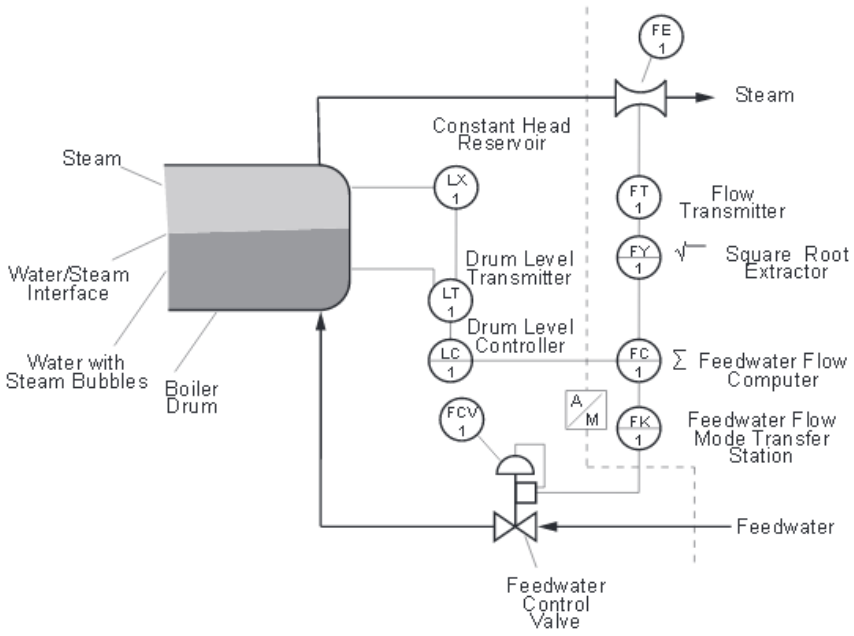
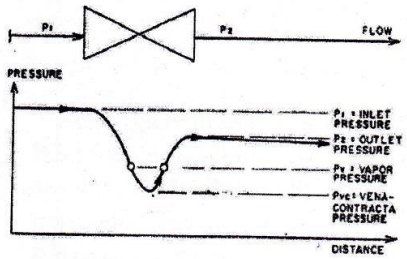
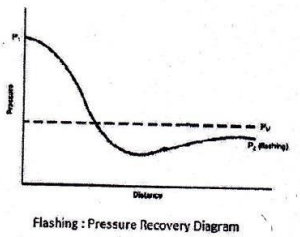
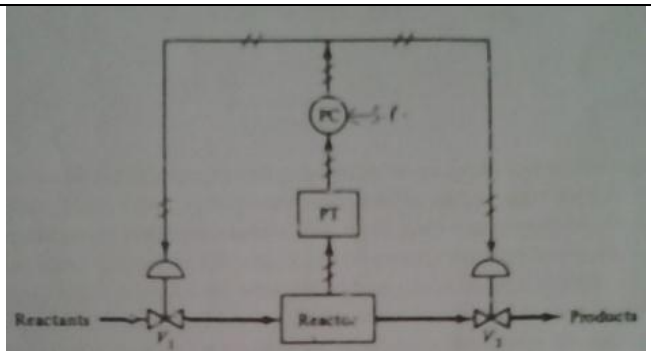
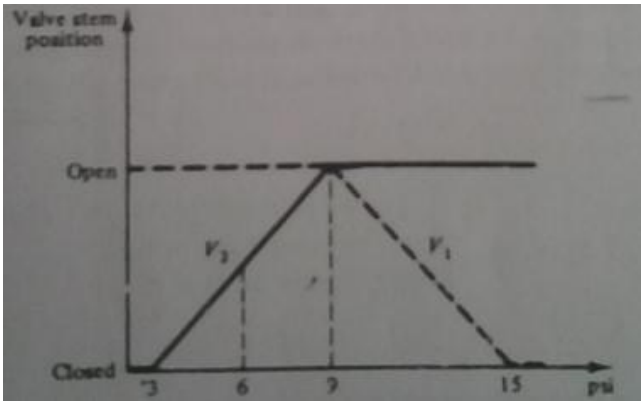
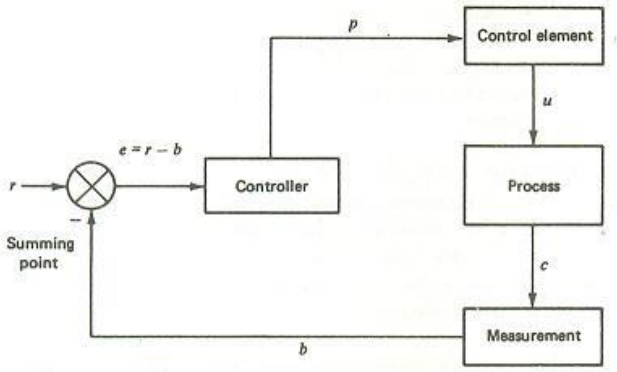
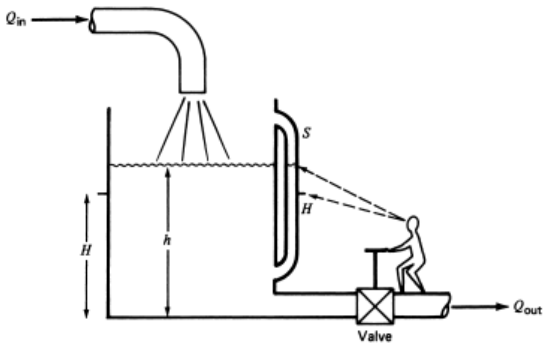
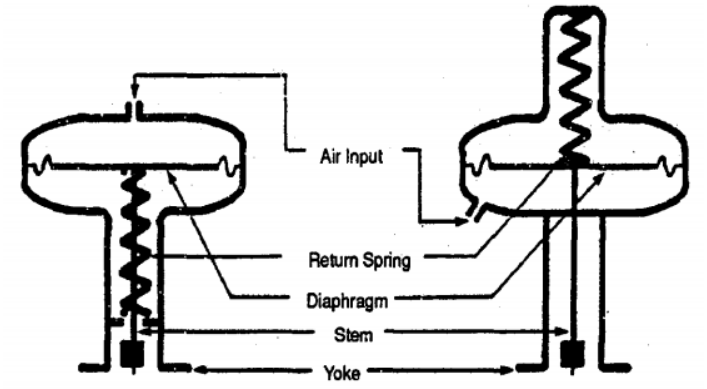
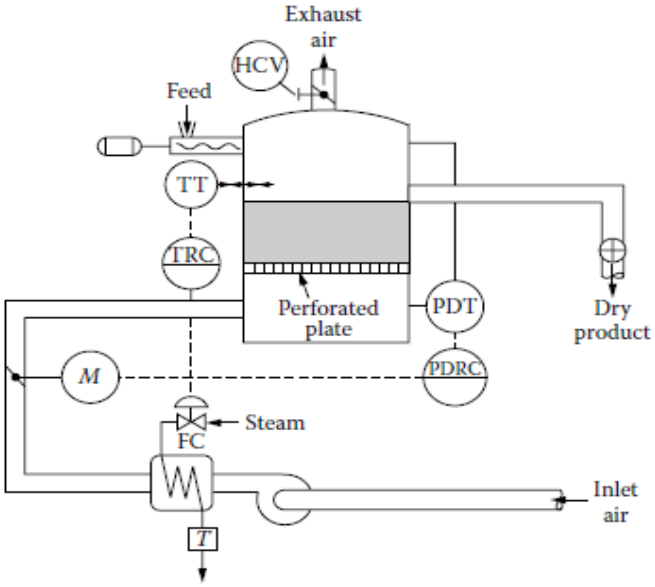
	extractor (FY-1). As in the single-element level control, the drum level is measured by the level transmitter (LT- 1) and its signal is transmitted to the drum level controller (LC- 1). In the drum level controller, the process signal is compared to the drum level set-point, where a required corrective output signal to maintain the drum level is produced. This corrective signal is sent to the feed water flow computer. The feed water flow computer combines the signal from the two variables, and produces an output signal to the feed water control valve (FCV- 1). Auto/Manual transfer of the feed water control valve is accomplished via FK-1.  *Two-element drum level control system*	**02 marks for description**	
b)	**Explain how flashing occurs in control valves. State the remedies to overcome it.**	**04**	
Ans.	**Flashing:** In liquid applications, when the downstream pressure (P2) is equal to or less than the vapor pressure(Pv), the vapor bubbles generated at the vena contracta stay intact and do not collapse. This happens because the pressure recovery is high enough for this to happen. This phenomenon is known as flashing(P2<Pv). When flashing occurs, the fluid downstream is a mixture of vapor and liquid moving at very high velocities, resulting in erosion in the valve and in the downstream piping.	**02 marks for explanation**	

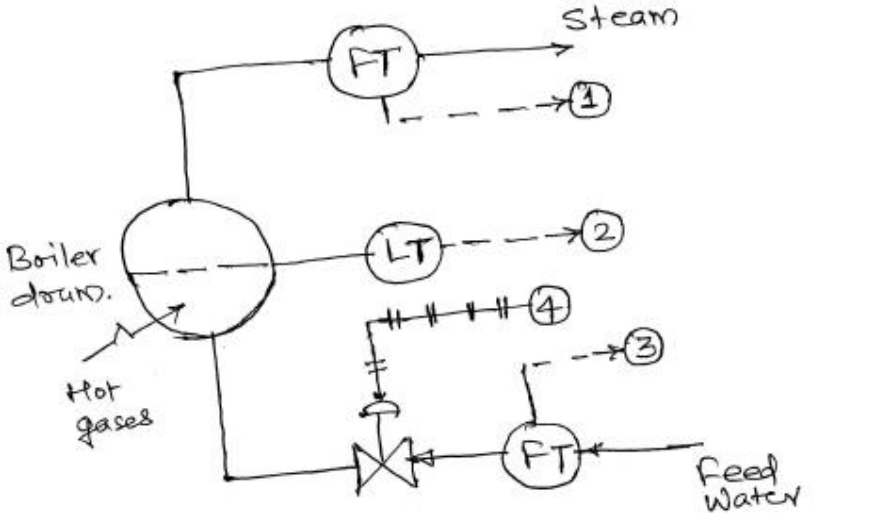
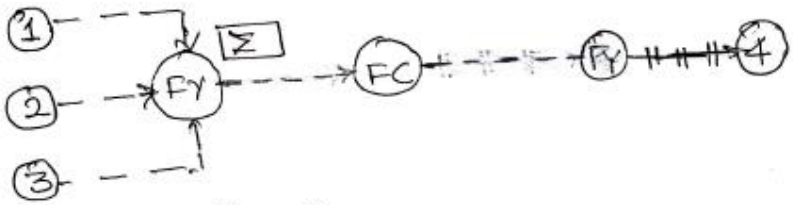
	Fig: Caviation phenomenon  Fig: Flashing  Flashing : Pressure Recovery Diagram phenomenon **Remedies to avoid the problem of flashing** 1. The damage from flashing can be minimized by reducing velocity by using reduced port angle valve discharging directly into vessel or flash tank. 2. Using erosion resistant material such as ceramic material lining provided at downstream of control valve.	**02 marks for remedies**	
c)	**Explain split range control.**	**04**	
Ans.	**Split range control:** It is control system which has one measurement (controlled output) and more than one manipulated Variable. Since there is only controlled output, we have only one control signal which is then split into several parts. i.e. Two or more final control devices(FCE) are controlled by one controller signal.(4-20mA) Consider the reactor shown in following **fig. a**, where a gas phase reaction takes place. Two control valves manipulate the flows of the feed and the reaction product. Let the controller‟s output signal corresponding to the desired operation of the reactor be 6 psig. From fig. we see that valve V2 is partly open while valve V1 is completely open. When for various reasons the pressure inside the reactor increases, the controllers‟ output signal also increases. Then it is split into two parts, affects the two valve simultaneously, and the following action takes place. 1. As the controller output increases from 6 psig to 9 psig, valve V2 opens continuously while V1 remains completely open. Both actions lead to a reduction in the pressure. 2. For the large increase the reactor pressure, the control output may exceed 9 psig. In such a case as we can see from **fig b** valve V2 is completely open while V1 starts closing. Both actions again lead to a reduction in pressure until the reactor has returned to the desired operation	**02 marks explanation**	

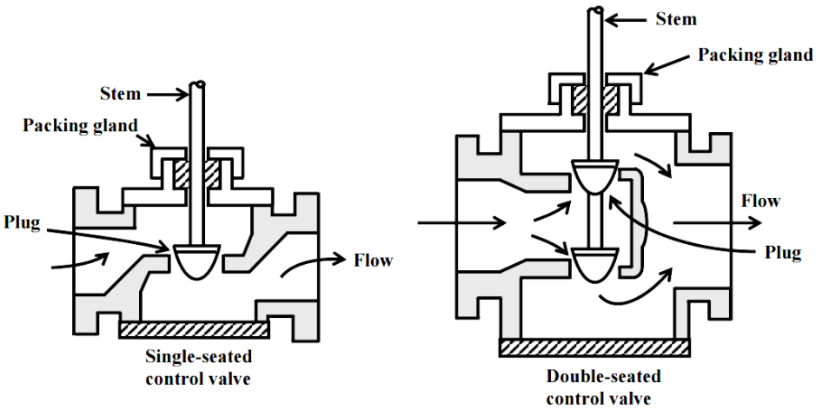
	 **Fig.a)**  **Fig.b)**	**01 mark for each diagram**	
d)	**Find the value of C_v for a valve that must allow 500 gallons per minute of ethyl alcohol with a specific gravity of 0.9 at a minimum pressure of 20 psi. Estimate the required the valve size.**		
Ans.	Q = 500 gal/min, ΔP = 20 Psi, G = 0.9 Equation for flow rate, $Q = C_V\sqrt{\frac{\Delta P}{G}}$ Therefore, $C_V = Q\sqrt{\frac{G}{\Delta P}}$ Substituting we get, $C_V = 500\sqrt{\frac{0.9}{20}}$ =106.06 For a C_V of 106.06 , the required valve size is 3 inches. The valve size in cm = 3 x2.54 = 7.62 cm	**01 mark for each step**	
e)	**i) Name the developers of Mod bus and control net.** **ii) Enlist any four features of profi-bus**	**02** **02**	

Ans.	**i) Developers of Mod bus and control net.** **Modbus**- Modicon **Control Net**- Allen Bradley **ii)Features of profi-bus** 1) PROFIBUS is based on RS-485 transmission technology 2) Maximum distance is 400-800 m with repeaters 3) Transmission speed is 9.6 Kbps to 12 Mbps 4) Up to 32 stations (master or slaves) can be connected in a single segment. For connecting more than 32 stations repeaters may be used. 5) A maximum of 126 devices can be connected to bus. 6) It requires shielded twisted pair copper cable , fibre optic cable for large distances.	**01 mark each** **01 mark each point(any four)**	
04 A)	**Attempt any THREE**		**12**
a)	**Draw the block diagram of Process Control system. Explain human aided control system with an example.**	**04**	
Ans.	 	**02 marks for block diagram**	

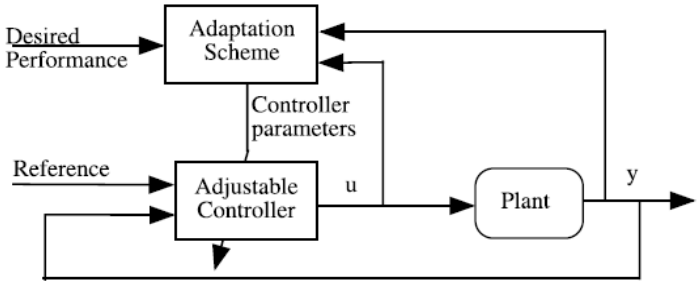
	To regulate the level so that it maintains the value H, a sensor is employed to measure the level in the tank through sight glass. The actual level, h is called the controlled variable. A control valve at the outlet of the tank is changed by the human to regulate the level. The output flow rate is called the manipulated or controlling variable	**02 marks for example explanation**	
b)	**With respect to the control valve explain direct and reverse action.**	**04**	
Ans.	 **Direct Acting Actuator (Air to close)** **Reverse acting actuator (Air to open)** Air to close: Direct acting actuator will cause the actuator stem to be pushed downwards as a result of applying signal air to the top of the diaphragm. Air to open: Reverse acting actuator will push the actuator stem upwards as a result of applying signal air applied to the bottom of the diaphragm **Any other relevant diagram can be considered**	**02 marks each** **(01 mark diagram** **01 mark explanation in each)**	
c)	**i) Explain the concept of "Unit Operation".** **ii) Draw the feedback control scheme of dryer and label it.**	**02** **02**	
Ans.	i)A **Unit operation** is a basic step in a process. Unit operations involve a physical change or chemical transformation such as separation, crystallization, evaporation, filtration, polymerization, isomerization, and other reactions. For example, in milk processing, homogenization, pasteurization, chilling, and packaging are each unit operations which are connected to create the overall process. A process may require many unit operations to obtain the desired product from the starting materials, or feedstocks.	**02 mark for definition**	

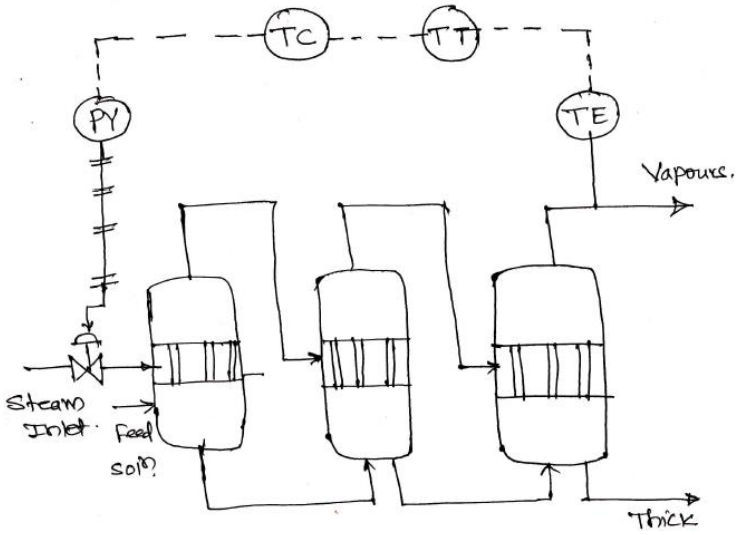
	ii) Feedback control scheme of dryer  **(Any other relevant diagram can be considered)**	**02 marks for diagram**	
d)	**Draw P & ID diagram for 3 element control system in boiler.**	**04**	

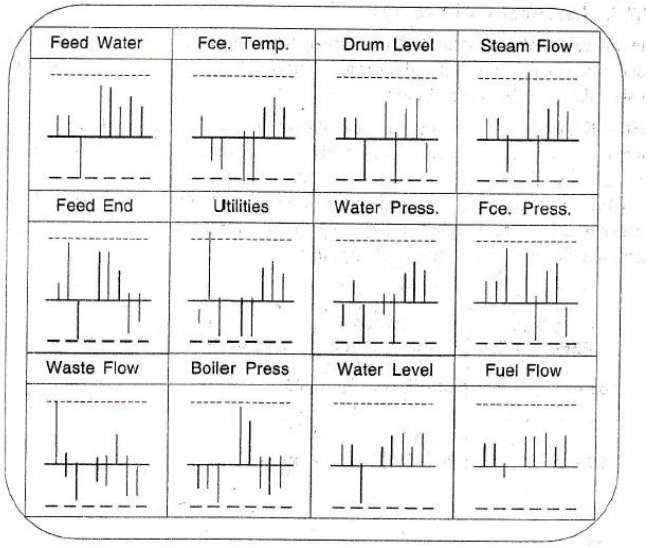
Ans.	 Fig:- Three element Drum level control. Alternative -1  Alternative-2  **Any other relevant diagram can be considered**	**04 marks**	
04 B)	**Attempt any ONE**		**06**
a)	**With neat diagram explain (1) Single seated control valve (2) Double seated control valve**	**06**	

Ans.	 **Single seated Valve-** 1) Has only one plug 2) Simple in construction 3) Used for sizes 2 inches and below 4) Unbalanced forces on the plug; therefore requires large size of actuators **Double seated valve** 1) Has two plugs 2) High flow capacities 3) Used for sizes 2 inches and above 4) Forces are balanced on the plug; therefore requires smaller size of actuators	**03 marks each** **(02 marks For diagram 01 mark for explanation in each)**	
b)	**Differentiate between single seated and double seated globe valve**	**06**	
Ans.		**01 mark each** **(any six points)**	

Sr No.	**Single seated valve**	**Double seated valve**
1	Single plug is used	Double plug is used
2	Low flow capacity	High flow capacity
3	Tight shut off	Tight shut off is not possible
4	No leakage	Leakage is present
5	Low pressure drop	High pressure drop
6	No cascade required	Cascade is required to avoid leakage
7	More force is required to drive the stem	Less force only is required to drive the stem
8	Used for small diameter applications	Used for large diameter applications

05	**Attempt any TWO**		**16**
a)	**i) Explain the technique of adaptive control for process control system.** **ii) Explain the necessity of valve positioners.**	**04** **04**	
Ans.	**i) Adaptive control for process control system:** **Diagram:**  In Adaptive control, the parameters are automatically adjusted to meet the corresponding variation in the parameters of the process being controlled in order to get the desired response of the control loop. Unlike the conventional control system where the parameters are fixed and outputs are variable, in adaptive control system, the parameters re adjusted. In the diagram shown above, a closed loop controller is shown whose parameters can be changed to change the response of the system. The output of the system is compared to the desired performance and based on this error, the controller parameters are adjusted. **ii) Necessity of valve positioned:** 1. To overcome friction on valve stem through high open loop gain. 2. To increase speed of response when the distance between controller and Valve is large by dead end controller. 3. To achieve faster response speed. 4. To provide reverse action of signal pressure. 5. To provide heat range application. 6. Delaying or slowing valve action. 7. Reduces valve hysteresis. 8. Large varying fluid pressures. 9. It can modify valve characteristics.	**02 marks diagram** **02 marks for explanation** **01 mark for each point** **(any four points)**	
b)	**i)Draw P & ID schematic of multieffect evaporator with feedback control.** **ii) State need of instrument index sheet and data sheet.**	**04** **04**	
Ans.	**<u>i)Multieffect Evaporator:</u>**	**04 marks for diagram**	

	 **ii)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 through 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 **(Any other point can be considered.)**	**01 mark for each point**	
c)	**i) Explain in brief overview and group display of DCS.** **ii) Draw the block diagram TDC 3000 DCS system.**	**04** **04**	
Ans.	**Overview Display**: The overview display shows the bare essentials of number of groups, each group in a separate rectangle. If a group display has eight loops in a row, the reference line will have eight segments. The set-point is shown as a straight line reference. Deviation of process variable from set-point appears as a vertical bar. If the process variable for a particular loop is greater than a set-point, a verticle line will rise up out of the reference line from the segment corresponding to that particular loop. IF the deviation is in the other direction, a vertical line will drop down from the segment.	**02 marks for Overview display explanation**	

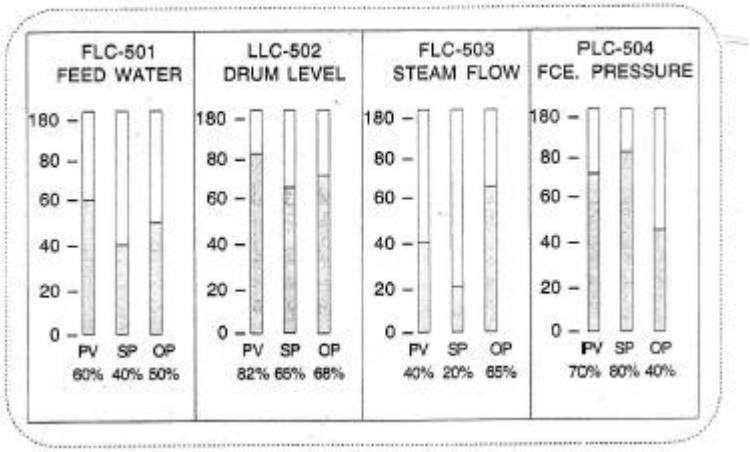


Overview display

Group Displays of DCS:

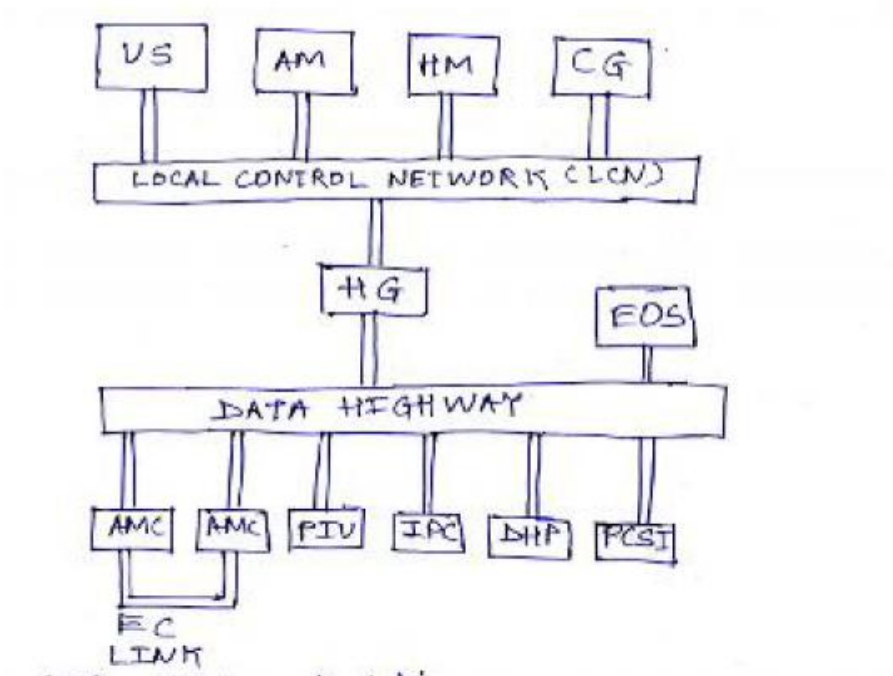
Group displays shows parameters for up to eight points and permit operators manipulation. These may be indicating or controlling
analog points, single or dual I/O points.
Group display shows the operating parameters of group of control loops such as four, eight, twelve, or sixteen control loops, arranged in rows so that they look the faces of instruments on an instrument panel.
Figure shows a four-unit group display. Each of the control loop is represented by a rectangle with a bar graphs to indicate the values of the process variable(PV) and the output (OP)signal.

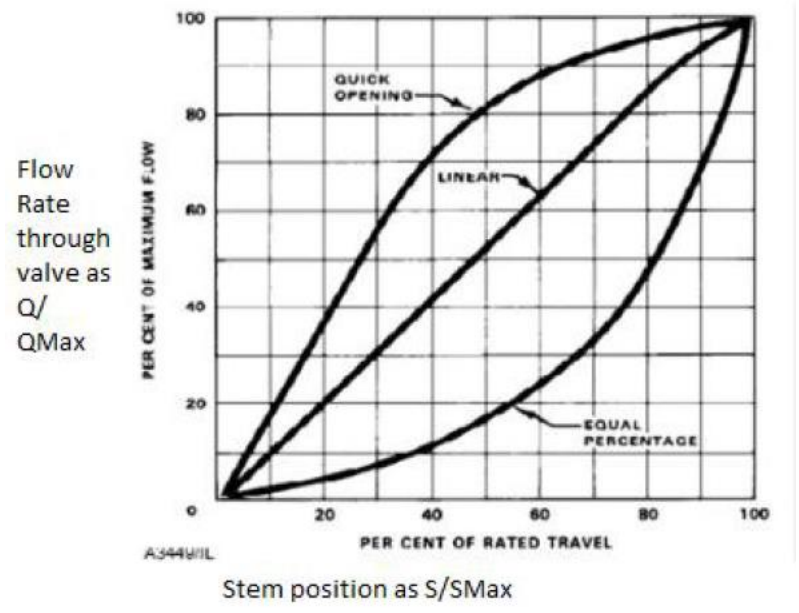
02 marks for group display explanation



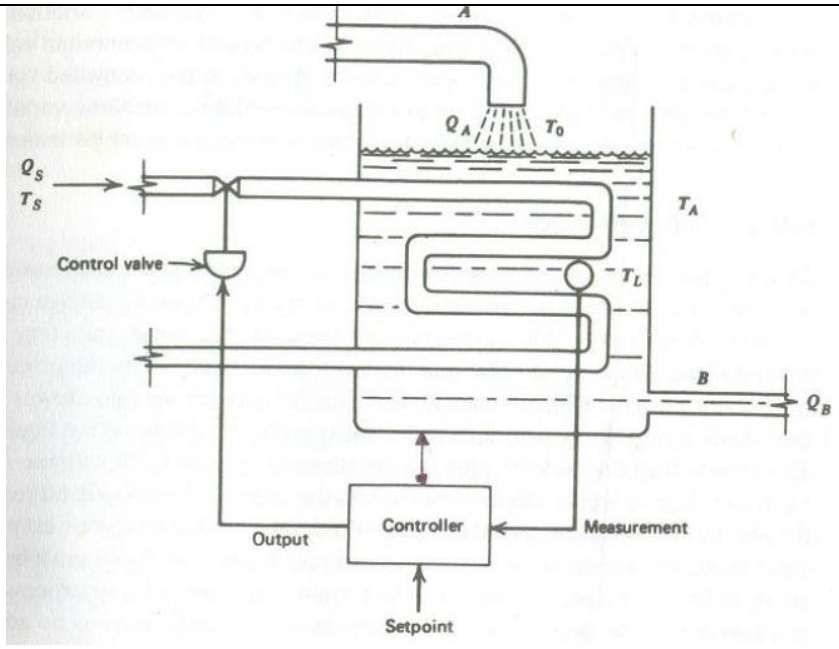
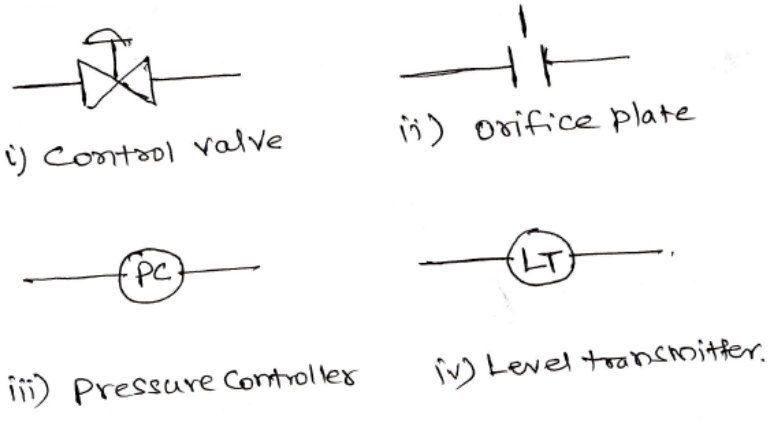
Group display

Additional detailed data is progressively exposed to operator as individual point are selected either by keyboard or touch screen. Up to 400 group displays may be configured in universal station.

	ii) Block diagram TDC 3000 DCS system  VS – Universal station AM – Application module HM – History module AMC – Advanced multifunction Controller CG – Computer gateway HG – Highway gateway PIU – Processor interface unit IPC – Industrial programmable controller DHP – Data Hiway Port. PCSI – PC serial interface. EOS – Enchanced operator station.	**04 marks for diagram**	
06	**Attempt any FOUR**		**16**
a)	**Describe alarm and event management in DCS.**	**04**	
Ans.	1. An event is any noteworthy occurrence in your process or system that you want the system to react to and record. 2. Events that are brought to the operator's attention are alarms. 3. Along with standard alarms and events, the DCS system provides the means for users to easily create their own specific alarms and events. 4. Alarms can be applied to any parameter. When that parameter is non-zero, the system can generate an alarm. 5. The event can be logged to the Event Chronicle and optionally brought to the operator's attention as an alarm.	**04 marks for description**	

	6. Hardware alarms are generated in the DCS system itself (controllers, workstations, I/O cards, and so on) to alert operations and system maintenance staff to problems so that expeditious actions can be taken to resolve these problems. 7. The DCS provides special preconfigured displays that show operators the most important active alarms under their control. Active alarm lists can be shown by plant area or unit. 8. With the appropriate security keys, the operator can acknowledge alarms and suppress noisy alarms until the cause can be resolved. 9. The DCS supports predefined (standard) alarms & custom alarms. 10. Standard alarms consist of HIGH-HIGH, HIGH, LOWLOW, LOW, DEVIATION HIGH, and DEVIATION LOW. Standard alarms are only available in function blocks with built-in alarm state computation. 11. Custom alarms are supported at the module level (except unit modules and phase logic modules). Custom alarms reference existing parameters or user-defined expressions. A custom alarm can be used as an alarm for the operator or an event to be logged. You customize the alarm by selecting from a set of options.		
b)	**Enlist and explain characteristic of control valve.**	**04**	
Ans.	 **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.	**02 Marks for diagram** **02 Marks for explanation**	

	2. Linear: This type of valve characteristic has a flow rate that varies linearly with stem position. It represents ideal situation where valve alone determine the pressure drop. Relationship is expressed as, **$Q/ Q_{max} = S/ S_{max}$** **3. Equal Percentage:** In equal percentage valve equal increment of the stem travels give equal % change of the existing flow. This type of valves does not shut off flow completely when at one end of its travel. Relationship is expressed as, **$R= Q_{max}/Q_{min}$** Where R = Rangebility Qmax = Maximum Flow rate Qmin = Minimum Flow rate **$Q= Q_{min}(R)^{S/Smax}$** Where Q = Flow rate S = Stem Position Smax = Maximum Stem Position **$Q/ Q_{max} = S/ S_{max}$**		
c)	**Describe any four safety interlocks for boilers.**	**04**	
Ans.	**Safety interlocks for Boilers:** **1. Purge Interlock:** Prevents fuel from being admitted to unfired furnace until furnace has been thoroughly purged. **2. Low Air Flow Interlock:** Fuel is shut off upon loss of air flow and / or combustion air fan. **3. Low fuel supply Interlock:** Fuel is shut off upon loss of fuel supply otherwise unstable flame condition results. **4. Loss of flame Interlock:** All fuel is shut off upon loss of flame. **5. Fan Interlock:** Stop of F.D. fan upon loss of I.D. fan.	**01 mark each point**	
d)	**Draw the block diagram of a temperature control system for any one application. Identify the element used.**	**04**	

Ans.	 **Element Used are:** 1) Temperature transmitter – Feedback Element 2) Temperature controller - To manipulate the error signal, generate and transmit control signal to the control valve 3) Control Valve – Final control element 4) Tank (Process vessel), flow & Steam pipes – Parts of the process. **(Any other relevant diagram may also be considered.)**	**02 marks diagram** **02 marks for element**	
e)	**Draw P & ID symbols of (i) control valve with actuator (ii) orifice plate (iii) pressure controller (iv) level transmitter**	**04**	
Ans.		**01 mark each symbols**	