

Course code	Course name	L-T-P-Credits	Year of Introduction
AE304	INDUSTRIAL INSTRUMENTATION	3-0-0-3	2016
Prerequisite : Nil			
Course Objective			
<ul style="list-style-type: none"> To equip the students with the basic knowledge of Pressure, Temperature, flow, level, Density and viscosity measurements. To understand the construction and working of measuring instruments 			
Syllabus			
Temperature measurement- Pressure measurement- Measurement of viscosity- Flow measurement- Anemometers- Target flow meters- Level measurement			
Expected outcome			
<p>The students will be able to</p> <ol style="list-style-type: none"> grasp the working of different types of instruments for measurement of mechanical quantities choose appropriate instruments for measurement of mechanical quantities 			
Text Books			
<ol style="list-style-type: none"> Doebelin E.O, “<i>Measurement Systems: Application and Design</i>”, 4th Edition, McGraw Hill, New York, 2003. Patranabis D, “<i>Principles of Industrial Instrumentation</i>”, 2ndEdition, Tata McGraw Hill, New Delhi, 1997. Spitzer D. W., <i>Flow measurement</i>, ISA press, New York, 1998 			
Reference Books			
<ol style="list-style-type: none"> Andrew W.G, “<i>Applied Instrumentation in Process Industries – A survey</i>”, Vol I & Vol II, Gulf Publishing Company, Houston, 2001. Douglas M. Considine, “<i>Process / Industrial Instruments & Controls Handbook</i>”, 5th Edition, McGraw Hill, Singapore, 1999. Liptak B.G, “<i>Process Measurement and Analysis</i>”, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003. Noltingk B.E., “<i>Instrumentation Reference Book</i>”, 2ndEdition, Butterworth Heinemann, 1995. 			
Course Plan			
Module	Contents	Hours	Semester Exam Marks
I	Temperature measurement: Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. Thermistors, principle and sensor types, manufacturing techniques, measuring circuits, linearization methods and applications. Pneumatic and suction pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.	7	15%
II	Pressure measurement basics, mechanical type instruments, electromechanical type, low pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic	7	15%

	transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters.		
FIRST INTERNAL EXAMINATION			
III	Measurement of viscosity: definitions, units, Newtonian and Newtonian behaviour, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application. Measurement of density, definitions, units, liquid density measurement, gas densitometers, its application and selection.	7	15%
IV	Flow measurement: Introduction, definitions and units, classification of flow meters, pitot tubes, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters.	6	15%
SECOND INTERNAL EXAMINATION			
V	Anemometers: Hot wire/hot film anemometer, laser Doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine Coriolis, gyroscopic and heat transfer type mass flow meters. Target flow meters: V-cone flow meters purge flow regulators, flow switches, flow meter calibration concepts, flow meter selection and application.	8	20%
VI	Level measurement: introduction, float level devices, displacer level devices, rotating paddle switches, diaphragm and differential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave level switches, radar and vibrating type level sensors. Level sensor selection and application.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100

Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)