FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **VI**

Course Code: **202050609**

Course Title: **Industrial Instrumentation**

Course Group: **Professional Elective Course -II**

Course Objectives: Sound knowledge about various techniques used for the measurement of industrial parameters is essential for the student of engineering. This subject provides the knowledge of measurement of Strain, Displacement, Force and Torque, Pressure, Flow, Level and Temperature, using various types of sensors and related circuits. Also, it gives the concept of Digital Data Acquisition Systems to students.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 /17	25 / 09	25 / 09	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Transducers:** Introduction to Instrumentation Systems, Static and Dynamic Characteristics of an Instrumentation Systems, Principles and Classification of Transducers, Electrical Transducers and Basic Requirements of Transducers.	05
2	**Strain Gauge and Strain Measurement:** Factors affecting Strain Measurements, Types of strain gauges, Theory of operation of Resistive Strain Gauge, Gauge factors, Types of Electrical Strain Gauges, Strain Gauge Materials, Gauging Techniques and other Factors, Strain Gauge Circuits and Temperature Compensation, Applications of Strain Gauges.	06

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3	**Displacement Measurement:** Resistive potentiometer (Linear, Circular and Helical), L.V.D.T., R.V.D.T. and their characteristics, Capacitance Transducers, Piezo-Electric Transducers-Output Equations and Equivalent Circuits, Hall Effect Devices and Applications of Displacement Sensors.	**07**
4	**Force and Torque Measurement:** Load Cells and Their Applications, Various Methods for Torque measurement.	**04**
5	**Pressure Measurement:** Mechanical Devices like Diaphragms, Bellows and Bourdon Tubes for Pressure Measurement, Variable Inductance, Capacitance, PiezoElectric, L.V.D.T. Transducers for Measurement of Pressure, Low Pressure and Vacuum Pressure Measurement using Pirani Gauge, McLeod Gauge, Ionization gauge etc.	**05**
6	**Flow Measurement:** Differential Pressure Meters like Orifice Plate, Venturi Tube, Flow Nozzle and Pitot Static Tube. Rotameter (Variable Area Meter), Turbine Flow Meter, Electro-Magnetic Flow Meter, Hot Wire Anemometer and Ultrasonic Flow Meters.	**07**
7	**Liquid Level Measurement:** Resistive, Inductive and Capacitive Techniques for Level Measurement, Ultrasonic and Radiation Methods.	**03**
8	**Temperature Measurement:** Resistance Type Temperature Sensors –RTD & Thermistors, Thermocouples & Thermopiles, Thermoelectric Laws–Fabrication of Industrial Thermocouples, Signal Conditioning of Thermocouples Output, Radiation Methods of Temperature Measurement, Radiation Fundamentals –Radiation and Optical Pyrometers.	**07**
9	**Digital Data Acquisition Systems & Control:** Introduction to Digital Data Acquisition Systems (PC Based Data Acquisition Systems) and its Components like Transducers, Signal Conditioners, Scanners, A/D and D/A Convertors, Multiplexing Systems, Recorders and Operation of Sample & Hold Circuits etc. and Data Loggers.	**04**

List of Practicals / Tutorials:

1	To Study the "Generalized Measurement Systems" and Transducers.
2	Measurement of Linear Displacement using Linear Variable Differential Transformer (LVDT).
3	Measurement of Force/Load using Cantilever Beam type Load Cell with Strain Gauges.
4	Speed Measurement (Digital) of DC Motor using Proximity Switch and Photoelectric Peak-up.
5	Measurement and ON-OFF Control of Temperature using Resistance Temperature Detector (RTD-PT_{100}).
6	Measurement and ON-OFF Control of Temperature using Thermistor (NTC TYPE).
7	Measurement and ON-OFF Control of Temperature using Thermocouple ('K' type).
8	Measurement of Angular Displacement using RVDT with its Output Characteristics.
9	To Calibrate the 'C' type Bourdon Tube Pressure Gauge using Dead Weight Tester (DWT).
10	Measurement and ON-OFF Control of Pressure using Pressure Transducer.
11	To Measure Liquid Level using Capacitive Transducer.
12	To Study the "Generalized Measurement Systems" and Transducers.

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Reference Books:

1	Industrial Instrumentation & Control by S. K. Singh. , MH Publication.
2	Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai & Sons Publications.
3	Measurement Systems –Application and Design by E.O. Doebelin, TMH Publication.
4	Principles of Industrial Instrumentation, D Patranabis, 3rd Edition, Mc Graw Hill.
5	Mechanical & Industrial Measurements by R. K. Jain, Khanna Publication.

Supplementary learning Material:	
1	http://www.electrical4u.com/
2	NPTEL video course on "Industrial Instrumentation" By Prof Alok Barua, IIT Kharagpur https://nptel.ac.in/courses/108/105/108105064/

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
30%	30%	20%	10%	10%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Select a Transducer based on its Operating Characteristics for the Required Application.	**20**
CO-2	Check Various Available Techniques and select Appropriate to Obtain Satisfactory Task for the Parameter to be Measured.	**30**
CO-3	Know Advantages and Limitations of Selected Techniques.	**20**
CO-4	Interpret the Measurement Results and Cause of any Possible Errors.	**15**
CO-5	Understand the Digital Data Acquisition Systems and its Components.	**15**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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