Marwadi University
Marwadi Chandarana Group

Syllabus for Diploma Engineering

Electrical Engineering

Semester – VI

Subject Name: Industrial Instrumentation and Condition Monitoring

Subject Code: 09EE2607

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: The aim of this course is to help the student to attain the industries identified competency through various teaching learning experiences, this course gives overview of the transduction, signal conditioning and signal presentation. **S**ound knowledge about various techniques used for the measurement of industrial parameters is essential for the student of engineering. Knowledge of measurement of velocity, displacement, viscosity, temperature using various types of sensors and related circuits use for condition monitoring and control. Thus, this course is very important for students who want to work in instrumentation and control industries or companies.

Credits Earned: 3 Credits

Course Outcomes: After completion of this course, student will be able

1. To select and use relevant instruments used for measuring electrical and non-electrical quantities.
2. To interpret the measurement results and cause of any possible error.
3. To check the signal conditioning and telemetry system for their proper functions.
4. To use data acquisition systems to enhance software and hardware interpretation.
5. To apply condition monitoring for diagnostic analysis of electrical equipment

Pre-requisite of course: Electrical Measurement & Instruments, Basic Electronics, Electrical Machines

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
2	0	2	3	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours	Weightage (%)
1	**Transducers** • Basic of instrumentation. • Transducer: block diagram, characteristics, advantages • Factors affecting the choice of transducers	**05**	**18**

	• Resistive transducer: potentiometer, variac, strain gauges. • Strain gauge: unbonded and bonded type • LVDT: construction and working principle • Piezo-electric transducer: construction and working principle • Applications of transducers		
2	**Measurement of Non-Electrical Quantities** • Temperature measurement - Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer, technical specifications and ranges. • Pressure measurement – Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit. • Speed Measurement: Construction and Working of contacting and non-Contact Type- DC tachometer, photo- electric tachometer, toothed rotor tachometer Generator - magnetic pickup and Stroboscope. • Vibration measurement: Construction and Working of accelerometer and LVDT accelerometer, • Flow measurement: Construction and Working of electromagnetic and Turbine Flow meter. • Liquid level measurement: Construction and Working of resistive, inductive, capacitive gamma rays and ultrasonic methods.	**07**	**25**
3	**Signal Conditioning** • Basic Concept of signal conditioning System. • Characteristics of ideal OP-AMP. • Draw pin configuration of Op-Amp IC 741. • Op-amp parameter: Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain, and bandwidth. • Use of op-amp as inverting, non- inverting mode, adder, subtractor and working of differential amplifier and instrumentation amplifier. • Application of op-amp as integrator, differentiator, Schmitt trigger • Filters: Types of RC filters and frequency response. • Sample and hold circuits: operation and its application.	**06**	**21**
4	**Data Acquisition System** • Generalized DAS: Block diagram and of transducer, signal conditioner, multiplexer, • Converter and recorder • Single channel and multi-channel DAS- block diagram only.	**06**	**21**

	• Difference between single channel and multi-channel DAS. • Data conversion- construction and working of analog to digital conversion- successive approximation method, ramp type method. • Digital to analog conversion: construction and working of binary weighted resistance method. • Data transmission: concept and methods of electrical and electronic transmission. • Electrical telemetering system: construction and principle of telemetry system and its type • Lab view-Introduction		
5	**Condition Monitoring and Diagnostic Analysis** • Condition monitoring-Definitions • Insulation deterioration Mechanism: factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration • Different tests on transformer, their purpose, and the necessary condition of machine. • Tests on Circuit breaker, purpose and required condition of machine • Tests on CT, purpose, item to be tested and required condition of machine. • Insulation and Polarization index, DC winding resistance test, Turns Ratio test • Tools and equipment used in Condition monitoring • Predictive maintenance system for monitoring vibration on rotating machine.	**04**	**15**

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
35%	35%	15%	15%	0%	0%

Suggested List of Experiments:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	Identify different switches used in instrumentation system.	4
2	1	Measure linear displacement by L.V.D.T.	2
3	1	Measure the strain with the help of strain gauge	2
4	2	Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.	2
5	2	Use Thermocouple to control the temperature of a furnace/machine.	2
6	2	Measure pressure using Burdon tube.	2
7	2	Measure angular speed using synchros and tachometer.	2
8	2	Measure the flow using anemometer.	2
9	3	Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.	4
10	4	Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.	2
11	5	Visit to testing center of electrical testing lab for tan delta and diagnostic tests and determine polarization index	2
12	5	Prepare a Report on various tools and equipment used for condition monitoring of electrical machines.	2

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses.

References:

1. Sawhney, A.K., *"Electric and Electronic Measurement and instrumentation",* Dhanpat Rai, Nineteenth revised edition 2011.
2. Rangan, C.S. G.R.Sharma. and V.S.V.Mani, *"Instrumentation devices and system",* Pen ram International Publishing India Pvt. Ltd. Fifth edition,1997
3. Mehta, V.K. "*Electronics and instrumentation*", S. Chand and company Pvt Ltd Third edition-Reprint- 2010.
4. Singh, S.K. "*Industrial instrumentation and control*", Tata McGraw-Hill, 1987.
5. J.G. Joshi, "*Electronic Measurement and Instrumentation*", Khanna Publishing House, New Delhi
6. R. K. Jain, "*Mechanical & Industrial Measurements*", Khanna publishers, 1995.

Supplementary Resources:

1. https://nptel.ac.in/course.php
2. https://electronicsforu.com/?s=Instrument
3. https://www.youtube.com/watch?v=60wVaFQ4igc
4. https://www.technicaltrainingsolutions.co.uk/courses/instrumentation-training-course.htmlhttp://nptel.ac.in/courses/108105064/
5. https://nptel.ac.in/courses/108/105/108105153/
6. https://nptel.ac.in/courses/112/105/112105048/
7. https://nptel.ac.in/courses/108/105/108105133/