

**Important Instructions to examiners:**

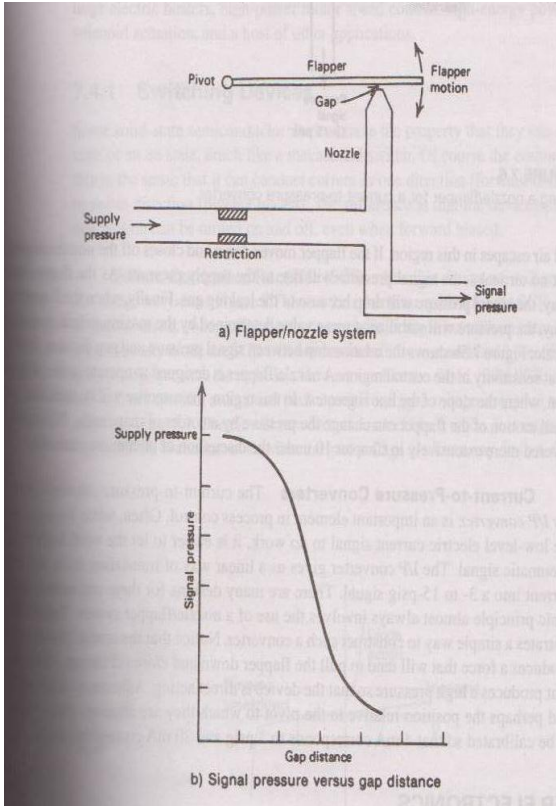
- 1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling 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
1	Answer any Four		16
a)	Define transducer and transmitter. State the need of transmitter.		04
Answer	<p>Transducer : Transducer is device which converts one form of energy into another form of energy.</p> <p>Transmitter : Transmitter is device combination of transducer and signal conditioning circuit which senses measured variable such as temperature, pressure and converts it into standard output signal in the form of electronic or pneumatic.</p> <p>Need of Transmitter:</p> <ol style="list-style-type: none">1. Distance between field location and remote location control room is large.2. Sometimes field instruments located in the hazardous area.3. Usually transducer output is weak signal hence it needs modification for indication purpose at control room.4. Receiver devices located in control room accepts signal in standard range.	<p>01 mark</p> <p>01 mark</p> <p>02 marks</p>	
b)	State the need of panels and enclosures.		04
Answer	<ol style="list-style-type: none">1. It provides mean of communication between process and the process operator2. It gathers process information, controls and displays technical data necessary for efficient and safe operation of plant.3. Due to reduction in size of individual instruments they can be measured together on panel.4. Increase in quality of instruments and new hardwares control panel	01 mark each (for any 4 points)	04



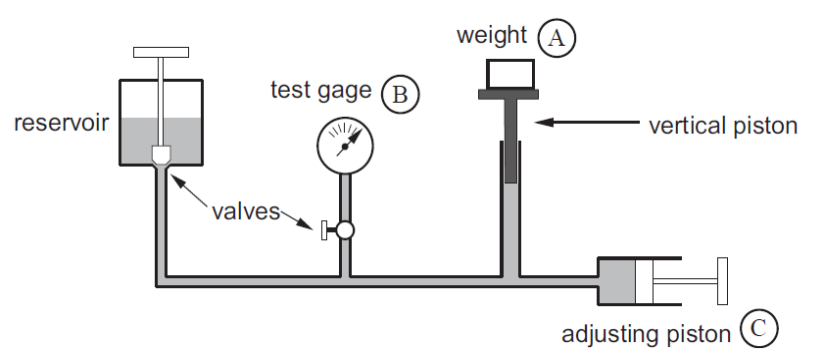
	is needed 5. Sometimes operations carried in hazardous area locations.		
c)	What is IP code? Explain IP 65 and IP 54		04
Answer	<p>IP Code : This code consists of letter IP followed with two numeral for degree of protection. IP stands for ingress protection. The first numeral denotes level of protection against solid object and the second numeral denotes level of protection against liquid object.</p> <p>IP 65 : IP stands for ingress protection. First numeral 6 stands for solid object dust tight. Second numeral 5 stands for protection against waterjet.</p> <p>IP 54 : IP stands for ingress protection. First numeral 5 stands for solid object dust protected. Second numeral 4 stands for protection against splashing water.</p>	02 mark 	

f)	List the six cabling accessories.		04										
Answer	1. Cable trays 2. Cable glands 3. Junction Boxes 4. Cable lugs 5. Ferrules 6. Cable terminations	04 marks											
2 A	Answer any Three.		12										
a)	Explain the concept of live zero w. r. to pneumatic and electronic signal transmission.		04										
Answer	Pneumatic Signal : In case of pneumatic signal range is 3-15 psi. In this 3psi indicates minimum value for live position of instrument & 0 psi indicates fault situation. Electronic Signal : Electronic signal range is 4-20mA. In this 4mA indicates minimum value for live position of instrument & 0mA indicates fault situation.	02 mark 02 mark											
b)	Compare Modbus and Profibus.		04										
Answer	<table><tr><td>Modbus</td><td>Profibus</td></tr><tr><td>1. Technical Developer Name Modicon</td><td>1. Technical Developer Name Seimen's</td></tr><tr><td>2. Maximum distance transmission is 1300m</td><td>2. Maximum distance is 400-4800 m with repeaters.</td></tr><tr><td>3. Transmission speed is 9.6 Kbps to 19.2 Kbps.</td><td>3. Transmission speed is 9.6 Kbps to 12 Mbps</td></tr><tr><td>4. Maximum node upto 247.</td><td>4. Maximum nodes upto 126</td></tr></table>	Modbus	Profibus	1. Technical Developer Name Modicon	1. Technical Developer Name Seimen's	2. Maximum distance transmission is 1300m	2. Maximum distance is 400-4800 m with repeaters.	3. Transmission speed is 9.6 Kbps to 19.2 Kbps.	3. Transmission speed is 9.6 Kbps to 12 Mbps	4. Maximum node upto 247.	4. Maximum nodes upto 126	01 mark for each point	
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c)	Define calibration. State the need of calibration of instrument(any 3 points)		04										
Answer	Calibration: Calibration is the comparison of specific values of Input and output of Instrument system with corresponding reference standard. It offers guarantee that instruments operates with required accuracy and specification. Need of Calibration : 1. In order to maintain accuracy of system with specification. 2. To remove errors from Instrument system such as gross error, Systematic errors etc. 3. If instrument undergone cleaning, replacement of any part, range change etc. 4. Instrument o/p will drift with time due to use, wear and tears.	02 marks 02 marks for any 3 points											

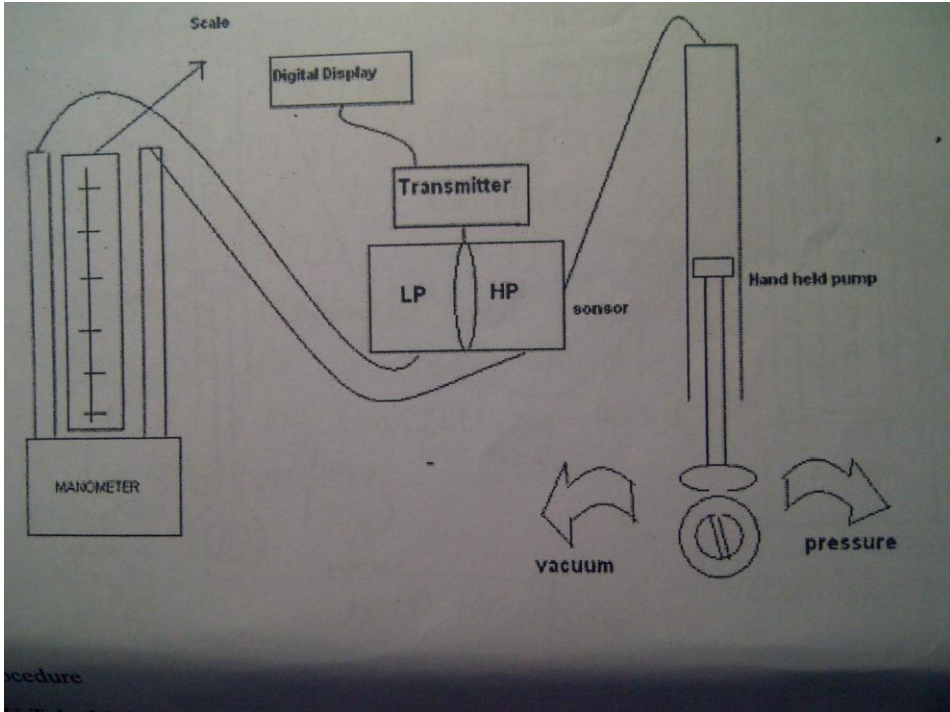
d)	State any four environmental considerations of a control room.		04
Answer	<ol style="list-style-type: none"> 1. Air conditioning system should be provided considering operator comfort and constant temperature at Instrument will minimize drift. 2. Room pressurization is used where plant atmosphere is explosive or flammable and it is achieved by forcing fresh air through ducts from safe area. 3. The heightening system should be designed to minimize reflections on instrument cases. 4. Noise level in the control room should be kept at minimum level. 	04 marks	
B	Answer any one.		06
a)	Explain flapper-nozzle amplifier with neat diagram. Draw its characteristics.		06
Answer	<p>Flapper-nozzle amplifier diagram :</p>  <p>flapper-nozzle amplifier: It consists of Nozzle restriction, supply air and flapper as shown in diagram. When flapper is moved towards Nozzle, air cannot escape out; hence maximum air pressure signal passes to the output of amplifier. When flapper is moved away from the nozzle air can escape out. Thus reducing the amount of air pressure to the output of amplifier. As flapper moves from one extreme position to another it serves to control the amplifier, it produces an air pressure signal proportional to measured variable.</p>	<p>02 marks for diagram</p> <p>2 marks for description</p> <p>02 marks for characteristics</p>	



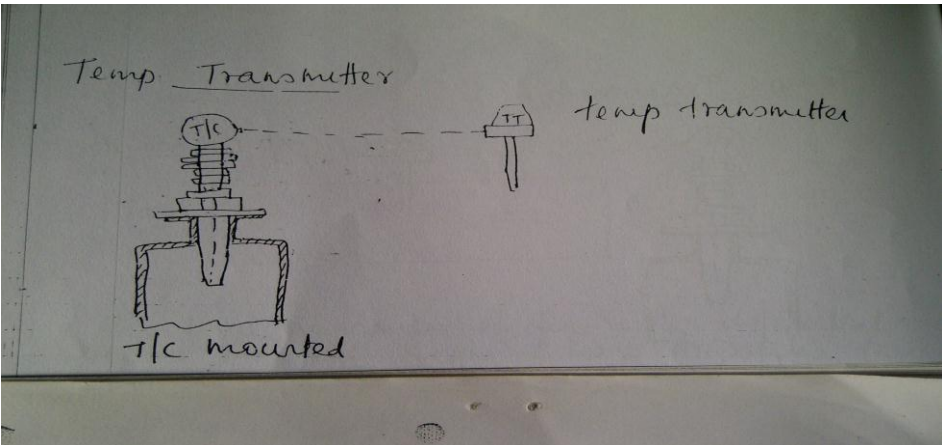
b)	List the design factor of instrument air system. Explain any one in detail.		06
Answer	<p>Instrument air system :</p> <p>Instrument air is the air which is moisture, dust, oil free and also it is dry and clean air used for instrument services such as transmitter panels etc.</p> <p>Design factors are :</p> <ol style="list-style-type: none"> 1. Air headers 2. Pipe Filter 3. Air Pressure regulators 4. Air pressure gauges 5. Relief valves 6. Take off needle valves <p>Air header pipeline usually made of red brass pipe, galvanized pipe, or aluminium. Air header and filter reducing units are properly sized on the basis of for air users. Air header is usually piped to dual parallel filter and reducing regulators, each set is sized to supply the air pressure panel requirement.</p> <p>Each set is valved for isolation, for repair and replacement. The reducing station should have pressure gauge and relief valve for panel air header.</p>	<p>03 marks</p> <p>03 marks</p>	
3. A	Answer any Three		12
a)	State the need of UPS. Draw its block diagram and explain in brief.		04
Answer	<p>UPS is a device connected between power source and the device which utilizes power to ensure that electrical flow is not interrupted. It maintains a continuous supply of electric power to the connected device by supplying power from a separate source when utility power is not available or falls below acceptable levels.</p> <p>Block Diagram of UPS :</p>	<p>01 Marks for Need</p> <p>1 Marks for Block Diagram</p>	

	<p>Functional blocks:</p> <ol style="list-style-type: none"> 1. AC mains section with filter, transformer and rectifier. It receives AC supply, filters it with line filters and rectifies it to the desired level. 2. Inverter and filter When power is available, this device delivers constant 230 V ac, 50 Hz o/p to the load. When power is lost, it takes 12 V DC from battery, convert it to 230 V, 50 Hz with the help of inverter and give it to the load. 3. Battery and battery charger When power supply is available, this section charges the battery through battery charger circuit, which converts input AC supply to the desired DC level and charges the battery. Also, it prevents overcharging of battery. 4. Static switch When power failure occurs, the inverter is connected to the load with the help of this switch. 	2 Marks for Explanation	
b)	State any 4 requirement of earthing in control panels.		04
Answer	<p>It is mainly for the safety of the personnel that earthing is needed. Earthing is needed for</p> <ol style="list-style-type: none"> 1) Reliable passage of fault current 2) Reliable operation of circuit protection device 3) Safe potential for all electrical equipments 4) Mechanical stability and integrity of connections 5) Reliable passage of single wire earth return load currents to ground or source 	1 Mark for each point	
c)	Write in brief calibration procedure for pressure gauge.		04
Answer	<p>Dead weight tester is used to calibrate the pressure gauge. It consists of a piston-cylinder assembly which freely moves in the chamber which has oil. A platform is attached to the piston to keep the known weights. The gauge is calibrated against the known weight.</p> 	01Mark for Diagram	



	<p>Procedure:</p> <ol style="list-style-type: none">1. Attach the gauge to the stem, B.2. Select a weight and place it on the vertical piston, A.3. Move the handle of the adjusting piston C to insure that the weight and piston are supported by oil.4. Spin the vertical piston to insure it is floating freely.5. Record the gauge reading and the weight.6. Repeat steps 2 through 5 for increasing and decreasing weights.7. Draw the calibration curve with the pressure indicated on the gauge Vs pressure of the oil in the dead weight tester.	03 Mark for explanation	
d)	Write the calibration procedure for level gauge.		04
Answer	<p>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 graduated 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</p> 	02 Mark for explanation	02 Marks for Diagram

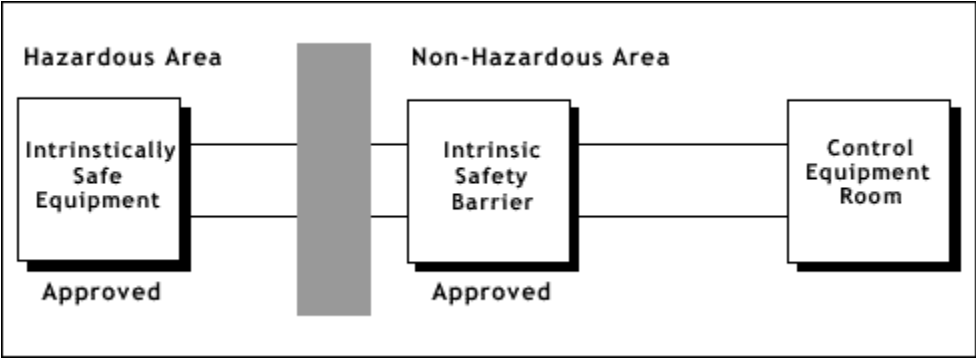


3. B	Answer any one		06
a)	State the need of instrument tubing. Explain in brief signal tubing and impulse tubing.		06
Answer	<p>Instrument tubing is used for transmission of pneumatic signals in the plant.</p> <p>These are normally made of copper with PVC coating.</p> <p>These are of 2 types: i) signal tubing ii) impulse tubing</p> <p>1. Signal tubing: These are used for the transmission of signals in the form of Pressure. Copper tubing with PVC outer sheath is used for signal tubing.</p> <p>2. Impulse tubing: It contains process fluids which run between the instrument impulse connection and process tapping point ie. For connecting directly to process. Example: tubing from a DP flow meter to transmitter. Here 2 tubing are needed for differential pressure from DP flow meter.</p> <p>The piping material should be compatible with the process fluid.</p>	02 Mark for Need 2 Mark for each type	
b)	Write the installation procedure for temperature transmitter with neat diagram.		06
Answer	<p>General guidelines:</p> <p>The accuracy of a process parameter measurement depends on proper installation of the transmitter and impulse piping.</p> <p>The need for easy access, safety of personnel, practical field calibration, and a suitable transmitter environment are to be considered.</p> <p>Install the transmitter so as to minimize vibration, shock, and temperature fluctuations. Installations in food, beverage, and pharmaceutical processes may require sanitary seals and fittings.</p> <p>Here, the sensor is the thermocouple which is mounted on the medium whose temperature is to be measured. Thermocouple is inserted into the thermowell for protection. The thermowell is inserted into the medium whose temperature is to be measured. No need of isolation or drain valve while installing thermowell.</p> 	02 Mark for each guideline 02 mark for explanation 02 mark for any related Diagram	



4	Answer any two.		16
a)	Draw the Block diagram of SMART transmitter and explain its working.		08
Answer	<p>Block Diagram of SMART transmitter :</p> <pre>graph LR Input((input)) --> Transducer[Transducer] Transducer --> Signal[Signal Conditioning] Signal --> ADC[ADC] ADC <--> DAC[DAC] DAC --> Output[4-20mA] μp[μp] <--> ADC μp <--> DAC μp <--> HHT[Hand Held Terminal] μp <--> Mem[Memory] μp <--> HCS[Heart Communication System]</pre> <p>SMART: Single Module Auto Ranging Transmitter</p> <p>It is a transmitter which uses a microprocessor along with a sensor/ transducer combined with a processing unit and a communication interface with the following features:</p> <ol style="list-style-type: none">1. Wider range of span due to microprocessor.2. Less error due to increased rangeability.3. Can change engineering units, zero, span and range.4. Can be provided with standby sensors or multiple sensors.5. Allows 2-way communication with the control room.6. Automatic span switching.7. Inclusion of control functions and other algorithm due to microprocessor in the SMART.8. They can memorize and recall tag number, location and specification of transducers.9. Measurement date can be expressed in engineering unit.10. Linearization, characterization and correction of the characteristic of transducer is possible due to the microprocessor. <p>Blocks:</p> <ol style="list-style-type: none">1. Transducer: detects and converts the process variable to an electrical quantity2. Signal conditioning and ADC: suitable modification or conditioning of the signal is done for effective transmission.3. Microprocessor with memory and HART communicator: this makes SMART different from other transmitters. The features mentioned above are due to this.	<p>02 mark for block diagram</p> <p>1 mark for each feature (total 03 marks)</p> <p>03 mark for explana tion</p>	

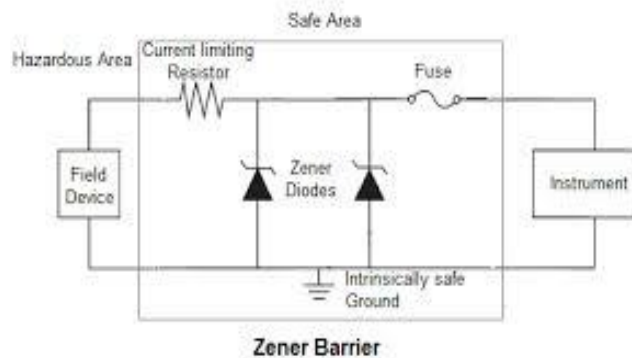


b)	What are the methods adopted for protection of hazardous area? Name them. Explain the method of intrinsic safety in detail.		08
Answer	<p>Methods :</p> <ol style="list-style-type: none">1. Intrinsic safety2. Explosion proofing3. Purging/pressurizing4. Sand filling <p>Intrinsic safety (IS) is a protection technique for safe operation of electrical equipment in hazardous areas by limiting the energy available for ignition. In signal and control circuits that can operate with low currents and voltages, the intrinsic safety approach simplifies circuits and reduces installation cost over other protection methods. High-power circuits such as electric motors or lighting cannot use intrinsic safety methods for protection. The basis for intrinsic safety is that the energy is kept at low levels so that ignition will not occur.</p> <p>National electrical code defines Intrinsic safety as: ‘Intrinsically safe equipments shall not be capable of releasing sufficient electrical or thermal energy under normal or abnormal condition to cause ignition of a specific flammable or combustible atmospheric mixture in its most ignitable condition’</p> <div data-bbox="240 1226 1211 1581"></div> <p>Interconnecting lines between hazardous and nonhazardous areas pass through a barrier which limit energy flow and restrict voltage in hazardous areas. This is done by resistors and zener diode to limit current and voltage. This is the zener barrier.</p> <p>A Zener barrier is associated equipment that is installed in the safe area. It is designed to limit the amount of energy that could appear in an electrical circuit passes through the hazardous area despite the connection before the barrier. A barrier consists of:</p>	<p>02 Marks for methods</p> <p>02 marks for Intrinsic safety diagram</p> <p>04 marks for explanation</p>	

- Resistors to limit the current
- Zener diodes to limit the voltage
- Fuses to protect the components

As any intrinsic safety equipment, the Zener barrier allows cables to short circuit to each other or to metallic parts connected to ground without danger.

The Zener barrier interfacing mode differs from others as there is no galvanic isolation. Cables that pass through the hazardous area thus share common features with those of the safe area. This implies equipotential grounding.



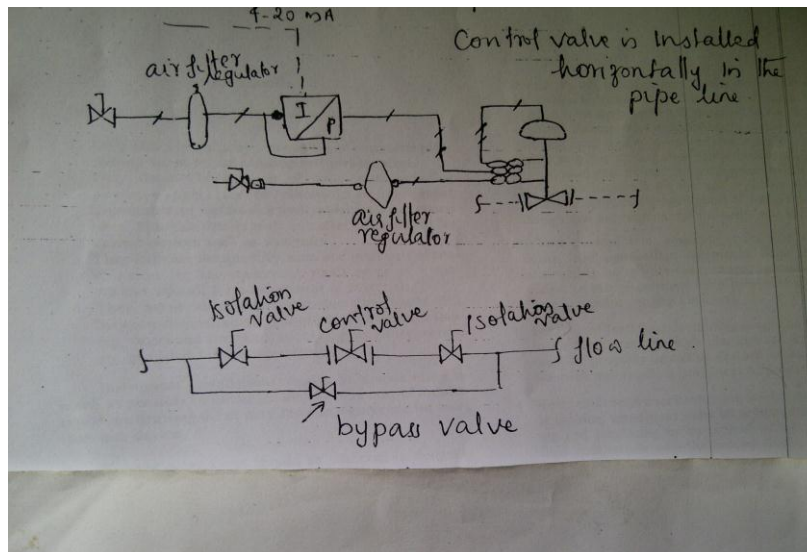
c) Explain with diagram the installation procedure for 1) Control valve 2) Pressure transmitter.

08

Answer

1) Control valve :

The valve body is installed in the pipe. Its end connections should be screwed or flanged or welded. Pipe anchors are used to minimize force concentration. In steam piping network, steam traps are provided at all low points. Control valves should be connected with isolation valves on upstream and downstream sides.



02 mark
for
explanation

2 Marks
for any
related
diagram

2) Pressure transmitter

The accuracy of a process parameter measurement depends on proper installation of the transmitter and impulse piping.

The piping between the process and transmitter must accurately transmit process pressure to the transmitter.

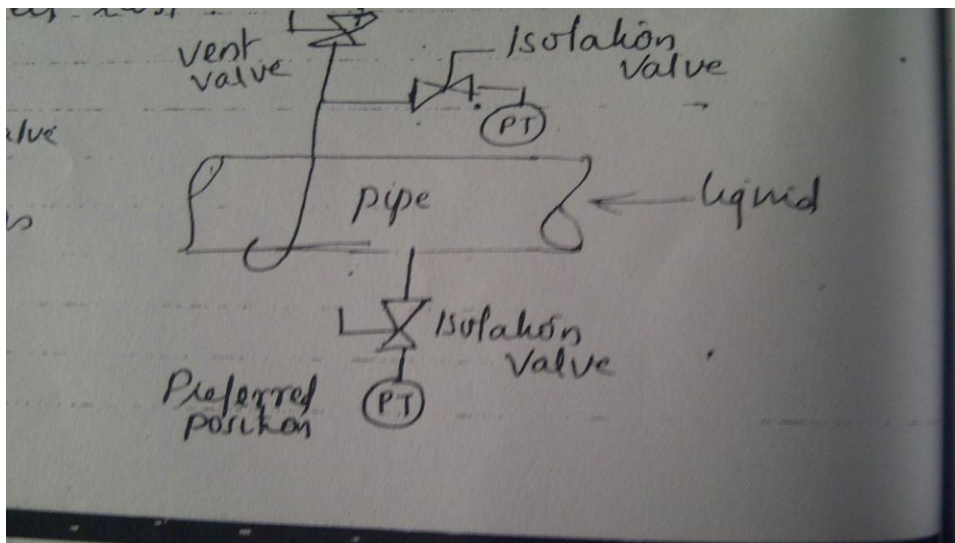
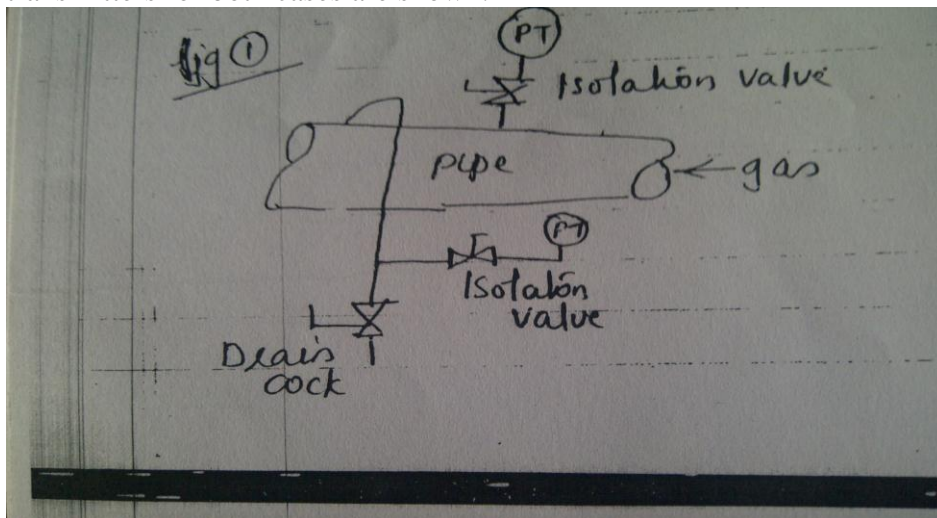
Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. Piping should not form traps where air bubbles can form.

The need for easy access, safety of personnel, practical field calibration, and a suitable transmitter environment are to be considered.

Install the transmitter so as to minimize vibration, shock, and temperature fluctuations. Installations in food, beverage, and pharmaceutical processes may require sanitary seals and fittings.

Isolation valves and bypass valves are needed which helps to change the pressure transmitters on line.

The following figures show the pipe line for gas and liquids. The pressure transmitters for both cases are shown.



**02 mark
for
explanation**

**2 Marks
for any
related
diagram**

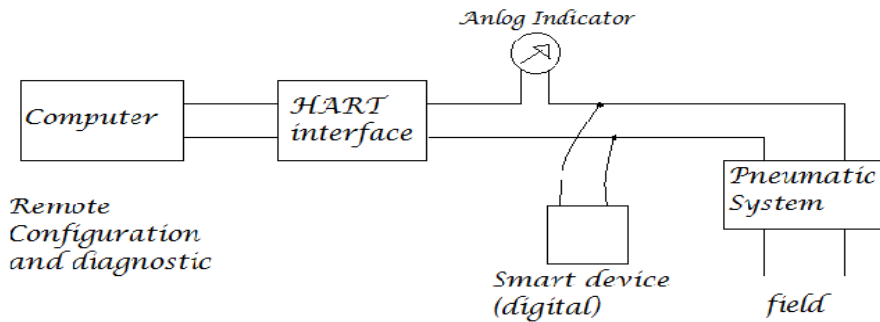
5	Answer any Two.		16
a)	Draw the diagram of electronic differential pressure transmitter and explain its working.		08
Answer	<p>Diagram of electronic force balance differential pressure transmitter</p> <p>Working:</p> <p>Fig. shows a force-balance differential pressure transmitter, in which the measurement that produces a force tends to move the top of the force bar. The differential pressure is applied across a pair of opposing liquid - filled diaphragms welded on the opposite sides of a capsule. The applied pressure produces a force to move the top of the force bar. The diaphragm seal acts as a fulcrum for the bar. This tiny motion acting through levers, moves the ferrite disc closed to the differential transformer changing its output. This changes the output of the LVDT, which is rectified and then amplified to generate a DC mA signal for transmission. This output signal is fed back through the voice coil on the armature of a force motor (A coil with a permanent magnet) which is in series with the output terminals. When this</p>	04 Mark for diagram	
		04 mark for explanation	



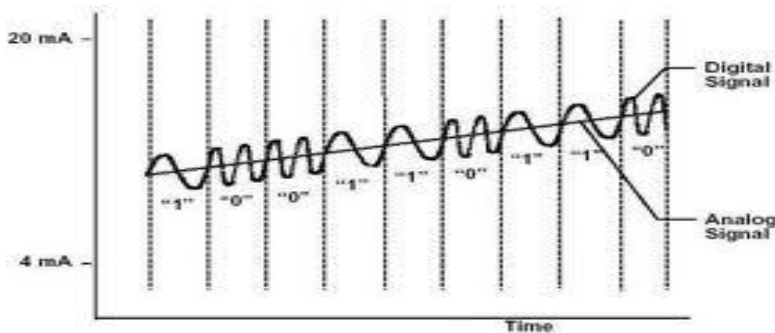
	feedback moment(F5) equal to the moment created by the measurement force (F2) the force bar is again in its original position and the amplifier signal stabilizes, indicating the measured differential pressure.																				
b)	Define Hazardous area in industry. Explain the hazardous area classification based on class, group and division.		08																		
Answer	<p><u>Definition of hazardous area:</u> Any industrial area in which there are fine particles or dust subject to explosion or spontaneous combustion is present is called a hazardous area.</p> <p><u>NEC Classification:</u> NEC classifies industrial areas according to class, division and group, as given in the table below.</p> <table><tr><th>Area Designation</th><th>Area Description</th></tr><tr><td>Class I</td><td>Locations made hazardous by flammable gases or vapour</td></tr><tr><td>Class II</td><td>Locations made hazardous by combustible dusts</td></tr><tr><td>Class III</td><td>Locations made hazardous by combustible fibers & flying</td></tr><tr><td>Division I</td><td>Locations which may contain hazardous mixtures under normal operating conditions.</td></tr><tr><td>Division II</td><td>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.</td></tr><tr><td>Group A</td><td>Atmosphere containing acetylene.</td></tr><tr><td>Group B</td><td>Atmosphere containing hydrogen or equivalent gases or vapors of manufactured gas having an equivalent hazard.</td></tr><tr><td>Group C</td><td>Atmosphere containing ethyl/ether vapours, ethylene or cyclopropane.</td></tr></table>	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.	<p>02 mark for definition</p> <p>02 mark for each category (any 3)</p>	
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c)	<p>1) Explain the protocol HART for digital communication with relevant diagram</p> <p>2) Explain the architecture of foundation field bus in brief.</p>		08								
Answer	<p>1. Description of HART digital protocol:</p> <p>HART (Highway Addressable Remote Transducer) Protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring system. It is principally a master slave protocol in which field device (slave) speaks only when spoken to by a master. Two masters (primary & secondary) can communicate with a slave in a HART network. Secondary masters such as handheld communicators can be connected almost anywhere on the n/w and communicate with field devices, without disturbing communication with the primary master. A primary master is a DCS or PLC or a computer based control or monitoring system. HART protocol uses both 4-20mA analog signal and HART digital signal to be transmitted over the same wiring. Primary variable and control signal information is carried by 4-20mA (if desired), while additional measurements, process parameters devices configuration, calibration and diagnostics information is accessible through the HART digital signal over the same wire at the same time. In HART digital communication signal, a logical ‘1’ is represented by a frequency 1200Hz and a logical ‘0’ 2200Hz.</p>	02 marks for explanation									



HART networking between field and control room



HART digital communication signal superimposed on the 4-20mA current signal

02
marks
for any
of the
diagram

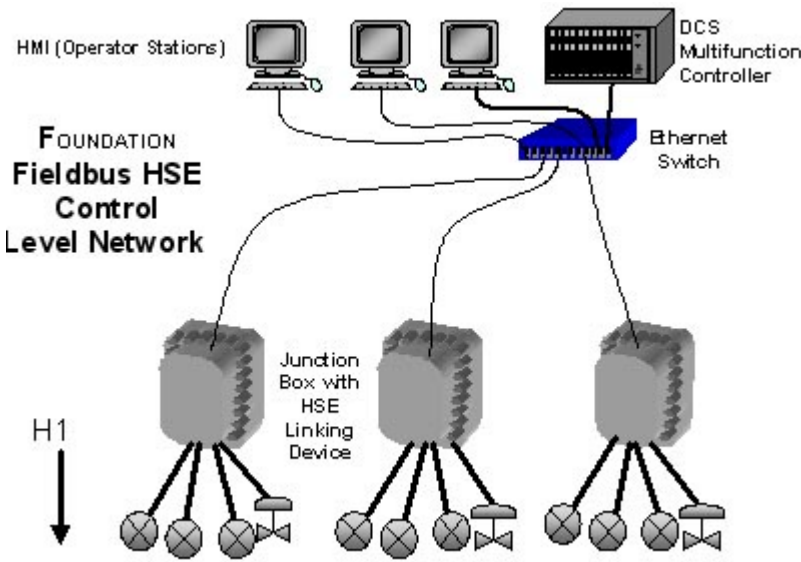
2. Description of Foundation Fieldbus Architecture :

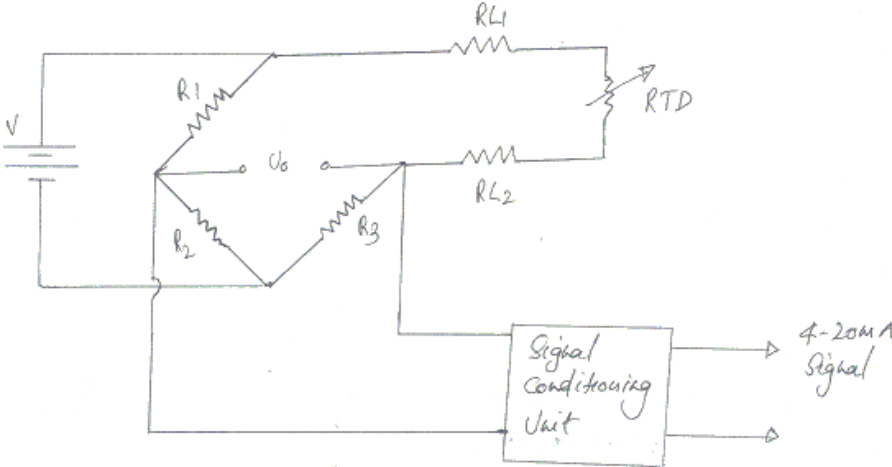
It is a digital, serial two way communication system that serves as the base-level network in a plant or factory automation environment. It is an open architecture, developed and administered by the Fieldbus foundation (an organization consists of more than 350 of world's suppliers and end users of process control and manufacturing automation products using field bus standards). Foundation fieldbus technology is mostly used in process industries, but nowadays it is being implemented in power plants also.

There are two types of foundation fieldbus introduced to meet different needs within the process automation environment. These two use different physical media and communication speeds.

- H1: It works at 31.25 Kbit/s and provides communication and power over standard twisted-pair wiring. It interconnects field

04 mark

	<p>equipments such as sensors, actuators and I/O.</p> <ul style="list-style-type: none"> HSE (High-speed Ethernet): It works at 100 Mbit/s and provides integration of high speed controllers (such as PLCs), H1 subsystems (via linking device), data servers and work stations using standard Ethernet cabling. It doesn't provide power over the cable.  <p>Foundation field bus architecture</p> <p>NB: diagram is optional. A detailed explanation alone or a minimum explanation with diagram, both are to be considered as a full answer.</p>		
6	Answer any Four		16
a)	Explain the method of explosion proofing of enclosures for hazardous area protection.		04
Answer	<p>Description of explosion proofing of enclosures</p> <p>Explosion proof housing or flame proof enclosure is the most practical protection method for motor starters and heavy equipments which produce sufficient energy in normal operation to ignite a flammable atmosphere. Explosion proof enclosures are not vapour tight. A flammable atmosphere will enter the enclosure. The explosion pressure range is 100 to 150lb/in². Because the enclosure must contain the explosion and also must cool escaping gases, cast or heavy metallic construction with wide close fitting flanges or threaded joints are used. Non-metallic construction is also permitted. The enclosure should be tested to ensure that an internal explosion is not transmitted to the outside. It must withstand a hydrostatic pressure of 4 times the maximum pressure observed during the explosion test. Its external case temperature should not be high enough to ignite the surrounding atmosphere. Special fasteners should be provided to prevent</p>	04 mark for explanation	

	unauthorized opening of flame proof enclosure. Routine testing at lower pressure should be conducted.		
b)	Draw the diagram of temperature transmitter with RTD. Describe its working.		04
Answer	<p>Working of temperature transmitter: A temperature transmitter converts the low level signal produced by any of the temperature sensor (RTD, thermocouple and thermistor) into a usual 4 -20 MA or (0-10 volts) signal. In the case of a RTD connected to the transmitter, the transmitter measures a change in resistance of the RTD proportional to the change in temperature measured. The transmitter then derives a current output (generally 4-20mA) which can be sent to the control room. An RTD can be connected in a two, three, or four-wire configuration. A four wire connection is the least error prone. The low voltage signal from the Wheatstone's bridge circuit is given to a signal conditioning circuit. It converts the signal into a 4-20 mA or 0-10 V signal. It also provides circuitry for 0 and span. The 0 and span ckt consists of potentiometers that can be adjusted to ensure that the signal is exactly 4 mA when it is at its min. temperature and 20 mA at maximum temperature.</p>  <p>RTD transmitter with two-wire configuration.</p>	<p>02 marks for explanation</p> <p>02 marks for diagram</p>	
c)	List the types of control panel. Draw the front view of flat panel		04
Answer	<p><u>Types of control panels:</u></p> <ol style="list-style-type: none"> 1) Flat panel 2) Break front panel 3) Console 	02 mark	

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	compensating cable.																
Answer	<p><u>Types of cables:</u></p> <p>1) Signal cables</p> <p>2) Control Cables</p> <p>3) Compensating cables</p> <p>4) Bus cables</p> <p><u>Applications:</u></p> <p>1) Compensating cable</p> <p>Compensating cables or extension cables are used for thermocouples to isolate the transmitter form the direct contact of process temperature.</p> <p>2) Bus cables</p> <p>Bus cables are the physical media used for the digital data transmission. It connects the field devices to the local as well as central microcontrollers (e.g. DCS system) through linking devices.</p>	<p>½ mark for each</p> <p>01 mark for each</p>															
f)	Compare electronic and pneumatic transmission systems for any 4 points.																
Answer	<table><tr><th>Pneumatic</th><th>Electronic</th></tr><tr><td>1) Signal is dry air</td><td>1) Electrical signal is used as medium</td></tr><tr><td>2)Output is 3-15psi</td><td>2) Output is 4-20ma,0-10v, ± 10v</td></tr><tr><td>3)Tubing is used for signal transmission</td><td>3) Wires are used for signal transmission</td></tr><tr><td>4)More maintenance is required</td><td>4) less maintenance is required</td></tr><tr><td>5)Non preferred for long distance transmission</td><td>5) Preferred for long distance transmission</td></tr><tr><td>6) Preferred for hazardous area</td><td>6) Less used in hazardous areas, and only with necessary protection</td></tr></table>	Pneumatic	Electronic	1) Signal is dry air	1) Electrical signal is used as medium	2)Output is 3-15psi	2) Output is 4-20ma,0-10v, ± 10v	3)Tubing is used for signal transmission	3) Wires are used for signal transmission	4)More maintenance is required	4) less maintenance is required	5)Non preferred for long distance transmission	5) Preferred for long distance transmission	6) Preferred for hazardous area	6) Less used in hazardous areas, and only with necessary protection	<p>01 mark each for point (any 4 points)</p>	
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