SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

IV SEMESTER

1907404 -INDUSTRIAL INSTRUMENTATION – I

Regulation – 2019

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Prepared by

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SUBJECT : 1907404 INDUSTRIAL INSTRUMENTATION-I

SEM / YEAR : IV/II

UNIT I	**MEASUREMENT OF FORCE, TORQUE AND SPEED**		
Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators – Stroboscope.			
PART A			
Q.No	**Question**	**BT Level**	**Competence**
1.	What is meant by Strobotron?	**BTL 1**	**Remember**
2.	What are the properties of materials used for Piezo electric transducers?	**BTL 1**	**Remember**
3.	Define gauge factor for strain gauge.	**BTL 1**	**Remember**
4.	What is magneto-elastic effect?	**BTL 1**	**Remember**
5.	What are the merits of stroboscope?	**BTL 1**	**Remember**
6.	List the main parts of a hydraulic load cell.	**BTL 1**	**Remember**
7.	Define Load Cell.	**BTL 2**	**Understand**
8.	What is the principle of drag cup type Tachometer?	**BTL 2**	**Understand**
9.	Give the different types of strain gauge load cell.	**BTL 2**	**Understand**
10.	Write the significance of stroboscope.	**BTL 2**	**Understand**
11.	Write the significance of the Load cell.	**BTL 2**	**Understand**
12.	What are the classifications of Tachometer?	**BTL 3**	**Apply**
13.	Illustrate the principle of DC Tacho generator.	**BTL 3**	**Apply**
14.	Show how Elastic materials are used for force measurement.	**BTL 3**	**Apply**
15.	List the types of load cell.	**BTL 3**	**Apply**
16.	Why are dummy gauges used? In what way they affect the output of a strain gauge bridge?	**BTL 4**	**Analyze**
17.	Point out the measurement procedure for force using load cell.	**BTL 4**	**Analyze**
18.	Identify the factors affecting the accuracy of force measurement.	**BTL 4**	**Analyze**
19.	Justify the effect of Temperature in strain gauge bridge circuitry? How it is to be compensated?	**BTL 5**	**Evaluate**
20.	Summarize the applications of load cell.	**BTL 5**	**Evaluate**
21.	Prepare a bridge circuit for any measuring instrument and justify its need.	**BTL 6**	**Create**

22.	Propose a suitable signal conditioning circuit for LVDT based force measurement system of your own.	**BTL 6**	**Create**
23.	List the factors to be considered in the selection of load cell for a application.	**BTL 4**	**Analyze**
24.	What are the advantages of measurement of torque by using electronic techniques.	**BTL 5**	**Evaluate**
	PART B		
1.	Explain the principle and working of a strain gauge. Also describe its usefulness in measurement of torque. **(13)**	**BTL 5**	**Evaluate**
2.	Explain the principle and construction of : **(i)** Hydraulic load cell. **(7)** **(ii)** Drag cup DC tachogenerator. **(6)**	**BTL 4**	**Analyze**
3.	Describe about Magneto Elastic and Piezo Electric Load cell with a neat diagram. **(13)**	**BTL 1**	**Remember**
4.	Draw the diagram and describe the working, construction of: **(i)** Inductive torque transducer. **(7)** **(ii)** Electric balance. **(6)**	**BTL 1**	**Remember**
5.	Discuss the construction and working of DC and AC Tachogenerator with diagram and mention its advantages and disadvantages. **(13)**	**BTL 2**	**Understand**
6.	Briefly describe the working of different speed measurement methods. **(13)**	**BTL 2**	**Understand**
7.	With necessary diagram, describe how speed can be measured using Revolution counter. **(13)**	**BTL 1**	**Remember**
8.	Describe how proximity sensor can be used for torque measurement, explain with relevant diagram. **(13)**	**BTL 5**	**Evaluate**
9.	**(i)** Illustrate the basic means of force measurement. **(7)** **(ii)**Illustrate with neat sketches, the working of pneumatic load cell. **(6)**	**BTL 3**	**Apply**
10.	With neat diagram explain ,the construction and working of **(i)** Strain gauge load cell. **(7)** **(ii)** Stroboscope. **(6)**	**BTL 4**	**Analyze**
11.	**(i)** Illustrate the construction, working of optical torsion meter. **(7)** **(ii)** Describe the torque measurement principle involving relative angular twist. **(6)**	**BTL 2**	**Understand**
12.	Explain the following methods of measurement of torque: **(i)** Capacitive torque transducer. **(7)**	**BTL 4**	**Analyze**

	(ii) Magneto strictive methods. **(6)**		
13.	**(i)** Illustrate the working of Strobotron. **(7)** **(ii)**Mention the advantages and disadvantages of stroboscope measurement technique? **(6)**	**BTL 3**	**Apply**
14.	Propose a method for strain gauge torsion meter. Discuss the construction, working and advantage of the same. **(13)**	**BTL 6**	**Create**
15.	Explain any two types of torque measurement with neat sketch. **(13)**	**BTL 1**	**Remember**
16.	A toothed rotor tachometer is used in a digital counter for measuring speed of rotation of the shaft on which the wheel is mounted. The grating period is 10^3 us and a reading of 0004 is obtained on the four digit display. Determine the speed of the shaft if the number of teeth on rotor is 150.	**BTL 3**	**Apply**
17.	The frequency of the flashes of a stroboscope is adjusted such that a disc with 20 points mounted on the shaft of the machine seems to be at standstill. If the adjusted frequency of the flashes is 5000 per minute and approximate speed of the machine is 765 rpm given by the other method, determine the correct speed of the machine in rpm. **(13)**	**BTL 2**	**Understand**
	PART C		
1.	**(i)**Draw and explain the equivalent circuit for piezoelectric transducer. **(8)** **(ii)** Draw and explain pulse response of piezoelectric transducer. **(7)**	**BTL 5**	**Evaluate**
2.	**(i)** A rotating disc has five equispaced radial lines marked on it. When a stroboscope is directed at the disc a true pattern is observed at the highest flash frequency equal to 3000 flashes per seconds. What will be the other flash frequencies which produce a 5 line pattern and 10 line pattern? **(8)** **(ii)** While measuring the speed of a steam turbine with stroboscope single line images were observed for stroboscope setting of 3000, 4000 and 5230 rpm.Evaluate the speed of turbine. **(7)**	**BTL 5**	**Evaluate**
3.	Design a Torsion bar dynamometer for torque measurement and discuss the various methods force measurement. **(15)**	**BTL 6**	**Create**
4.	Design a Bonded strain gauge transducer for measuring compressive force and explain with bridge circuit. **(15)**	**BTL 6**	**Create**
5.	**(i)** A disc having 8 pattern point is mounted on the motor shaft. The number of flashes projected on the disc by a stroboscope is 6000 per minute. Determine the speed of the machine when the disc (i) appears stationary	**BTL 5**	**Evaluate**

	(ii) appears to rotate in forward direction at 15 rpm (iii) appears to rotate in backward direction at 10 rpm. **(8)** **(ii)** The speed of a 6-pole induction motor supplied at 50 Hz is measured by a stroboscopic method. The neon lamp is supplied from the same source to which the induction motor is connected. The stroboscopic disc has six black and six white sectors. Determine the (i) slip (ii) the speed of the induction motor when the sector appears to be moving at 50 rpm. **(7)**		

UNIT II -MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY			
Accelerometers :- LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers Mechanical type vibration instruments - Seismic instruments as accelerometer - Vibration sensor Calibration of vibration pickups - Units of density and specific gravity - Baume scale and API scale Pressure type densitometers - Float type densitometers - Ultrasonic densitometer – gas			
PART A			
Q.No	**Question**	**BT Level**	**Competence**
1.	What is a seismic instrument? State the function of seismic transducer.	**BTL 1**	**Remember**
2.	List the properties of spring employed seismic type of instrument for measurement of vibration and acceleration.	**BTL 1**	**Remember**
3.	State the principle of operation of Ultrasonic densitometer.	**BTL 1**	**Remember**
4.	Give any two features of piezo-electric accelerometer.	**BTL 1**	**Remember**
5.	What is meant by vibration pickups? Give example.	**BTL 1**	**Remember**
6.	Define specific weight and density.	**BTL 1**	**Remember**
7.	State the properties of semiconductor strain gauge.	**BTL 2**	**Understand**
8.	Give the units of density used in industries.	**BTL 2**	**Understand**
9.	Mention the advantages of LVDT type accelerometers.	**BTL 3**	**Apply**
10.	Summarize the different ways to measure density.	**BTL 2**	**Understand**
11.	Specify the applications of bridge type gas densitometer.	**BTL 2**	**Understand**
12.	What is the basic principle of strain gauge accelerometer?	**BTL 2**	**Understand**
13.	Draw the block diagram ad label the parts of Piezo electric type vibration pickup.	**BTL 4**	**Analyze**
14.	Examine the quantities required in a vibration measurement system.	**BTL 3**	**Apply**
15.	Show the advantages of mechanical type vibration measuring instruments.	**BTL 3**	**Apply**
16.	Draw the block diagram of Seismic transducer.	**BTL 5**	**Evaluate**
17.	An accelerometer has a seismic mass of 0.05kg and a spring constant of 3000 N/m. Maximum mass displacement is +/- 0.02 m. Calculate the natural frequency.	**BTL 3**	**Apply**
18.	Differentiate relative and absolute Acceleration measurement.	**BTL 4**	**Analyze**

19.	Realize the role of Baume scale and API scale in instrumentation.	**BTL 4**	**Analyze**
20.	Differentiate the two modes of operation of accelerometer.	**BTL 4**	**Analyze**
21.	Compare the terms specific weight and specific gravity.	**BTL 5**	**Evaluate**
22.	Criticize how a seismic instrument acts as accelerometer.	**BTL 5**	**Evaluate**
23.	Formulate the expression for sinusoidal vibration.	**BTL 6**	**Create**
24.	Design a setup for Gas densitometer.	**BTL 6**	**Create**
	PART B		
1.	**(i)** Explain about the working of LVDT type and Piezo electric type accelerometers which are used for measurement of acceleration. **(8)** **(ii)**Write their advantages and disadvantages. **(5)**	**BTL 1**	**Remember**
2.	An accelerometer has a seismic mass of 0.06 kg and a spring constant of 4500 N/m. Maximum mass displacement is ± 0.025m (before the mass hits the top). Determine i) maximum measurable acceleration and ii) natural frequency **(13)**	**BTL 4**	**Analyze**
3.	Discriminate the seismic instruments as a vibrometer and accelerometer. **(13)**	**BTL 1**	**Remember**
4.	Discuss about the quantities involved in vibration measurement. Explain the operation of seismic transducer in different modes of operation. **(13)**	**BTL 1**	**Remember**
5.	In an LVDT accelerometer the outputs are 0.4 mV/mm with a ±25 mm core displacement. The spring constant is 300 N/m and the mass of the core is 50g. Determine (i) maximum measurable acceleration (ii) natural frequency and (iii) sensitivity of the accelerometer. **(13)**	**BTL 3**	**Apply**
6.	Investigate how relative motion is measured using seismic instruments. **(13)**	**BTL 6**	**Create**
7.	**(i)**What is a vibrational pick up? Explain about the nature of vibration. **(8)** **(ii)** What are the quantities involved in Vibration Measurements? **(5)**	**BTL 1**	**Remember**
8.	**(i)**Describe about the basic of Vibration Measurement System. **(8)** **(ii)**Describe the different methods of controlling exposure to vibration. **(5)**	**BTL 2**	**Understand**
9.	**(i)** Explain in detail about Variable reluctance accelerometer with a neat sketch. **(8)** **(ii)** Explain in detail about strain gauge accelerometer. **(5)**	**BTL 4**	**Analyze**

10.	Draw the schematic diagram of Pressure head type densitometer and explain its working and construction. **(13)**	**BTL 4**	**Analyze**
11.	Explain the following with a neat sketch **(i)** Float type densitometer **(6)** **(ii)** Electromagnetic suspension type gas densitometer. **(7)**	**BTL 5**	**Evaluate**
12.	Briefly describe about the construction and working principle of Ultrasonic densitometer. **(13)**	**BTL 2**	**Understand**
13.	Briefly describe about the construction and working principle of Hydrostatic type densitometer. **(13)**	**BTL 2**	**Understand**
14.	Explain the working and construction of displacement-type densitometers. **(13)**	**BTL 2**	**Understand**
15.	Mention in detail about the API scale and Baume scale. **(13)**	**BTL 3**	**Apply**
16.	Explain the working and construction of Thermal gas densitometer. **(13)**	**BTL 4**	**Analyze**
17.	Illustrate in detail about the calibration of vibration pickup. **(13)**	**BTL 3**	**Apply**
	PART C		
1.	Analyze three stages of measuring system for seismic mass accelerometer with the help of neat sketch. **(15)**	**BTL 5**	**Evaluate**
2.	Propose method to measure a vibration using Laser Doppler technique and discuss above meter in detail. **(15)**	**BTL 6**	**Create**
3.	An accelerometer is constructed from a centre zero moving coil voltmeter. The movement is aligned so that the pointer is in horizontal and moves in a vertical plane. A mass of 1.5g is placed at the pointer tip 20 mm from the pivot. The pointer deflection sensitivity is 1.6 X 10^5 radians / Nm and the deviation of the pointer from the horizontal is detected by a separate sensor of the sensitivity 1.5 V/m rad. This signal is passed through an amplifier having a gain of 200 mA/V. The output current of the amplifier is used to drive the meter movement in a direction to lift the pointer towards the horizontal position. The movement develops a torque of 0.025 Nm per ampere of coil current. Assume system stable. Draw the block diagram of the system and determine (i) Open loop gain (ii)The current flowing through the coil when the instrument is	**BTL 5**	**Evaluate**

	accelerated vertical upwards at 9.8 m/s^2.		
4.	Design an ultrasonic slurry densitometer. Discuss about the attenuation of sonic or ultrasonic pulses increases as the sludge density rises. **(15)**	**BTL 6**	**Create**
5.	Deduce a displacer type densitometer with Torque-Tube. **(15)**	**BTL 5**	**Evaluate**

UNIT III	**MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE**		
Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.			
PART A			
Q.No	**Question**	**BT Level**	**Competence**
1.	Outline the limitations of psychrometer?	**BTL 2**	**Understand**
2.	Distinguish between dry and wet bulb psychrometer.	**BTL 5**	**Evaluate**
3.	Illustrate the term viscosity.	**BTL 3**	**Apply**
4.	Define psychrometer.	**BTL 5**	**Evaluate**
5.	Compare Saybolt and rotary type viscometers in terms of principle of operation.	**BTL 4**	**Analyze**
6.	Differentiate Newtonian and non-Newtonian fluids.	**BTL 4**	**Analyze**
7.	Write down the uses of anemometer system.	**BTL 1**	**Remember**
8.	Explain humidity.	**BTL 5**	**Evaluate**
9.	State the advantages of Aluminium Oxide Hygrometer.	**BTL 6**	**Create**
10.	List the limitations of Aluminium Oxide Hygrometer sensor.	**BTL 3**	**Apply**
11.	What are the commonly used electrical transducer used for the humidity measurement.	**BTL 2**	**Understand**
12.	Explain about the relative humidity of the substance.	**BTL 4**	**Analyze**
13.	What is meant by dew-point temperature? What is the dew-point temperature of a gas or air?	**BTL 1**	**Remember**
14.	Mention the factors which should be considered as possible sources of error in humidity measurements.	**BTL 6**	**Create**
15.	Define kinematic viscosity.	**BTL 1**	**Remember**
16.	Write the principle of dew cell.	**BTL 2**	**Understand**
17.	What do you mean by the term consistency?	**BTL 1**	**Remember**
18.	Justify the importance of viscosity measurement for industrial process.	**BTL 6**	**Create**
19.	Compare and contrast about fluidity and relative humidity.	**BTL 2**	**Understand**
20.	Define fluidity and relative humidity.	**BTL 1**	**Remember**
21.	Differentiate kinematic viscosity from specific viscosity.	**BTL 4**	**Analyze**

22.	Examine the different types of viscometer.	**BTL 3**	**Apply**
23.	Which device is suitable for measuring the level of corrosive and abrasive liquids?	**BTL 2**	**Understand**
24.	What is meant by viscosity index?	**BTL 1**	**Remember**
	PART B		
1.	Explain the different methods of consistency measurement. **(13)**	**BTL 4**	**Analyze**
2.	**(i)**Define the terms associated with viscosity. **(7)** **(ii)** Explain the principle of operation of commercial dew point meter. **(6)**	**BTL 1**	**Remember**
3.	Describe the different methods used for measurement of Humidity. **(13)**	**BTL 2**	**Understand**
4.	Explain the working of industrial type dew point determination. **(13)**	**BTL 5**	**Evaluate**
5.	**(i)** Explain the measurement of moisture content of solid bodies by measuring electrical conductivity. **(7)** **(ii)** How relative humidity is measured using automatic electron psychrometer? **(6)**	**BTL 6**	**Create**
6.	Explain in detail about dry and wet bulb psychrometer. **(13)**	**BTL 3**	**Apply**
7.	Describe the principle of humidity measurement and also explain the working principle of any one type of hygrometer with neat sketch. **(13)**	**BTL 1**	**Remember**
8.	Discuss the principle of operation of different methods of moisture measurement. **(13)**	**BTL 2**	**Understand**
9.	Explain the working principle of hot wire electrode type hygrometer for humidity measurement with neat sketch. (**13)**	**BTL 4**	**Analyze**
10.	**(i)**What is psychrometer? **(2)** **(ii)**How does it differ from hygrometer? **(3)** **(iii)**Explain any one Psychrometer in detail. **(8)**	**BTL 1**	**Remember**
11.	Explain Rotameter type viscometer with a neat sketch. **(13)**	**BTL 4**	**Analyze**
12.	Briefly describe about consistency meters with neat sketch. **(13)**	**BTL 2**	**Understand**
13.	Explain how moisture is measured in granular materials and solid penetrable materials. **(13)**	**BTL 5**	**Evaluate**
14.	Explain the conductivity and IR sensors used in moisture, humidity and viscosity measurement. **(13)**	**BTL 3**	**Apply**
15.	Explain the microwave and NMR and IR probes used in moisture, humidity and viscosity measurement. **(13)**	**BTL 3**	**Apply**
16.	Illustrate with neat sketch about Saybolt Viscometer. **(13)**	**BTL 2**	**Understand**
17.	**(i)**Describe the Chemical reaction method of measuring moisture. **(7)**	**BTL 1**	**Remember**

	(ii) Write short notes on moisture measurement in paper industry.**(6)**		
PART C			
1.	Write short notes on dew point and explain in detail about different ways of measuring it. **(15)**	**BTL 5**	**Evaluate**
2.	Explain the principle of measurement involved in Hair hygrometer. **(15)**	**BTL 5**	**Evaluate**
3.	Compare the characteristic behaviour of Resistive type, Electrolytic type and Oxide type hygrometer. **(15)**	**BTL 5**	**Evaluate**
4.	Generalize the structure, sources of errors and maintenance involved in capacitive hygrometer. **(15)**	**BTL 6**	**Create**
5.	Propose a method for measuring Kinematic Viscosity. **(15)**	**BTL 6**	**Create**

UNIT IV TEMPERATURE MEASUREMENT			
Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple – Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two color radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration.			
PART A			
Q.No	**Question**	**BT Level**	**Competence**
1.	List the sources of error in filled in system thermometer.	**BTL 1**	**Remember**
2.	Show the relationship between Celsius and Fahrenheit.	**BTL 1**	**Remember**
3.	What are the primary standards for temperature measuring calibration?	**BTL 1**	**Remember**
4.	State the law of Homogeneous metals.	**BTL 2**	**Understand**
5.	State the law of Intermediate metals.	**BTL 4**	**Analyze**
6.	Define boiling point, freezing point and triple point.	**BTL 1**	**Remember**
7.	Illustrate the working principle of bimetallic thermometer.	**BTL 2**	**Understand**
8.	Classify the different temperature measurement types using change in physical properties.	**BTL 2**	**Understand**
9.	Define thermocouple.	**BTL 3**	**Apply**
10.	Explain Peltier effect.	**BTL 5**	**Evaluate**
11.	Draw the response curve for different bimetallic elements.	**BTL 3**	**Apply**
12.	Draw the different compensation types in filled in system thermometers.	**BTL 3**	**Apply**
13.	Sketch the response curves for resistance thermometers in air and water.	**BTL 3**	**Apply**

14.	Point out the operation of optical pyrometer.	**BTL 4**	**Analyze**
15.	A bimetal element formed with stainless steel and invar at 100^0 C is raised to 200^0C. Each strip has a thickness 0.0107cm, calculate ρ.	**BTL 4**	**Analyze**
16.	Write down the classification of Expansion thermometers.	**BTL 4**	**Analyze**
17.	Assess the criteria to be considered while selecting a temperature sensor.	**BTL 5**	**Evaluate**
18.	Propose the sources of error is occurring in filled system thermometer.	**BTL 6**	**Create**
19.	Write the features of liquid in glass thermometer.	**BTL 6**	**Create**
20.	State the selective radiation pyrometer principle.	**BTL 1**	**Remember**
21.	List any four types of Thermocouples with composition and temperature range.	**BTL 1**	**Remember**
22.	Illustrate the need for cold junction compensation.	**BTL 2**	**Understand**
23.	Sketch the thermoelectric characteristics of thermocouple.	**BTL 2**	**Understand**
24.	Summarize the application of thermograph and thermostat.	**BTL 5**	**Evaluate**
	PART B		
1.	**(i)** Demonstrate the applications of bimetallic thermometer in detail. **(8)** **(ii)** Mention the merits and demerits of bimetallic thermometer. **(5)**	**BTL 3**	**Apply**
2.	Discuss the various types of filled in system thermometers.What are the possible sources of errors in filled-in thermometers and how are they compensated? **(13)**	**BTL 2**	**Understand**
3.	With neat sketch, describe the construction and working principle of gas expansion type thermometer. **(13)**	**BTL 1**	**Remember**
4.	Explain the construction and working principle of Total radiation pyrometer. **(13)**	**BTL 2**	**Understand**
5.	Explain the construction and working principle of Optical pyrometer. **(13)**	**BTL 2**	**Understand**
6.	**(i)** Name different types of Pyrometer and recall the basic working principle of Pyrometer. **(5)** **(ii)**Describe the working principle of two colour radiation pyrometers. **(8)**	**BTL 1**	**Remember**
7.	With neat sketch, describe the construction and working principle of Fluid expansion type thermometer. **(13)**	**BTL 1**	**Remember**
8.	**(i)** Elaborate how the fiber optic temperature measurement is advantageous than other methods? **(8)** **(ii)** Explain in detail about the cold junction compensation used	**BTL 4**	**Analyze**

	in thermocouple. **(5)**		
9.	Demonstrate the different types of thermocouple with necessary specification. **(13)**	**BTL 3**	**Apply**
10.	Describe the special techniques adopted for measuring high temperature using thermocouples. **(13)**	**BTL 1**	**Remember**
11.	Determine the thermoelectric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature difference of 25^0C between its junctions. Given that thermo-electric emfs of copper and constantan against platinum are 7.4 and -34.4 uV per ^{0}C temperature difference. **(13)**	**BTL 3**	**Apply**
12.	**(i)** Describe the advantages and disadvantages of optical pyrometer. **(8)** **(ii)** Describe the applications of optical pyrometer in detail. **(5)**	**BTL 2**	**Understand**
13.	Explain about the construction and working of different types of radiation pyrometer with neat sketch. **(13)**	**BTL 4**	**Analyze**
14.	Explain in detail about Thermograph, Temperature switches and thermostats. **(13)**	**BTL 5**	**Evaluate**
15.	Draw and explain the signal conditioning circuit diagram of thermocouple. **(13)**	**BTL 4**	**Analyze**
16.	Prepare a short note on Temperature sensor selection, Installation and its Calibration. **(13)**	**BTL 6**	**Create**
17.	A copper constantan thermocouple has α = 37.5 $\mu V/^0C$ and β = 0.0045 $\mu V/^0C$. determine the emf developed by the thermocouple when its hot junction is at 200 ^{0}C and cold junction is kept in ice. **(13)**	**BTL 5**	**Evaluate**
PART C			
1.	**(i)**A McLeod gauge has volume of bulb capillary and tube down to its opening equal to 90 cm3 and a capillary diameter of 1 mm. Evaluate the pressure indicated by a reading of 3 cm. **(8)** **(ii)**Explain about the manometer dynamics. **(7)**	**BTL 5**	**Evaluate**
2.	Explain about the testing and obtaining error of pressure gauges by a suitable calibration technique. **(15)**	**BTL 5**	**Evaluate**
3.	Prepare a detail notes on helix and spiral Bimetallic thermometer. **(15)**	**BTL 6**	**Create**
4.	Generalize the features of various types of industrial thermocouples with the information like materials used, temperature range, accuracy and reliability. **(15)**	**BTL 6**	**Create**
5.	Design a commercial circuit for the cold junction compensation of thermocouple and explain how the difference in temperature is compensated. **(15)**	**BTL 6**	**Create**

UNIT V PRESSURE MEASUREMENT			
Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.			
PART A			
Q.No	**Question**	**BT Level**	**Competence**
1.	List the transducer used for measuring low pressure.	**BTL 1**	**Remember**
2.	Tabulate the difference between absolute pressure and gauge pressure.	**BTL 2**	**Understand**
3.	What are the various types of manometers?	**BTL 2**	**Understand**
4.	Draw the structure of U tube manometer and label its parts.	**BTL 3**	**Apply**
5.	Draw the structure of dead weight tester and label its parts.	**BTL 4**	**Analyze**
6.	List the applications of piezo resistive pressure sensor.	**BTL 1**	**Remember**
7.	What is a dead weight tester?	**BTL 1**	**Remember**
8.	State the principle of McLeod gauge.	**BTL 1**	**Remember**
9.	Mention any three elastic type pressure gauges.	**BTL 1**	**Remember**
10.	Identify the equipment require to install a pressure gauge in a pipeline.	**BTL 1**	**Remember**
11.	Illustrate the working principle of thermal conductivity gauge.	**BTL 2**	**Understand**
12.	Give the relationship between pressure and its measuring devices.	**BTL 2**	**Understand**
13.	Express the different units of pressure.	**BTL 2**	**Understand**
14.	Write the advantages and disadvantages of diaphragm type pressure gauge.	**BTL 2**	**Understand**
15.	Classify the types of Diaphragms.	**BTL 3**	**Apply**
16.	What do you infer from the limitations of McLeod gauge?	**BTL 3**	**Apply**
17.	Classify the pressure based on the type of measurement.	**BTL 3**	**Apply**
18.	Categorize the different application of dead weight tester.	**BTL 4**	**Analyze**
19.	Compare the materials used for Diaphragm design.	**BTL 4**	**Analyze**
20.	How is differential pressure measured in multiple fluid column?	**BTL 4**	**Analyze**
21.	Assess the working principle of capacitive transducer for pressure measurement.	**BTL 5**	**Evaluate**
22.	Why elastic element type gauges are recommended and preferred to liquid column manometers in industry?	**BTL 5**	**Evaluate**
23.	Develop an arrangement used for calibration of pressure gauge	**BTL 6**	**Create**
24.	Formulate the expression for pressure in hot cathode type ionization gauge.	**BTL 6**	**Create**
PART B			

1.	Describe the methods of measurement of pressure using thermal conductivity gauges and ionization gauge. **(13)**	**BTL 1**	**Remember**
2.	Describe the pressure measurement process using the following: **(i)** Bourdon tubes **(4)** **(ii)** Bellows **(4)** **(iii)**Diaphragms **(5)**	**BTL 1**	**Remember**
3.	With neat sketch describe the method of measurement differential pressure using Capacitive differential pressure sensor. Mention its advantages and disadvantages. **(13)**	**BTL 1**	**Remember**
4.	Describe the methods of pressure measurement using resistive type pressure transducers. **(13)**	**BTL 2**	**Understand**
5.	Describe the methods of pressure measurement using pirani gauge. **(13)**	**BTL 2**	**Understand**
6.	What are the different types of electrical pressure transducers commonly used in industries? Discuss. **(13)**	**BTL 1**	**Remember**
7.	Describe with a neat sketch, the construction and working principles of U tube manometer with and without large seal pots used for pressure measurement **(13)**	**BTL 2**	**Understand**
8.	Describe with a neat sketch, the construction and working principles of well type manometer and enlarged leg type manometer used for pressure measurement. **(13)**	**BTL 4**	**Analyze**
9.	**(i)**Classify the pressure transducer based on range of measurement and type of measurement. **(8)** **(ii)**Explain with a neat sketch, the construction and working principles of inclined type manometer used for pressure measurement. **(5)**	**BTL 5**	**Evaluate**
10.	Illustrate, the pressure measurement method by using the Capacitance Pressure Transducer with neat diagram. **(13)**	**BTL 3**	**Apply**
11.	Explain the pressure measurement method by using the Potentiometric Pressure Transducer with neat diagram. **(13)**	**BTL 3**	**Apply**
12.	Demonstrate how a Dead weight tester is used to calibrate Pressure measuring device and mention the factors affecting the accuracy of Dead weight Tester. **(13)**	**BTL 3**	**Apply**
13.	**(i)**What is meant by pressure? Write short notes on its classification based on Reference pressure. **(8)** **(ii)**Outline the working cold cathode type ionization gauge. **(5)**	**BTL 4**	**Analyze**

14.	**(i)**How LVDT is used for process pressure measurement? Explain. **(8)** **(ii)**A pressure gauge in the range of 0 to 100kg/cm2 is to be calibrated with the help of Deadweight tester. Calibration is used to be checked in the steps of 10kg/cm2. Recommend the standard weights required if the average area of piston and cylinder is 1cm2. Assume that the friction and other effects are negligible. **(5)**	**BTL 5**	**Evaluate**
15.	Describe the working of all types of bourdon tube pressure gauges with a neat schematic. **(13)**	**BTL 2**	**Understand**
16.	Explain how McLeod gauge used for low pressure measurement. Justify this with your answer . **(13)**	**BTL 4**	**Analyze**
17.	Propose a setup to measure vacuum pressure. Explain the mechanism behind it. **(13)**	**BTL 6**	**Create**
	PART C		
1.	**(i)**Draw the measurement setup for measurement of pressure using LVDT and explain its operation. **(7)** **(ii)**Discuss the procedure involved in calibration of pressure gauges using dead weight tester. **(8)**	**BTL 6**	**Create**
2.	Prepare a detail notes on various types of diaphragm and bourdon tubes. **(15)**	**BTL 6**	**Create**
3.	**(i)**A McLeod gauge has volume of bulb capillary and tube down to its opening equal to 90 cm3 and a capillary diameter of 1 mm. Evaluate the pressure indicated by a reading of 3 cm. **(8)** **(ii)**Explain about the manometer dynamics. **(7)**	**BTL 5**	**Evaluate**
4.	Explain about the testing and obtaining error of pressure gauges by a suitable calibration technique. **(15)**	**BTL 5**	**Evaluate**
5.	Explain about Hot cathode type Ionization gauge along with its circuit arrangement and internal control circuit diagram. **(15)**	**BTL 5**	**Evaluate**