INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION								
VII Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD49	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electronic Devices and circuits, Electrical circuits								

I. COURSE OVERVIEW:
The purpose of this course is to design, realization and use of Electronic Systems for the measurement of electrical and non-electrical quantities. It gives an emphasis on analog and digital instruments, oscilloscopes, signal generators, signal analyzers, AC / DC bridges and transducers. The knowledge of measurements and instrumentation is used to test and analyze the performance of measuring instruments in the field of science, engineering and technology.

II. COURSES OBJECTIVES:
The students will try to learn

I. The performance characteristics and working principle of analog and digital instruments for measuring electrical quantities.
II. The analysis of different signals by using oscilloscopes and signal analyzers which are generated by built in signal generators.
III. The measurement of unknown resistive and reactive components by using AC and DC bridge circuits.
IV. The construction and working of transducers for the conversion of physical quantities into electrical quantities.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1 Illustrate the fundamentals and working principle of analog and digital instruments for measuring of electrical parameters.
CO 2 Demonstrate the building blocks and functionality of oscilloscopes to display and measure the parameters of the signals
CO 3 Utilize the signal generators to produce various signals for design and test the signal processing applications.
CO 4 Analyze the relative amplitude of the signal and its harmonic components in frequency domain by using Signal Analyzers.
CO 5 Identify appropriate bridge circuits for the measurement of unknown electrical parameters.
CO 6 Select the suitable transducers for measuring electrical and non-electrical parameters to resolve the real-world problem.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO MEASURING INSTRUMENTS (09)

Block schematics of measuring systems, performance characteristics, Static characteristics, Dynamic characteristics, Analog measuring instruments: D' Arsonval movement, DC voltmeters and ammeter, AC voltmeters and current meters, ohmmeters, multimeters, Oscilloscopes: CRT, block schematic of CRO, function generators, sweep frequency generators, video signal generators, and specifications.

MODULE-II: TRANSDUCERS (09)

Transducers: Classification, Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor. Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details. Characteristics of Capacitive transducers – different types & signal conditioning – Applications: - capacitor microphone, capacitive pressure sensor, proximity sensor, Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors -Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors - Environmental Monitoring sensors (Water Quality & Air pollution).

MODULE-III: TEMPERATURE & PRESSURE MEASUREMENT (10)

Definitions and standards, Different types of filled in system thermometers, Bimetallic thermometers , Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Special techniques for measuring high temperature using thermocouple, Radiation methods of temperature measurement , Total radiation pyrometers, Optical pyrometers.

Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection, Installation and Calibration, Manometers: Different types, Bourdon tube, Bellows, Diaphragms and Capsules, Pressure gauge selection, installation and calibration using dead weight tester.

MODULE-IV: SENSORS (10)

Introduction to IoT Sensors- Temperature sensors, Proximity sensor, Pressure sensor, Water quality sensor, Chemical sensor, Gas sensor, Smoke sensor, IR sensors, Level sensors, Image sensors, motion sensor, Humidity sensor, Ultrasonic Sensor, MQ2 Sensor, Digital switch, Electro Mechanical switches.

MODULE-V: BRIDGES (10)

Measurements using DC and AC bridges: Wheat stone bridge, Kelvin bridge, AC bridges, Maxwell, Hay, Schering, Wien, Anderson bridges, Wagner & ground connection.

V. TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2019.
2. Patranabis D, "Sensors & Transducers", 2nd Edition, PHI, New Delhi, 2011.
3. H.S.Kalsi, "Electronic Instrumentation", TMH, 2nd Edition,2004.

VI. REFERENCE BOOKS:

1. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 1st Edition, 2007
2. A. D. Helbincs, W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 56th Edition, 2003.

VII. ELECTRONICS RESOURCES:

1. NPTEL :: NOC : Electronic Measurements and instrumentation
2. https://www.youtube.com/playlist?list=PLbRMhDVUMnge4gDT0vBWjCb3Lz0HnYKkX

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations