



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Applied Instrumentation

Subject Code : ME02067101

Subject Name : Intelligent Sensors and Instrumentation

WEF Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite :	Op-amps
Rationale :	The course introduces fundamentals of sensors and provides essential knowledge about design of signal conditioning circuits for the purpose of interfacing with embedded hardware.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understanding Op-amp for sensor interface	UN
02	Apply knowledge of signal conditioning circuit for sensor interface to digital computer.	AP
03	Design intelligent sensors as per IEEE standard.	CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150



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Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Sensors Fundamental Sensor classification, Thermal sensors, Humidity sensors, Capacitive sensors, Planar inter digital sensors, Planar electromagnetic sensors, Light sensing technology, Moisture sensing technology, Carbon dioxide (CO ₂) sensing technology, Sensors parameters, Selection of sensors.	5	12
2	Operational Amplifier Fundamentals Amplifier fundamentals, Basic opamp configurations, Ideal op-amp circuit analysis, Negative feedback, Feedback in op amp circuits, Loop gain, Op-amp powering.	6	13
3	Circuits with Resistive Feedback I/V and V/I converters, Current amplifiers, Difference amplifiers, Triple and dual Op-amp Instrumentation amplifiers, Instrumentation applications, Transducer bridge amplifiers.	8	18
4	Active Filters Transfer function, First order active filters, Standard second order responses, KRC filters, Multiple feedback filters, Sensitivity, Filter approximations, Cascade design, Direct design, Switched capacitor, Switched capacitor filter.	8	18
5	Static Op-Amp Limitations Simplified op-amp circuit diagram, Input bias and offset currents, Low input bias Current op-amp, Input offset voltage, Low input offset voltage op-amps, Input offset error compensation.	8	18
6	Dynamic Op-Amp Limitations Open loop response, Closed loop response, Transient response: rise Time, slew rate limiting, full-power bandwidth, settling time, Passive and active compensation of integrators.	6	13
7	Wireless sensors and sensors network Introduction, Frequency of wireless communication, Development of wireless sensor network based project, Wireless sensor network based on only Zigbee.	2	4
8	Standards for Smart Sensing Introduction, Setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE P1451.4, Extending the system to the network	2	4
Total		45	100



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Reference Book:

1. Smart Sensors, Measurement and Instrumentation by Subhas Chandra Mukhopadhyay, Springer publication
2. Operational Amplifiers and Analog Integrated Circuits by Franco S. McGraw Hill International Edition, 1988
3. Understanding Smart Sensors by Randy Frank, Artech House sensors library.
4. Analog Circuit Design by John Marcus, PH
5. Data Acquisition and Signal Processing for Smart Sensors by Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadi m Deynega, John Wiley & Sons Ltd.

Suggested Course Practical List:

Student has to simulate/synthesis signal processing circuits based on designed syllabus.

1. WSN Based Physiological Parameters Monitoring System (Measurement of Human Body Temperature)
2. Intelligent Sensing System for Emotion Recognition
3. WSN Based Smart Power Monitoring System

List of Laboratory/Learning Resources Required:

NPTEL, Multisim, PSpice, Orcade

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