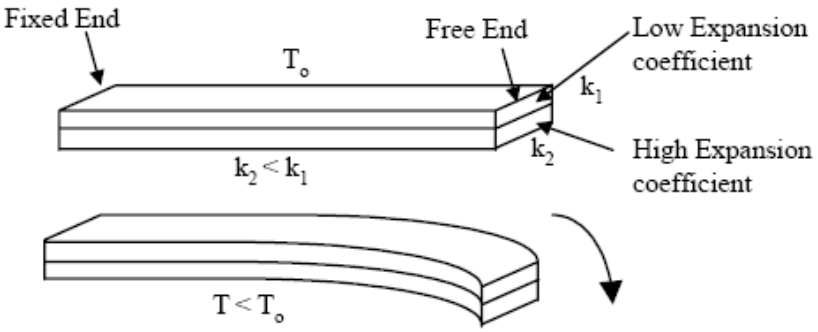
MODEL ANSWER

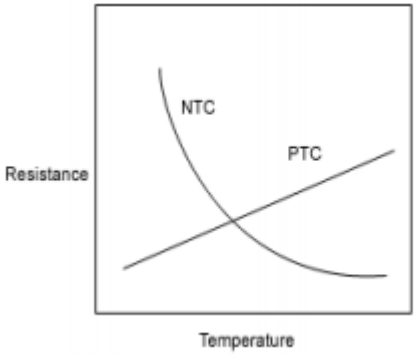
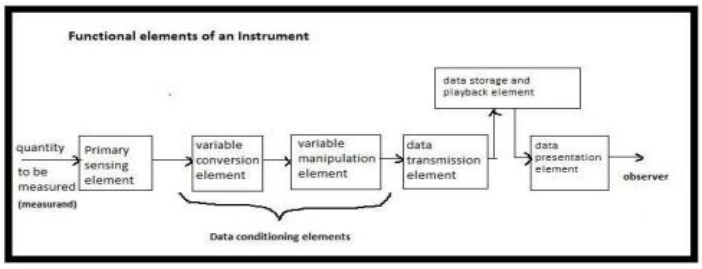
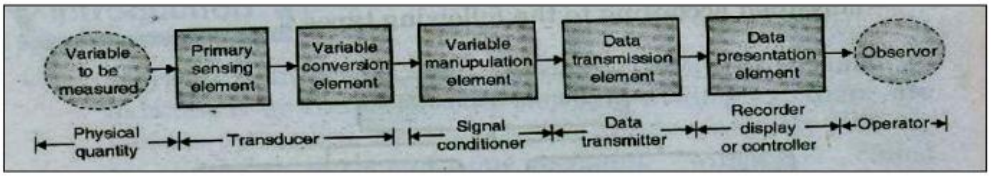
SUMMER– 17 EXAMINATION

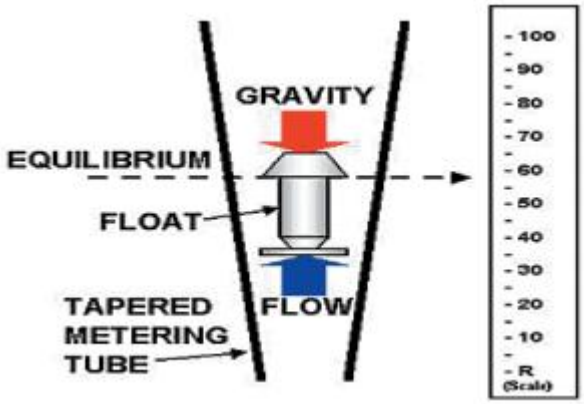
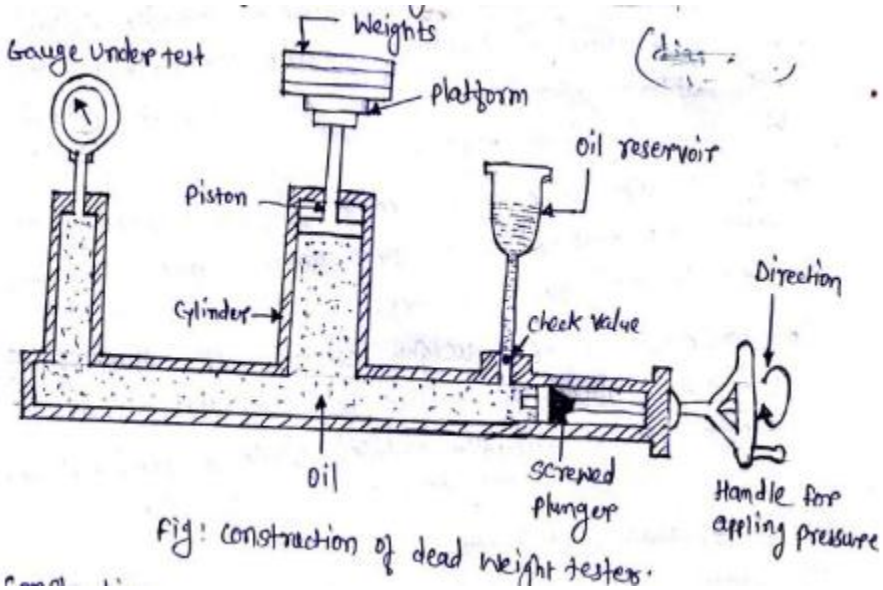
Subject Title: Industrial measurements Subject Code: 17434

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
Q.1	(A)	**Attempt any SIX:**	**12-Total Marks**
	(a)	**Classify the following transducers as active or passive transducer:** **i)Thermocouple** **ii) Strain Gauge**	**2M**
	Ans:	i) Thermocouple – Active transducer ii) Strain Gauge – Passive Transducer	**(1M each)**
	(b)	**Define primary and secondary transducer.**	**2M**
	Ans:	**Primary Transducers:** The device which converts physical quantity into a mechanical displacement is called primary transducers. **Secondary Transducers:** The device that converts the mechanical form into an electrical form is called secondary transducers.	**(1M each)**
	(c)	**Draw the constructional diagram of bimetallic thermometer and label it**	**2M**
	Ans:		**2M**

(d)	**Define laminar flow and turbulent flow.**	**2M**
Ans:	• Laminar Flow: When all the molecules of flow are parallel to each other, it is called laminar flow. • Turbulent flow: When the flow molecules are scattered without any fixed pattern, it is called Turbulent Flow.	**(1M each)**
(e)	**Define humidity. List any one unit of it.**	**2M**
Ans:	**Humidity:** Amount of water vapour present in the atmosphere. 1) gm/ml^3 2) grams of water vapour per cubic meter volume of air.	**(1M- Definition 1M- units)**
(f)	**Draw NTC and PTC characteristics of temperature transducer.**	**2M**
Ans:		**2M**
(g)	**Define Reynolds number . Write its value for laminar flow.**	**2M**
Ans:	Reynolds number is a dimensionless value which is applied in fluid mechanics to represent whether the fluid flow in a duct or pat a body is steady or turbulent. This value is obtained by comparing the inertial force with the viscous force. If the Reynolds number is less than 2000, the flow is said to be Laminar flow.	**(1M- definition, 1M-value)**
(h)	**Draw the block diagram of instrumentation system.**	**2M**
Ans:	 **OR** 	**2M**

B)	**Attempt any TWO:**	**8M**
a)	**Draw the neat sketch of Rotameter. Explain why it is classified under variable area type flow meter.**	**4M**
Ans:	**Diagram:**  	**2M**
	Explanation: Rotameter is called as a variable area flow meter because in rotameter the area is varied i.e, bottom area is small and it increases towards top, to maintain steady pressure difference.	**2M**
b)	**Draw the neat diagram of Dead Weight Tester. Explain its operation in brief.**	**4M**
Ans:	**Diagram:**  Fig: construction of dead weight testers.	**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.	**2M**

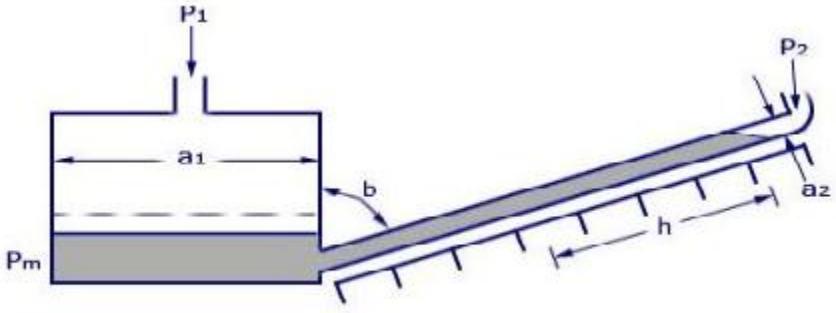
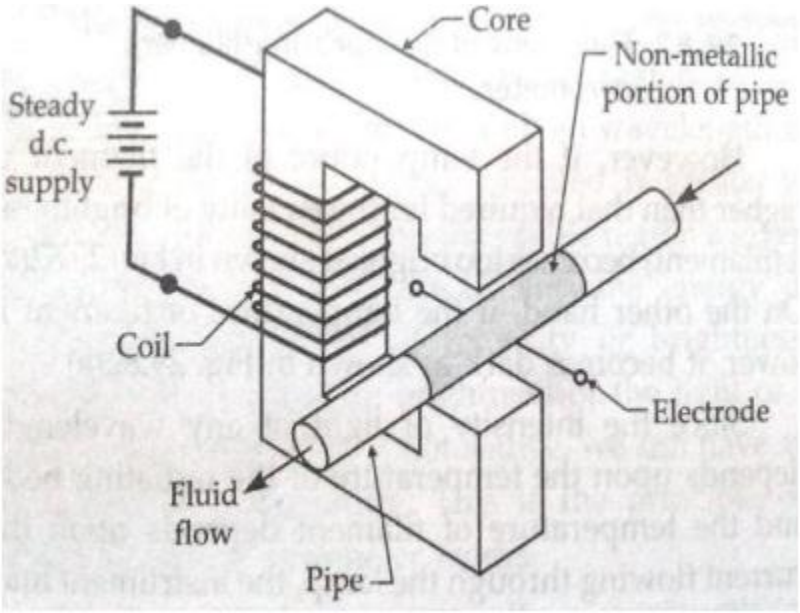
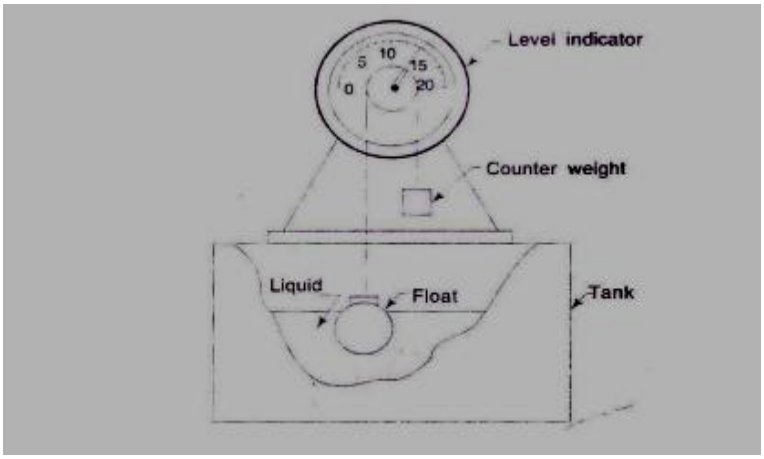
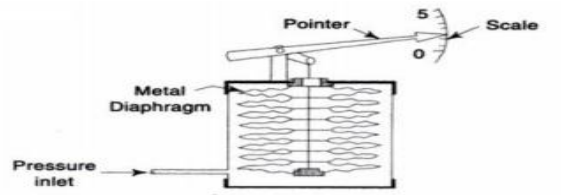
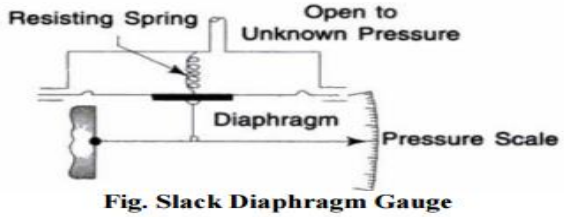
		• Now the handle is turn to press in clockwise direction so that the pressure will buildup on the gauge side as well as platform side. • Increase the pressure by rotating the handle clockwise until enough pressure is developed inside the cylinder and lifts the platform with weights placed on it and it 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.	
	(c)	**State any two advantages and any two disadvantages of radiation type level measurement system.**	**4M**
		Advantages: **1)** There is no physical contact with the liquid. **2)** They are suitable for mplten metals as well as liquids of all types. **3)** They are useful at very high temperatures/ pressures. **4)** They have good accuracy and response. **5)** They have no moving parts. **Disadvantages:** **1)** The reading is affected by density change of fluid. **2)** Radiation source holders may be heavy. **3)** Their cost is relatively high.	**2M** **2M**
Q 2		**Attempt any FOUR:**	**16M**
	(a)	**Draw the diagram of inclined tube manometer.State any two of its advantages over U-tube manometer.**	**4M**
	Ans:	**Diagram:**  Inclined Tube manometer **Advantages:** **1)** High sensitivity and accuracy **2)** Used to measure small pressure difference	**2M** **2M**
	(b)	**Draw the electromagnetic flow meter.State its output voltage equation.**	**4M**
	Ans:		

		Diagram:  **Fig: Electromagnetic Flow meter**	**2M**
		Equation: **E=CBLV** Where, E= induced voltage in volts C= dimensional constant B= magnetic field in weber/m^2 L= Length of conductor (fluid) in m V= velocity of conductor (fluid) in m/s	**2M**
(c)		**Convert 50^0 C into any two different scales of temperature.**	**4M**
Ans:		**Given :** Temperature = 50 o C 1) Temperature = o K = ? o K = o C + 273.15 = 50 + 273.15 = 323.15 o K Therefore, Temperature = 323.15 o K 2) Temperature = o F = ? o F= o C * 1.8 + 32 = 50 * 1.8 + 32 = 122 o F Therefore, Temperature = 122 o F	**2M each**

	(d)	**Explain float type –linear potentiometer type level measurement with neat diagram.**	**4M**
	Ans:	**Diagram:**  **Explanation:** 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 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 surface between 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.	**2M** **2M**
	(e)	**Explain in brief with diagram:** **i. Diagram** **ii. Piezoelectric transducer.**	**4M**
	Ans:	**Diaphragm:**  **Fig. Metallic Diaphragm** **OR**  **Fig. Slack Diaphragm Gauge**	**1M**

Explanation: **1M**

The diaphragms can be in the form of flat, corrugated or dished plates.

- In high precision instruments the diaphragms are generally used in a pair, back-to-back, to form an elastic capsule.
- Two types of diaphragms are 1. Metallic Diaphragm Gauge. 2. Slack Diaphragm Gauge.
- It consist of a thin flexible diaphragm made of materials such as brass or bronze.
- A pointer is attached to the diaphragm, the force of pressure against the effective area of the diaphragm causes a deflection of diaphragm.
- In some cases the deflection of the diaphragm is opposed by the spring to limit the deflection.
- The motion of the diaphragm operates an indicating or a recording type of instrument.

Piezoelectric transducer.

Working principle:

When force or pressure is applied to the piezoelectric material like quartz crystal or barium titanate, then an e.m.f. is generated across the material or vice versa. **1M**

- The piezoelectric element used for converting mechanical movement into electrical signals.
- The mechanical deformation generates a charges and this charges appears as a voltage across the electrodes.

The voltage is given by ,

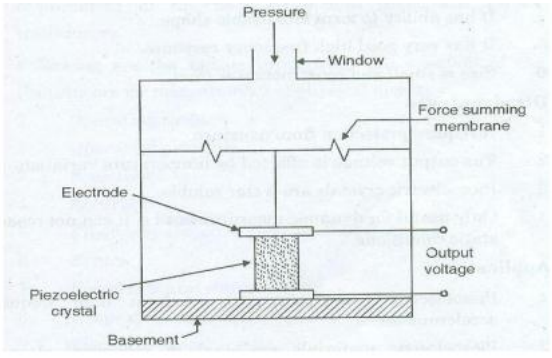
$V = Q / C$

Where, V = e.m.f across electrode

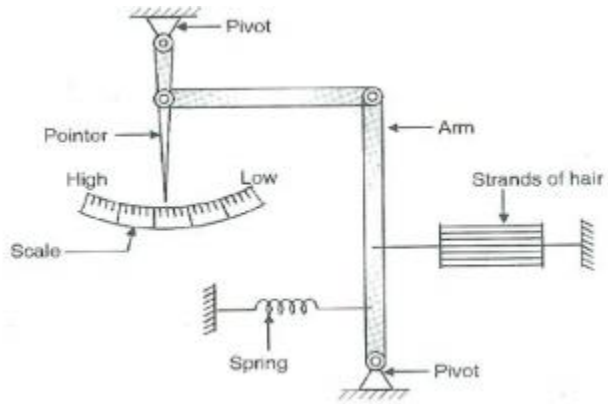
Q = Charges

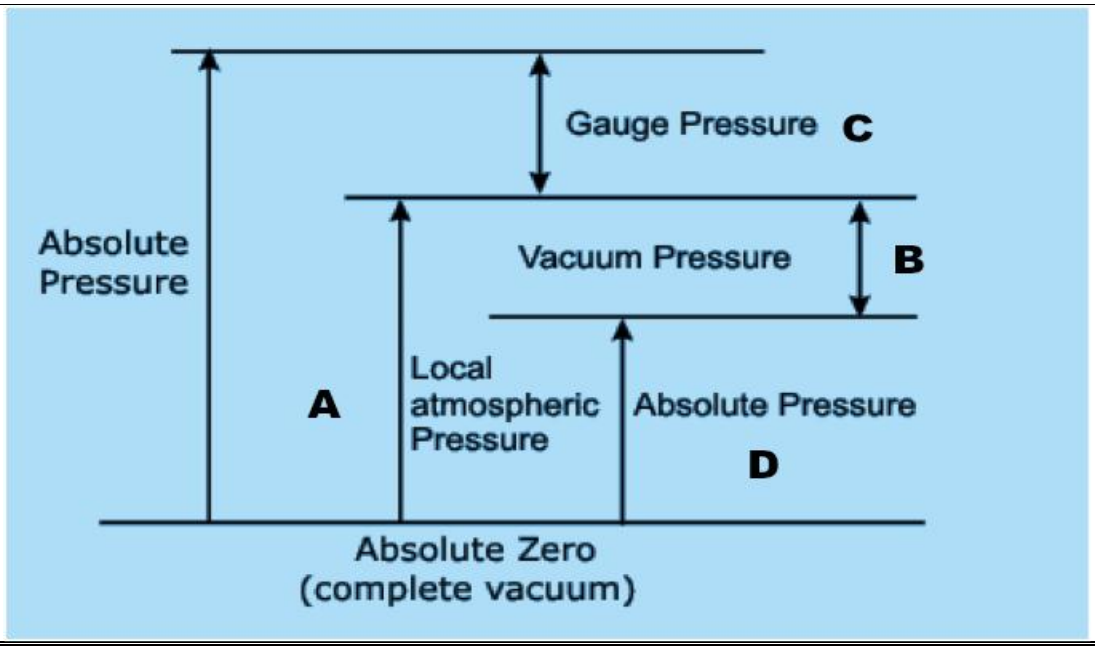
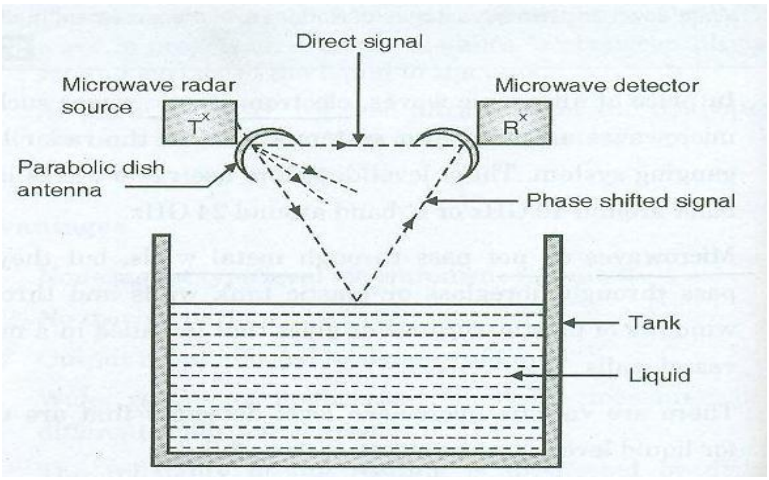
C = capacitance.

(or any relevant answer)



1M

	(f)	**Draw neat diagram and explain the operation of hair hygrometer.**	**4M**
	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. • 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.	**2M** **2M**
Q. 3		**Attempt any FOUR:**	**16M**
	(a)	**Write two names of transducers:** **i. Resistive type transducer** **ii. Primary transducer**	**4M**
	Ans:	**Resistive transducer:** 1) Linear Pot, 2) Angular Pot 3) Strain guage 4) RTD ***(Any two)*** **Primary transducers** 1) bourdon tube 2)strain guage	**(1M For each one correct name)**
	b)	**Show diagrammatically-** **i. Absolute** **ii. Gauge** **iii. Vaccum** **iv. Atmospheric pressure**	**4M**

	Ans:		**4 M**
	c)	**Explain the working principle of RADAR type level measurement with diagram.**	**4M**
	Ans:	**Diagram:**  **Working Principle:** In this method, the changes in the amplitude and or phase of the reflected signal are used to determine material present i.e. liquid height. The microwave signal is generated by the source which is directing constant amplitude/ frequency modulated microwave signal. In microwave reflection level the changes in the amplitude and or phase of the reflected signals used to determine material presence. Reflection is proportional to the dielectric constant of the material immediately next to process window.	**2M** **2M**
	d)	**Compare RTD and thermistor on the basis of –** **i. Temp coefficient** **ii. Temp. range** **iii. Materials**	**4M**

iv. Linearity

Ans:

Parameter	RTD	Thermistor
1. Temp. Coefficient	Positive Temp Coefficient (PTC)	Negative Temp Coefficient (NTC)
2. Temp. Range	-200^0 C To 650^{0}c	-15 ^{0}C To 30^{0}c
3. Materials	Platinum, Copper, Nickel, Tungsten Etc	Manganese, Copper, Cobalt, Iron Oxides Etc.
4. Linearity	The RTD characteristics are linear	Thermistor characteristics are highly non linear

(1M for each parameter)

e) Explain the working of photo-electric pick-up type speed measurement with neat diagram. **4M**

Ans: **2M**

Diagram:

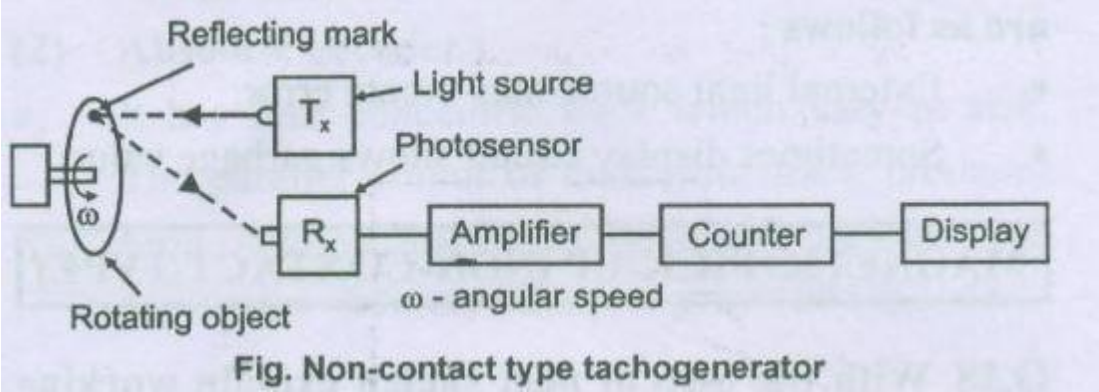
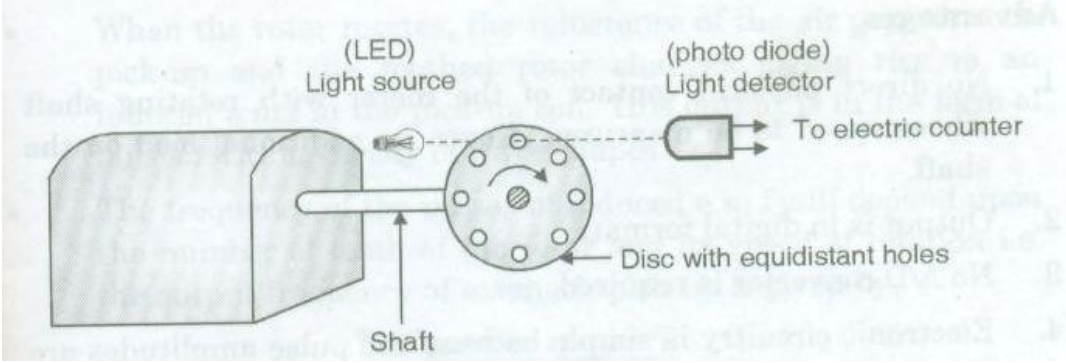


Fig. Non-contact type tachogenerator

OR



Working:

Photo electric pick-up or tachometer is noncontact type device which is used to measure speed in rpm.

It consists of a source light which directs the light beam towards rotating object.

A reflecting mark is affixed to the rotating object. The photosensor is focused on the area

toward the mark.
When the object rotates, it modulates light by reflecting mark, producing a tray of pulses, whose frequency is proportional to the speed.
The number of pulses counts the number of revolutions of object. The output of photosensor is amplified. The counter is used to count the number of pulses.
A display device is used to read out the output. It may be CRO or seven segment display or analog meter.
The external light may produce error if simple LED and photosensor is used. Therefore to avoid this, IR (Infra-Red), LED and photosensor is used.
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

$N = f/H_s$
where
N=speed

f=frequency

H_s=holes on the disc

2M

f) **i. Calculate the resistance of PT-100 for 40^0 C.**
ii. List any one name of material used for
1) RTD
2) Thermistor
3) Thermocouple
4) Bimetallic strip

4M

Ans: **i)** Assume $\alpha = 0.00392/^0$ C
Resistance at $t=40^0$ C,
$R_t=R_0(1+\alpha\Delta t)$
$=100[1+0.00392*40]$
$=115.68\ \Omega$

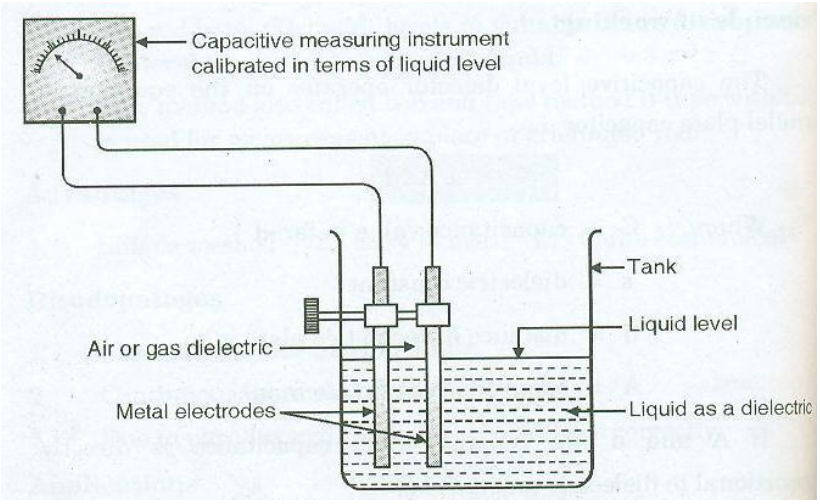
(Formula-1M Correct Answer -1 M)

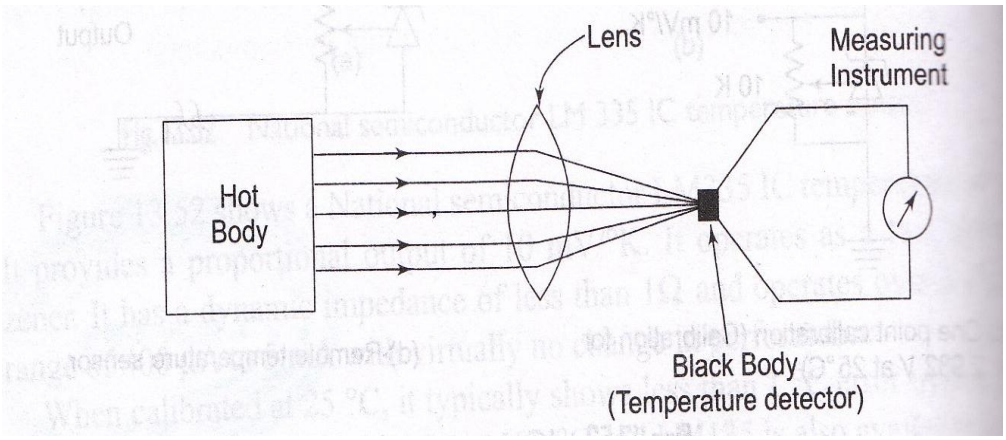
ii)

Transducer	Material used
1. RTD	Platinum, Copper, Nickel, Tungsten Etc
2. Thermistor	Manganese, Copper, Cobalt, Iron Oxides Etc.
3. Thermocouple	Copper/ Constantan Chromel/Constantan Iron/Constantan Chromel/Alumel
4. Bimetallic strip	steel and copper, or in some cases steel and brass, Nickel-iron alloyed with chromium & manganese, Invar (alloy of nickel & iron)

(½ M each for correct name)

Q. 4 **Attempt any FOUR:** **16M**

	(a)	**Explain the working of capacitor type level measurement with neat diagram.**	**4M**
	Ans:	**Diagram** :  **Explanation:** It consists of two probes firmly fixed parallel to each other and acts as plates of capacitor. This system is used for non-conducting liquid which act as an dielectric material. A capacitance measuring instrument is connected to the probes to measure the capacitance and it is calibrated in terms of liquid level in the tank. When the liquid in the tank increases, the capacitance also increases and when the liquid level decreases the capacitance decreases. This value of capacitance is measures by capacitance measurement instrument and displayed on the indicator calibrated in terms of liquid level.	**2M** **2M**
	(b)	**List any four selection criteria of a transducer.**	**4M**
	Ans:	**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	**(Any 4 points: 4M)**
	(c)	**Draw the neat diagram of pyrometer. Explain principle of working of it.**	**4M**
	Ans:	**Diagram:**	**2M**



Working :

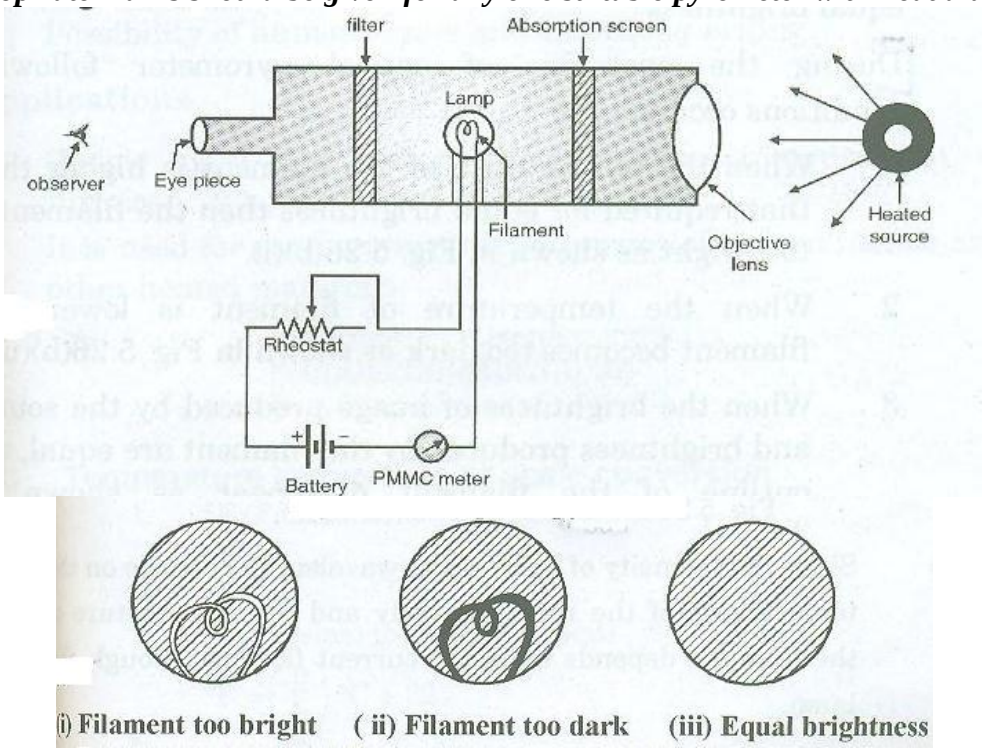
According to the principle of thermal radiation, the energy radiated from the hot body is function of its temperature from the figure the heat radiated by the hot body is focused on the radiator detector. The radiation detector is blackened and it absorbs all or almost all radiations falling on it.

Therefore the heat received by the detector is proportional to the fourth power of the absolute temperature of the hot body

2M

OR

[Appropriate marks should be given for any one suitable pyrometer with neat diagram] **2M**

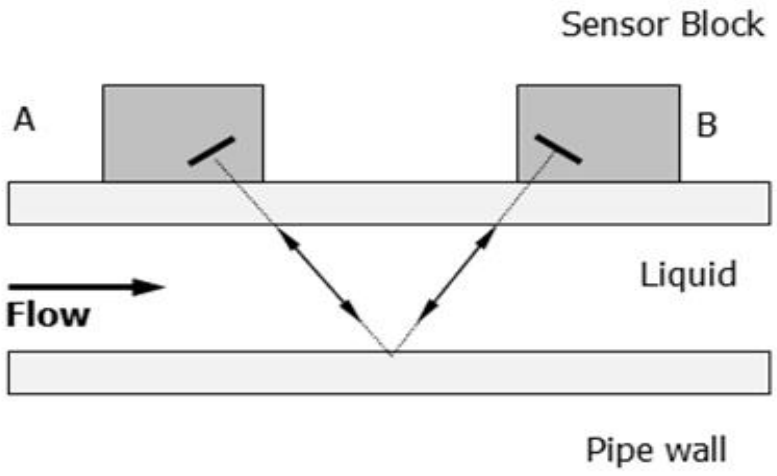


The working principle of optical pyrometer state that the brightness of light of a given color emitted by a hot source, gives an indication of temperature.

		Working: It consists of a tube, one end of this tube has objective lens and other end has a sighting eye piece to observe the filament. The filament is viewed through filter and eye piece. The lens side of tube is projected towards the hot body whose temperature is to be measured. An image of radiating source is produced by a lens and made to coincide with the filament of an electric lamp. The current through the lamp filament is made variable so that lamp intensity can be adjusted. The current through filament is adjusted until the filament and the image are of equal brightness. During the operation of optical pyrometer following conditions occurs. 1. When the temperature of the filament is higher than that required for equal brightness then the filament is too bright as shown in the figure. 2. When the temperature of filament is lower, the filament becomes too dark as shown in fig. When the brightness of image produced by the source and brightness produced by the filament are equal, the outline of the filament disappear.	**2M**
	(d)	**Define absolute humidity and relative humidity. Write any one unit of each.**	**4M**
	Ans:	**Absolute humidity:** • It is defined as a mass of water vapour present per unit volume. • Absolute humidity = $\frac{Mass\ of\ water\ vapour}{Mass\ of\ dry\ air}$ • Absolute humidity changes as air pressure changes • Unit of absolute humidity is Kg/m^3 or g/m^3. **Relative humidity:** • It is defined as a ratio of moisture content of gas to the maximum moisture the gas can contain at that temperature. • Unit of relative humidity-It is expressed in percentage(%). • Relative humidity = $\frac{moisture\ content\ of\ gas}{Fully\ saturated\ air}$	**(Definition -2M, Units-2M)**
	(e)	**List the values and names of following parameters for thermocouple types J,K:** **i) Temp. Range ii) Materials used in it.**	**4M**
	Ans:		**(2M each for two types)**

Thermocouple	Temp. Range	Materials used
J- type	-200 to 900	Iron/Constantan
K-type	-200 to 1250	Chromel/Alumel

	(f)	**List any four units for pressure.**	**4M**
	Ans:	The different units of pressure $1N/m^2$= 1 pascal (1 Pa) 1 kPa (kilo pascal) = 1000 Pa 1 millibar = 100 dyne/cm^2 =100Pa 1 torr = 1mm Hg= 133.3 Pa 1 atmospheric pressure (atm) = 101.325 kPa PSI (pound per square inch) SI unit N/m^2 (Newtons per square meter)	**(4M for any four units)**
Q.5		**Attempt any FOUR:**	**16M**
	a)	**Explain the working principle of ultrasonic flow meter with neat diagram**	**4M**
	Ans:	There are two measurement principles in ultrasonic flow meters ***Note: Student can explain any one*** a. Time of Flight or Transit-time b. Doppler **Transist-Time**: Flow measurement shown in Figure 2 based on Transit time principle that utilizes two transducers, which function as both ultrasonic transmitters and receivers. The transducers are clamped to the outside of a closed pipe at a specific distance from each other	**(Principle:2M And Diagram: 2M) [For any one method]**



The flow meter operates by alternatively transmitting and receiving ultrasonic signal pulses between the two transducers. The ultrasonic signals are first transmitted in the direction of the fluid and then against fluid flow.
Since sound energy in a moving liquid is carried faster when it travels in the direction of flow than against it, a time difference between the signals time-of-flight will occur. If the fluid is not moving, the time difference is zero and the flowmeter will indicate zero flow. The transit-time of the signals is accurately measured in both flow directions and the difference in time calculated.

$L = c * dt + v * dt$

here L = distance between emitter-sensor
dt = runtime
v = flow velocity
c = speed of sound

Thus,

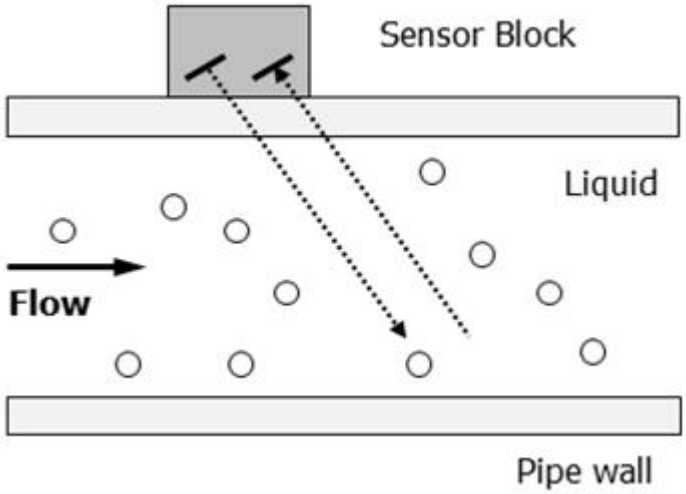
Flow Velocity $(v) = (L/dt) – c$

[**Note :This principle can be explain with different diagram with same concept marks can given**]

OR

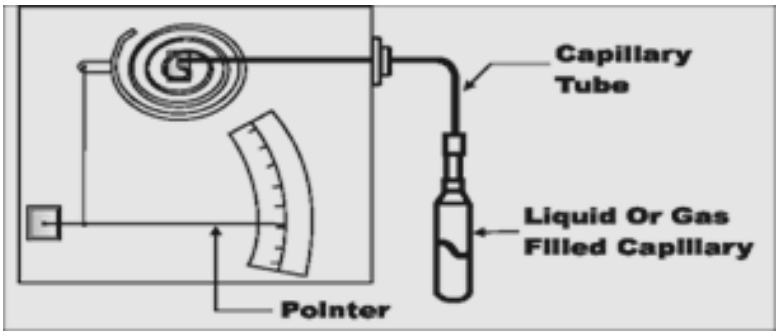
b) Doppler Principle

Doppler principle of measurement is suitable for contaminated or aerated liquids where the solid content is pretty high (> 10% by volume) and measurement cannot be done using Time of flight method. Doppler principle actually relies on particles or gas bubbles flowing with the liquid in order to give a flow rate reading.



When ultrasound hits a moving particle or gas bubble, the reflected sound can be detected and the frequency shift measured. The frequency change is proportional to flow velocity which is converted to volumetric flow rate by multiplying by the cross sectional area of the pipe.

b)	**Explain the working principle of gas filled thermometer with diagram.**	**4M**
Ans:	**Diagram:**	**2M**



Explanation: **2M**

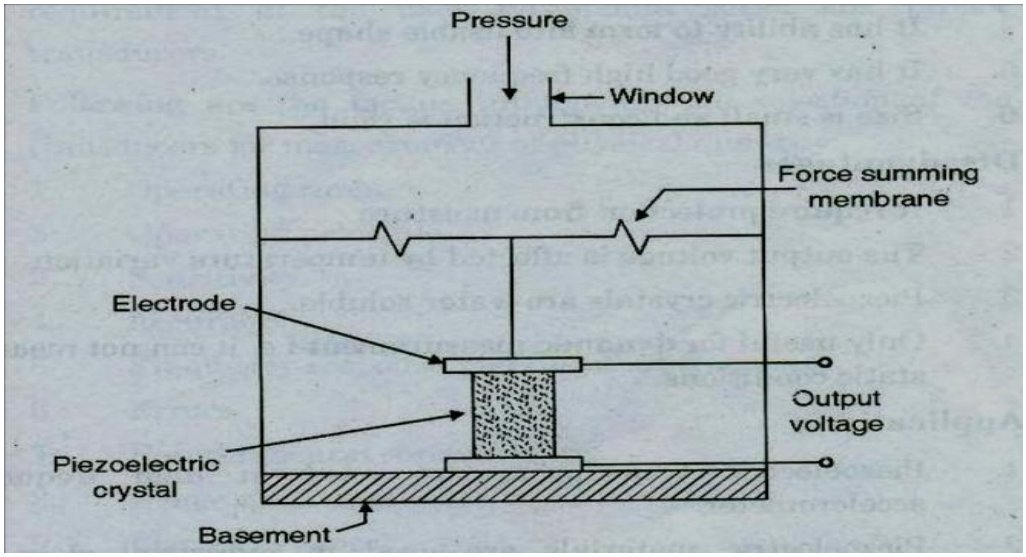
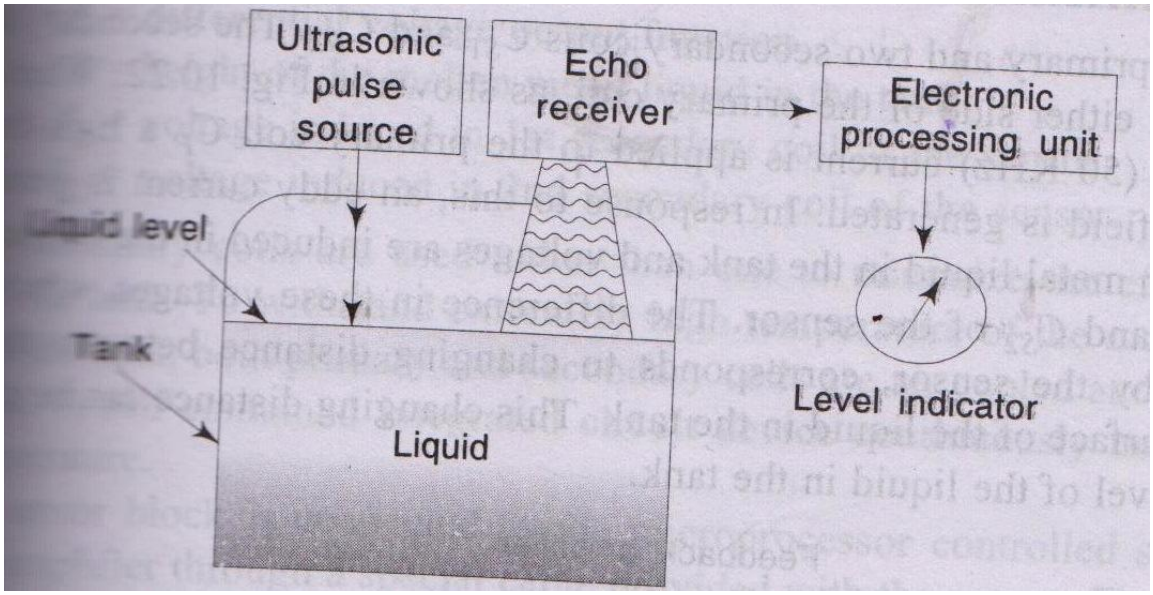
If volume of a gas is maintained at constant and If a certain volume of inert gas is enclosed in a bulb, capillary and bourdon tube, the most of the gas in the bulb, then the pressure increases with increase in temperature and that pressure is indicated by the bourdon tube may be calibrated in terms of the temperature of the bulb

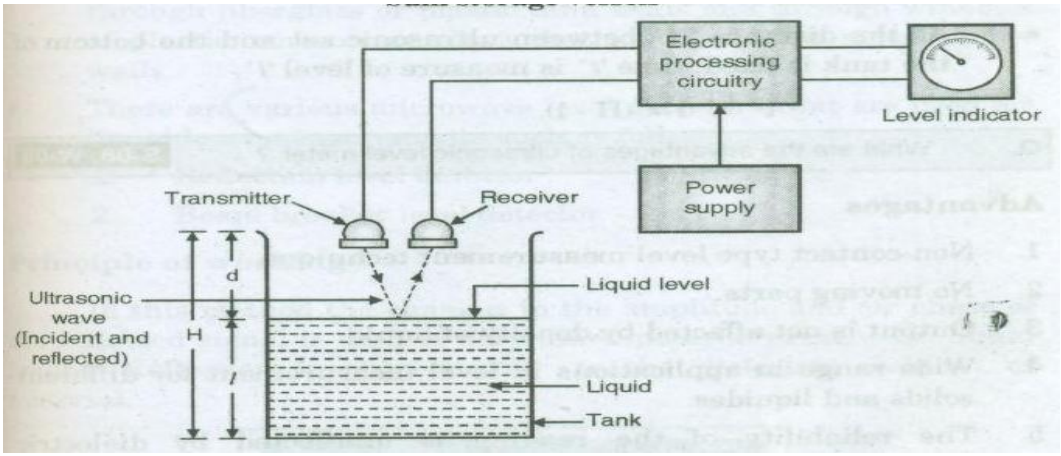
In other words

Working of Gas thermometer is depend upon ideal gas law which state that the volume of the gas increases with increase in temperature if pressure maintained constant.

Name of the gases used in Gas filled thermometers.

1. Nitrogen
2. Helium

		3. Inert Gas	
	c)	**Explain the working principle of piezoelectric transducer with neat diagram.**	**4M**
	Ans:	**Diagram:**  **Working Principle:** 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.	**2M** **2M**
	(d)	**Explain the working of ultrasonic level measurement with neat diagram.**	**4M**
	Ans:	**Diagram:**  **[Note :For any other conceptual diagram Marks can be given]** **OR**	**2M**



Principle :

It operates by generating on ultrasonic pulse and measuring the time it takes for the echo to return.

In above diagram ultrasonic pulse source which is acts as transmitter. It will generate pulse which will pass through liquid and reflect back after certain time depend on level of liquid and base which will capture by receiver. Time will be measure between generation pulse and echo which then calibrated interm of distance.

2M

(e) **Compare contact type and noncontact type speed measurement method.(any four points)** **4M**

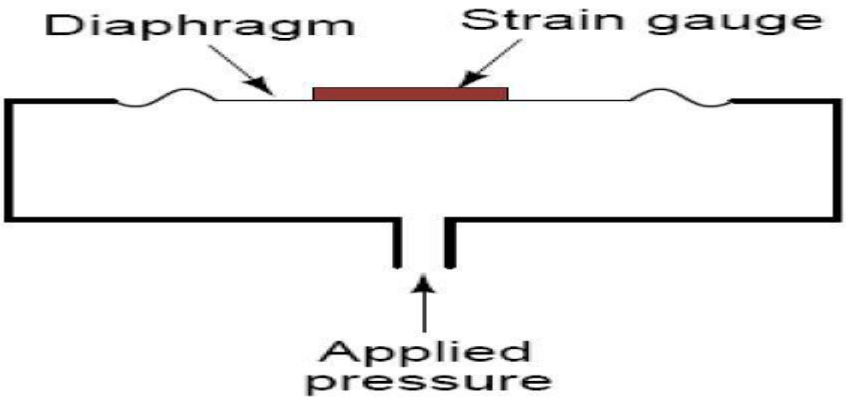
Ans:

Sr no	contact type speed measurement	noncontact type speed measurement
1	Physical contact between mater and shaft	No Physical contact between meter and shaft
2	As output is electrical signal easy to indicate reading	Output has to be converted in term of electrical signal
3	No optical transducer is used	Optical transducer is used
4	ADC is require	ADC is not require since output is in form of pulse
5	Maintenance is more since moving part	Maintenance is less since no moving part
6	AC / DC tachometer	Rotary Encoder, Photo electric tachometer

(Each point 1M)

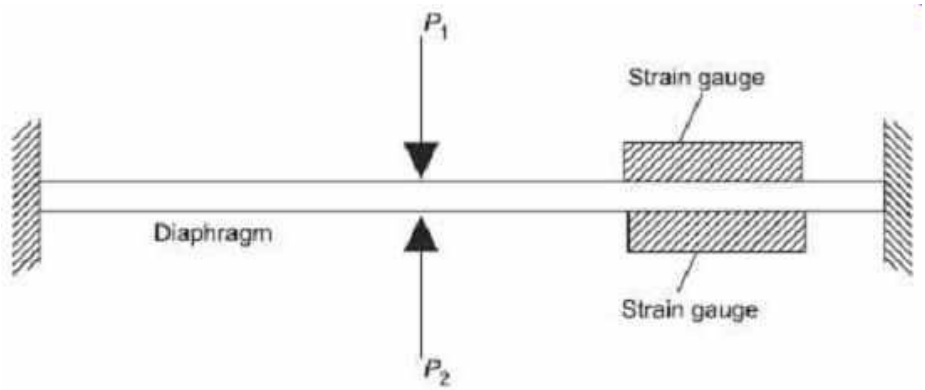
(f) **Explain the working principle of diaphragm with strain gauge for pressure measurement.** **4M**

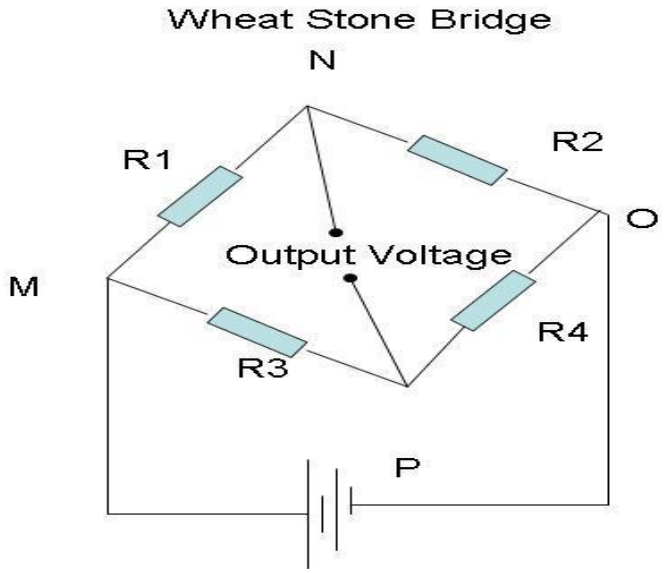
Ans: **Diagram:**


Diaphragm
Strain gauge
Applied pressure

2M

OR

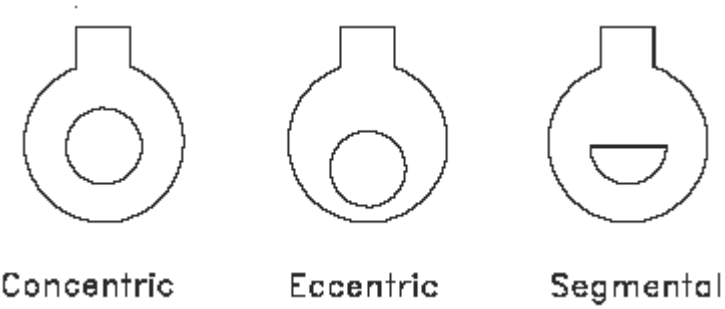

P_1
Strain gauge
Diaphragm
Strain gauge
P_2


Wheat Stone Bridge
N
R1
R2
O
Output Voltage
M
R4
R3
P

		[Any other conceptual diagram of strain gauge with iaphragm can be consider] **Explanation:** 1) Strain gauge is a passive type resistance pressure transducer whose electrical resistance changes when it is stretched or compressed. It can be attached to a pressure sensing diaphragm as shown in fig 2) When diaphragm flexes due to the process pressure applied on it , the strain gauge stretches or compresses due to this its resistance changes . 3) As soon as the pressure is applied the strain gauge stretches or compresses accordingly and the bridge circuit in fig is unbalanced due to the change in resistance of the strain gauges. 4) Thus a current flows in the galvanometer, Which is measured by the deflection of the galvanometer, this change in output voltage may be calibrated for the pressure change.	**2M**
Q.6		**Attempt any FOUR:**	**16M**
	a)	**Compare active and passive transducer.(Any four points)**	**4M**
	Ans:		**(1M for each point)**

Sr No	Parameters	Active Transducer	Passive Transducer
1	Working Principle	Operate under energy conversion principle.	Operate under energy controlling principle.
2	Example	Thermocouple, Piezoelectric Transducer etc.	Thermistors, Strain Gauges etc.
3	Advantage	Do not require external power supply for its operation.	Require external power supply for its operation.
4	Application	Used for measurement of Surface roughness in accelerometers and vibration pick ups.	Used for measurement of Power at high frequency

	b)	**List the materials used for Bourdon tube and bellows. List the range of pressure measurement by both transducers.**	**4M**
	Ans:	**Material for Bourden tube:** 1)Berlyium copper Range 10000 psi 2)Phosphour Bronze Range 600 psi 3)Stainless steel or steel Alloy range above 10000psi **Material for Bellows:** 1)Brass 100 psi 2) bronze 1000psi 3) Berylium Copper 10000psi 4) steel above 10000psi	**2M for bourden tube(1M for material 1M for range)** **2 M for bellows)**
	c)	**Draw the different types of orifice plate (any two) .Explain working principle of orifice plate for flow measurement in brief.**	**4M**
	Ans:		

		Diagram:  **Working Principle:** An orifice plate is a thin plate with a hole in it, which is usually placed in a pipe. When a fluid (whether liquid or gaseous) passes through the orifice, its pressure builds up slightly upstream of the orifice but as the fluid is forced to converge to pass through the hole, the velocity increases and the fluid pressure decreases. A little downstream of the orifice the flow reaches its point of maximum convergence where the velocity reaches its maximum and the pressure reaches its minimum. Beyond that, the flow expands, the velocity falls and the pressure increases. By measuring the difference in fluid pressure across tappings upstream and downstream of the plate, the flow rate can be obtained from Bernoulli's equation	**2M** **2M**
	d)	**List the range of level in float type and capacitance level measurement when liquid is (i) conducting type and (ii) nonconducting type.**	**4M**
	Ans:	Conducting type float Standard -guided tape gauges are available up to 100 ft (30 m); pressure upto 30 psi Non conducting -type surface sensors are available up to 200 ft (60 m) pressure upto 300psi For capacitance Non conducting upto 8 feet with dielectric constant 80 Conducting material upto 12 feet variation of capacitance upto 320 pf	**(2M for float 2M for capacitance)**
	e)	**List the range of temperature measured by-(i) RTD, (ii) Pyrometer (iii) Bimetallic thermometer, (iv) Gas filled thermometer.**	**4M**
	Ans:	1)RTD Range -270^{o}C to 2800^{o}C 2)Pyrometer= 600^{o}C to 3000^{o}C 3)Bimetallic Thermometer=0 to 260^{o}C 4)Gas Filled thermometer= -50^{o}C to 500^{o}C	**(1M for each type)**
	(f)	**Convert 520 mm of Hg into bar, PSI.**	**4M**
	Ans:	1psi= 51.71484 mm of Hg Therefore, 520 mm of Hg=10. 050psi 1 bar = 750.063mm of Hg Therefore , 520 mm of Hg =0 .69328bar.	**2M** **2M**