

Kadi Sarva Vishvavidyalaya, Gandhinagar
Bachelor of Engineering (Electrical Engineering Syllabus)

B.E Semester: VIth (EE)

Subject Name & Subject code: Industrial Instrumentation (EE-605)

Course Objective:

- To focus on the application of industrial instrumentation of various electrical parameters.
- To have an adequate knowledge about different industrial instrumentation.
- To study in detail, the constructional and operational aspects of various instruments used in industry.
- Practical aspects of the subject will make the students capable of static and dynamic characteristics of industrial instrumentation.

A. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Examination Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EE-605	Industrial Instrumentation	3	0	2	5	4	3	70	30	20	30	150

Introduction To Instrumentation:

Role of instruments in industrial processes. Block representation of measurement systems Need for calibration and standards Instrument parameters: Sensitivity, Accuracy, Resolution, Span, Range Static errors: Zero error, Proportionality error, hysteresis, maximum non-linearity error.

Level Measurement:

Factors influencing level measurement, Direct level measuring systems: the dip stick, the sight glass, floats Resistive, inductive and capacitive techniques for level measurement Ultrasonic and radiation methods.

Transducers:

Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers.

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Strain Gauge And Measurement Of Strain:

Theory of strain gauge Types of strain gauge Strain gauge circuits, Ballast circuits Wheastone Bridge, gauge sensitivity and temperature compensation Strain gauge calibration Load Cells Applications of strain gauges

Displacement Measurement:

Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders.

Forces and Torque Measurement:

Load cells and their applications, various methods for torque measurement. Use of torque wrenches

Flow Measurement:

Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter.

Pressure Measurement:

Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration.

Temperature Measurement:

Thermistors:-Construction, Characteristics, Applications and Salient features, Thermocouples:- Thermoelectric laws and construction, Bimetallic thermometers, Thermistors:-Construction, Characteristics, Applications and Salient features ,Humidity measurement and Moisture measurement techniques.

Instrumentation System Scheme of Process Industry

Lesson Planning:

SR No.	Lectures (Hours)	Weight age in % in Exam	Topic
1	02	30	Introduction To Instrumentation:Role of instruments in industrial processes. Block representation of measurement systems Need for calibration and standards Instrument parameters: Sensitivity, Accuracy, Resolution, Span, Range Static errors: Zero error, Proportionality error, hysteresis, maximum non-linearity error.

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2	05		Level Measurement: Factors influencing level measurement, Direct level measuring systems: the dip stick, the sight glass, floats Resistive, inductive and capacitive techniques for level measurement Ultrasonic and radiation methods.
3	04		Transducers:Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers.
4	06	25	Strain Gauge And Measurement Of Strain:Theory of strain gauge Types of strain gauge Strain gauge circuits, Ballast circuits Wheastone Bridge, gauge sensitivity and temperature compensation Strain gauge calibration Load Cells Applications of strain gauges
5	05		Displacement Measurement:Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders.
6	05	10	Forces and Torque Measurement: Load cells and their applications, various methods for torque measurement. Use of torque wrenches
7	06		Flow Measurement:Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube,Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter.
8	05	35	Pressure Measurement:Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration.
9	05		Temperature Measurement :Thermistors:-Construction, Characteristics, Applications and Salient features, Thermocouples:- Thermoelectric laws and construction, Bimetallic thermometers, Thermistors:-Construction, Characteristics, Applications and Salient features ,Humidity measurement and Moisture measurement techniques
10	02		Instrumentation System Scheme of Process Industry
	45	100	

Instructional Method And Pedagogy (Continuous Internal Assessment (CIA) Scheme):

- At the start of course, the course delivery pattern, prerequisite of the subject will be Discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.

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- Attendance is compulsory in lectures and laboratory, which carries five marks in overall evaluation.
- One internal exam will be conducted of 30 Marks as a part of internal theory evaluation.

- Assignments based on course content will be given to the students for each unit/topic and will be evaluated at regular interval. It carries a weightage of five marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorials will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.

Students Learning Outcome:

- Student Learning Outcomes: The students will be well aware with the construction, working principle, Operation and application of various industrial instrumentation like strain gauge, thermocouples, thermistors, transducers, tachometers, load cells, Radiation Pyrometers, Thermopile, Bolometer, accelerometers, recorders.

- After successful completion of this course, students will be able to carry the fundamental knowledge to understand a fact behind the industrial automation process.

Suggested List of Experiments:

1.	Measurement and control of temperature using RTD.
2.	Measurement and control of temperature using thermocouple.
3.	To perform and measurement the pressure by using the pressure transducer.
4.	To study the operation of synchro transmitter and receiver.
5.	To perform strain measurement using Strain gauge.
6.	To study and perform the Linear Variable Differential Transducer(LVDT)
7.	To study and perform analog and digital converter.
8.	To study and perform digital and analog converter.
9.	To study angular displacement by using electrical transducer.
10.	To study various types of liquid flow meters.
11.	Introduction Of Data Acquisition System.

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Suggested books:

Text Books:

1. A. K. Shawney, Electrical and Electronics Measurement and Instrumentation
2. Rangan, Sharma, Mani, Industrial Instrumentation
3. Patranabis, Transducers and Instrumentation

Reference Books:

1. Murthy, Transducers and Instrumentation
2. R. K. Jain, Mechanical & Industrial Measurements
3. S. K. Singh, Industrial Instrumentation & Control
4. E.O. Doebelin, Measurement Systems – Application and Design, Tata McGraw Hill publishing company, Revised edition. 17 –
5. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Ltd, Revised edition.
6. B.C. Nakra & K.K.Chaudary, Instrumentation Measurement & Analysis, Tata McGraw Hill Publishing Ltd, 2004.
7. S.K. Singh, Industrial Instrumentation and Control, Tata McGraw Hill, Revised edition.
9. W. Buchanan, Industrial Instrumentation and Control, Butterworth- Heinemann, Revised edition.
8. D.P. Eckman, Industrial Instrumentation, Wiley Eastern Ltd.