Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2021-2022
Course Handout Part II

20-08-2021

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. : INSTR F312
Course Title : TRANSDUCERS AND MEASUREMENT SYSTEMS
Credits : 3
Instructor-in-charge : Sudha Radhika

COURSE DESCRIPTION:

This course deals with importance and types of transducers used in instrumentation and measurement. Different types of passive and active transducers. Generalized measurement system, functional elements, static & dynamic performance characteristics and error analysis. Measurement techniques for Velocity, Temperature, Pressure, Flow, Motion, Seismic, Level, Humidity, pH, Viscosity etc. Interfacing transducers with instrumentation systems.

SCOPE AND OBJECTIVE OF THE COURSE:

The objective of the course is to impart knowledge on the various types of sensors and transducers, their measurement techniques and applications instrumentation systems. The course also introduces basics of LabVIEW programming.

COURSE OUTCOMES

After learning the course, students will be able to

- Use the concepts in common methods for converting a physical parameter into an electrical quantity
- Select a suitable sensor/transducer for a given application/specification.
- Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers
- Design a real-life instrumentation system.

1. TEXT BOOK (T):

Title	Author	Edition	Publisher	Library #	ISBN
Introduction to Measurements and Instrumentation	Arun N Ghosh	4th 2012	PHI	620.0028 GHO-A (3rd Edition)	9788120346253

2. REFERENCE BOOKS:

Title	Author	Edition	Publisher	Library #	ISBN
R1: Transducers and Instrumentation	DVS Murthy	2nd 2013	PHI	530.7 MUR-D	9788120335691
R2: Instrumentation Measurement and Analysis	Nakra and Chaudhry	4th 2017	McGraw Hill		9789385880629
R3: A Course in Electronic Measurements and Instrumentation	A K Sawhney	2015	Dhanpat Rai & Co	621.37 SAW-A	9788177001006
R4: Theory and Design for Mechanical Measurements	RS Figliola	3rd 2005	John Wiley & Sons	530.8 FIG-R	9788126516391
R5: Doebelin's Measurement Systems	E O Doeblin	6th	Tata McGraw Hill	681.2 DOE-E	9780070699687

COURSE PLAN

Lecture #	Topics to be covered	Learning Objectives	Chapter in the Text Book
1-2	Introduction to Transducers and measurement system	Definition, classification of transducers and generalized measurement system	T1 (5.1- 5.3, 1.2)
3-6	Study of performance characteristics and error analysis.	Calibration, Precision, Accuracy, Threshold, Resolution, Hysteresis, Linearity, Sensitivity, Drift, Span, Range, Mean, Deviation, Normal distribution curve, Probable errors.	Class slides
7-10	Resistance type Transducers	Use of resistance type transducers for temperature, pressure, displacement, moisture and other measurements.	T1 (6.2, 10.3) R1 (6.1.1-6.1.6)
11-12	Inductive type Transducers	Different types of inductive type transducers and their use in thickness and displacement measurements.	T1 (6.2) R1 (6.2)
13-15	Capacitive type Transducers	Use of capacitive type transducers for displacement, thickness and moisture measurements.	T1 (6.2) R1 (6.3)
16-18	Thermoelectric and piezo electric transducers	Thermocouple for temperature measurement and Piezo electric transducers for mechanical measurements	T1 (10.4) R1 (7.1, 7.2), R2 (12.5.2, 4.5)
19-21	Magentostrictive and hall effect transducers	Use of Magentostrictive transducers for force and torque measurements and applications of hall effect transducers	T1 (6.5) R1 (7.3, 7.4)
22	Electro-mechanical transducers	Study of various types of Electro-mechanical transducers and their use.	T1 (9.5) R1 (7.5.1, 7.5.2)
23-25	Photoelectric transducers	Study of various types of Photoelectric transducers and their use.	R1 (7.6)
26-27	Digital transducers and Proximity sensors	Study of encoders and proximity sensors and their use.	T1 (6.6- 6.7) R1 (7.8)

			R2 (4.9)
28-29	Acceleration measurement	Study of absolute and relative displacement, velocity and acceleration.	R1 (6.1.3, 6.2.2, 6.3.2) R2 (7)
30-31	Force and torque measurement	Strain gauges, load cell, Torsion bar, Dynamometer and Inverse transducers	T1 (9) R1 (5.3, 5.4)
32-34	Pressure measurement	Fundamentals of pressure measurement and techniques of high and low pressure measurement. Elastic elements (Bourdon tube, Bellows, Diaphragm), Dead weight gauges, manometers, elastic elements. Bridgman, McLeod, Thermal conductivity, Ionization Gauge.	T1 (8) R1 (5.2)
35-36	Flow measurement	Obstruction meters, Rota meters, Pitot static tube meters, Turbine meters, electromagnetic flow meters, ultrasonic flow meters, vortex shedding, laser Doppler velocity meter. Hot wire anemometer, mass flow meter, positive displacement meter.	T1 (11) R1 (5.8)
37-38	Level measurement	Direct and indirect methods, ultrasonic, radar, microwave	T1 (12) R1 (5.6)
39-40	Viscosity, density, pH, humidity measurement	Hydrometer, air bubbler, weighing system, electrode element hygrometers, wet and dry psychrometers.	T1 (13.1, 13.2, 13.5, 13.7) R1 (5.5, 5.7, 6.1.6, 6.3.3, 7.9.4)
41-42	Interfacing transducers with instrumentation systems.	Discussing various methods with examples.	Class slides

3. **EVALUATIONSCHEME:**

Component	**Duration**	**Weightage**		**Date & Time**	**Nature of Component**
		%	**Marks**		
Midsem	1.5 hours	30	90	To be announced	OB
Comprehensive Exam	2 hours	40	120	13/12 FN	OB
Quiz (Announced/ surprise)	-	10	30	During Lecture / Tutorial	OB
Term paper/mini project	-	20	60	To be announced	OB
Total		**100**	**300**		

CB → Close book; OB → Open book

4. **CHAMBER CONSULTATION HOUR:** To be announced in class

5. **Makeup Policy:** Make-up will be given on **genuine** grounds only. Prior application should be made for seeking the make- up examination. No make-up will be given for the quiz.

6. **NOTICES & OTHER INFORMATION:** Please refer course CMS/Google Classroom page regularly.

7. **Academic Honesty and Integrity Policy**:
   Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Sudha Radhika
Instructor-in-charge- INSTR F312