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**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 **i**mportance 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):**

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

1. **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 |

1. **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*

1. **CHAMBER CONSULTATION HOUR:** To be announced in class
2. **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.
3. **NOTICES & OTHER INFORMATION:** Please refer course CMS/Google Classroom page regularly.
4. **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