

<b>Devi Ahilya University, Indore, India Institute of Engineering &amp; Technology</b>				<b>ME I Year Electronics (Sp. Digital Instrumentation) Semester- A</b>			
<b>Subject Code &amp; Name</b>	<b>Instructions Hours per Week</b>			<b>Credits</b>			
<b>DIR1C1: Industrial Transducers and smart Sensors</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>
	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>5</b>
<b>Duration of Theory Paper: 3 Hours</b>							

### Course Objective:

Acquire the knowledge of basic principles of sensing various parameters. Learn comparative methods of selection of sensors for typical applications

### COURSE CONTENT

#### Unit I

**Temperature Measurement:** Classification of temperature sensors, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistors), radiation sensors (pyrometers), temperature switch.

**Pressure Measurement:** Definition, working principle, types, materials, manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure sensors, low-pressure sensors, pressure switch.

#### Unit II

**Level Measurement:** Working principle, types, materials, float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type, solid level detectors, fiber optic level detectors, level switch.

**Flow Measurement:** Working principle, types, materials, primary or quantity meters (positive displacement flow meter), secondary or rate meter (obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), Flow switch.

#### Unit III

**Force and Torque Measurement:** Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, strain gauge torque meter, Inductive torque meter, magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement.

#### Unit IV

**Allied Sensors:** Standards, working principle, types, materials, design criterion: LLeak detector, flame detector, smoke detector, humidity, density, viscosity sensors, and digital transducers, sound sensors, and proximity sensors.

**Advanced sensors:** Working Principle, types, materials: Smart sensors, MEMS, nano sensors IC sensors, optical fiber sensors.

#### Unit V

**Industrial Communication Systems:** Introduction to interface, fieldbus, PROFIBUS-PA, foundation fieldbus.

### Text and Reference books:

- [1] B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education, Second ed., 2004.
- [2] Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, First ed., 1998.
- [3] A. K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.
- [4] Dr. D. S. Kumar, "Mechanical Measurements and Control", 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd., 2004.
- [5] B. E. Noltingk, "Instrumentation Reference Book", 2nd Edition, Butterworth Heinemann, 1995.
- [6] B. G. Liptak, "Process software and digital networks", 3rd Edition, CRC press, Florida.