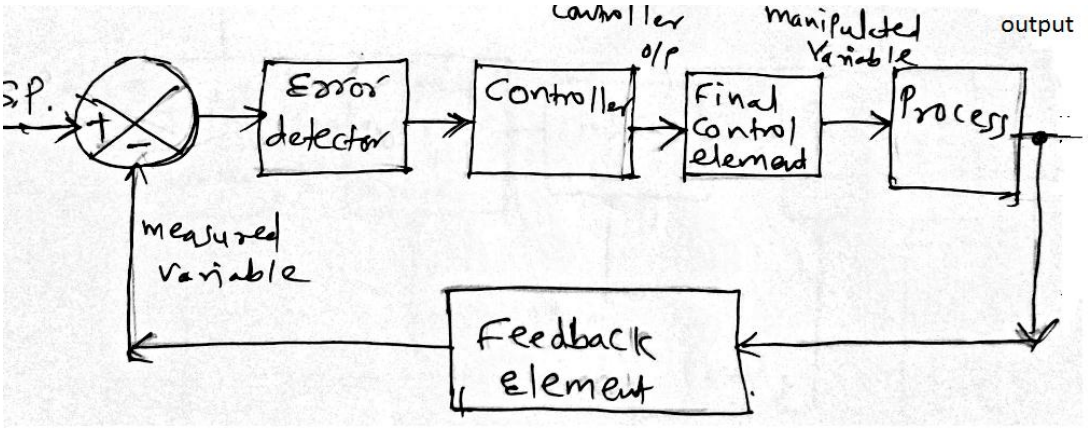
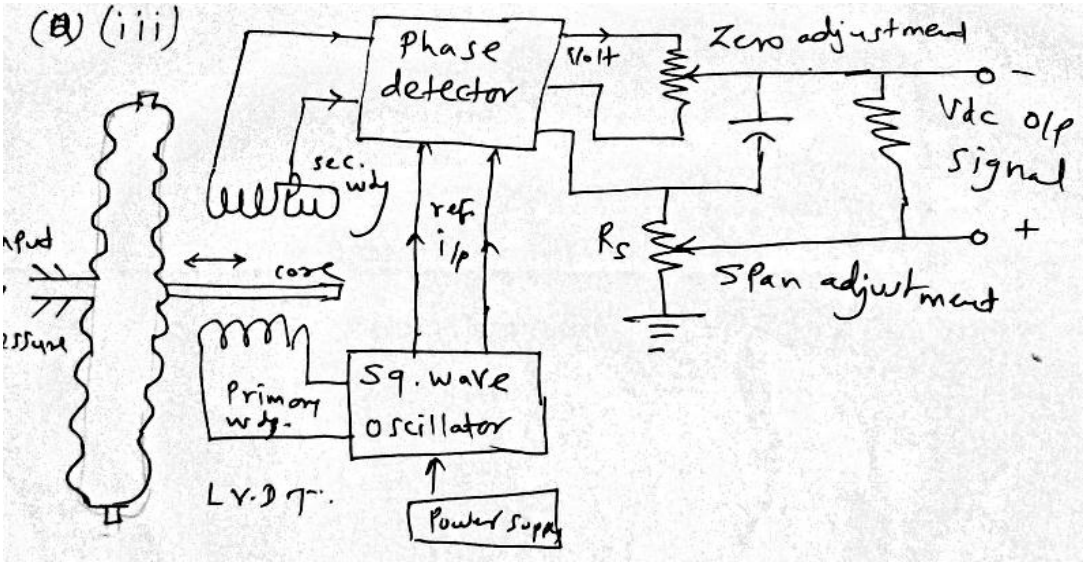
WINTER – 14 EXAMINATION

Subject Code: 17540 **Model Answer**

Important Instructions to examiners:

1) The Answer should be examined by keywords and not as word-to-word as given in the model Answer scheme.
2) The model Answers and the Answers 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 Answers.
6) In case of some questions credit may be given by judgments on part of examiner of relevant Answers 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
1 a	**Attempt any Three of the following:**		12
i.	**Draw a generalized block diagram of process control system and define the terms:** **1. Manipulated variable 2.Controlled variable**	04	
Ans:		Diagram: 2 marks	

	Definition 1. Manipulated variable: It is a variable that is manipulated to control the controlled variable. 2. Controlled variable: it is variable that is being controlled in the process control system.	1 mark for each definition	
ii.	**State the need for signal transmission. Write the standard electronic and pneumatic transmission signal ranges.**	**04**	
Ans:	**Need for signal Transmission**: If the distance between working field (process / Plant) and control room is far then there is need of signal transmission. The sensed variables by transducer at field are to be transmitted to control room and control signal generated by controller in the control room are to be transmitted to field Standard electronic transmission signal range: 4 mA to 20mA Standard pneumatic transmission signal Range: 3 psi to 15 psi.	2 Marks 1 mark 1 Mark	
iii.	**Explain pressure to current converter with neat labeled diagram.**	**04**	
Ans:	 **pressure to current converter**	**2marks diagram**	

Explanation:-
The input pressure to be converted is applied to corrugated type capsule pressure sensor. It gives mechanical deformation of free end when input pressure applied increases.
As the free end is connected to core of LVDT, the displacement of capsule sensor displaces core.
Primary winding of LVDT is excited by square wave oscillator. The o/p voltage between two secondary windings of LVDT is given to phase detector circuit.
The reference signal for this ckt is given to be from square wave oscillator. The dc o/p voltage of Phase detector circuit is given to zero adjustment and span adjustment circuit.

2marks explanation

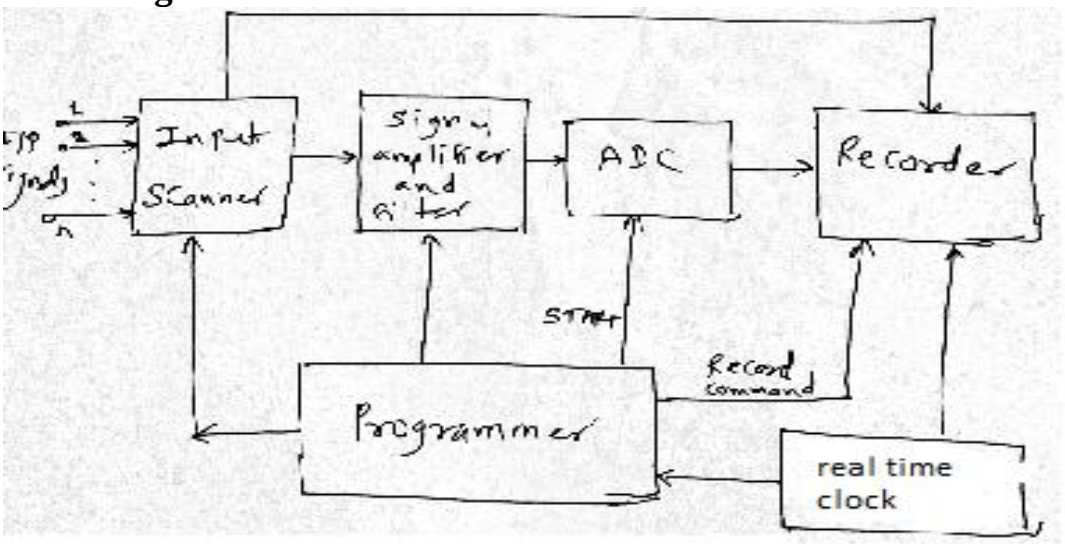
iv. Differentiate between DAS and Data logger .(any 4 points) **04**

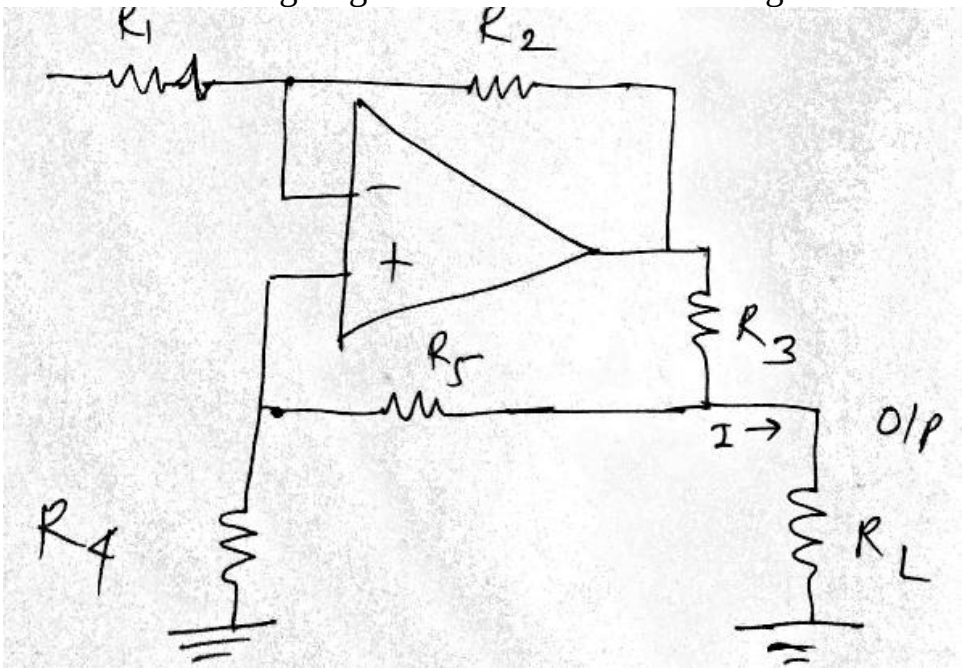
Ans:

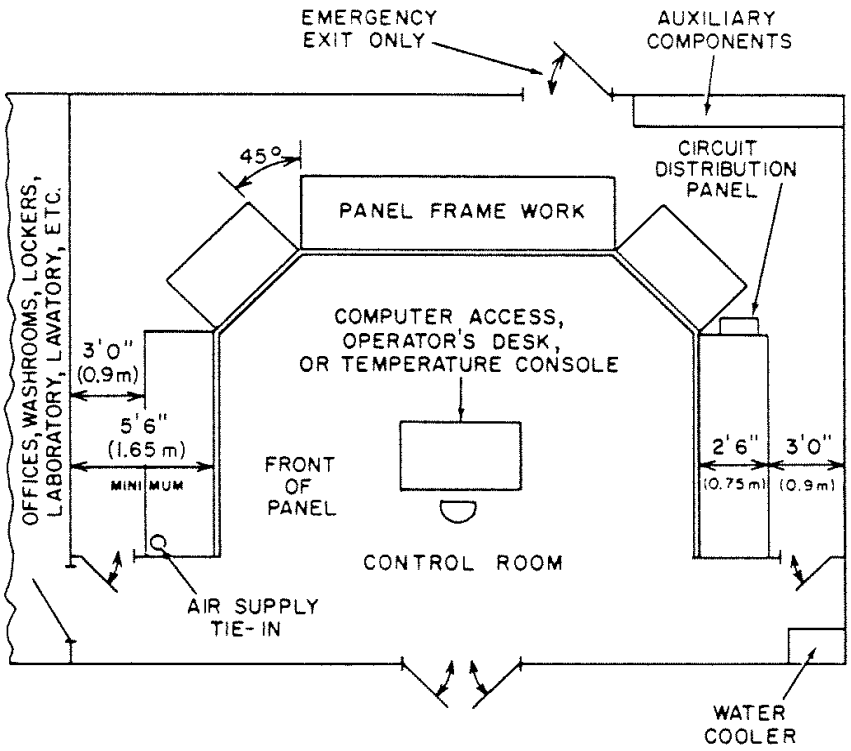
DAS	Data logger
1) It is system in which analog data form source is acquired and converted in to digital form	1)it is system in which automatically make record of reading of source or instrument located at a different parts of plant.
2) There are single channel and multichannel types of DAS	2)It is multichannel only
3)It doesn't contain programmer / Processor	3)It contains programmed which control all operations of Data logger
4) Recording devices are not part of DAS	4)There are recording devices connected for data logging
5) It is used for acquisition of real time data from process	5)It is used for automatic recording of process parameters
6) Used for applications like wind tunnel measurements, Radar control , Fire control etc.	6)Used in applications like power generation plant, in engine testing , evaluation of equipment or system

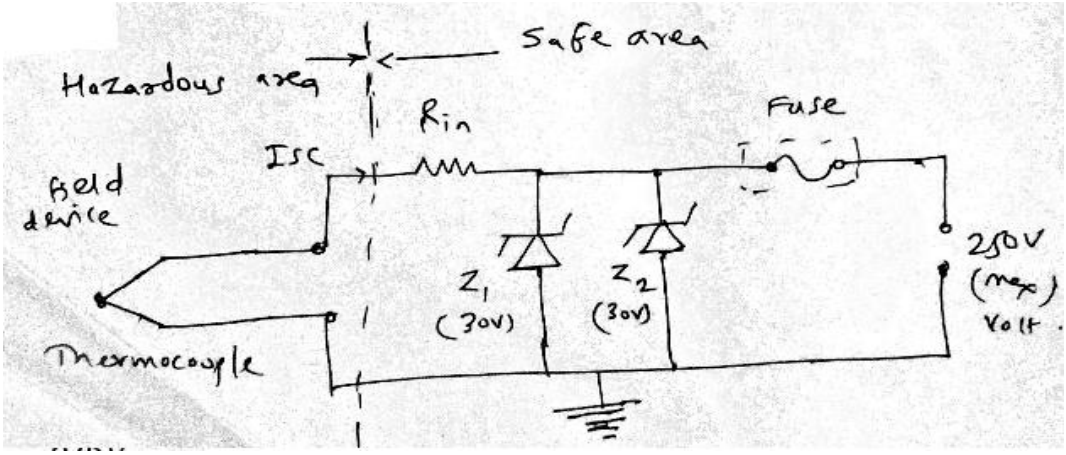
one difference point 1 mark (max 4 marks for 4 points)

- **other than above relevant points should be considered**

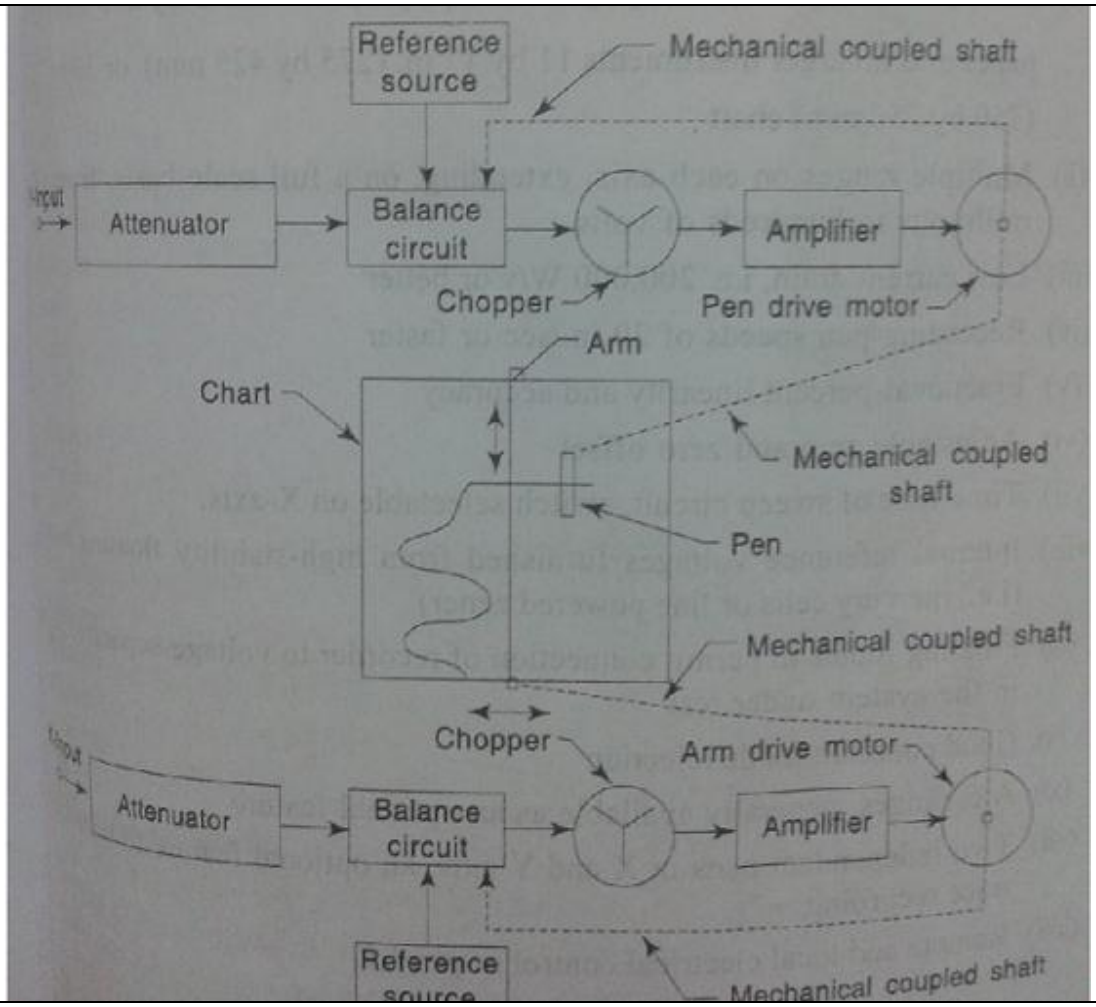
1 b	Attempt any one of the following:		06
i.	Draw a block diagram of data logger and explain its working.	06	
Ans:	**Block diagram:**  **Explanation :** It is highly advanced DAS. I/P Signals: variety of signals are recorded by data logger like o/p of transducer , pressure, temperature, AC signals, Digital , Pneumatic signals etc. I/P Scanner: it is multi way switch which is operated by scanner drive unit for selecting i/p channel. it selects each i/p signal in sequences , so has require only one signal conditioner circuit and ADC Modern i/p scanner have scan rate of 150 i/ps per sec. Signal amplifier and filter ckt: It linearizes the o/p of nonlinear transducer or signals. Low level signals are amplified. Noise and harmonics are removed by filter ADC: it convert analog signal from scanner into digital, which are compatible to programmer. More number digital o/p bits, higher the resolution of ADC. There are different methods to convert analog into digital signal. Any suitable method is used. Programmer: It is processor which does control over all operation form scanner to recording data. Setting of amplifier gain, linearization is done by programmer. It sets high, low level for alarm unit that will initiate audio or video indication when variable crosses set limit. It gives command to recorder for displaying and recording of data. Recorder: It permanently records the digital data by any type of recorder. Data may be printed on paper or recorded in digital signal form.	**2marks** **4marks**	

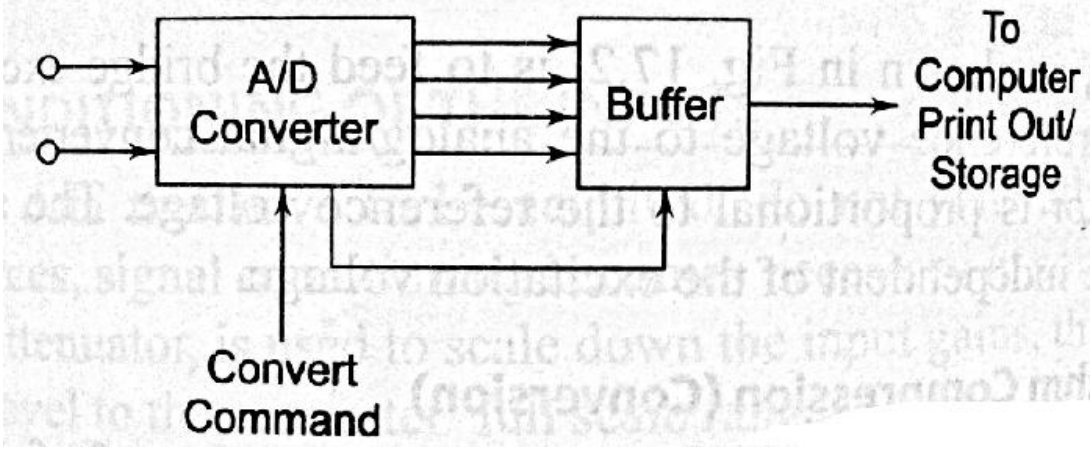
b.	**Explain with a neat circuit diagram grounded load type V to I converter**	**06**	
Ans:	This converts Voltage signal into standard current signal.  **V to I converter with grounded load** **Explanation:** In process control system mostly current signals are used for transmission. So it is necessary to convert voltage signals in to current signal. Above circuit converts voltage signal in to standard current signal 4mA to 20mA. This is simply differential amplifier with grounded load. The o/p equation of current is described by $I = \frac{R2}{R1*R3} * Vin$ Provided with condition of resistances that resistances are selected such a that R1*(R3 + R5) = R2*R4 By selecting proper resistors the o/p current is obtained in standard range.	**Diagram 3 marks** **3 marks**	

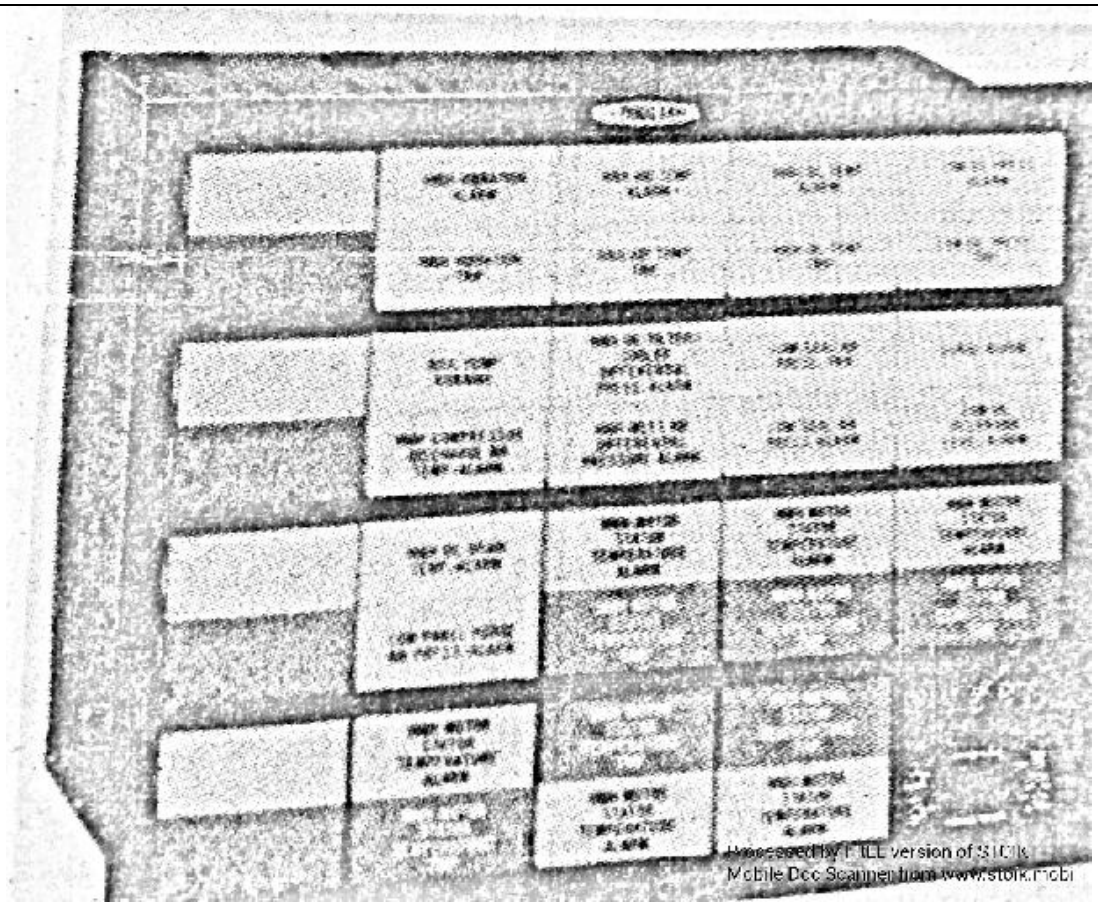
2.	Attempt any two of the following:		16
a.	**Draw a general layout of control room. Discuss any six ergonomic considerations of it.**	**08**	
Ans:	 **general layout of control room** Ergonomic consideration required for control room: 1) There should be sufficient light for better visibility of panel and its equipment's for an operator. 2) Back side of panel should also be lightened 3) Some panels are indicating devices may require lower light intensity better readability, in case of LCD , LED display . 4) There should be better communication between panel instrument and field instrument, so that there is fast exchange of data. Communication network should support all types of communication protocols 5) The signal cables, power cables, control cables are to be grouped together which are of same nature. Each group of Cable should be in enclosed piping with fire proof, withstanding with atmospheric condition changes. 6) There should be Fans and good ventilation for maintaining Temperature of control room in safe limit 7) There should be minimum required spacing between devices for	Diagram:2 marks One point 1 mark max 6 marks	

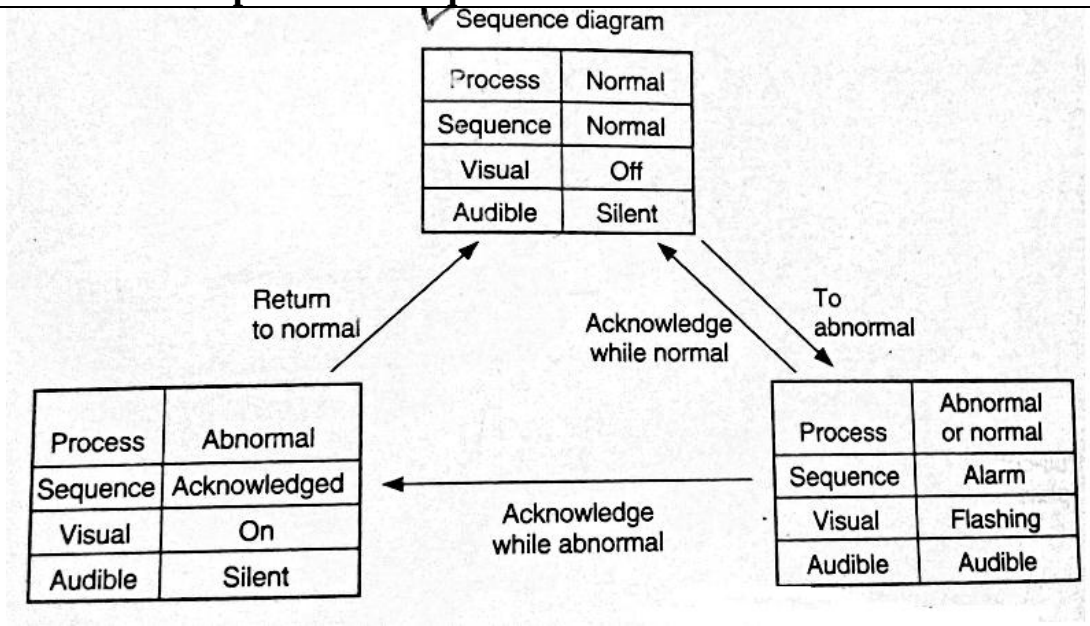
	optimum use of control room 8) Control room should be free from vibrations, dust free. **(Other relevant points should be considered for answer.)**		
b.	**state any 8 features of SMART transmitter**		
Ans:	Features of SMART transmitter: 1. It is microprocessor microcontroller based. 2. It has self-diagnostic loops for removal of errors occurred in itself. 3.It does remote fault diagnosis 4. It has auto ranging adjustment. or Auto span adjustment 5. It has zero adjustment 6. It supports digital communication 7. It does local indication along with long transmission of data 8. There are standby sensors. **(Other relevant points should be considered for answer.)**	one feature for 1 mark Max 8 marks	
c.	**Construct a zener barrier to make a thermocouple intrinsically safe and explain it.**	**08**	
Ans:	 **A zener barrier circuit for thermocouple intrinsically safe** **Explanation :** This is protection placed between Hazardous area and safe area. This works on protection by limiting voltage or current in abnormal or fault condition. In this circuit there is diversion of fault energy to ground through zener diode The thermocouple placed in hazardous are is connected to zener barrier ckt .In normal condition barrier ckt passes electrical signals in both direction. But when fault occurs then high current due to fault passes to ground through fuse and zener diode.	4 marks for diagram 4 marks Explanation	

	The fuse is rated to blow off very quickly in order to prevent failure of even zener diode and to keep isolation between hazardous area and safe area. Once fuse is blown off, total zener barrier ckt is replaced by new ckt. Proper grounding is necessary in this ckt. But is simple to construct , maintain , economical.		
3.	**Attempt any Four:**		**16**
a.	**List different process instruments used as feedback and final control element (four each)**	**04**	
Ans:	Feedback control element: 1.Temperature transducer/ transmitter 2.Level transducer/ transmitter 3.Pressure transducer/ transmitter 4.Flow transducer/ transmitter Final control element: 1.Control valves 2.Variable speed drives 3.Relays 4.Variable fluid pumps • Any other relevant examples can be considered.		
b.	**Draw block diagram of X-Y chart recorder**	**04**	
Ans:	1. An X-Y recorder is an instrument for the graphic recording of the relationship between two variables. 2. The signal enters each of the two channels through input attenuators where they are adjusted to the inherent recorder. 3. The signal then passes through a balance circuit where it is compared with an internal ref. signal (voltage or source) 4. The error (difference) signal is fed to a chopper or vibrator which converts d.c signal into ac signal. 5. The signal is then amplified in order to drive a servomotor which is used to balance the system. 6.The servomotor holds it in balance, as the value of the quantity being measured changes. 7. Thus a record is made of one variable w.r.t another, i.e a function is plotted on a graph paper. **Note: Explanation is optional**	**04 marks for block diagram**	

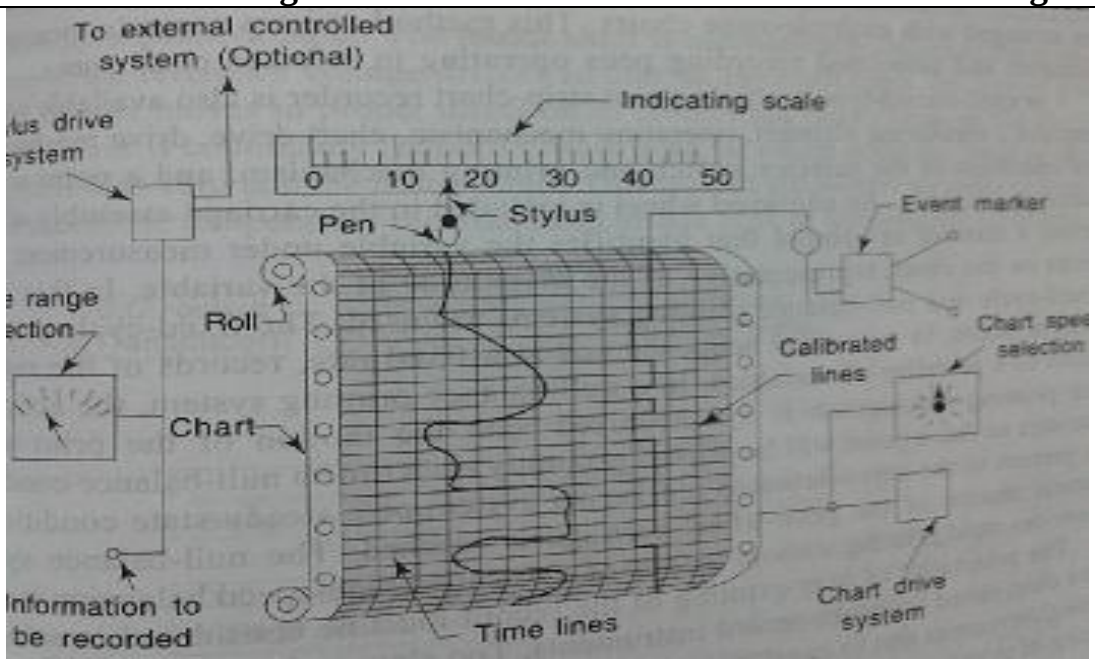
			
c.	**Explain documents needed to design the control panel**	**04**	
Ans:	1.Front panel layout 2.Back of panel layout 3.Panel of writing diagram 4.Power distribution 5.Wiring and termination diagram 6.Panel piping and tubing diagram 7.panel specification 8.panel installation details	½ marks for each	

d.	**Describe single channel DAS with a neat diagram**	**04**	
Ans:	 A single channel DAS consists of a signal conditioner followed by an ADC, performing repetitive conversions at a free running, internally determined rate. The outputs are in digital code words including over range indication, polarity information and a status output to indicate when the output digits are valid. The digital outputs are further fed to storage or a printer, or a computer for analysis.	**02 marks for diagram** **02 for explanation**	
e.	**Explain working of alarm annuciator with a neat sketch**	**04**	

Ans:	 Annuciator are usually made up of a lamp display cabinet with nameplates incorporating engraved messages, an audible device, manually operated push buttons, and sequence logic circuits. These circuits are used to co ordinate the response of lights, audible device and push button operation of the action of the alarm circuits being monitored. This is called "sequence." Typically an annuciator sequence may proceed as follows: During normal, all visual and audible devices are quiescent. Upon an abnormality (off normal or alarm condition), an audible device, such as horn will sound. The horn thus advices an attendant or operator that an alert condition exists. The name plates that flash direct the attendant to their specific points which are in the alarm stage.	**02 marks for diagram** **02marks for explation**	

4.A	**Attempt any three :**		**12**
i)	**Describe the operational sequence of alarm annuciator.**	**04**	
Ans:	 Each alarm point is synonymous with the circuit it is monitoring and the associated nameplate with its engraved message-describing the function being monitored. Attendant response to the foregoing events involves pressing an acknowledgement push button. This results in silencing the horn as well as changing the flashing lights to a steady on state. The later will remain illuminated as long as the point remains off-normal. If the new points are alarmed, the horn will sound again and the back lighted windows associated with their alarm will flash. Note that the flashing mode distinguishes newly alarmed point from those off normal points acknowledged previously and whose lights remain steady on. Upon acknowledgement, once again the audible device is silenced and all points which remain steady on lights. An operational (full-function) test can be accomplished by pressing a test push button.	**01 marks diagram** **03 marks for explaination**	
ii)	**Illustrate the calibration procedure of pressure transmitter**	**04**	
Ans:	Calibration procedure of pressure transmitter: 1. Connect the 24 V dc power supply to the transmitter with certified multimetre in series for measuring ma output of transmitter. 2.check zero of transmitter 4ma at zero pressure if not then adjust zero to 4ma 3. Apply 100% test pressure corresponding to the transmitter range and check span of transmitter.	**04 marks for relevant explainati**	

	4. Check zero of transmitter range and check span of transmitter for 20mA . If not adjust span to 20Ma. 5. Repeat 2 and 3 to achieve accuracy. 6. Repeat till you get 4ma for zero and 20Ma for span. 7. When this is achieved check readings for 25%, 50%,75% corresponding to 8mA, 12mA, 20mA for span. 8. Note readings. 9. Prepare calibration certificates. 10. Put calibration stickers mentioning sr no, tag no, calibration due and certificate nos.	**on**	
iii)	**Interpret the NEMA ratings** **1. NEMA 12** **2. NEMA 67**	**04**	
Ans:	1. NEMA 12: Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, dripping non – corrosive liquids. 2. NEMA 67: • Such type doesn't exist. NEMA 6 – Submersible NEMA 7 – Hazardous (Class 1, group A,B,C,D) If students write the answer as assuming NEMA 6, or NEMA 7 or IP67 give marks.	**02 marks for each**	
iv)	**Discuss need of converters**	**04**	
Ans:	1. For forming link between electronic and pneumatic system & vice versa. 2. If field devices are pneumatic operated and controllers are electronic type in nature. 3. Field control signal feedback is pneumatic and interfaced with DCS/PLC in control room. 4. Transmission of signal over large distance. 5. If field area is hazardous in nature. 6. If instrument air is not available at the receiver end.	**04 Any four points**	

B.	Attempt any one :		06
i)	**Draw a block diagram of X-t chart recorder. describe its working**	06	
Ans:		03 marks for diagram	
	Strip chart recorders are used to record a function wrt time. Construction and working: it consists of a long roll of paper graph known as chart, moving vertically, and is graduated in rectilinear co ordinates. The chart is usually driven by a synchronous motor equipped with a speed selector switch to change the chart speed in increments. A broad range of chart speed is available. When firing begins, the jump speed drive is activated by a remote contact closure, where upon the chart is fed for a brief at a very high rate to take down every detail of the short period event. A stylus is used for making marks on the moving chart which moves horizontally, proportional to the quantity being recorded. A range selector is used so that the input to the recorder drive system is within acceptable level. Most recorders use a pointer attached to the stylus which moves over a calibrated scale for indication of the value of parameter under observation.	03 marks for explaination	
ii)	**Draw and explain the architecture of foundation field bus.**	06	
Ans:			

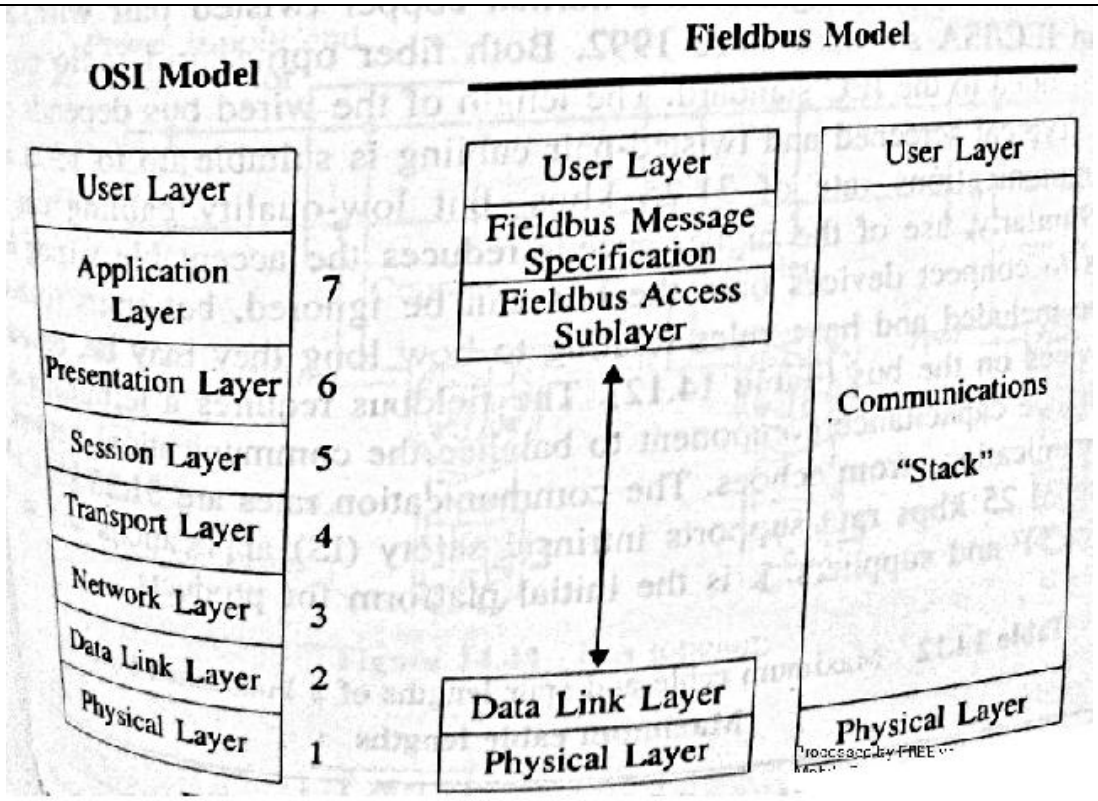


Diagram : 3 marks

1. There are two major parts to the Field bus system architecture: - interconnection and application.
2. Interconnection refers to the passing of data from one device to another (a field device, operator console or a configurator).
3. This is the communication protocol part of the field bus.
4. The application is the automation function the system performs.
5. By standardizing part of application, field bus has gone further than any other communication standard, ensuring interpolability between conforming products.
6. The field bus interconnection architecture is based on a three layer subset of the architecture from the OSI reference model.
7. Layers three through 6 are not used because field bus has no interconnection between networks, which is purpose of these layers.
8. This simplification makes it simpler to implement with limited processor power and faster.

Only layers 1, 2, 7(physical, data, application layers) are used by field bus.

9. Layers 2 and 7 are considered bundled together in communication stack.
10. Application functionality is provided by function blocks.

Description : 3 marks

5.	Attempt any two of the following:		16
a)	Give classification of hazardous area location	08	
Ans:	**Hazardous area location** **Hazardous Zone categories (IEC classification)** **For Gases, Vapor and For dust particles:**	8 Marks For entire classification	

Area Designation	Area Description
Zone 0	Ignitable concentrations of flammable gases or vapors are present continuously or present for long periods of time. Examples include, · Interior of tanks · Locations near vents
Zone 1	There may be ignitable concentrations during normal operating conditions or concentrations exist frequently from repair or maintenance of the equipment. Examples include, · An area where the breakdown of equipment could lead to a release · Remember that pumps and compressors can have small leaks.
Zone 2	There may be ignitable concentrations during temporary situations. Examples include, · Storage where hazardous materials are in containers. · Areas adjacent to Zone 1 with no hazards of its own · Ventilation could prevent the hazard, but it could fail during a leak

Area Designation	Area Description

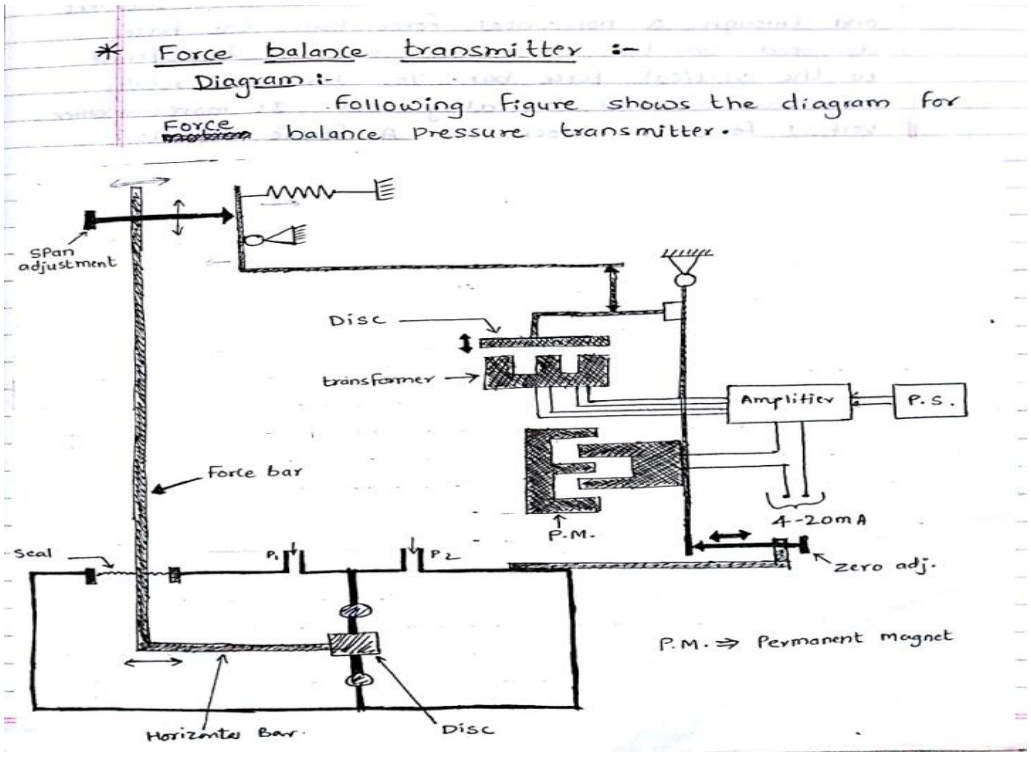
Zone 20	A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.
Zone 21	A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
Zone 22	A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but if does occur, will persists for a short period only.

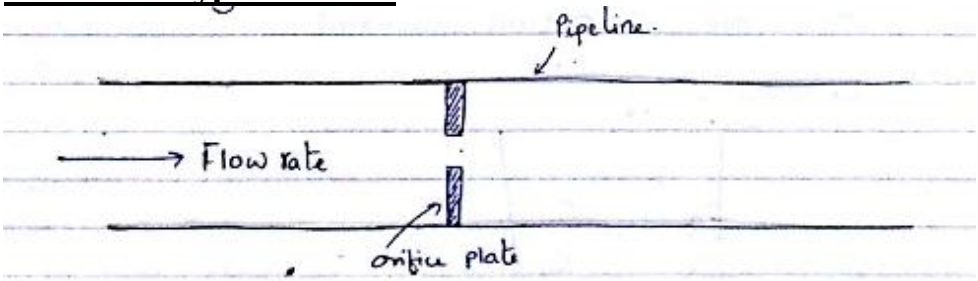
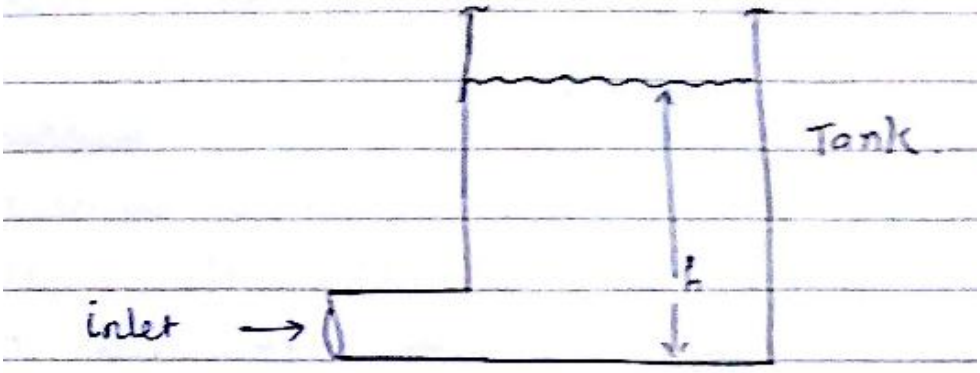
(OR)

NEC Classification

Area Designation	**Area Description**
Class I	Locations made hazardous by flammable gases or vapour
Class II	Locations made hazardous by combustible dusts
Class III	Locations made hazardous by combustible fibers & flying
Division I	Locations which may contain hazardous mixtures under normal operating conditions.
Division II	Locations in which the atmosphere is normally non-hazardous but may become hazardous under abnormal circumstances such as equipment failure, failure, failure of ventilating systems.
Group A	Atmosphere containing acetylene.
Group B	Atmosphere containing hydrogen or equivalent gases or vapors of manufactured gas having an equivalent hazard.

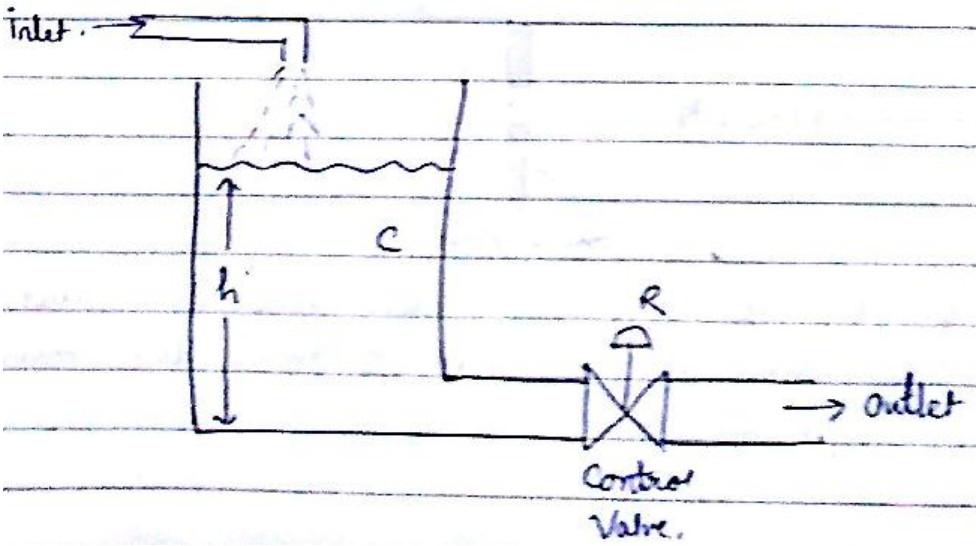
	Group C: Atmosphere containing ethyl/ether vapours, ethylene or cyclopropane. Group D: Atmosphere containing gasoline, hexane, benzene, butane, propane, alcohol, acetone, benzol, lacquer solvent. Natural gas. Group E: Atmosphere containing metal dust, including aluminium, magnesium or other metals of similar hazard. Group F: Atmosphere containing carbon black, coal or coal dust. Group G: Atmosphere containing flour, starch, grain dust Note - with minimum materials mentioned, it can be in any format		
b)	**Illustrate the design considerations of control panels (any four)**	**08**	
Ans:	Control panel design based on shape, size, color and general layouts. Some of the guidelines are as follows: 1. Panel must be free standing usually color shall be green. 2.instrument should be arranged so that they are readable to operator Controllers : middle level Recorders: lower level 3. Important switches should easily be assessed. 4. Minimum spacing between instruments for maintenance purpose. 5. Fans and blowers for high density instrumentation. 6. Panels shall be properly wired and piped on external connection to be done. 7. An access way of 3ft from back of panel and switches 8. All instruments must be provided with descriptions. **NOTE: Any other relevant points can be considered.**	**1mark 1 point**	
c)	**Explain force balance pressure transmitter with neat sketch.**	**08**	

Ans:	 The pressure difference p1-p2 is applied to a chamber which has a membrane with a disc in its center. If the pressure difference Δp=p1-p2 increases, disc will move to the left and through a horizontal force bar, the force developed on the membrane will be transferred to the vertical force bar. The force bar rotates clockwise around an alloy seal. It moves another vertical force bar. A ferrite disc is connected to it, is kept near a differential transformer .The disc moves towards the differential transformer due to the movement of force bar. The output of the transformer increases and is given to amplifier which is connected to a power supply. This signal is rectified to a direct current and thus standard 4-20mA dc is obtained. This rectified signal is given to a winding which is placed between the poles of a permanent magnet. The winding is connected to a vertical bar. Bar is also connected to the disc which is kept near the differential transformer. As a result of interaction of magnetic field from the winding and the permanent magnet, the winding moves to left under force proportional to	**Diagram- 4 marks** **Explanation - 4marks**	

	the signal from diff. transformer and hence proportional to the measured differential pressure. Thus the lever system of the transmitter is rebalanced in a new position		
6.	**Attempt any Four of the following :**		**16**
a)	**List different types of process dynamics. explain any one**	**04**	
Ans:	The mathematical modeling and theoretical analysis of processes depends on certain dynamics that describe a process. Every process contains one or more such dynamic elements. Therefore the different elements with which a mathematical model may be formulated for a process are: 1.resistance element 2.capacitance element 3.time constant element 4.oscillatory element 5.dead time element **Resistance type element:**  figure shows the section of a pipeline in which the orifice plate is inserted .the insertion of orifice plate creates the obstruction to fluid. This resists the flow rate of fluid in the pipeline. Therefore in this system is resistance element system. 2.**Capacitance Element:**  	**List - 1 mark** **Explanation of any one process dynamics -3 marks**	

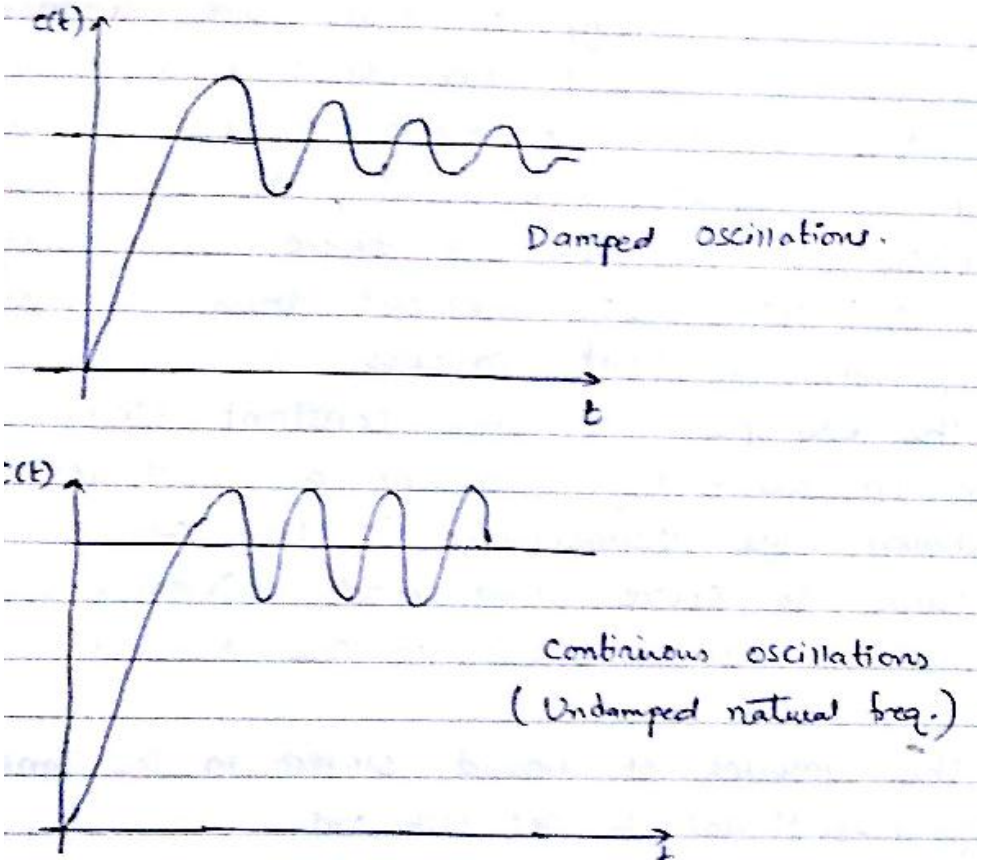
Capacitance is the ability of a system to store charge, mass or energy. An example of capacitance element is a tank with inlet as shown.
The flow of the fluid into the tank is the output. This ability of the tank to store liquid is capacitance.

3.Time Constant Element:



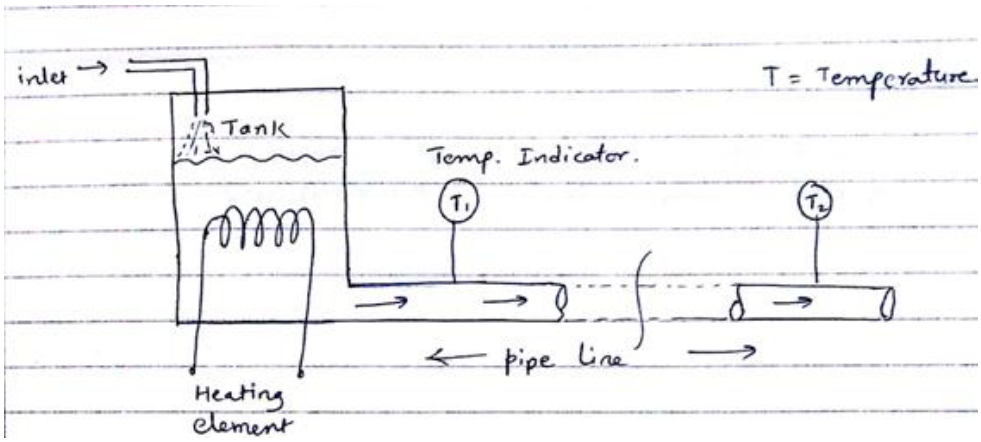
A combination of a resistance and capacitance element result in a time constant process. Those parts of the process that have the ability to store energy are termed as capacitance element and those parts that resist the transfer of energy or mass are termed as resistance element.
Hence in a process if there is a combination of both these elements then it is called a time constant process.consider a liquid level system as shown.the capacitance is the ability of the tank to store fluid and resistance element is introduced at the outlet in the form of control valve. The amount of liquid stored is proportional to net flow.

4.Oscillatory Element

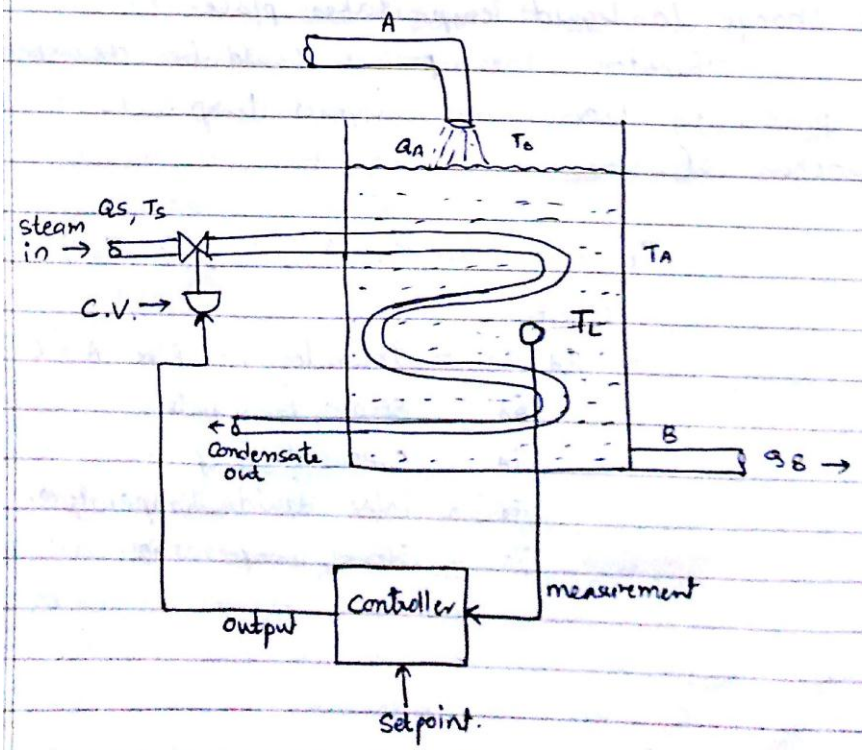


his element is a typical characteristic of a higher order system. It can be proved that the response of a second order system show oscillations about the steady state value of input. fig is an example of an oscillatory element system.

5.Dead Time Element:



	A phenomenon often encountered during transfer of mass or energy is called dead time.it is also called transportation lag. Consider the foll. System where hot water is to be passed through a tube having uniform cross section. In this syste , when hot water is transferred from one point to another no process action takes place, which creates the dead time in the process		
b)	**State different process characteristics. define any two**	**04**	

Ans:	* Process Characteristics :- Every process consists of certain properties called as process characteristics. The selection of controller mode (P, PI, PID) depends upon the nature or characteristics of the process. The characteristics of process are classified as, 1) Process Equation, 2) Process load, 3) Process lag, 4) Self regulation. Consider the following process of temperature control system  	**Stating the characteristics-1mark** **Define any two characteristics-1.5 marks each.**	

→ Process Equation :-

Every system can be described by mathematical expression or equation by which the behaviour or nature of the system can be studied.

In above example, consider the control of liquid temperature in a tank. The controlled variable is the liquid temperature, T_L. This temp. depends on many parameters in the process, such as - input flowrate A, output flowrate B, the ambient temperature T_A, steam temperature T_s, inlet temperature T_o, and the steam flowrate Q_s. In this case the steam flowrate is the controlling parameter. If one of the other parameter changes a change in liquid temp. takes place.

Therefore, this process could be described a process equation where liquid temp. T_L is a function of,

$$T_L = F(Q_A, Q_B, Q_s, T_A, T_s, T_o)$$

where,

Q_A, Q_B = Flowrates in pipe A & B.
Q_s = steam flow rate.
T_A = Ambient temp.
T_o = inlet fluid temperature.
T_s = steam temperature.

→ Process load :-

From the process equation of above process we can write as,

$$T_L = F(Q_A, Q_B, Q_S, T_A, T_S, T_O)$$

In this case the steam flowrate Q_S is the controlling parameter chosen to provide control over the variable (liquid Temp. T_L). To keep the liquid temperature T_L at set point value, we manupulate the this steam flow rate.

But apart form steam flowrate Q_S, the other parameters like Q_A, Q_B, T_A, T_S, T_O are also affecting the liquid temperature. Therefore these other parameters are called as process load.

While controlling any process we must consider the process load parameters and accordingly manage the controlling parameters.

→ Process lag :-

In the process, when load changes occurs, it changes the controlled parameters, to control this, a controlling parameter is changed, but the control loop respond to this change a finite time later and make the necessary change in controlled parameter. this delay in change is called process lag.

With respect to above example, assume the inlet flow is suddenly doubled. Such a large process load change reduces the liquid temperature.

The control loop responds by opening the steam inlet valve to allow more steam and heat input to bring the liquid temperature back to the set point. but the process takes some finite time to bring the liquid temperature back to the set point value. This finite time delay is process lag.

→ Self Regulation :-

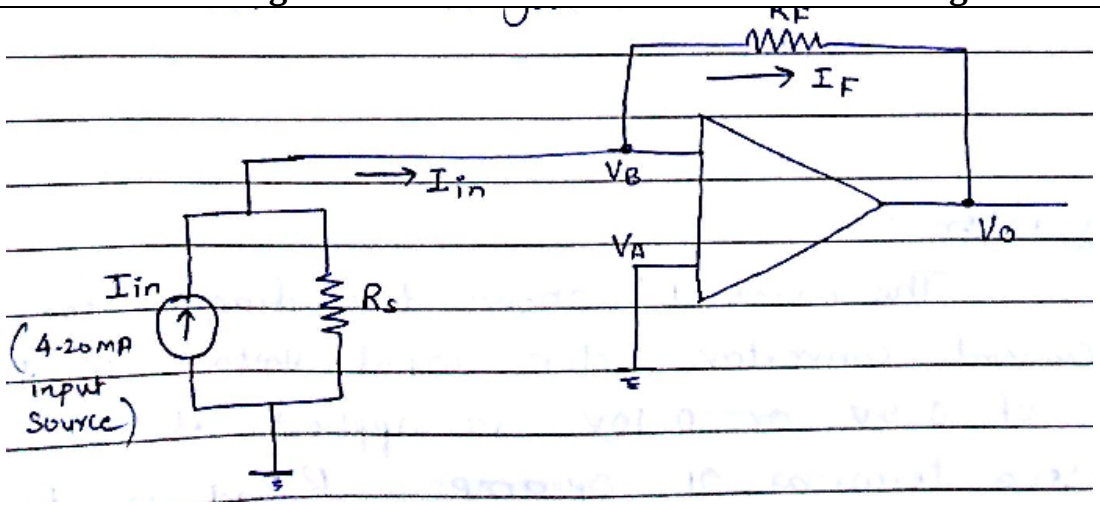
A significant characteristics of some processes is a tendancy to adopt a specific value of the controlled variable for nominal load with no control operations. The control operations may be significantly affected by self-regulation. The process in the initial example has self regulation, as shown by the following argument –

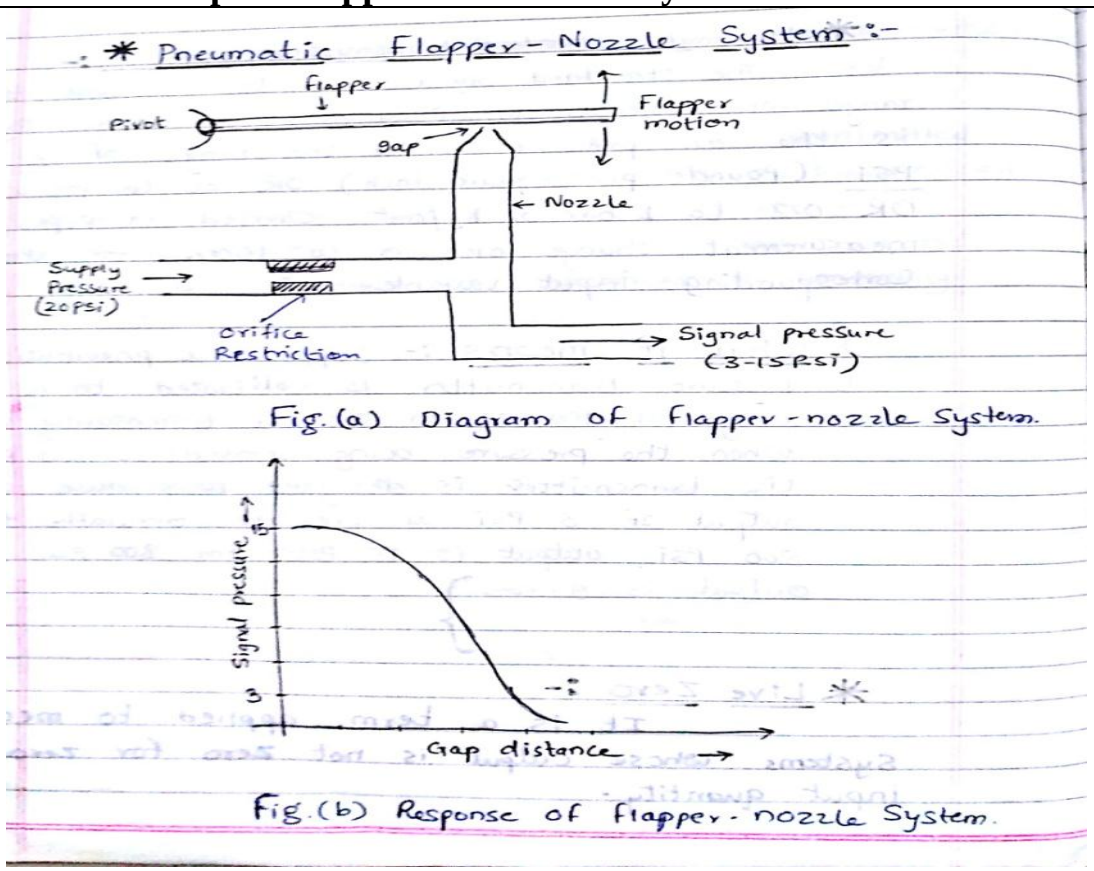
(i) Suppose we fix the steam valve at 50%. and open the control loop so that no changes in valve position are possible.

(ii) The liquid heats up until the energy carried away by the liquid equals that input energy from the steam flow.

(iii) if the load changes, a new temperature is adopted.

(iv) The process is self regulating, however, because the temp. will not "run away", but stabilizes at some value under given conditions.

c)	**Describe working of I to V converter with a neat circuit diagram**	**04**	
Ans:	 It is also called as transresistance amplifier Iin is the input current in the range of 4-20mA . since resistance offered by op amp is very high nearly some current flows as feedback current If. Iin = If …..{1} Due to virtual ground in op amp , we can write : Va=Vb Therefore: Va=0; Vb=0 By applying ohm's law , we can write : If = Vb-Vo/Rf = -Vo/Rf Vo = - Rf*If ….{2} Substitute equation {1} in {2} we get; Vo=-Rf * Iin Vo α Iin Thus output voltage is directly proportional to current.	**02 mark diagram** **02 mark explianation**	

d)	**Draw and explain flapper nozzle assembly.**	**04**	
Ans:	 **Explanation:** The flapper nozzle assembly consists of movable flapper which is positioned against open nozzle. The measured physical quantity is supplied to flapper. The flapper moves according to change in physical quantity. This movement of the flapper increases or decreases the distance between flapper and nozzle. The nozzle is supplied with the constant air pressure of 20 psi through a restriction of orifice based on the change in the value of measured physical quantity, flapper moves near and away from the nozzle. Which decreases or increases the distance between the flapper and nozzle. i.e when the value of measured quantity is minimum flapper is away from nozzle, therefore, distance is maximum which generates very low back pressure. This back pressure is 3psi o/p pneumatic signal. When value of measured quantity is max., flapper comes very near to nozzle; therefore distance is minimum which generates very high back pressure. This back pressure is 15 psi o/p pneumatic signal.	**Diagram - 1mark** **Wavefor m- 1 mark** **Explanation – 2 marks.**	

e)	**Explain applications of data logger (any four)**	**04**	
Ans:	1.Weather station recording (such as wind speed/direction, temperature etc.) 2. Road traffic counting. 3. process monitoring for maintenance and troubleshooting application. 4. Tank level monitoring. 5. Environmental monitoring. 6.Monitoring of relay status in railway signalling. 7. Load profile recording for energy consumption management. 8. Measure variation in light intensity	1 mark for each point	