DIGITAL INSTRUMENTATION
(Professional Elective- V)

Course Code: 19EE1165

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Prerequisites: Electrical Measurements, Digital Electronics

Course Outcomes: At the end of the course, the student will be able to

CO1: Understand various types of Analog and Digital instruments.

CO2: Understand data acquisition and conversion systems.

CO3: Understand various digital measurement techniques used in industrial process.

CO4: Learn the principle of operation of various electrical / electronic instruments.

CO5: Develop basic skills in the design of electronic equipment.

UNIT-I 10 Lectures

ANALOG & DIGITAL INSTRUMENTS

Introduction, Electrical indicating instruments, Advantages of Digital instruments, Digital versus Analog Instruments, Cathode Ray Oscilloscope –Operation, observation of waveform on CRO, measurement of voltages and currents, Analog storage oscilloscope –principle of operation, Sampling oscilloscope-operation, Digital Storage Oscilloscope – operation, signal & function generation.

Learning Outcome:

1. Differentiate between Analog and Digital instruments (L2)
2. Understand the operation of Cathode Ray Oscilloscope and Digital Storage Oscilloscope (L2)
3. Understand the principle of operation of Analog Storage oscilloscope. (L2)

UNIT-II 10 Lectures

DATA ACQUISITION AND CONVERSION

Introduction, Objective of Data acquisition and Conversion, Signal Conditioning of the Inputs, Single Channel Data Acquisition Systems, Multi Channel Data Acquisition Systems, Data Conversion, Digital to Analog Converter(DAC), Analog to Digital Converter(ADC), Data Loggers, Digital Transducer.

Learning Outcome:

1. Understand the operation of Data acquisition and conversion in processing data from various sources (L2)
2. Apply the concept of data conversion from digital to analog and vice-versa (L3)
3. Understand the concepts of data loggers and Digital transducers(L2)

UNIT-III 10 Lectures

DIGITAL METHODS OF MEASUREMENTS

Voltage to time and Voltage to Frequency conversion techniques, Digital Multimeters -Analog to digital conversion in practical multimeters, four wire technique for low resistance measurement in multimeter, Digital Frequency meter, time period measurements, Universal Counter, Digital tachometers, Resolution and Sensitivity of Digital Meters,

Learning Outcome:

1. Apply basic conversion techniques used in digital instruments (L3)
2. Demonstrate the operation of Digital Multimeters (L2)
3. Explain the operation of various Digital instruments and its applications (L2)

UNIT-IV 10 Lectures

DIGITAL DISPLAY AND RECORDING DEVICES

Digital Printers/Plotters, Bar graph display, Seven segment and dot matrix display , Signal recorders, XY recorders, Digital magnetic tape recorders, Methods of recording-Direct, Frequency Modulated, Pulse Duration Modulation Recordings.

Learning Outcome:

1. Explain the operation of digital printers (L2)
2. Compare different types of display patterns in digital devices (L2)
3. Utilize different methods of data recorders in digital instruments (L3)

UNIT-V 10 Lectures

SIGNAL CONDITIONING

Instrumentation Amplifiers, AC Amplifiers, Direct Coupled Amplifiers, Chopped and Modulated D.C. Amplifiers, Operational Amplifiers, Inverter, Integrator, Differentiator, Buffer Amplifier, Differential Amplifier, Amplitude Modulation and Demodulation circuits for measurement, Filters, Types of Filters.

Learning Outcome:

1. Choose different types of Amplifiers used in instrumentation (L3)
2. Explain different modulation circuits for measurement (L2)
3. Differentiate between low pass, high pass and band pass filters (L2)

TEXT BOOK:

1. A.K. Sawhney, Dhanpat Rai & Sons, "*A course in Electrical and Electronic Measurements and Instrumentation"*, 4thEdition, 2012.

REFERENCES:

1. Ernest O. Doebelin, "*Measurement System, Application & Design"*, 7th Edition, McGraw-Hill Education, 2019.
2. H.S. Kalsi, "*Electronic Instrumentation"*, Tata McGraw-Hill Education, 3rd Edition, 2012.
3. Nihal Kularatna, *"Digital and Analogue Instrumentation-testing and measurement"*, IET Publication, First published 2003, Reprint 1st Edition2008.
4. C.S. Rangan, G R Sarma, V S V Mani, "*Instrumentation Devices and Systems"*, 2nd Edition, Tata McGraw Hill, 2001.
5. Albert D. Helfrick, William D. Cooper, *"Modern Electronic instrumentation and measurement techniques"*, Prentice Hall India Learning Pvt. Ltd, First published 1989, Reprint 1st Edition2016.

6. A.J. Bouwens, "*Digital Instrumentation"*, McGraw Hill Education, First published 1984, Reprint 1st Edition2004.