SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

EI3561- INDUSTRIAL INSTRUMENTATION

V SEMESTER

Regulation – 2023

Academic Year 2025 – 26 (Odd semester)

Prepared by

Dr. M. JOE MARSHELL, M.E., Ph.D.,

Assistant Professor (Sr.G) / EIE

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

SUBJECT : EI3561 - INDUSTRIAL INSTRUMENTATION

SEM / YEAR : V/ III

UNIT I MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE, FORCE, TORQUE AND SPEED.

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers. 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. 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, and D.C and A.C tacho generators – Stroboscope.

PART A

Q.No	Question	COs	BT Level	Competence
1.	Define absolute viscosity.	CO1	BTL 1	Remember
2.	What is kinematic viscosity?	CO1	BTL 1	Remember
3.	List the units used for measuring viscosity.	CO1	BTL 2	Understand
4.	State the principle of operation of a Saybolt viscometer.	CO1	BTL 2	Understand
5.	Mention, how a torque-type viscometer measures viscosity.	CO1	BTL 2	Understand
6.	What is a dry-and-wet bulb psychrometer?	CO1	BTL 1	Remember
7.	Differentiate between absolute and relative humidity.	CO1	BTL 2	Understand
8.	What is a dew point?	CO1	BTL 1	Remember
9.	Define hygrometer.	CO1	BTL 1	Remember
10.	Mention two types of hygrometers.	CO1	BTL 2	Understand
11.	What is meant by percent moisture content?	CO1	BTL 1	Remember
12.	List the types of moisture measurement gauges.	CO1	BTL 2	Understand
13.	Write the working principle of a hydraulic load cell.	CO1	BTL 1	Remember
14.	Describe any two types of load cells	CO1	BTL 2	Understand
15.	How is torque measured using a strain gauge torsion meter?	CO1	BTL 1	Remember
16.	What is the principle of relative angular twist method	CO1	BTL 1	Remember

	of torque measurement?			
17.	State the construction and working of a capacitive tachometer.	CO1	BTL 2	Understand
18.	Mention the principle and construction of a drag-cup DC tachogenerator.	CO1	BTL 2	Understand
19.	State the differences between D.C. and A.C. tachogenerators	CO1	BTL 2	Understand
20.	State the principle and construction of a piezoelectric load cell.	CO1	BTL 1	Remember
21.	Define the magneto-elastic load cell	CO1	BTL 1	Remember
22.	Name any two types of torque measurement methods	CO1	BTL 1	Remember
23.	Draw the construction of a stroboscope.	CO1	BTL 1	Remember
24.	Write short notes on stroboscope and its applications.	CO1	BTL 1	Remember
PART B				
1.	Draw and explain the construction and working of a Saybolt viscometer. Compare it with a friction-tube type viscometer. **(16)**	CO1	BTL 3	Apply
2.	With neat sketch, discuss the construction and working principle of torque-type viscometers. Explain where this type is preferred over rotational viscometers. **(16)**	CO1	BTL 3	Apply
3.	Examine in detail the design and operation of a rotameter used for viscosity measurement. Explain how the float position varies with fluid viscosity. **(16)**	CO1	BTL 4	Analyze
4.	Explain the working of dry and wet bulb psychrometers with necessary diagrams. Derive the relation used to compute relative humidity. **(16)**	CO1	BTL 4	Analyze
5.	Discuss the construction, working, advantages, and limitations of resistive and capacitive hygrometers. Provide typical applications of each. **(16)**	CO1	BTL 3	Apply
6.	Explain the working principle and construction of a dew-cell and a commercial chilled-mirror dew-point meter. **(16)**	CO1	BTL 4	Analyze
7.	With neat sketches, explain thermal and conductivity methods for measuring moisture in solids. Compare their working range and accuracy. **(16)**	CO1	BTL 3	Apply
8.	Describe the operation of a capacitive moisture sensor and explain how microwave and infrared (IR) sensors measure moisture in granular materials. **(16)**	CO1	BTL 3	Apply
9.	Explain the construction and working of strain gauge load cells with neat diagrams. **(16)**	CO1	BTL 4	Analyze
10.	With neat sketches, compare hydraulic and pneumatic load cells. **(16)**	CO1	BTL 3	Apply
11.	Describe the working principle of piezoelectric load	**CO1**	BTL 3	Apply

	cells. **(16)**			
12.	Explain in detail the strain gauge method of torque measurement. **(16)**	CO1	BTL 4	Analyze
13.	Describe the relative angular twist method for torque measurement in rotating shafts. **(16)**	CO1	BTL 3	Apply
14.	Explain the construction and working of a capacitive tachometer. **(16)**	CO1	BTL 4	Analyze
15.	Compare D.C. and A.C. tachogenerators. **(16)**	CO1	BTL 3	Apply
16.	Explain the working of a stroboscope with a neat diagram. **(16)**	CO1	BTL 4	Analyze
17.	Explain in detail the construction and working of a drag cup type tachometer. **(16)**	CO1	BTL 4	Analyze

UNIT II TEMPERATURE MEASUREMENT

Units of Temperature –Different types of filled in system thermometers – Bimetallic thermometers - IC sensors – Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Special techniques for measuring high temperature using thermocouple – Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection.

PART A

Q.No	Question	COs	BT Level	Competence
1.	What is the relationship between Celsius, Fahrenheit, and Kelvin scales?	CO2	BTL 1	Remember
2.	State the term “filled-in system thermometer.	CO2	BTL 1	Remember
3.	Name two types of filled system thermometers and state their working ranges.	CO2	BTL 1	Remember
4.	How does a filled system thermometer indicate temperature change?	CO2	BTL 1	Remember
5.	Mention the working principle of a bimetallic thermometer.	CO2	BTL 2	Understand
6.	Answer, why bimetallic strips bend when heated.	CO2	BTL 2	Understand
7.	Compare coil-type and spiral-type bimetallic thermometers.	CO2	BTL 2	Understand
8.	Mention one application where bimetallic thermometers are preferred.	CO2	BTL 1	Remember
9.	Name a commonly used IC temperature sensor and its output type.	CO2	BTL 1	Remember
10.	List two advantages of using IC temperature sensors over RTDs or thermocouples.	CO2	BTL 1	Remember
11.	State the Seebeck effect and its relevance to thermocouples.	CO2	BTL 1	Remember

12.	List two commonly used thermocouple types and their temperature ranges.	CO2	BTL 1	Remember
13.	State that "cold junction compensation" in thermocouple measurements	CO2	BTL 1	Remember
14.	How does a commercial thermocouple circuit compensate for cold junction errors?	CO2	BTL 2	Understand
15.	Mention one special technique to measure high temperatures (>1500 °C) with thermocouples.	CO2	BTL 2	Understand
16.	What is the working principle of a total radiation pyrometer?	CO2	BTL 1	Remember
17.	How does an optical pyrometer differ from a total radiation pyrometer?	CO2	BTL 2	Understand
18.	Define emissivity and explain its importance in radiation measurement.	CO2	BTL 1	Remember
19.	How a fiber-optic temperature sensor works?	CO2	BTL 1	Remember
20.	What is a thermograph and what applications does it have?	CO2	BTL 1	Remember
21.	List at least three important criteria for temperature sensor selection.	CO2	BTL 1	Remember
22.	Draw a neat schematic of a filled system thermometer and describe briefly how it works.	CO2	BTL 1	Remember
23.	State the working principle of a thermocouple.	CO2	BTL 1	Remember
24.	Write the principle of an optical pyrometer, along with its advantages and limitations	CO2	BTL 1	Remember
PART B				
1.	Explain the various temperature scales (°C, °F, K, °R) and derive relations for converting between them. **(16)**	CO2	BTL 4	Analyze
2.	Describe the construction, working, and applications of liquid-filled and gas-filled system thermometers. **(16)**	CO2	BTL 3	Apply
3.	With neat sketches, explain the principle and construction of coil-type and spiral-type bimetallic thermometers. Discuss their applications. **(16)**	CO2	BTL 4	Analyze
4.	Analyse the factors affecting the accuracy and range of bimetallic thermometers. Suggest design enhancements for improved performance. **(16)**	CO2	BTL 4	Analyze
5.	Explain the working principle, characteristics, and practical applications of IC temperature sensors like LM35 or AD590. **(16)**	CO2	BTL 4	Analyze
6.	Compare IC sensors, thermocouples, and RTDs with regard to accuracy, linearity, temperature range, and interfacing in instrumentation systems. **(16)**	CO2	BTL 4	Analyze
7.	Explain the Seebeck, Peltier, and Thomson effects. Draw a neat diagram of a thermocouple and explain its	CO2	BTL 4	Analyze

	operation. **(16)**			
8.	Describe a complete signal conditioning circuit for thermocouple output that includes amplification and cold junction compensation. **(16)**	CO2	BTL 3	Apply
9.	Compare commercial cold junction compensation techniques: ice bath, electronic CJ sensors, and IC-based methods. Highlight advantages & limitations. **(16)**	CO2	BTL 4	Analyze
10.	Discuss methods to measure very high temperatures (>1500 °C) with thermocouples. Include material choices and protective techniques. **(16)**	CO2	BTL 3	Apply
11.	Explain the construction and working of a total-radiation pyrometer. Derive its calibration relation using Stefan–Boltzmann law. **(16)**	CO2	BTL 4	Analyze
12.	Explain the working of an optical pyrometer. Discuss emissivity effects and how they are compensated in measurement. **(16)**	CO2	BTL 4	Analyze
13.	Compare total-radiation and optical pyrometers in terms of principle, temperature range, response time, and accuracy. **(16)**	CO2	BTL 4	Analyze
14.	Describe the working principle and structure of fiber-optic temperature sensors. Explain why they are preferred in high EMI or explosive environments. **(16)**	CO2	BTL 3	Apply
15.	Explain the principle and construction of a thermograph. Discuss its applications in industrial and medical fields. **(16)**	CO2	BTL 4	Analyze
16.	Discuss the key criteria for selecting a temperature sensor. **(16)**	CO2	BTL 3	Apply
17.	A process requires -50 °C to 500 °C measurement in a corrosive medium with fast response. Propose a suitable sensor system. **(16)**	CO2	BTL 4	Analyze

UNIT III FLOW MEASUREMENT				
Units of Flow - Orifice plate: different types of orifice plates – Cd variation – pressure tapping– Venturi tube – Flow nozzle – Dall tube – Pitot tube, Installation and applications of head flowmeters, Positive displacement flow meters, Rotameter –theory, characteristics, installation and applications, Mass flow meter, Calibration of flow meters: – Dynamic weighing method - Electrical type flow meters Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.				
PART A				
Q.No	**Question**	**COs**	**BT Level**	**Competence**
1.	List the different types of orifice plates and state one	CO3	BTL 1	Remember

	application of each.			
2.	Answer, why the discharge coefficient (Cd) of an orifice plate varies with Reynolds number.	CO3	BTL 2	Understand
3.	What are the preferred pressure-tapping positions for an orifice plate?	CO3	BTL 1	Remember
4.	Define a Venturi tube and explain how it reduces energy loss compared to an orifice.	CO3	BTL 1	Remember
5.	Mention the use and advantage of a flow nozzle over an orifice plate.	CO3	BTL 1	Remember
6.	What is a Dall tube and where is it typically used?	CO3	BTL 2	Understand
7.	Write the principle of a Pitot tube and its main application for flow measurement.	CO3	BTL 1	Remember
8.	Outline key installation guidelines for head-type flowmeters in pipelines.	CO3	BTL 1	Remember
9.	How a rotameter measures flow rate?	CO3	BTL 1	Remember
10.	Sketch a generic rotameter characteristic curve.	CO3	BTL 1	Remember
11.	Give two advantages and one limitation of rotameters in industrial use.	CO3	BTL 1	Remember
12.	What is a positive displacement flowmeter? Provide one example.	CO3	BTL 1	Remember
13.	Name three types of positive displacement meters used in instrumentation.	CO3	BTL 1	Remember
14.	What is a mass flowmeter? Mention one application.	CO3	BTL 1	Remember
15.	State the principle and construction of an electromagnetic flowmeter.	CO3	BTL 1	Remember
16.	How an ultrasonic flowmeter measures flow velocity.	CO3	BTL 1	Remember
17.	What is a laser Doppler anemometer, and where is it used?	CO3	BTL 1	Remember
18.	Mention the operating principle of a vortex shedding flowmeter.	CO3	BTL 1	Remember
19.	How a target flowmeter works?	CO3	BTL 1	Remember
20.	Outline the dynamic weighing method used for flowmeter calibration.	CO3	BTL 2	Understand
21.	Name two electrical-type flowmeters and their working principles.	CO3	BTL 1	Remember
22.	List four guidelines for selecting an appropriate flowmeter for an application.	CO3	BTL 2	Understand
23.	How flow is measured in an open channel.	CO3	BTL 1	Remember
24.	Give briefly a method for measuring solid flow rate.	CO3	BTL 1	Remember
PART B				
1.	Explain the various units used in flow measurement and illustrate how volumetric and mass flow rates can be interconverted. **(16)**	CO3	BTL 4	Analyze

2.	Discuss the classification of orifice plates with neat sketches and examples of application for each type. **(16)**	CO3	BTL 3	Apply
3.	Explain how the discharge coefficient (Cd) for an orifice plate varies with Reynolds number and β-ratio. **(16)**	CO3	BTL 4	Analyze
4.	Explain the different pressure tapping arrangements used with orifice plates. Discuss their advantages and limitations. **(16)**	CO3	BTL 4	Analyze
5.	With neat sketches, explain the construction and working principle of a Venturi tube. Include advantages over orifice plates. **(16)**	CO3	BTL 3	Apply
6.	Examine the flow nozzle and discuss its construction, where it is preferred over Venturi and orifice plates. **(16)**	CO3	BTL 4	Analyze
7.	Explain the principle and design of a Dall tube with diagram. Compare its performance with Venturi tubes. **(16)**	CO3	BTL 4	Analyze
8.	Demonstrate the construction and working of a Pitot tube. Include the velocity head equation and its application. **(16)**	CO3	BTL 3	Apply
9.	Infer the installation requirements for differential-pressure type flowmeters. **(16)**	CO3	BTL 4	Analyze
10.	Explain the working principle of a rotameter with neat diagram. Discuss its calibration curve and typical applications. **(16)**	CO3	BTL 4	Analyze
11.	With neat sketches, explain the principle, construction, and working of a positive displacement flowmeter. **(16)**	CO3	BTL 3	Apply
12.	Discuss the advantages of mass flow measurement and describe Coriolis mass flowmeters with principle and applications. **(16)**	CO3	BTL 3	Apply
13.	Explain the dynamic weighing method for calibration of flowmeters with neat diagram and procedure. **(16)**	CO3	BTL 4	Analyze
14.	Explain the principle, construction, and working of an electromagnetic flowmeter. Discuss its limitations and applications. **(16)**	CO3	BTL 4	Analyze
15.	Demonstrate the working principles and configurations of ultrasonic flowmeters. Include advantages and challenges. **(16)**	CO3	BTL 3	Apply
16.	Explain the working principle of Laser Doppler Anemometry for flow measurement. **(16)**	CO3	BTL 4	Analyze
17.	Discuss the working principle and construction of a vortex shedding flowmeter, and compare it with a target flowmeter in terms of performance and application. **(16)**	CO3	BTL 3	Apply

UNIT IV 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 – Pressure Transmitter: Conventional and Smart Transmitter, Level measurement using DPT.				
PART A				
Q.No	**Question**	**COs**	**BT Level**	**Competence**
1.	List the transducer used for measuring low pressure.	CO4	BTL 1	Remember
2.	Tabulate the difference between absolute pressure and gauge pressure.	CO4	BTL 2	Understand
3.	What are the various types of manometers?	CO4	BTL 2	Understand
4.	Draw the structure of U tube manometer and label its parts.	CO4	BTL 2	Understand
5.	Draw the structure of dead weight tester and label its parts.	CO4	BTL 2	Understand
6.	List the applications of piezo resistive pressure sensor.	CO4	BTL 1	Remember
7.	What is a dead weight tester?	CO4	BTL 1	Remember
8.	State the principle of McLeod gauge.	CO4	BTL 1	Remember
9.	Mention any three elastic type pressure gauges.	CO4	BTL 1	Remember
10.	Identify the equipment require to install a pressure gauge in a pipeline.	CO4	BTL 1	Remember
11.	Illustrate the working principle of thermal conductivity gauge.	CO4	BTL 2	Understand
12.	Give the relationship between pressure and its measuring devices.	CO4	BTL 2	Understand
13.	Express the different units of pressure.	CO4	BTL 2	Understand
14.	Write the advantages and disadvantages of diaphragm type pressure gauge.	CO4	BTL 2	Understand
15.	Classify the types of Diaphragms.	CO4	BTL 2	Understand
16.	What do you infer from the limitations of McLeod gauge?	CO4	BTL 2	Understand
17.	Classify the pressure based on the type of measurement.	CO4	BTL 2	Understand
18.	Categorize the different application of dead weight tester.	CO4	BTL 2	Understand
19.	Compare the materials used for Diaphragm design.	CO4	BTL 2	Understand
20.	How is differential pressure measured in multiple fluid column?	CO4	BTL 1	Remember
21.	Assess the working principle of capacitive transducer	CO4	BTL 1	Remember

	for pressure measurement.			
22.	Why elastic element type gauges are recommended and preferred to liquid column manometers in industry?	CO4	BTL 1	Remember
23.	Develop an arrangement used for calibration of pressure gauge	CO4	BTL 1	Remember
24.	Formulate the expression for pressure in hot cathode type ionization gauge.	CO4	BTL 1	Remember
	PART B			
1.	Describe the methods of measurement of pressure using thermal conductivity gauges and ionization gauge. **(16)**	CO4	BTL 3	Apply
2.	Describe the pressure measurement process using the following: **(i)** Bourdon tubes **(6)** **(ii)** Bellows **(5)** **(iii)** Diaphragms **(5)**	CO4	BTL 3	Apply
3.	With neat sketch describe the method of measurement differential pressure using Capacitive differential pressure sensor. Mention its advantages and disadvantages. **(16)**	CO4	BTL 4	Analyze
4.	Describe the methods of pressure measurement using resistive type pressure transducers. **(16)**	CO4	BTL 3	Apply
5.	Describe the methods of pressure measurement using Pirani gauge. **(16)**	CO4	BTL 3	Apply
6.	What are the different types of electrical pressure transducers commonly used in industries? Discuss. **(16)**	CO4	BTL 3	Apply
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 **(16)**	CO4	BTL 3	Apply
8.	Describe with a neat sketch, the construction and working principles of well type manometer and enlarged leg type manometer used for pressure measurement. **(16)**	CO4	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. **(8)**	CO4	BTL 5	Evaluate
10.	Illustrate, the pressure measurement method by using the Capacitance Pressure Transducer with neat diagram. **(16)**	CO4	BTL 3	Apply
11.	Explain the pressure measurement method by using the Potentiometric Pressure Transducer with neat diagram. **(16)**	CO4	BTL 4	Analyze
12.	Demonstrate how a Dead weight tester is used to calibrate Pressure measuring device and mention the	CO4	BTL 3	Apply

	factors affecting the accuracy of Dead weight Tester. **(16)**			
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. **(8)**	CO4	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. **(8)**	CO4	BTL 4	Analyze
15.	Describe the working of all types of bourdon tube pressure gauges with a neat schematic. **(16)**	CO4	BTL 3	Apply
16.	Explain how McLeod gauge used for low pressure measurement. Justify this with your answer. **(16)**	CO4	BTL 4	Analyze
17.	Propose a setup to measure vacuum pressure. Explain the mechanism behind it. **(16)**	CO4	BTL 4	Analyze

UNIT V LEVEL MEASUREMENT AND TRANSMITTER

Units of Level: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydra step method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

PART A

Q.No	Question	COs	BT Level	Competence
1.	What are the commonly used units for level measurement in process industries?	CO5	BTL 1	Remember
2.	Distinguish between level measurement in liquids and solids.	CO5	BTL 2	Understand
3.	Define interface level in the context of level measurement.	CO5	BTL 1	Remember
4.	State the principle of operation of a float-type level gauge.	CO5	BTL 1	Remember
5.	What are the limitations of float-type level sensors?	CO5	BTL 1	Remember
6.	What is the working principle of a displacer-type level transmitter?	CO5	BTL 1	Remember
7.	Compare float gauge and displacer-type gauge with respect to operating conditions.	CO5	BTL 2	Understand
8.	Define dead zone in ultrasonic level measurement.	CO5	BTL 1	Remember
9.	How does an ultrasonic level transmitter work?	CO5	BTL 1	Remember
10.	Mention one advantage and one disadvantage of ultrasonic	CO5	BTL 1	Remember

	level sensors.			
11.	What is the role of the transducer in ultrasonic level measurement?	CO5	BTL 1	Remember
12.	What is the principle behind the differential pressure method for boiler drum level measurement?	CO5	BTL 1	Remember
13.	Why is a three-element control used in boiler drum level measurement?	CO5	BTL 1	Remember
14.	What are the advantages of using the hydra step method in boiler level monitoring?	CO5	BTL 1	Remember
15.	Mention two limitations of the DP method in high-pressure boiler applications.	CO5	BTL 1	Remember
16.	List two methods used for measuring the level of solid materials.	CO5	BTL 1	Remember
17.	What challenges are faced while measuring the level of bulk solids?	CO5	BTL 2	Understand
18.	Name any one non-contact method used for solid level measurement.	CO5	BTL 1	Remember
19.	What is the purpose of guided wave radar in solid level sensing?	CO5	BTL 1	Remember
20.	What is the function of a smart transmitter?	CO5	BTL 1	Remember
21.	State the differences between analog and smart transmitters.	CO5		
22.	Define HART protocol and mention its role in smart transmitters.	CO5	BTL 1	Remember
23.	What is the advantage of using microprocessor-based transmitters?	CO5	BTL 1	Remember
24.	List the primary variables that can be measured using smart transmitters.	CO5	BTL 1	Remember
PART B				
1.	Explain the various units used in level measurement. Compare direct and indirect level measurement techniques with suitable examples. **(16)**	CO5	BTL 4	Analyze
2.	With neat sketches, explain the construction and working principle of float-type level gauges. Mention their merits and limitations. **(16)**	CO5	BTL 3	Apply
3.	Explain the working principle of displacer-type level measurement system and mention its applications. **(16)**	CO5	BTL 4	Analyze
4.	Explain the principle, construction, and working of ultrasonic level gauges. Mention advantages, limitations, and applications. **(16)**	CO5	BTL 4	Analyze
5.	Compare radar and ultrasonic level measurement methods with diagrams. Under what conditions is one preferred over the other? **(16)**	CO5	BTL 3	Apply
6.	With neat diagrams, explain the differential pressure method for boiler drum level measurement. Include derivations where needed. **(16)**	CO5	BTL 3	Apply

7.	Explain the hydra step method used for drum level measurement in high-pressure boilers. Mention the steps involved in signal generation. **(16)**	**CO5**	BTL 4	Analyze
8.	Compare single-element, two-element, and three-element drum level control strategies. In what situations is each used? **(16)**	**CO5**	BTL 4	Analyze
9.	Discuss various methods used for solid level measurement. Explain any two with neat sketches and applications. **(16)**	**CO5**	BTL 3	Apply
10.	Explain the challenges in measuring solid levels compared to liquid levels. Suggest suitable sensors for powders, grains, and bulk solids. **(16)**	**CO5**	BTL 4	Analyze
11.	What is a smart transmitter? Explain its architecture, working principle, and advantages over conventional transmitters. **(16)**	**CO5**	BTL 4	Analyze
12.	Discuss the role of microprocessors in modern transmitters. How do smart transmitters perform diagnostics and calibration? **(16)**	**CO5**	BTL 3	Apply
13.	With a block diagram, explain the working of a pressure transmitter. How is output linearized and compensated? **(16)**	**CO5**	BTL 3	Apply
14.	Explain the construction and working of a level transmitter used in closed tank systems. Include the role of pressure tapping. **(16)**	**CO5**	BTL 4	Analyze
15.	Explain the construction and working of a level transmitter used in closed tank systems. Include the role of pressure tapping. **(16)**	**CO5**	BTL 4	Analyze
16.	Discuss the working principle and compensation methods used in temperature transmitters. Explain with examples. **(16)**	**CO5**	BTL 3	Apply
17.	Explain how an integrated transmitter system can be used to measure and transmit multiple process variables with a neat sketch. **(16)**	**CO5**	BTL 4	Analyze