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| **ECX510** | **Electronic Instrumentation** | **L-T-P: 3-0-0; Total 42 Lectures** |

**COURSE OBJECTIVES (COs)**

The objectives of this course are

* To introduce the working principle of electronic measurement of basic circuit parameters like voltage, current, resistance, power and frequency.
* To provide knowledge on working principle and application of various types of oscilloscopes and signal analyzers.
* To introduce different types of waveform generators and analyzers and their applications.
* To educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
* To give exposure to telemetry, industry automation and Internet of Things (IoT).

**UNIT-I INTRODUCTION TO INSTRUMENTATION [4]**

Specifications of instruments and their static and dynamic characteristics. Measurement error: gross error, systematic error, absolute error, and relative error. Uncertainty analysis and statistical analysis of measured data. Signal measurement in the presence of noise.

**UNIT-II BUILDING BLOCKS OF ELECTRONIC INSTRUMENTS: [7]**

Instrumentation amplifiers; Noise in Electronic systems; Design of low noise circuits, Sampling and quantization: sample & hold circuits, antialiasing filters; Multiplexers and de-multiplexers, Data converters: A/D, D/A converter, voltage-to-frequency and frequency-to-voltage converter. Programmable instruments and digital interfacing: serial, parallel. GPIB.

**UNIT-II BASIC ELECTRONIC INSTRUMENTS [7]**

Electronic Voltmeter and their advantages – Types, Differential amplifiers, source follower, rectifier – True rms reading voltmeter – Electronic multimeter and ohmmeter – Current measurement – Power measurement - Microprocessor based DMM with auto ranging and self-diagnostic features. Digital frequency meter.

**UNIT-III CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS [7]**

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

**UNIT-IV WAVEFORM GENERATORS [7]**

Wien’s bridge and phase shift oscillators – Hartley and crystal oscillators – Square wave and pulse generators – Triangular wave-shape generator - Signal and function generators – Q meter – Electronic Counters.

**UNIT-V VIRTUAL INSTRUMENTATION [6]**

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture of virtual instruments – Virtual instruments versus traditional instruments – Software in virtual instrumentation - VI programming techniques – DAQ cards for VI applications – DAQ modules with serial communication.

**UNIT-VI TELEMETRY AND IOT [4]**

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing. Introduction to industry automation and internet of things (IoT).

**COURSE OUTCOMES (COs)**

After successful completion of this course, students will be able to

* Understand and analyze instrumentation systems and their applications to various industries.
* Use different measuring instruments

**TEXT BOOKS:**

1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, 2010.

2. David A Bell, “Electronic Instrumentation and Measurements”, Ox for University Press, 2013.

3. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi, 2010.

**REFERENCES:**

1. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.

2. J. J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.

3. M .M. S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009. 4. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.