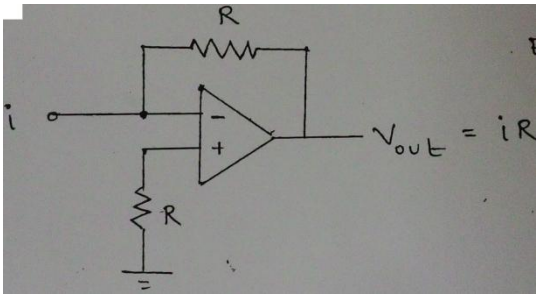
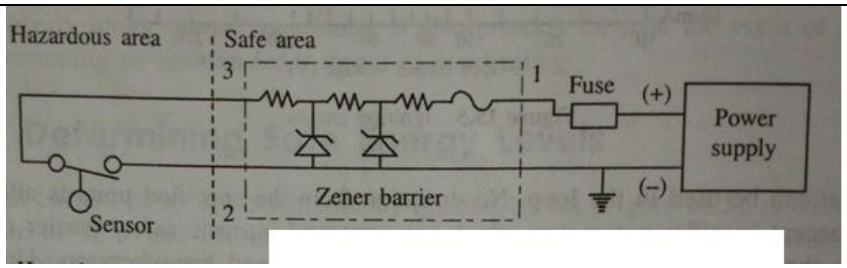
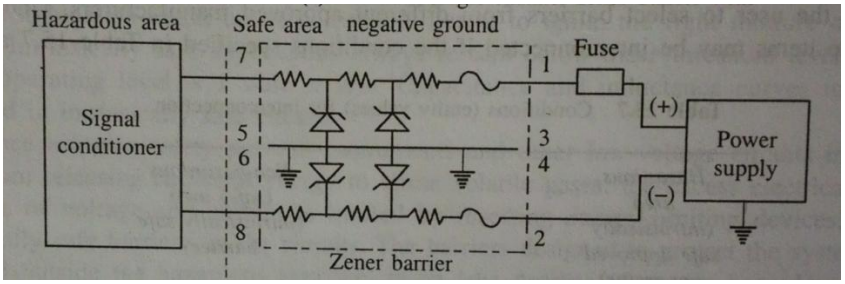
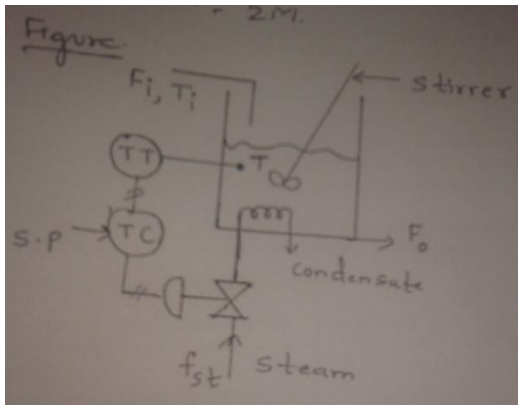
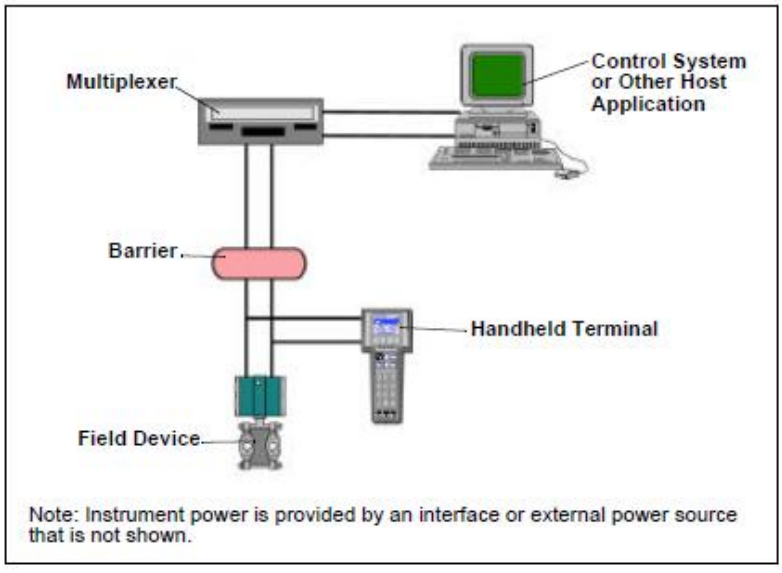
Important Instructions to examiners:

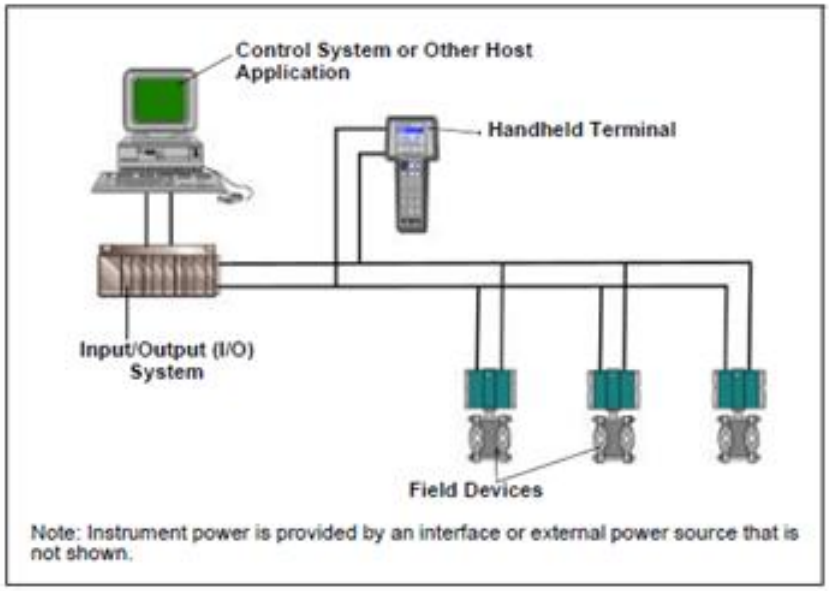
1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 judgment 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.

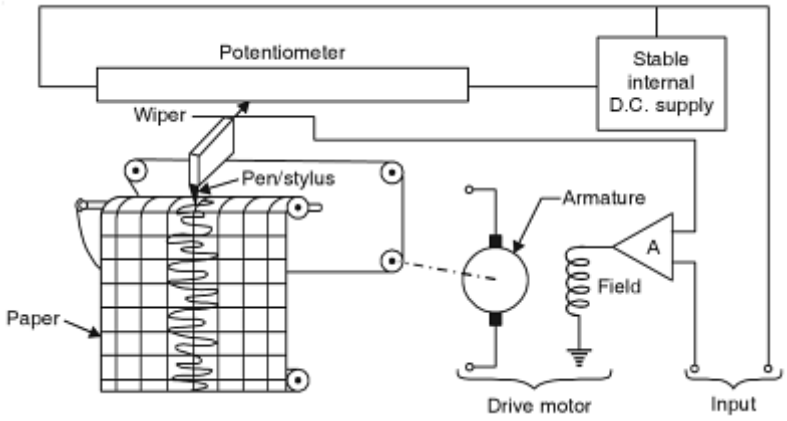
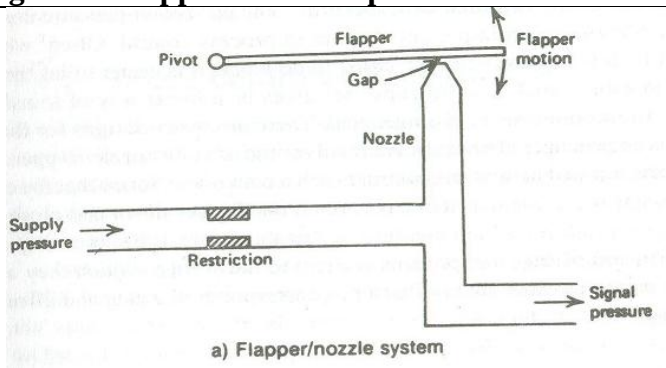
<table>
<tr><th>Q. No.</th><th>Question & its Answer</th><th>Remark</th><th>Total Marks</th></tr>
<tr><td>Q.1</td><td>Attempt any FOUR</td><td></td><td>16</td></tr>
<tr><td>a)</td><td>Explain the elements of a process control system.</td><td></td><td>04</td></tr>
<tr><td>Ans.</td><td>In general elements of process control system are:
i)Process ii) Measurement iii)Controller iv) Final control element
Process: It consist of complex assembly phenomenon that relate some manufacting sequence. Many variable may be involved in such a process. It may be desired to control all these variables.
Measurement: A sensor is device that performs initial measurement & energy conversion of variables into analogus electrical signal.
Controller: In this first error detector performs comparison of actual value & desired value & determines the error. In the next step error is examined & determines what action if any should be taken. This part of control system is known as controller.
Final control element: It is that device exert direct influence on the process that provides those required changes in controlled variable to bring it to the set point of controller.</td><td>01 mark for each point</td><td></td></tr>
<tr><td>b)</td><td>Compare electronic and pneumatics transmission for any four points</td><td></td><td>04</td></tr>
<tr><td>Ans.</td><td>
<table>
<tr><th>Sr. No</th><th>Electronic transmission</th><th>Pneumatic transmission</th></tr>
<tr><td>1</td><td>Voltage supply is used as power source</td><td>Air supply is used as power source</td></tr>
<tr><td>2</td><td>Standard o/p signal is 4-20mA</td><td>Standard o/p signal is 3-15mA</td></tr>
<tr><td>3</td><td>Signal can be transmitted using pair of wires</td><td>Signal can be transmitted using pneumatic tubes</td></tr>
<tr><td>4</td><td>Signal can be transmitted to long</td><td>Signal can not be transmitted to</td></tr>
</table>
</td><td>01 mark for each comparison point</td><td></td></tr>
</table>

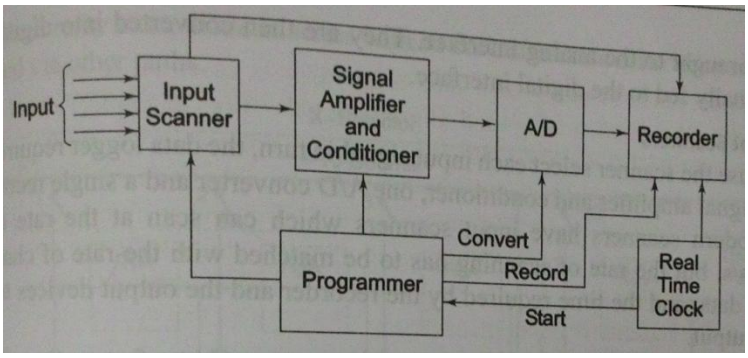
		distance	long distance		
	5	They are not preferred in hazardous area	They are preferred in hazardous area		
	6	It requires less maintainance	It requires more maintainance		
	7	Signal can be given directly to computer system	Signal can not be given directly to computer system		
	8	It requires less space for installation	It requires more space for installation		
c)	**Draw and explain current to voltage converter.**				**04**
Ans.	**Diagram:**  **Explanation:** The current which is to be converted into voltage is applied at inverting terminal of the OPAMP. The o/p of the above circuit is V_{out}=-iR, provided that the OPAMP saturation voltage has not been reached. The resistor R at the non-inverting terminal provides temperature stability.			**02 marks for diagram** **02 marks for explanation**	
d)	**State and difference between strip chart and X-Y recorders.**				**04**
Ans.	**Sr. No**	**Strip Chart**	**X-Y Recorder**	**01 mark for each point**	
	1	Data is recorded w.r.t. time	Data is recorded one input w.r.t another input		
	2	The paper is movable	The paper(graph) is stationary		
	3	It requires only one servomotor to drive the pen stylus	Requires two servomotor one for pen(stylus) & other for arm.		
	4	Used to record any physical variable w.r.t .time	Used to plot speed torque & diode characteristic		
e)	**Define intrinsic safety. How can it be achieved?**				**04**
Ans.	**Definition:** It is a protection technique for safe operation of electrical equipment in hazardous areas by limiting the energy available for ignition. **Methods:** By reducing or eliminating internal sparking . This is accomplished by limiting the stored energy so that only low voltages and current enter the hazardous area zener barrier circuits are used for the same. The voltage and current in the hazardous area will be limited by the zener D_2 to limit the voltage. D_1 may be given a little higher rating.			**02 marks Definition** **02 marks Methods**	

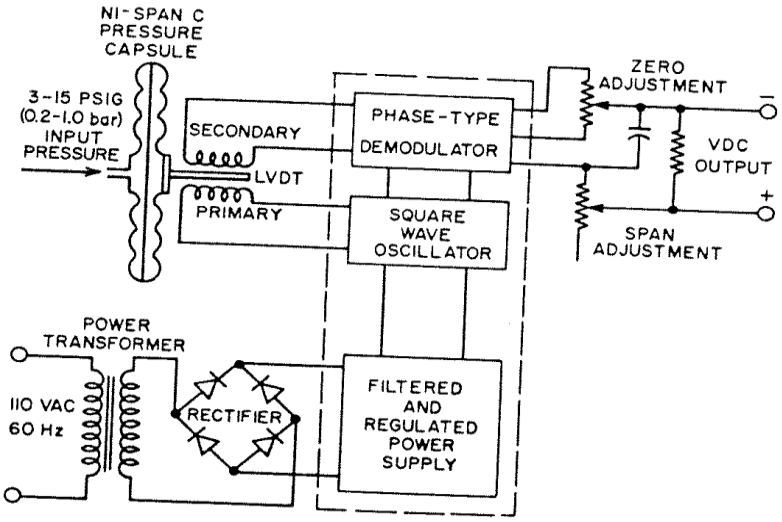
	 **OR** 		
Q.2	**Attempt any FOUR**		**16**
a)	**Draw and explain temperature control loop for a tank containing liquid to be heated by steam.**		**04**
Ans.	**Diagram:**  **Explanation:** The control objective is to keep the temperature of the liquid in the tank at a desired value. The disturbances to the process are flow and temperature of the inlet stream. Fig. show the conventional feedback loop. The temperature of the liquid is measured and after comparing it with the desired value, either increases or decreases the flow of steam. ‘ T’ is the measured as well as controlled variable and f_{st} is the manipulated variable.	**02 marks diagram** **02 marks explanation**	
b)	**Describe HART communication system with relevant diagrams.**		**04**
Ans.	HART ("Highway Addressable Remote Transducer") is a communication protocol	**02 marks Explainat**	

	designed for industrial process measurement and control applications. It is called a hybrid protocol because it combines analog and digital communication. It can communicate a single variable using a 4-20 ma analog signal, while also communicating added information on a digital signal. The digital information is carried by a low-level modulation superimposed on the standard 4-to-20 mA current loop. The digital signal does not affect the analog reading because it's removed from the analog signal by standard filtering techniques. The HART communication protocol is based on the *frequency shift keying* (FSK) principle. In point-to-point mode, the traditional 4–20 mA signal is used to communicate one process variable, while additional process variables, configuration parameters, and other device data are transferred digitally using the HART protocol(Figure 1). The 4–20 mA analog signal is not affected by the HART signal and can be used for control in the normal way. The HART communication digital signal gives access to secondary variables and other data that can be used for operations, commissioning, maintenance, and diagnostic purposes. **Diagram:**  **OR**	**ion** **02 marks diagram**	

	 The multidrop mode of operation requires only a single pair of wires. All process values are transmitted digitally.(figure 2).		
c)	**Explain the purpose of using signal convertors in process industries with an appropriate example.**		**04**
Ans.	**Purpose(Any four)** 1) Converting a sensor input signal to a proportional output signal that is suitable for transmission 2) Since the signals in process control are often transmitted as current (4 to 20 mA), it is necessary to convert voltage to current. 3) At the receiving end of the process control system, we often need to convert current back into voltage. Thus, Current to voltage convertor is required for this. 4) Since the final control element in majority of the processes is a pneumatic control valve, we need to convert electronic/electrical signal into pneumatic. Thus, I/P convertors are required. 5) An analog signal needs to be converted into digital for digital control system. Therefore, ADCs are required for this The digitized signal may be converted back to analog for the purpose of throttling a control valve or for analog recorders. DACs would be required for this purpose	**01 mark for each point**	
d)	**State the advantages of graphic panels.**		**04**
Ans.	1. To enable the plant operator to visualize a complex flow pattern. 2. To make understandable a sophisticated control philosophy with complex relationship between variables. 3. Convenient to train the new operators 4. For aesthetic enhancement of the control room.	**01 mark for each point**	

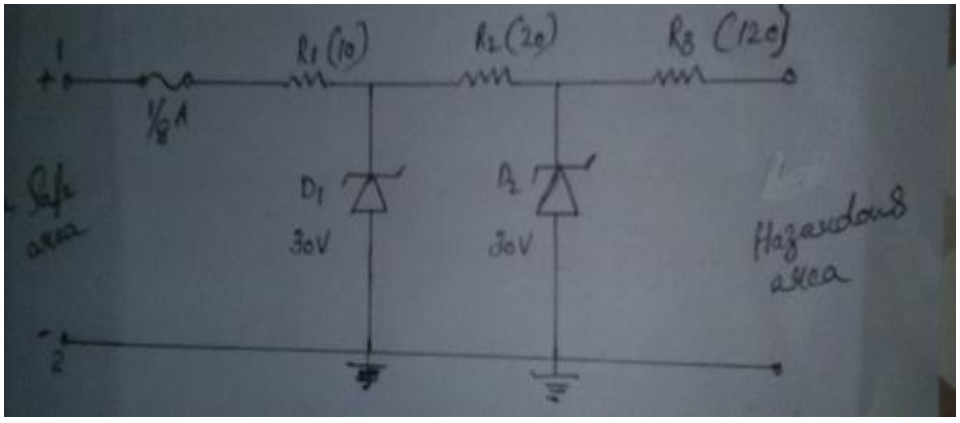
e)	**Draw a neat diagram of potentiometric type recorder and label the parts.**		**04**
Ans.	 **OR** **(Any other relevant diagram should be considered)**	**4 Marks**	
Q.3 A)	**Attempt any THREE**		**12**
a)	**Define the terms process control system. Define the terms controlled variable and controlling variable.**		**04**
Ans.	1) **Process control system:** A Combination of components that act together to regulate or control processes in a process industry may be called as a process control system. 2) **Controlled variable:** It is the variable that is being controlled in a process control system 3) **Controlling variable:** It is the variable that is manipulated to control the controlled variable.	**2 Marks** **1 Mark** **1 Mark**	
b)	**Draw neat diagram of flapper nozzle amplifier. Describe its working**		**04**
Ans.	 a) Flapper/nozzle system **Description:** It consists of Nozzle restriction, supply air and flapper as shown in the diagram. The force from the sensor, which is a measure of the quantity under measurement is	**2 Marks diagram** **2 Marks descriptio**	

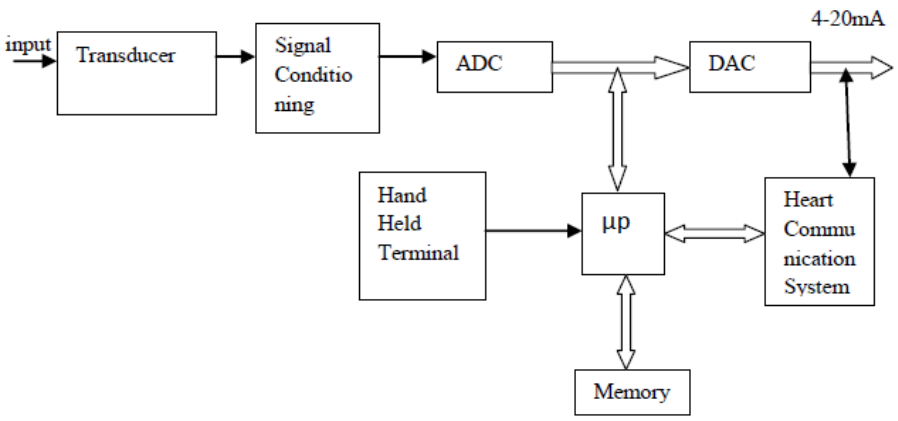
	acted upon the flapper. As the flapper approaches the nozzle, restriction to the flow of air through the nozzle increases and thus the nozzle back pressure 'Pb' also increases. If the nozzle is completely closed by the flapper the nozzle back pressure becomes equal to the air supply pressure 'Ps'. When flapper is moved away from the nozzle air can escape out, thus reducing the amount of air pressure at the output.	**n**	
c)	**Draw the block diagram of data logger. State the functions of each block**		**04**
Ans.	**Diagram:**  **Functions of each block:** It is a highly advanced DAS. **I/P Signals:** Variety of signals is 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 sequence, so 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 the number of digital o/p bits, higher the resolution of ADC. **Programmer:** It is a processor which does the control of overall operation from scanner to recording data, like setting of amplifier gain, linearization etc. It sets high, low level for alarm unit that will initiate audio or video indication when variable crosses the 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.	**2 Marks diagram** **02 mark descriptio n**	
d)	**Classify the hazardous area for the following:** **i) Aluminium dust**		**04**

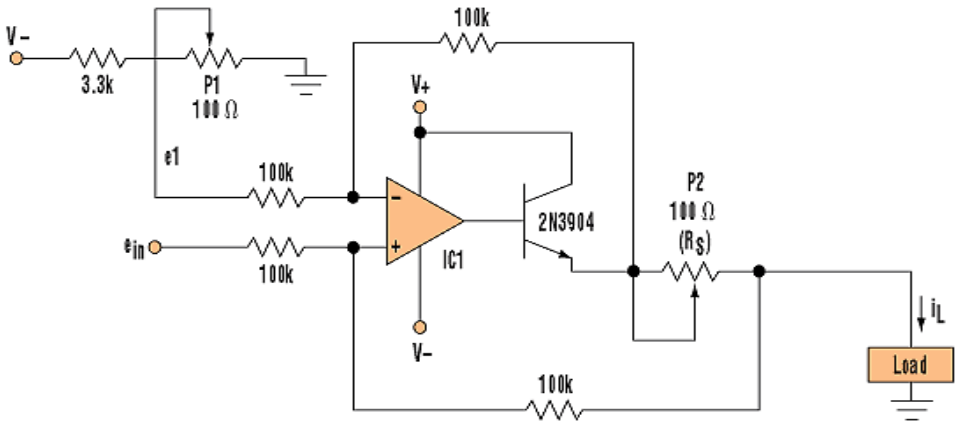
	ii) Hydrogen **iii) Hard coal Kentucky bituminous** **iv) Wheat**		
Ans.	**Classification of manufacturing materials** 1. Aluminium dust- Class II, div. II, Group E 2. Hydrogen- Class I, Div 1, Group B 3. Hard coal Kentucky bituminous- class II, div II, group F 4. Wheat- Class III, Division II, Group G	**1 mark for each point**	
B)	**Attempt any ONE**		**06**
a)	**Draw and explain P/I converter.**		**06**
Ans.	**Diagram of P/I converter:**  **Description:** The input pressure to be converted is applied to a 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 the 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 from square wave oscillator. The dc o/p voltage of Phase detector circuit is connected with zero adjustment and span adjustment circuit.	**3 marks diagram** **3 marks description**	
b)	**Explain the ergonomic considerations of designing a control system.**		**06**
Ans.	**Design considerations for control room: (Any four)** The design of room must meet the following specific environmental conditions. 1) **Climate control:** Temperature and humidity should conform to ANSI/ISA-S71.01 environmental conditions for process measurement and	**1 ½ Marks for each**	

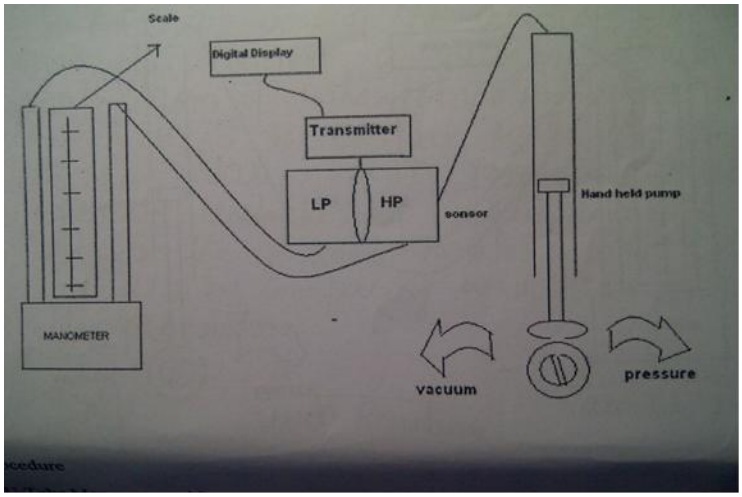
	control systems; temperature and humidity. Air filtration should conform to ANSI/ISA-S71.04, environmental conditions for process measurement and control systems; airborne contaminants. Air intake ducts for the room must be carefully designed so as not to drop in contaminants from the process area. It is preferable to maintain the room at a slight positive pressure (0.08 inches of water), as heavy traffic may cancel out the effects of environmental control. 2) **Audible noise reduction:** Acoustic treatment should be provided to reduce noise. A level of 55 dB is desirable. 3) **Electrical interference (noise) reduction:** The room should be located away from high voltage electrical rooms, high voltage cable and other possible electromagnetic interference (EMI). Where this is not possible, suitable protection using high permeability metallic screening should be provided. Radio frequency interference (RFE) from radio telephones (walkie talkies) and similar devices must be avoided. In most cases control room is no single but two. Adjacent to a control room is an equipment room containing process control cabinets, cable termination cabinets, computers and their associated devices and any other instrument that not need to be accessed continuously. Adequate lightening is essential for good operator comfort. 4) **lighting levels:** a) For video display areas: a controllable level of 100-450 lux of indirect non glare, incandescent lights. b) Control panel areas, printers, recorders: a level of about 650 lux. c) For equipment maintenance, room cleaning etc.: a level of 1200 lux. **(Any other relevant point to be considered)**	**point**	
Q.4 A)	**Attempt any THREE**		**12**
a)	**Name the characteristics of a process that need to be considered while designing a control system. Define any of the two terms.**		**04**
Ans.	**Different Process Characteristics:** 1) Process equation 2) Process load 3) Process Lag 4) Self- Regulation **Definitions: (Any two)** **Process equation**: It is the equation which describes the relation the controlled variable has with the other dynamic parameters of the system. **Process load**: Process load refers to the nominal set of parameters, excluding the	**2 Marks** **02 marks (1 mark for each)**	

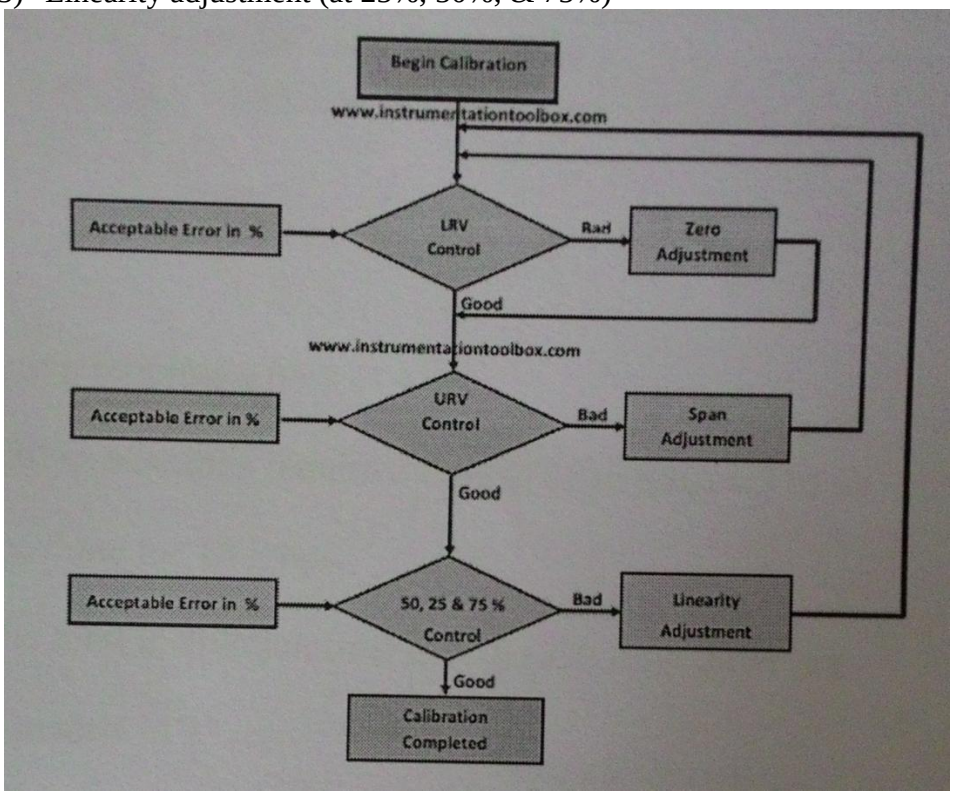
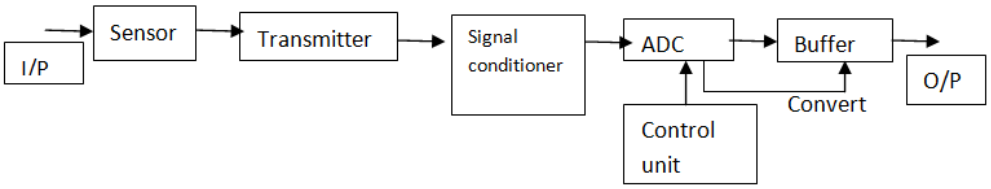
	controlled variable, where nominal set is the set of values for the process parameters that results in the controlled variable having the set point value. **Process Lag**: Part of the time taken by a process itself before the controlled variable returns to the set point, after a control loop responds to a process load change or a transient. **Self- Regulation:** Some process has a tendency to adopt a specific value of the controlled variable for nominal load with no control operation. This particular characteristic of a process to regulate a variable by itself is called self-regulation.		
b)	**Give the classification of control of control panel. Explain break front panel.**		**04**
Ans.	**Types of panel structures:** 1) Vertical Flat Panel 2) Slant Top Section 3) Standing Console 4) Desk Console 5) Break Front Panel **Description of Break Front Panel:** Breakfront panel allow greater utility for the front plane of the panel. The instruments located in the lower rows are swung upward, whereas the top portion is swung downward to an angle normal to the line of sight, allowing better visibility. Thus this increasingly popular construction improves the visual quality of both upper and lower panel sections without seriously degrading serviceability. It has a highly aesthetic appeal, which justifies its high cost by better looks and improved operator acceptance. It finds increased use in large control rooms, particularly in oil refineries, chemical plants and nuclear power stations.	**2 marks for Types** **2 marks description**	
c)	**Explain the following terms w.r.t. to DAS:** **i) Rationmetric conversion** **ii) Logarithmic conversion**		**04**
Ans.	**Ratiometric Conversion:** It is one of the methods of signal conditioning used in DAS. Consider a transducer using strain gauges in a Wheatstone bridge. In this case, if the excitation to the bridge varies the output also varies, accordingly making the	**2 mark description**	

	measurement inaccurate. In such a case the bridge output needs to be conditioned in such a way that the output varies only according to the strain gauge input variation. The system uses an analog divider to which both the excitation supply and amplifier output are connected. The output of the divider is the ratio between the two inputs, which will eliminate the error from the output. **Logarithmic conversion:** Logarithmic signal conversion / compression is a method of signal conditioning for compressing wide dynamic range input signals to a range of an output utilization apparatus. A logarithmic law compresses signals by offering equal output amplitude changes in response to a given ratio of input amplitude increase. For eg., a scaling of 1V/decade means that the output would change by 1V when the input changes from 10-100mV, or from 100mv to 1V. ie., rather than amplifying, logarithmic amplifiers convert a voltage or current proportional to the ratio of input voltage or current to a reference voltage or current.	**2 mark description**	
d)	**Draw and explain Redding Zener barrier circuit.**		**04**
Ans.	**Diagram:**  **Redding zener barrier circuit:** Figure shows the diagram of a Redding zener barrier circuit for 28V 93mA barrier. **Description:** It consists of, 1) Wire wound resistors for limiting the current 2) Redundant zener diodes for limiting the voltage	**2marks diagram** **2marks description**	

	3) A fuse in series with the resistors If a high voltage other than (-0.7v to 30v) appear across terminals 1&2, the zener diode starts conducting. If the fault voltage is high enough and appears for a longer period, the current through the diode D_1 increases until the fuse blows. If the fuse does not blow immediately and the power dissipation of D_1 is exceeded, the zener is designed to short circuit before the fuse opens. With shorting D_1, current will rise rapidly blowing the fuse. Thus an excess current is always diverted to the ground by the barrier and is never allowed to reach the hazardous area. Once fuse is blown off, the entire circuit is replaced by new one. Proper grounding of installation is necessary in this case. It is simple to construct , maintain and economical. **Note: Any other suitable diagram with explanation to be considered**		
B)	**Attempt any ONE**		**06**
a)	**Draw neat block diagram of SMART transmitter. Explain each functional block.**		**06**
Ans.	**Block diagram of SMART transmitter:**  **Functions of Blocks:** 1. Transducer: Detects and converts the process variable to an electrical quantity 2. Signal conditioning and ADC: Suitable modification or conditioning of the signal is done for effective transmission. 3. Microprocessor with memory: This makes SMART different from other transmitters, by providing SMART features. 4. HART communicator: Allows data transfer between device and control room 5. Hand held communicator: With this, data can be accessed anywhere in the loop.	**3 marks diagram** **3 marks explanation**	

	(Any other suitable diagram with explanation to be considered)		
b)	**Draw and explain voltage to current converter. State its working principle**		**06**
Ans.	**Diagram:**  **Description:** This conventional circuit gives 4 to 20 mA of output for an input of 0 to 1V. First adjust P1 for zero(4mA), then P2 for span(20mA). The circuit needs a positive and negative supply(+,-15v). At the input, $e_{in} - e_1 = I_L R_S$ Therefore, the load current is: $I_L = \frac{e_{in}-e_1}{R_s} = \frac{e_{in}}{R_s} - \frac{e_1}{R_s}$ The first term is proportional to the input voltage e_{in}, and the second term is a constant. Here, e_1 is derived from the negative power-supply through a potentiometer: $I_L = e_{in}/R_S + (-e_1)/R_S$ R_S is selected so that the first term (e_{in}/R_S) gives 16 mA for full-scale input voltage, and the potentiometer is adjusted so that the second term provides a constant 4 mA. In effect, the output ranges from 4 to 20 mA corresponding with zero to full input voltage. 2N3904 is a NPN BJT acting as a low power (100mA) switch. (**Any relevant circuit diagram or block diagram with necessary description**	**3 marks diagram** **3 marks Descripti on**	

	should also be considered)		
Q.5	**Attempt any TWO**		**16**
(a)	**Define calibration. With neat diagram explain the procedure of calibration of a DP transmitter at the bench. Draw the five point calibration graph.**		**08**
Ans.	**Calibration**: Calibration is defined as comparison of a measured value with a known standard reference value. When using a measuring instrument in any process, the results should be accurate and within the specification. Calibration verifies this. It also documents the performance of the instrument so that the operator can be certain that the process meet the requirements. **Procedure of calibration of a DP transmitter:**  **Explanation:** Fill U-Tube manometer with water till water level indicated is '0' on the graduated scale. Connect the o/p of pressure pump to 'H' i/p terminal of the DP transmitter. Leave the 'L' i/p to atmosphere. Adjust the knob of pressure pump so that U-tube manometer shows '0'on scale. Adjust zero control on DP transmitter so that it shows 4mA on digital indicator. Rotate the hand pump knob in clockwise direction till water level on u-tube manometer shows 100mm water column on the manometer. Adjust the span control on the DP transmitter so that digital indicator shows 20 mA. **Five point calibration graph:** In a five point calibration three basic steps are involved: 1) Zero adjustment(at LRV)	**02 marks definition** **02 marks diagram** **02 marks explanation**	

	2) Span adjustment(at URV) 3) Linearity adjustment (at 25%, 50%, & 75%)  **(Any other suitable diagram and explanation to be considered)**	**02 marks for graph**	
b)	**i) Draw the block diagram of single channel data acquisition system.**		**04**
Ans.	 A single channel DAS consists of a sensor, transmitter and signal conditioner followed by an ADC, performing repetitive conversions at a free running, internally determined rate. The outputs are in digital code.The digital outputs are further fed to storage or a printer, or a computer for analysis.	**4 marks For diagram**	
b)	**ii) A data logger is monitoring 10 analog loops. A computer requires 4 μs per instruction and 80 instructions to address a multiplexer line and to read in and process the data in that line. The ADC does the conversion in 25 s. If the multiplexer requires 15 $\mu s$to select and capture the input line,**		**04**

	determine the maximum sampling rate of a particular line.		
Ans.	One instruction requires a time of 4 μs Therefore, 80 instructions require a time of (4 μs)(80) = 320 μs This must be done for 10 loops. Therefore the total instruction time is (10) (320μs)=**3200 μs …… (1)** The ADC converts in 25μs. So for 10 conversions of 10 analog loops, it needs a time of (10) (25 μs)=**250 μs …….(2)** To select one input line, multiplexer requires 15 μs So for 10 input lines (10 loops),it needs (10) (15 μs)= **150 μs ……(3)** Adding (1), (2) and (3), **3200 μs+ 250 μs+ 150 μs= 3600 μs** Therefore the minimum time before a particular line can be readdressed is**3600 μs** Therefore the maximum sampling rate of a particular line is the reciprocal of 3600 μs **=277 samples per sec**	**1 mark for each step**	
c)	**Give IEC classification of the industrial area of process industries**		**08**
Ans.	Hazardous Zone categories (IEC classification) For Gases, Vapor and For dust particles: 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 vent	**Zones 06 marks (02 marks for each zone)**	

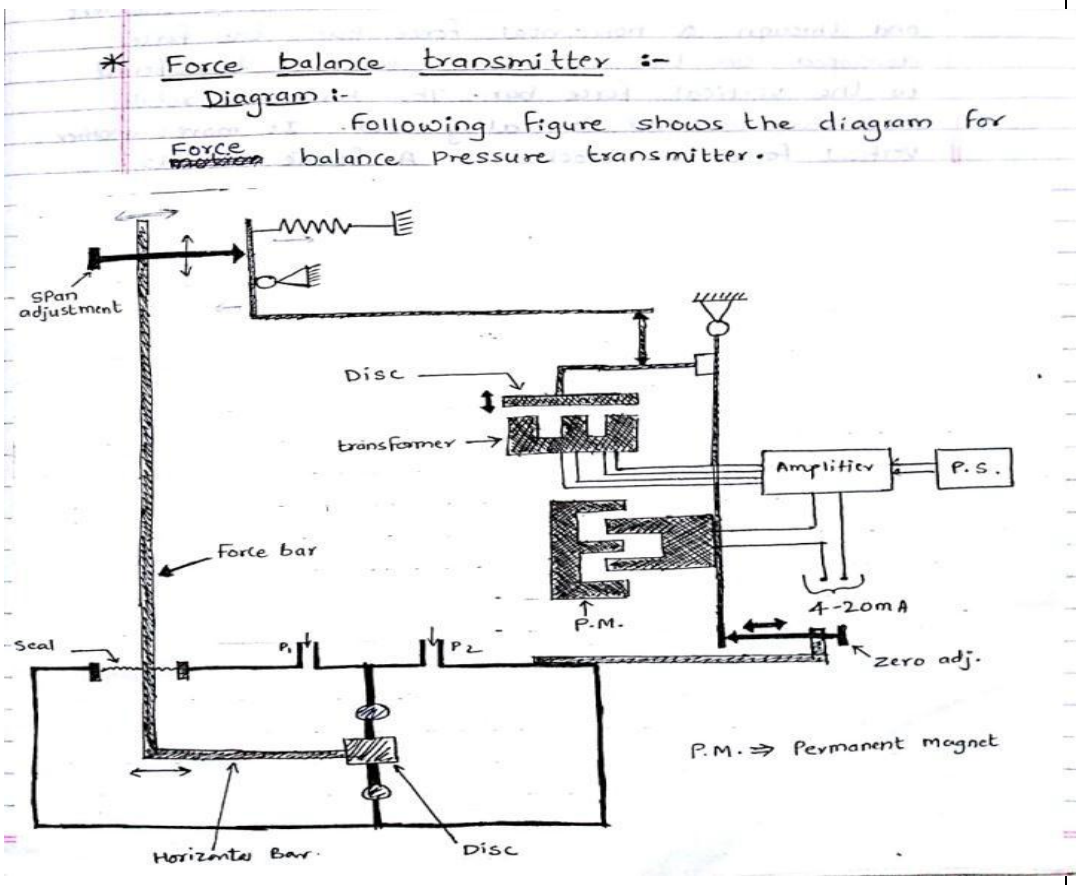
Zone 1	There may be ignitable concentrations during normal operating conditions or concentrations exist frequently from repair or maintenance of the equipment. **Examples include,** · An area where the breakdown of equipment such as pumps and compressors could lead to a release	**Example of zones: 02 mark**
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	

(OR)

NEC Classification

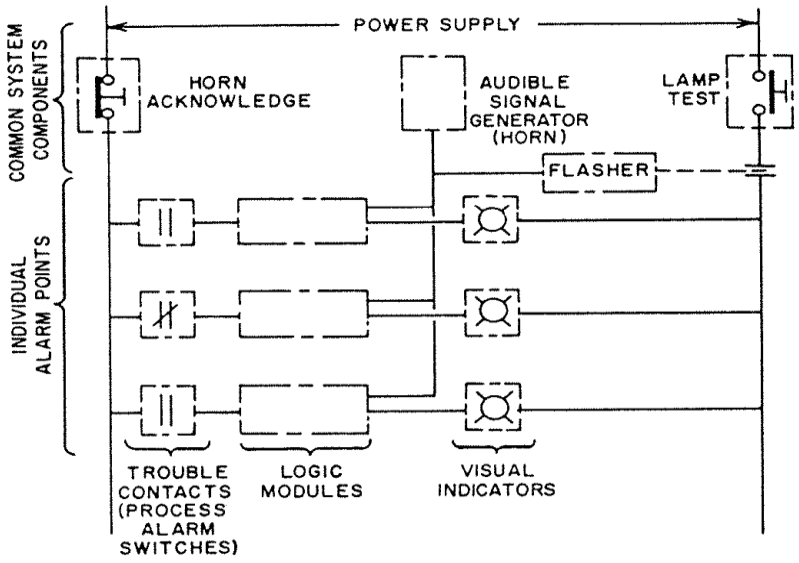
Hazardous area is divided into Class, Group and Division. Group is the sub-division of Class**.**

Area Designation	Area Description	
Class I	Locations made hazardous by lammable gases or vapour	**Class: 2marks, division: 2marks, Group: 4 marks**
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 nonhazardous but may become hazardous under abnormal circumstances such as equipment failure, failure, failure of ventilating systems	**Mark can be given for ANY of the classifications among these two.**
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		
6.	**Attempt any TWO**				**16**
a)	**Draw a neat labeled diagram of force balance type electronic transmitter. Explain its working**.				**08**
Ans.			**4 marks Diagram**	

- The pressure difference $p_1 - p_2$ is applied to a chamber which has a membrane with a disc in its center.

	• If the pressure difference $\Delta = p_1 - p_2$ 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 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. **(Any other suitable diagram with explanation also can be considered)**	**4 marks Explanation**	
b)	**Define IP classification of enclosures. Explain the meaning of following codes**		**08**
Ans.	**Defination:** The IP Code defined in IEC classifies the degrees of protection provided against the intrusion of solid objects ,dust, accidental contact, and water in electrical enclosure. It consists of the letter IP(ingress protection rating) followed by two digits and an optional letter. This standard aims to provide more detailed information regarding the enclosure protection. The IP rating normally has two numbers: 1. Protection from solid objects or materials 2. Protection from liquids (water) **Meaning of IP code:** **i)IP 54**: Protected against dust limited ingress (no harmful deposit). Protection against water sprayed from all directions **ii) IP 34**: Protected against solid objects over 2.5mm (tools and wires). Protection against water sprayed from all directions **iii) IPX4**: X shows that there is no protection rating with regard to solids. Protection against water sprayed from all directions	**04 mark** **Meaning 04 marks** **(1 Mark for each)**	

	iv) IP65: Totally protected against dust. Protected against low pressure jets of water from all directions		
c)	**i) What is alarm annunciator?**		**02**
Ans.	Alarm annunciator is a system used to bring the attention of the operator to some unsafe operating condition in the plant. Hard-wired switches are arranged to operate when a process condition enters an abnormal state (such as high temperature, low pressure, loss of cooling water flow, or many others). In one common alarm sequence, the light in a window will flash and a bell or horn will sound to attract the operator's attention when the alarm condition is detected. The operator can silence the alarm with a button, and the light will remain lit as long as the process is in the alarm state. When the alarm clears (process condition returns to normal), the lamps in the window go out.	**02 marks**	
c)	**ii) Explain the terms used in specifying an alarm annunciator sytem**		**06**
Ans.	 ***FIG. 3.1b*** *Elements of basic annunciator system.* **Terms used in specifying an alarm annunciator sytem are:** 1) Power supply 2) Test push button 3) Acknowledgement 4) Trouble contact 5) Logical module 6) Visual indicator	**03 marks diagram** **03 marks explanation**	

	7) Audible sound The individual alarm points are operated from a common power supply. They also share different annunciator system components such as horn, flasher and acknowledge and test push buttons. In normal operation, the annunciator system is silent. The trouble contact is an alarm switch that monitors a particular process variable and is activated when a variable exceeds preset limits. This activates the logic module which initiates the alarm condition. The audible signal can be a horn, a buzzer or a bell. The alarm with audible sound light flashing acknowledged by 'ack' test push button. All visual indicators tested with test push buttons.		