

## INSTRUMENTATION AND CONTROL SYSTEMS

<b>III Semester: ME</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME019	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	
<p><b>COURSE OBJECTIVES:</b>  <b>The course should enable the students to:</b></p> <ol style="list-style-type: none"> <li>Visualize the concepts of measurement and dynamic performance characteristics of measuring instruments.</li> <li>Understand the measurement of typical physical quantities like displacement, temperature, pressure, discharge, and speed.</li> <li>Applying techniques for measurement of Level, Flow, Speed, Acceleration and Vibration.</li> <li>Visualize the measurement of Stress, Strain, Humidity, Force, Torque and Power.</li> <li>Understand the control systems for instrumentation and develop Temperature, Speed and Position control systems.</li> </ol> <p><b>COURSE OUTCOMES (COs):</b></p> <p>CO 1: Ability to describe the static and dynamic characteristics, identify functional elements of generalized measuring system and error control.</p> <p>CO 2: Ability to analyze and design the measuring system for the measurement of displacement, temperature and Pressure</p> <p>CO 3: Ability to analyze and design the measuring system for the measurement of Flow and liquid level.</p> <p>CO 4: Ability to analyze and design the measuring system for the measurement of stress, strain, humidity, force and torque.</p> <p>CO 5: Ability to analyze &amp; design the control system for control of position, temperature, acceleration &amp; process control.</p> <p><b>COURSE LEARNING OUTCOMES (CLOs):</b></p> <ol style="list-style-type: none"> <li>Comprehend generalized configuration and functional description of measuring instruments.</li> <li>Visualize static and dynamic performance characteristics.</li> <li>Understand the sources of various errors and its elimination.</li> <li>Apply the working principles and identify the measurands for displacement.</li> <li>Evaluate temperature measuring methods in various equipments.</li> <li>Understand the fluid pressure, its importance and measurement techniques.</li> <li>Comprehend the level measuring devices for ascertaining liquid level.</li> <li>Visualize the importance of flow measurement and know various flow measuring devices.</li> <li>Evaluate the measurement of speed in engineering applications and importance of speed measurement in instrumentation.</li> <li>Comprehend the importance of acceleration and vibration measurement with various techniques.</li> <li>Visualize the stress and strain experienced by various elements and understand the importance of strain measurement with various techniques.</li> <li>Understand the concept of humidity in atmosphere as well as the storage applications and maintenance of</li> </ol>								

<p>humidity by measurement.</p> <p>13. Apply the basic principles of instrumentation for force measurement in various fields of engineering.</p> <p>14. Apply the basic principles and characteristics for torque measurement.</p> <p>15. Comprehend the instrumentation techniques in solving the engineering measuring applications of power.</p> <p>16. Understand the control systems for instrumentation in various practical applications.</p> <p>17. Classify the control systems, advantages, limitations and control system terminology.</p> <p>18. Comprehend servo mechanism, process control and regulators for process and position control.</p> <p>19. Apply control system for control of position, temperature and acceleration.</p>		
<b>UNIT-I</b>	<b>PRINCIPLES OF MEASUREMENT</b>	<b>Classes: 09</b>
<p>Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, Classification and elimination of error.</p>		
<b>UNIT-II</b>	<b>MEASUREMENT OF DISPLACEMENT, TEMPERATURE, PRESSURE</b>	<b>Classes: 09</b>
<p>Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.</p> <p>Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.</p> <p>Measurement of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, McLeod pressure gauge.</p>		
<b>UNIT-III</b>	<b>MEASUREMENT OF LEVEL, FLOW, SPEED, ACCELERATION AND VIBRATION</b>	<b>Classes: 09</b>
<p>Measurement of Level: Direct method – Indirect methods capacitive, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators. Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).</p> <p>Measurement of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Noncontact type of tachometer. Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.</p>		
<b>UNIT-IV</b>	<b>MEASUREMENT OF STRESS–STRAIN, HUMIDITY, FORCE, TORQUE AND POWER</b>	<b>Classes: 09</b>
<p>Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.</p> <p>Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.</p> <p>Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters, Dynamometers.</p>		
<b>UNIT-V</b>	<b>ELEMENTS OF CONTROL SYSTEMS</b>	<b>Classes: 09</b>
<p>Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems Servomechanisms–Examples with block diagrams–Temperature, speed &amp; position control systems.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. K Padma Raju, Y J Reddy, “Instrumentation and Control Systems”, McGraw Hill Education 1st Edition, 2016.</li> <li>2. S W. Bolton, “Instrumentation and Control Systems”, Newness Publisher, 1st Edition, 2004.</li> <li>3. K Singh, “Industrial Instrumentation and Control”, McGraw Hill Education, 3rd Edition, 2015.E</li> </ol>		

**Reference Books:**

1. Chennakesava R Alavala, —Principles of Industrial Instrumentation and Control Systems, Cengage Learning, 1st Edition, 2013.
2. S. Bhaskar, —Instrumentation and Control systems, Anuradha Agencies, 1st Edition, 2013.
3. Holman, —Experimental Methods for Engineers, McGraw-Hill, 8th Edition, 2013
4. R. K. Jain, —Mechanical and Industrial Measurements, Khanna Publishers, 1st Edition, 2013.
5. Sirohi, Radhakrishna, —Mechanical Measurements, New Age, 3rd Edition, 2015.
6. A. K. Tayal, —Instrumentation & Mech. Measurements, Galgotia Publications, 1st Edition, 2013.

**Web References:**

1. <https://nptel.ac.in/courses/112106138/>