MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
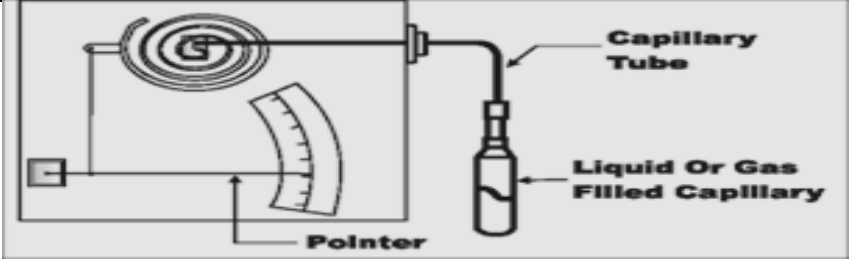**(ISO/IEC - 27001 - 2005 Certified)**

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WINTER– 16 EXAMINATION   (Subject Code: 17434)
Model Answer

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for 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.	Sub Q. N.	Answer	Marking Scheme
Q1)		**Attempt any <u>SIX</u> of following**	**12-Total M**
	a)	**i) Define: 1)Absolute pressure 2)Gauge pressure**	**2M**
	Ans	**1)** <u>Absolute Pressure:</u> Absolute Pressure is the actual pressure including atmospheric pressure acting on a surface. It is Abbreviated as psia (pounds per square inch absolute) **2)** <u>Gauge pressure:</u> The difference between the actual and atmospheric pressure is called gauge pressure. The pressure here is abbreviated as psig (pounds per square inch gauge)	1M for each
		ii) State the need of transducer in instrumentation system.	**2M**
	Ans	Input quantity for most of the instrumentation systems is non – electrical quantity. To convert there non- electrical quantity like heat, pressure, level, flow rate, humidity, temperature, etc. into electrical quantity in order to use electrical methods and techniques for measurement, manipulation and control transducers are required.	2M
		iii) Draw labeled diagram of gas filled thermometer.	**2M**
	Ans		2 M

|			
	iv) Define laminar and turbulent flow.		**2 M**
Ans	• <u>Laminar Flow:</u> When all the molecules of flow are parallel to each other, it is called laminar flow. • <u>Turbulent flow:</u> When the flow molecules are scattered without any fixed pattern, it is called Turbulent Flow.		1M for each
	v) What is absolute and relative humidity?		**2 M**
Ans	• <u>Absolute humidity</u> : It is defined as amount of vapour present in each unit volume of air or gas. • <u>Relative Humidity:</u> It is the ratio of the moisture content of gas to the maximum moisture content in the gas at that temperature.		1M for Each
	vi) Define NTC and PTC.		**2 M**
Ans	• <u>NTC:</u> The NTC thermistors are ceramic semiconductors that have a high Negative Temperature Coefficient of resistance. NTC thermistors decrease in resistance as the temperature increases. • <u>PTC:</u> PTC thermistors are Positive Temperature Coefficient resistors generally made of polycrystalline ceramic materials that have a high positive temperature coefficient, which increases in resistance as the temperature increases. 		1M for each
	vii) Draw neat lebelled diagram of Rotameter.		**2 M**
Ans			2 M

		viii) Give the classification of pressure of measuring devices.	**2 M**

	Ans	1. Non-Elastic Pressure Transducers (Manometer):
		  • U- Tube
		  • Inclined Tube
		  • Well type Manometer
		2. Elastic Pressure Transducers:
		  • Bourdon Tube
		  • Bellows
		  • Diaphragm
		  • Capsule
		3. Electrical Pressure Transducers:
		  • Bourdon Tube with LVDT
		  • Diaphragm with strain gauge
			2 M

b)		**Attempt any <u>TWO</u> of following:**	**8 M**
		i) Draw the neat diagram of venturimeter and describe how flow is being measured.	**4 M**
	Ans	It is a primary element of differential pressure Flow meters. 1) It consists of a straight inlet section, a converging conical inlet section, a cylindrical throat and adiverging recovery cone. 2) Straight inlet section has same diameter as pipe. In converging conical inlet section, the cross-section of stream decreases & velocity increases. 3) In cylindrical throat, flow velocity will be maximum & static pressure will be minimum. 4) In diverging recovery cone flow velocity decreases taps are located at. 5) The pressure taps are located at straight edge section and at cylindrical throat where pressure is minimum thus the maximum Pressure Gauges across this point. 6) As it have no sharp edges or warner and does not project into fluid stream. It can be used to handle fluids with solid, slurries, etc.	Digram:2 M & Describe:2M

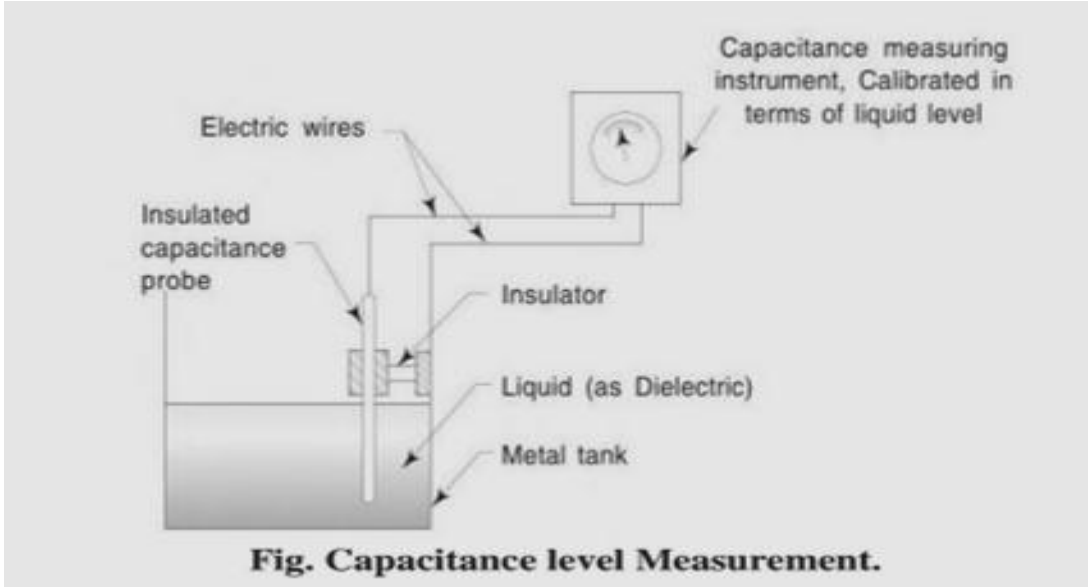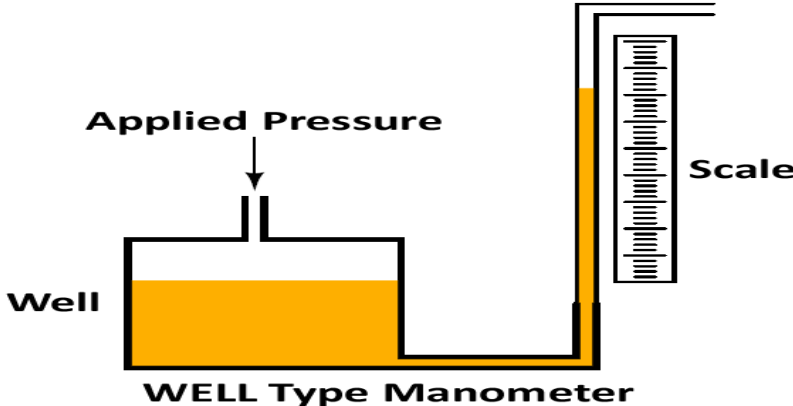| | | 7) The cross sectional area of fluid does not increase or decreases. Abruptly, so permanent pressureloss or energy loss is very low as compared to orifice plate.

8) Ventury tube are usually made up of cast iron or steel and built up in several forms such as.

a) Long from or classic ventury tube.
b) Short from where outlet cone is shortened.
c) Eccentric from to minimize the buildup of heavy materials.
d) Rectangular from which is used in air-duct work. | |
| | | **ii) Draw the constructional detail of 'C' type Bourdon tube and describe it`s operation of pressure measurement.** | **4 M** |
| **Ans** | |
Fig: C-Type Bourdon Tube

Bourdon Tube Pressure Gauge
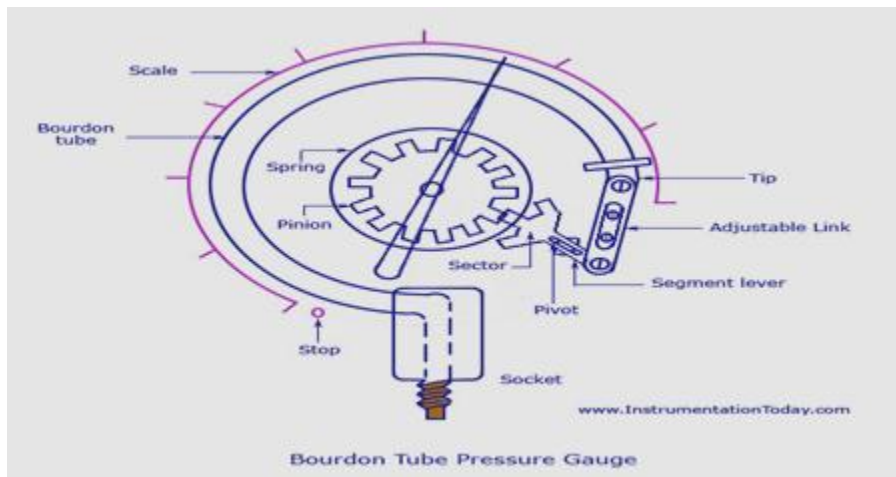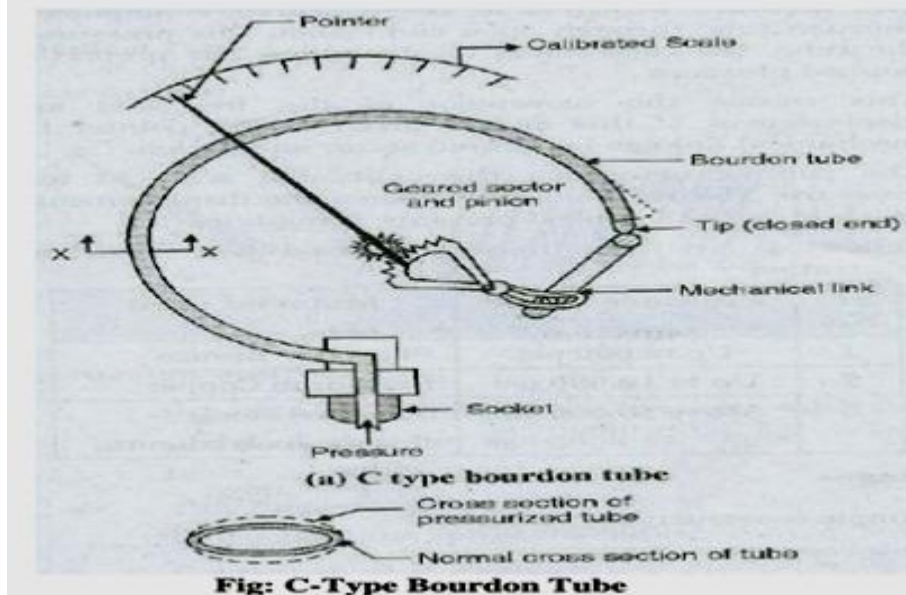
Working-

• C type bourdon tube is made up of an elliptically flattened tube bent in such a way as to produce the C shape as shown in the fig. Oneend free end of this tube is closed or sealed and the other end (fixedend) opened for the pressure to enter. | Digram:2 M &

Describe:2M |

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- The free end connected to the pointer with the help of geared sector and pinion. Calibrated scale and pointer is provided to indicate the pressure.

- The cross section view of C type bourdon tube under normal condition and pressurized condition is as shown in figure.

- The pressure which is to be measured is applied to the bourdon tube through open end. When this pressure enters the tube, the tube tends to straighten out proportional to applied pressure.

- This causes the movement of the free end and the displacement of this end is given to the pointer through mechanical linkage i.e. geared sector and pinion.

- The pointer moves on the calibrated scale in terms of pressure. The relationship between the displacement of the free end and the applied pressure is nonlinear.

		iii) **Draw a neat setup diagram to measure level of liquid in a tank using capacitive method.**	**4 M**
	Ans	Fig. Capacitance level Measurement.	Digram:2 M & Lebelled:2M
Q 2)		**Attempt any FOUR of following:**	**16 M**
	a)	**Draw the constructional details of well type manometer and list its two opplications.**	**4 M**
	Ans	Diagram of well type manometer	2 for diagram 2for application

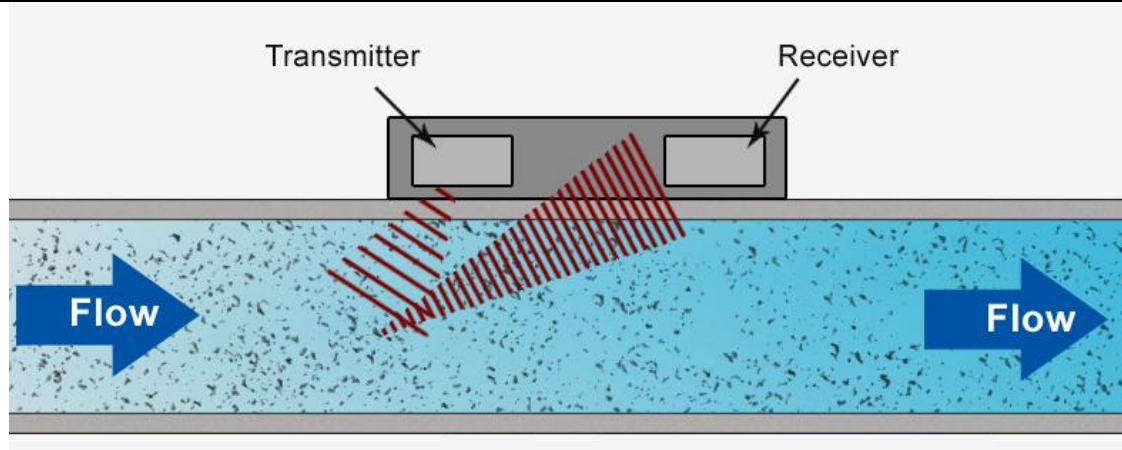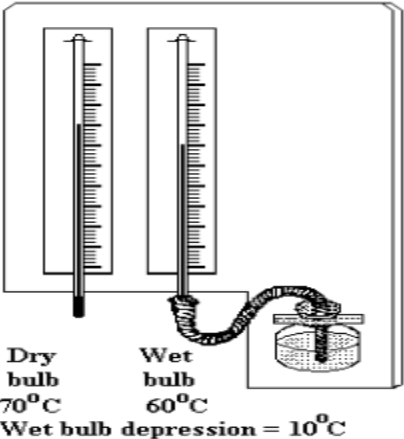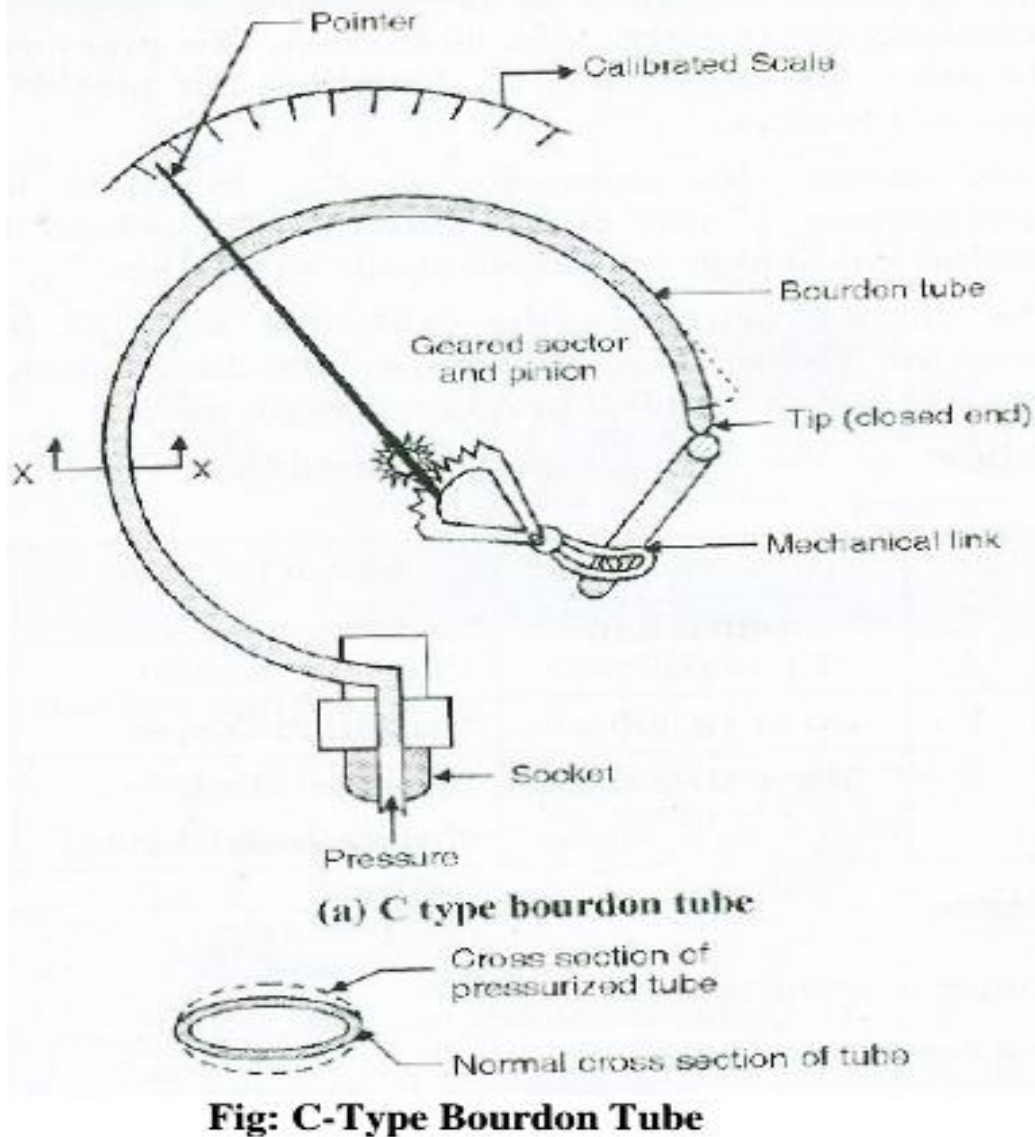|			
		Applications of well type manometer (any two) 1. Used in flow, pressure measurement systems. 2. Used in force measurement systems. 3. Used in pneumatic or gas systems.	
	b)	**Described the working of ultrasonic flow meter with neat diagram.**	**4 M**
	Ans	 One crystal transducer is mounted outside the pipe. This transducer emits an ultrasonic wave and the wave is projected at an angle through the pipe wall into the liquid. The transducer is basically piezoelectric crystal with a heavy backing to attenuate the unwanted rear movement. Some parts of the ultrasonic wave are reflected by the liquid particles and bubbles in the liquid and it is returned through the pipe wall towards the transducer. As the liquid flows through the pipe the particles and bubbles in the liquid also moves these particles acts as reflectors for the ultrasonic wave. The particles and bubbles moving with the velocity of the fluid, the frequency of the reflected wave is shifted according to particle velocity, it is given by Doppler principle **OR** Ultrasonic flow meters use sound waves to measure the flow rate of a fluid. Doppler flow meters transmit ultrasonic sound waves into the fluid. These waves are reflected off particles and bubbles in the fluid. The frequency change between the transmitted wave and the received wave can be used to measure the velocity of the fluid flow. Time of Flight flow meters use the frequency change between transmitted and received sound waves to calculate the velocity of a flow.	Digram:2 M & Describe:2M

	c)	With the help of neat labelled diagram describe the operation of RTD.	4 M
	Ans	**Working:** An RTD (resistance temperature detector) is a temperature sensor that operates on the measurement principle that a material's electrical resistance changes with temperature. Temperature sensitive materials used in the construction of RTDs include platinum, nickel, and copper; platinum being the most commonly used. RTD operates on the principle that the electrical resistance of a metal changes predictably in an essentially linear and repeatable manner with changes in temperature. RTD has positive temperature coefficient (resistance increases with temperature). The resistance of the element at a base temperature is proportional to the length of the element and the inverse of cross sectional area. A typical electrical circuit designed to measure temperature with RTD's actually measures a change in resistance of the RTD, which is then used to calculate change in temperature.	Digram:2 M & Describe:2M
	d)	What is the need of level measurement? Give classification of level measurement methods with two examples for each.	4 M

	Ans	In almost all industries, vast quantities of liquid such as water solvents, chemicals etc. are used in number of processes. It is widely employed to monitor as well as measure quantitatively the liquid content in the tanks, containers and vessels etc liquid level affects both pressure and rate of flow in and out of the container and therefore its measurement becomes important in a variety of processes encountered in modern manufacturing plants.
		
		Classification of Liquid Level Measurement:
		Direct method
		1. Hook type
		2. Sight glass type
		3. Float type
		4. Dip stick
		Indirect method
		1. Hydrostatic pressure type
		2. Electrical type:
		   a) Capacitance level indicator
		   b) Radiation level detector
		   c) Ultrasonic level gauge
		3. Radar type
			1M- Need,
			3M-
			Classification

e)	**Give the classification of transducer with one example for each.**		**4 M**
Ans	(i) Active transducer: Thermocouple (ii) Resistive transducer: Strain-gauge (iii) Inductive transducer: LVDT (iv) Digital transducer: Rotary Encoder (v) Passive transducer : Thermistor		Any four points : 4M
f)	**Describe the dry and wet bulb thermometer method for humidity measurement. What is the unit of humidity expressed by it.**		**4 M**
Ans	Explanation:- A psychrometer, or wet-and- dry-bulb thermometer, consists of two thermometers,one that is dry and one that is kept moist with distilled water on a sock or wick.The two thermometers are thus called the dry-bulb and the wet-bulb. At temperatures above the freezing point of water, evaporation of water from the wick lowers the temperature, so that the wet-bulb thermometer usually shows a lower temperature than that of the dry-bulb thermometer. When the air temperature is below freezing, however, the wet-bulb is covered with a thin coating of ice and may be warmer than the dry bulb. **Wet and dry bulb thermometer Hygrometer** Dry bulb 70°C Wet bulb 60°C Wet bulb depression = 10°C Relative humidity is computed from the ambient temperature as shown by the dry-bulb thermometer and the difference in temperatures as shown by the wet-bulb and dry-bulb thermometers. Psychrometers are commonly used in meteorology, and in the HVAC industry for proper refrigerant charging of residential and commercial air conditioning systems. Unit of humidity: Units are grams of water vapour per cubic meter volume of air or it is expressed as grams per kilogram or kilogram per kilogram or it is expressed as a percentage.		1M- Diagram, 2M – Explanation, 1M- Unit

Q.3.		Attempt any **FOUR** of following:	16 M
	a)	**List any six selection criteria of a transducer. Why motor/ generator is not transducer?**	**4 M**
	Ans	Transducer is a device which transforms energy from one form to another. The following points should be considered while selecting a transducer for particular application. 1. Operating range 2. Operating principle 3. Sensitivity 4. Accuracy 5. Frequency response and resonant frequency 6. Errors 7. Environmental compatibility 8. Usage and ruggedness. 9. Electrical aspect. 10. Stability and Reliability 11. Loading effect 12. Static characteristics 13. General selection criteria Motor/genrator are Form of energy into another(Electrical to mechanical) but it is not involved in any measurement. Therefore, motors/generators are not transducers. It does not sense the variation in physical quantity	3mark for list Reason 1 M
	b)	**List the names of elestic pressure transducers and draw construction details of any one.**	**4 M**
	Ans	The commonly used elastic pressure tranduces are : 1)Bourdon Tube: 1)C-Type 2)Spiral 3)Twisted 4)Helical 2)Bellows 3)Diaphragms	List: 2M & Diagram: 2 M

(a) C type bourdon tube

Fig: C-Type Bourdon Tube

		Write two advanteges and applications of ultrasonic level measurements.	4 M
Ans		Advantages of Ultrasonic Method of Level Mesurements: 1)Ultrasonic gague needs to physical contact with the liquid. 2)It is a non-disturbance technique. 3)Used for both solid and liquid level measurement. 4)They have no moving parts. Applications of Ultrasonic Method of Level Mesurements: 1)Ultrasonic level measuring device is used for both continuous and point measurement. 2)The point measuring ultrasonic dectors are used for measurement of gas/liquid, liquid/liquid or gas/solid interface. 3) It is used for level measurement of hazardous liquids and solids.	Advantages- 2M & Applications- 2M

The "c)" label appears in the first data row's second column.

| d)	Comapre RTD and Thermistor w.r.t. : (i)Characteristics,(ii)Materials,(iii)Tempreture Range,(iv)any other point			4 M
Ans				1M for Each Point

| Parameter	RTD	Thermistor
Characterstics	The resistance temperature characteristics of RTD's are linear.	The resistance temperature characteristics of thermistor are highly nonlinear.
Materials	Material used in the RTD are platinum,copper, nickel, tungsten etc.	Material used in thermistor are manganese, copper,cobalt, iron oxides etc.
Tempreture Range	-200^0 C to 650^0 C.	-150^0 C to 300^0 C.
Size	RTD's are relatively larger in size.	Size of thermistors are small.
Digram		
Sensitivity	More	less

e)	Give the classification of speed measurement methods. Draw neat Diagram of any one.	4 M
Ans	**Diagram : Photo Electric Method**	**Classification- 2M & Diagram- 2M**
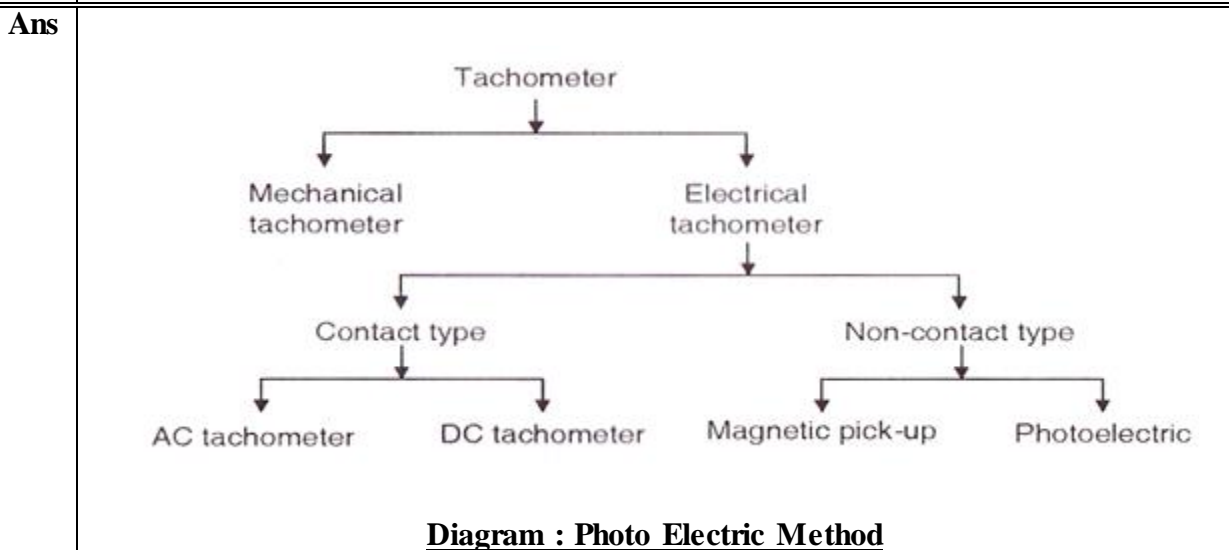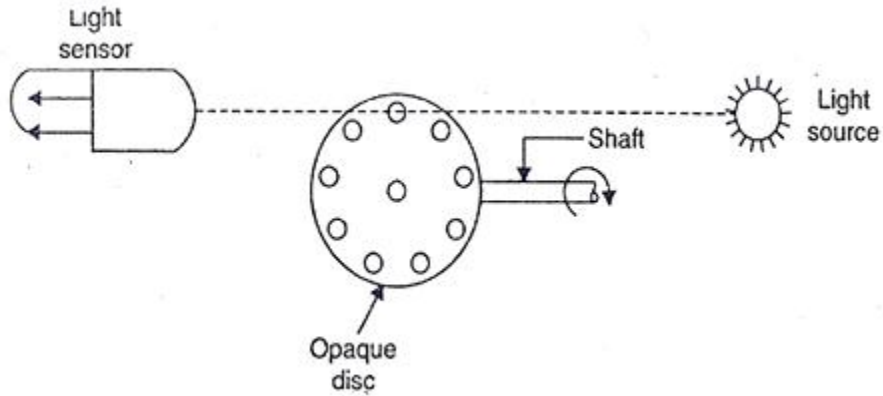
NOTE:Any other relevant diagram will do

f)	Write the tempreture range and material used for following thermocouples: (i)J type (ii)K type (iii)R type (iv)T type	4 M
Ans		1M for Each Type

Type	Tempreture Range	Material Used
J	-200 to 900	Iron/Constantan
K	-200 to 1250	Chromel/Alumel
R	0 to 1600	Platinum/Platinum 13% Rhodium
T	-200 to 400	Copper/Constantan

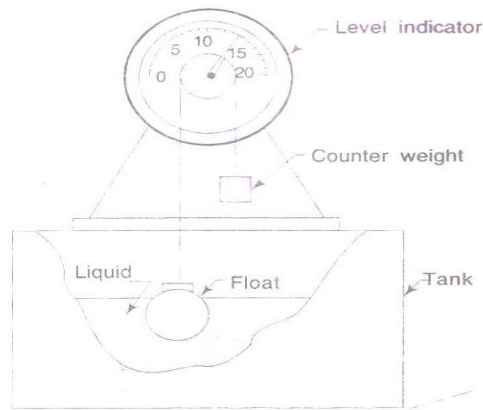| Q4)		Attempt any <u>FOUR</u> of following:	16 M
	a)	**Described the float type level measurment technique with neat diagram.**	4 M
	Ans	Float type level Measurement:	Diagram -2M & Description-2M

Above figure shows the simplest form of float operated mechanism for the continuous liquid level measurement. In this case, the movement of the float is transmitted to the

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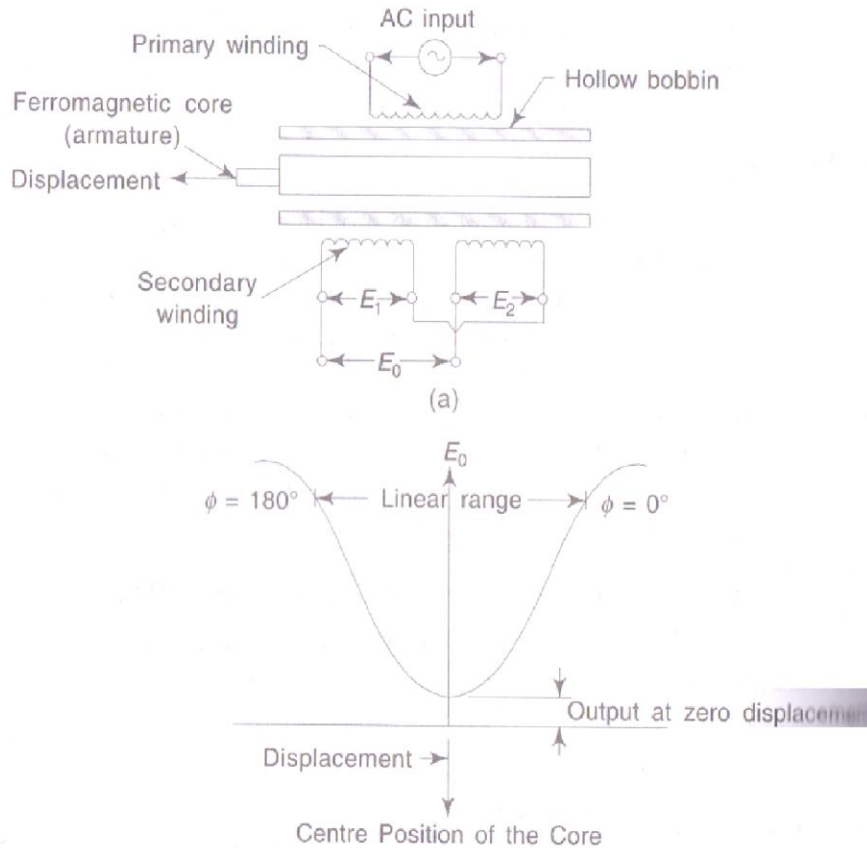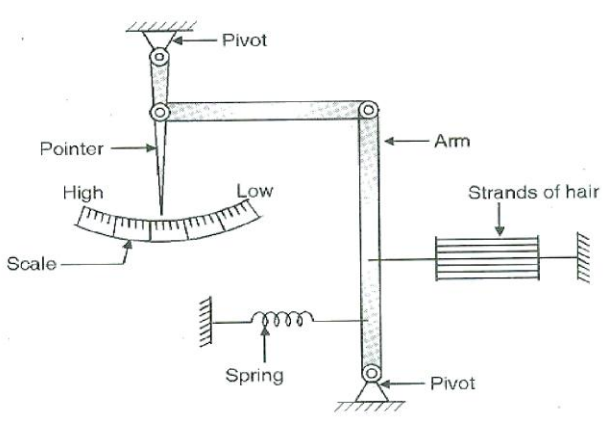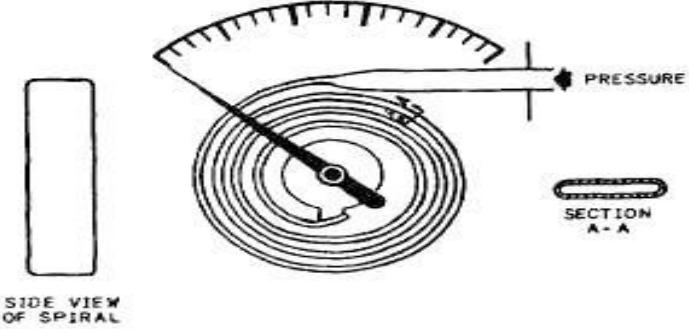|			
		pointer by stainless steel or phosphor-bronze flexible cable wound around a pulley, and the pointer indicates liquid level in the tank. The float is made of corrosion resisting material (such as stainless steel) and rests on liquid level surfacebetween two grids to avoid error due to turbulence. With this type of instrument, liquid level from ½ ft. (152mm) to 60 ft. (1.52m) can be easily measured.	
	b)	**Draw the input-output characteristics of LVDT?Why the secondary windings are connected in series opposition?**	**4 M**
	Ans	 The two seconderies S_1 & S_2 are connected in series opposition. So the output voltage of the tranducer is the difference of the two voltages. **Differential output Voltage** $E_0 = E_{S1} - E_{S2}$ So that we can measure the displacement using LVTD as well as direction of displacement.	Digram-2M & Reason- 2M
	c)	**i)Give different temperature scales with conversion formulae.Convert 107^0 into C.** **ii)Write the used of centigrade and Kelvin scale.**	**4 M**

	Ans	i) Different tempreture Scales are :
		     1) Degree celsius or centigrade(^{0}C)
		     2) Degree Fahrenheit (^{0}F)
		     3) Kelvin (K)
		     4) Degree Rankin (^{0}R)
		
		     1) ^{0}C = 5/9 (^{0}F – 32)
		     2) ^{0}F = 9/5 (^{0}C)+32
		     3) ^{0}R = ^{0}F + 459.7
		     4) K = ^{0}C + 273.15
		
		 Convert 107^0 into ^{0}C ,If 107^0F into ^{0}C
		 ^{0}C = 5/9 (107-32)
		 ^{0}C = 5/9 (75)
		 Thus, 107^0F = 41.66^0C
		
		 Convert 107^0 into ^{0}C ,If 107K into ^{0}C
		 K = ^{0}C + 273.15
		 ^{0}C = K – 273.15
		 ^{0}C = 107 – 273.15
		 Thus,^{0}C = -166.75
		
		 ii) centigrade and Kelvin scales are:
		 1)Used in Scientific energy work.
		 2) Used in Industry.
			Different temperature scales -2M &
			
			 Conversion Formules-1M
			
			 Used of centigrade& used of Kelvin scale- 1M

d)		**Give the construction details of hair hygrometer and describe it`s operation. List two materials used for it.**	**4 M**
	Ans	**Diagram:** Explanation: • It consists of bunch of human hair which increases mechanical strength of the instrument, arm with pivot joints and points scale assembly. • The element is maintained at slight tension by a spring. The hair strands are generally arranged parallel to each other with sufficient space between them for giving free access to the air sample whose humidity is to be measured.	Diagram 2M, Explanation 2M

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		• The indicator scale is directly calibrated to give a direct indication of humidity. The pointer or recording pen is operated through mechanical linkage.
		
		• As the relative humidity surrounding to that of hygrometer increases, length of hair strands increases, which move the pointer on the calibrated scale for maximum value.
		
		Materials used for hair hygrometer: (Any 2)
		    1. Indicator adjusting screw
		    2. Weight
		    3. Main cam
		    4. Sub cam
		    5. Rotation axis for main cam
		    6. Rotation axis for sub cam
		       Plate attaching sensor part of humidity,
		    8. Screw attaching sub cam
		    9. Connecting spring
		   10. lever
		   11. Hair bundle
			Used- 1 Mark each

e)		**Name the materials with tempreture ranges and shapes of thermistor.**	**4 M**
Ans		NTC-Thermistor compared of sintered mixture oxides such as magnese, nickel, cobalt, iron & ceranium, tin, zinc. PTC-Thermistor materials manufactured from compounds of barium lead & strontium titanates. Tempreture ranges of thermistor: -60^0C to 15^0C Shapes of thermistor: 1)Bead Type 2)prole type 3)Disc type 4)Rod type 5)Wosher type	Materials:1 M &Tempreture ranges-1M & Shapes of thermistor-1M
f)		**Draw the construction of spiral and helical bourbon tube. List its one advantage over C-type bourbon tube.**	**4 M**
Ans		Spiral bourbon tube: Helical bourbon tube:	Spiral bourbon tube-1.5 M & helical bourbon tube-1.5M

(DETAIL VIEW OF TYPICAL HELIX)

(SCHEMATIC)
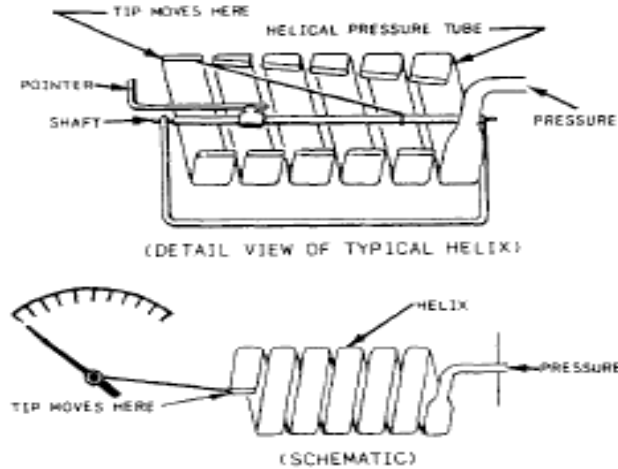
Advantage over C-type bourbon tube: (any One)
1) Magnification of displacement is not required.
2) Accuracy is higher than C type bourbon tube
3) High over range capability.
4) More stable in Fluctuating Pressure application.

Advantage-1M

Q.5		Attempt any **FOUR** of following:	16 M
	a)	**Describe with sketch electromagnetic flow meter .Write the o/p Equation of it.**	**4 M**
	Ans	Electromagnetic Flow meter Daigram: Magnetic flow meter, simply known as mag flow meter is a volumetric flow meter which is ideally used for wastewater applications and other applications that experience low pressure drop and with appropriate liquid conductivity required. The device doesn't have any moving parts and cannot work with hydrocarbons and distilled water. Mag flow meters are also easy to maintain. Principle of Magnetic Flow Meter Based on Faraday's Law:	Diagram: 1.5M & Description: 1.5M & Output Eq.:1M
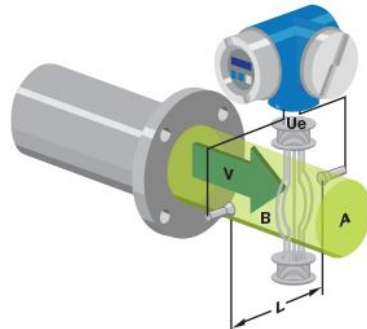
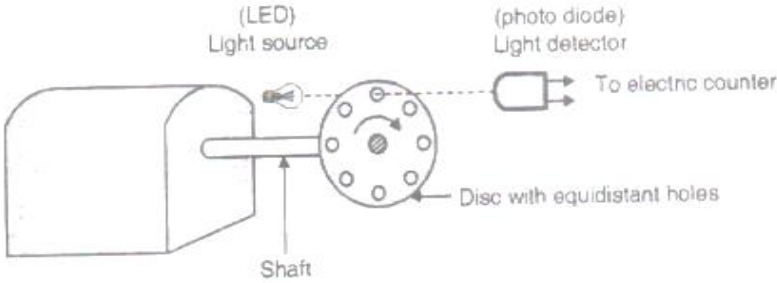| | | Magnetic flow meters works based on Faraday's Law of Electromagnetic Induction. According to this principle, when a conductive medium passes through a magnetic field B, a voltage E is generated which is proportional to the velocity v of the medium, the density of the magnetic field and the length of the conductor.

In a magnetic flow meter, a current is applied to wire coils mounted within or outside the meter body to generate a magnetic field. The liquid flowing through the pipe acts as the conductor and this induces a voltage which is proportional to the average flow velocity. This voltage is detected by sensing electrodes mounted in the Magflow meter body and sent to a transmitter which calculates the volumetric flow rate based on the pipe dimensions.

The induced voltage
E=B L V
Where B=flax density wb/m^2
    L=length of Conductor
i.e diameter of pipe in meter
    v= velocity of Conductor
i.e flow m/sec | |
b)		**What is pyrometry ? state two types and application of it.**	**4 M**
Ans		Pyrometers: Pyrometers is a technique for measuring temperature without physical contact. It depends upon the relationship between the temperature of a hot body and the electromagnetic radiation emitted by the body. When a body is heated, it emits thermal energy known as heat radiation. A black matt surface (or a black body) is a very good absorber of heat radiation and, also, a very good emitter of such radiations when heated. Pyrometry is a technique for determining a body's temperature by measuring its electromagnetic radiation.	2 M
		Types: 1. Radiation Pyrometers 2 .Optical pyrometers	1 M

		Application:
		    1.Used for moving targets
		    2. They are used for the targets not easily accessible,such as furnace interiors
			1 M

c)		**State the working principle of potentiometric transducer with two applications.**	**4 M**
Ans		• Working principle of potentiometric transducer The transducer output signal is a dc or ac voltage which is proportional to the potentiometer resistance that is proportional to the slider displacement.	2 M
		• Resistive Displacement Transducer: The simplest transducer for converting linear (translator) or angular (rotary) displacement into a change of resistance is the resistive element provided with a movable contractor. The change in resistance is brought out by only a change in the length or portion of the resistor from one end to the point of contact. When	1M

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		measuring the relative motion between a moving body a fixed body, the moving body is mechanically coupled to the contractor and the relative displacement is measured.
		
		• Applications (any 2)
		   1. In servo technology applications.
		   2. All applications that requires simple displacement transducer
		   3. For real time applications since there is no signal lag.
			1M For each

d)		**Describe the working of radiation type level measurement. List the materials used for it.**	**4 M**
Ans		Radiation level detector: Radiation type level measurement. is non contact type detector which is used where electrical method would not survive .	Diagram: 1.5M & Discription:1.5 M

Fig: Radiation type Level Measurement.

Construction and working-

1.It consist of gamma ray source holder on one side of the tank and a gamma detector on the other side of the tank.

2. The gamma rays from source are directed towards the detector in a thin band of radiation.

3. When gamma rays penetrate the thick wall of the tank, its energy level afterwards is greatly reduced.

4. The radiation received at the gamma detector is inversely proportional to the thickness of the walls and the medium between the radiation source and detector.

5. The amount of radiation received is inversely proportional to the amount of liquid between the radiation source and detector.

6. The difference in the amount radiation received by detector,corresponds to the liquid level in the tank.

7. Thus, when liquid level rises, the amount of radiation received is reduced and vice versa.

| **e)** | | **Explain the speed measurement using photoelectric pick-up.Write the output** | **4 M** |

		equation of it.	
	Ans	Constructional diagram:	Diagram:2M
		Working:	
		• Working principle:The light passes through the holes available on the rotating disc with a specific interval, depends on the angular speed of disc having equidistant holes. The frequency of this light pulses is measure of angular speed of the disc. • It consists of an opaque disc on the rotating shaft.The disc has a number of equidistant holes on its periphery.At one side of the disc a light source is fixed like LED and on other side of the disc, and on the line of the light source, alight sensor like phototube or some photosensitive semiconducting device is placed. • When a hole appears between two,the light following upon the sensor produces an output pulse. • The frequency at which the pulses are produced depends on the number of holes in the disc and its speed of rotation. Hence the speed is given by $N=f/H_S$ N=speed f=frequency H_s=holes on the disc	Working:2M
	f)	**What is manometer? List types of manometer.**	**4 M**

	Ans	<u>Manometers:</u>
		 The manometer is the simplest measuring instrument used for gauge pressure (low-range pressure)measurements, by balancing the pressure against the weight of a column of liquid. The action of all manometers depends on the effect of pressure exerted by a fluid at a depth.
		
		 Types of Manometer:
		     1. U-Tube Manometer
		     2. Well Type Manometer
		     3. Micro manometer
		     4. Inclined Manometer
			2 M
			
			 2 M

Q.6		**Attempt any <u>FOUR</u> of following:**	**16 M**
	a)	**Write the principle of piezoelectric transducer with neat diagram.List two applications of it.**	**4 M**
	Ans	Principle of operation: When a pressure or force or vibration applied to the crystalline material like quartz crystal or crystalline substances then an e.m.f. is generated across the material or vice versa.	1M- Principle, 1M -Diagram, Applications:2

_____

			M
		Applications of piezo electric transducer (any two):	

1) It is used in under water detection system i.e. SONAR.
2) These are used in measurement of surface roughness in accelerometers and vibration picks ups.
3) It is used in ultrasonic flow meters, non-destructive test (NDT) equipment's
4) Piezoelectric materials are use in ultrasonic transducers.
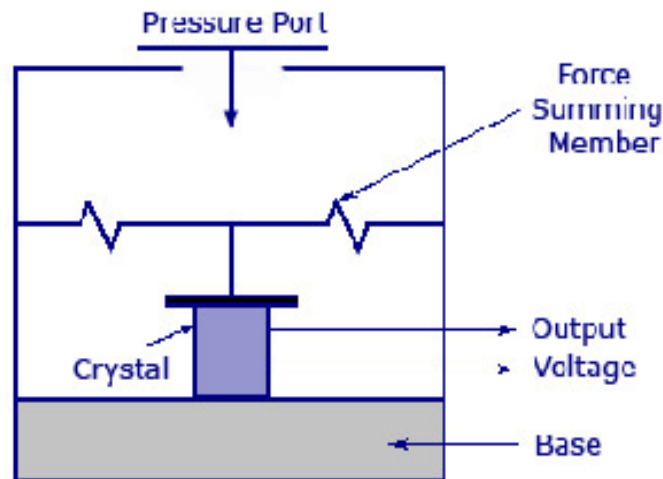
Piezo-Electric Transducer

OR

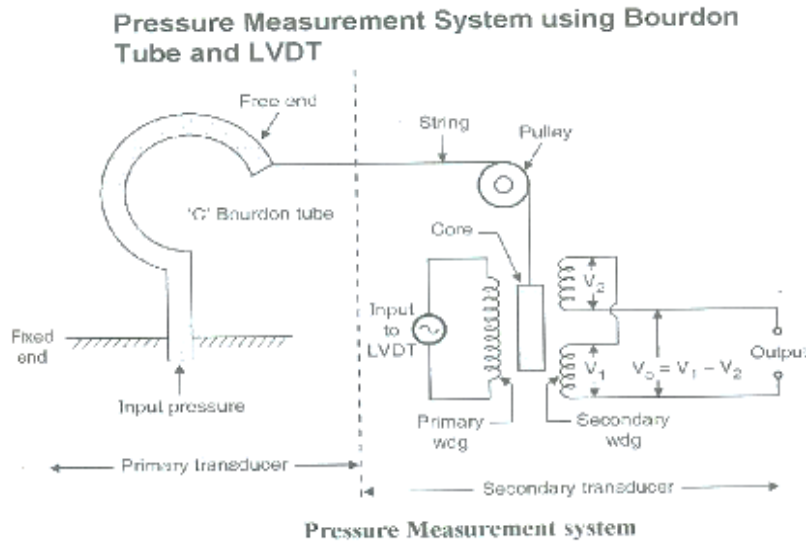| b)	Draw the diagram of electronic pressure transducer : i) Bourdon tube with LVTD.	4 M

	ii) Diaphagram type to get electrical voltage as output.	
Ans	**Bourdon tube with LVTD** Pressure Measurement system **Diaphagram type to get electrical voltage as output**	2 M for each Diagram
c)	**(i) State the materials used for followings restrictions:**	**4 M**
Ans	1) Orifice plate: Stainless steel , Carbon Steel, Titanium 2) Venturi tube Stainless Steel , Chromium Steel, Carbon Steel(ii) Draw any two types of orifice plate.	1M – any two materials 1M – any two materials
d)	**State two advantages and disadvantages of capacitance level indicator.**	**4 M**
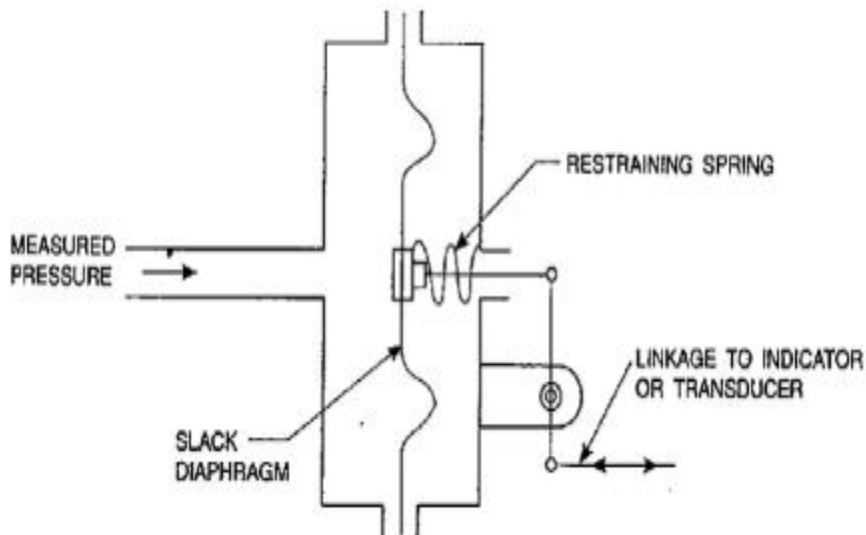
Ans	Advantages of capacitance level indicator (any two): • Inexpensive • Versatile • Minimal maintenance • Contains no moving parts • Good range of measurement • Rugged Disadvantages of capacitance level indicator: • Not suitable for low dielectric material • Dirt or other foreign debris can cause an offset in the measurement		2M – Advantages, 2M – Disadvantages
e)	**Draw the bimetallic thermometer. Draw its effect for hot and cold temperature. Write the materials used for it.**		**4 M**
Ans	 **Effect for hot cold Temperature** Materials used are usually steel and copper, or in some cases steel and brass, Nickel-iron alloyed with chromium & manganese, Invar (alloy of nickel & iron).		1M 2M Materials (any two)-1M
f)	**How pressure gauge is calibrated with dead weight tester?**		**4 M**
Ans	 Working:		2M - Diagram & 2M - Working

		- The handle is fully drawn out and the oil is allowed to enter in the cylinder (i.e. gauge and piston) - A known accurate weight is placed on the platform. The area of piston is also known; hence we can calculate the pressure. - Now the handle is turn to press in clockwise direction so that the pressure will build up on the gauge side as well as platform side. - Increase the pressure by rotating the handle clockwise until enough pressure is developed inside the cylinder and lifts the platform with weights placed on it and it floats freely within the limit stops. - Repeat the same procedure for different weights. In the same way most of the pressure gauge are calibrated against dead weight testers. - An error in dead weight tester is less than 0.1% in order to reduce the friction between the piston and cylinder, the piston is gradually rotated while a reading being taken.	