

COURSE CODE	COURSE TITLE	L	T	P	C
1152AE127	INSTRUMENTATION FOR THERMAL SYSTEMS	3	0	0	3

Course Category:

Programme Elective

a. Preamble :

This course explains the concepts of basic analysis of instruments and measurements techniques for pressure, temperature and viscosity. This course also deals with fundamentals for data acquisition systems.

b. Prerequisite Courses:

Linear system analysis

Aero thermodynamics

c. Related Courses:

- Wind tunnel techniques

d. Course Educational Objectives :

- To understand the concept of instruments and its calibration techniques.
 - To familiarize with force, pressure and temperature measurements and its manipulation.

e. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the general concepts of instrumentation.	K2
CO2	Describe the calibration techniques	K3
CO3	Explain the force and distance measurements	K3
CO4	Explain the Pressure and temperature measurements	K3
CO5	Explain the Viscosity measurements and data acquisition system	K3

f. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H				H	H			
CO2	H		H	H				H	H			
CO3	H		H	H				H	H			
CO4	H	H	H	H				H	H			
CO5	H	H	H	H				H	H			

H- High; M-Medium; L-Low

g. Course Content :

UNIT I- GENERAL CONCEPTS AND STATISTICAL ANALYSIS

9

General concepts: Types of applications of measurement instrumentation -Functional elements and modes of operation of an instrument – Standards – Accuracy – Precision – Resolution – Sensitivity – Errors - Limiting error. Statistical analysis: Average or mean value - deviation from

the mean value - average deviation standard deviation- variance- probability of error – histogram - probable error.

UNIT II- PERFORMANCE CHARACTERISTICS – STATIC AND DYNAMIC 9

Performance Characteristics – Static: Static calibration -Basic statistics - Least squares calibration - Estimation of errors and uncertainty-Specifying sensitivity, linearity, threshold, noise floor, resolution, hysteresis.- Stiffness and input impedance. Performance Characteristics – Dynamic: Generalized math model of measurement system - Transfer functions- Zero-order instrument -First-order instrument and responses to step, ramp, frequency and impulses- Second-order instrument and responses to step, ramp, frequency and impulses.

UNIT III- MOTION AND DIMENSIONAL MEASUREMENT 9

Fundamental standards -Introduction to relative displacement devices - Resistive potentiometers, Resistance strain gage - Differential transformers- Piezoelectric transducers - Electro-optical devices Seismic pickups for displacement, velocity, and acceleration.

UNIT IV- PRESSURE AND TEMPERATURE MEASUREMENTS 9

Pressure measurement: Diaphragm – capacity pressure sensor – Fibre optic pressure sensor – Resonant wire devices – Intelligent pressure transducers – selection of pressure sensors, Elastic pressure transducers **Temperature Measurement:** Thermoelectric effect sensors – resistance thermometer – thermistor – thermography (thermal imaging) – Quartz thermometer – Fibre optic temperature sensor Flow Measurement: Coriolis flow meter – variable area flow meters– intelligent flow meters – Schlieren – interferometer - Laser Doppler anemometer.

UNIT V- VISCOSITY MEASUREMENT AND DATA ACQUISITION 9

Viscosity measurement: Capillary and tube viscometer, rotational viscometer Manipulation of Data: Bridge circuits – Amplifiers - noise problems, shielding, and grounding –Filters - Analog-to-Digital and Digital-to-Analog converters - Signal and system analyzers, Recording of Data, Voltage-indicating and recording devices - Data acquisition and processing.

Total : 45 Hrs

Learning Resources

i. Text Books :

1. Doebelin. E. O, "Measurement Systems, Application and Design", Fifth edition, McGraw Hill, New York, 2004
2. Holman. J.P., "Experimental methods for Engineers", Seventh edition, McGraw Hill, 2000.
3. Norman A. Anderson, "Instrumentation for process measurement and control", Third edition, McGraw Hill, 2004.

ii. Reference:

1. Allan S. Morris, "Measurement and instrumentation principles", Butterworth - Heinemann publication, Oxford, 2001
2. Ramsay. D.C., "Principles of Engineering Instrumentation", Butterworth Heinemann publication, Oxford, 1996
3. James W. Dally, William F. Riley, Kenneth G. Mcconnel, "Instrumentation for Engineering
4. Measurement", Second Edition, Wiley publications, 1993.