Program: B. Tech. (ECE)	Course Title: Industrial Instrumentation			Course Code: ECEXXX
Type of Course: Program Elective	Prerequisites: Basic Electronics			Total Contact Hours: 40
Year/Semester: 5/Odd	Lecture Hrs/Week: 3	Tutorial Hrs/Week: 0	Practical Hrs/Week: 0	Credits: 3

Learning Objective:

The objective of the Industrial Instrumentation Course is to provide students with an understanding of the concept and design of the different types of industrial instruments to measure physical signals such as Pressure, Flow, Temperature, Velocity and Level.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	Identify and analyse the physical signals and use of the suitable transducers for measurement.	1,2
CO-2	Understand and analyse concept of Pressure and Flow measuring instruments.	2,3,4
CO-3	Understand the principle of the Temperature and Velocity measurements and their use to design the measuring instruments.	2,3,4
CO-4	Understand and analyse concept of Level measurement, PH measurement, Hydro- & Hygro-meter.	2,3,4
CO-5	Identify the reasons of the measurement delay and its effect on process control.	1,2
CO-6	Understand the concept virtual instruments, Soft sensor, and Smart Transducers	2

Course Topics		Lecture Hours
UNIT – I (Transducer Basics and Pressure Measurement)		10
1.1	Classification of the transducer and its characteristics, Measurements Noises	2
1.2	Strain Gauge and its signal Conditioning circuit, temperature compensation for Strain gauge, Piezoelectric Transducers, and its Frequency response.	3
1.3	Pressure Measurement: Manometers, Elastic pressure elements, Electromechanical Pressure Transducers,	3
1.4	Vacuum Pressure Measurement: Knudsen gauge, Pirani Gauge, Ionization gauge, McLeod Gauge.	2

UNIT – II (Temperature and Flow Measurement)			
2.1	Temperature Measurement: Liquid in glass and Bimetallic type, Radiation Pyrometers and Optical Pyrometers.	**4**	**12**
2.2	Flow Measurement: Laminar and Turbulent flow, Bernoulli equation, Venturimeter, Orifice plate, Pitot tubes, Rotameter	**4**	
2.3	Turbine Flowmeter, Electromagnetic Flowmeter, Hot wire anemometer, Ultrasonic Flowmeter, Laser Doppler anemometer.	**4**	
UNIT – III (Level and Velocity Measurement)			
3.1	Level Measurement: Sight Glass, Hydrostatic, Purge type level sensor, differential pressure method for level measurement,	3	**10**
3.2	Buoyancy methods, Nucleonic level gauge, Ultrasonic level meter, and capacitive type level sensor.	4	
3.3	Velocity Measurement: DC and AC Tacho-generators, Seismic Transducer for vibration measurement, Accelerometers.	3	
UNIT – IV (Miscellaneous Measurement)			
4.1	pH Sensor, hygrometer, measurement of thermal conductivity and thickness, Hydrometer	4	**8**
4.2	Virtual Instrumentation, Soft Sensor, Smart Transducer	3	
4.3	Measurement Delay and Its effect on process control	1	

Textbook References:

Textbook:

1. Sawhney, A. K. (2015). *A Course in Electrical and Electronic Measurements and Instrumentation*. Dhanpat Rai Publication.
2. Nakra, B.C. & Chaudhry, K.K. (2016). *Instrumentation, Measurement and Analysis* (4th ed.). Tata McGraw Hill.

Reference books:

1. Doebelin, E. O. (1990). *Measurement Systems: Application and Design* (4th ed.). Mcgraw Hill International.
2. Eckmann, D. P. (2006). *Industrial Instrumentation*. CBS Publishers and Distributors.
3. Kalsi, H.S. (2017). *Electronic Instrumentation* (3rd ed.). Mcgraw Hill Education.
4. Singh, S.K. (2017). *Industrial Instrumentation and Control* (3rd ed.). Mcgraw Hill Education.
5. Rangan, C., Sharma, G. & Mani, V.S.V. (2017*). Instrumentation: Devices and systems* (3rd ed.). Mcgraw Hill Education.

Additional Resources:

1. https://nptel.ac.in/courses/112103174/3
2. https://swayam.gov.in/course/3764-industrial-instrumentation
3. https://online.stanford.edu/courses/me220-introduction-sensors

Evaluation Method*	
Item	**Weightage (%)**
Quiz 1	10
Quiz 2	10
Quiz 3	10
Quiz 4	10
Midterm	25
Final Examination	35

Note: **Due to the Covid-19 pandemic situation, evaluation components may change as directed by the academic office.*

**Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

CO and PO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1					1	2		3	3	1	1
CO2	3	3	1	1	1				1	2		3	3	1	1
CO3	3	3	1	1	1				1	2		3	3	1	1
CO4	3	2	2	1					1	2		3	3	1	1
CO5	3	3	1	1	1				1	2		3	3	1	1
CO6	3	3	3	1					1	2		3	3	1	1

Last Updated On: 04-05-2021

Prepared By: Dr. Bharat Verma **Approved By:**