GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720317

INTELLIGENT SENSOR AND INSTRUMENTATION

SEMESTER: II

Type of course: Major Elective IV

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.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Topics	Teaching Hrs.
1	**Sensors Fundamental** Sensor classification, Thermal sensors, Humidity sensors, Capacitive sensors, Planar interdigital sensors, Planar electromagnetic sensors, Light sensing technology, Moisture sensing technology, Carbon dioxide (CO_2) sensing technology, Sensors parameters, Selection of sensors.	4
2	**Operational Amplifier Fundamentals** Amplifier fundamentals, Basic op amp configurations, Ideal op-amp circuit analysis, Negative feedback, Feedback in op amp circuits, Loop gain, Op amp powering.	6
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
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
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
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
7	**Wireless sensors and sensors network** Introduction, Frequency of wireless communication, Development of	2

	wireless sensor network based project, Wireless sensor network based on only Zigbee.	
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

Note: This module weightage shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table

Reference Books:

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, Vadim Deynega, John Wiley & Sons Ltd

Course Outcome:

After learning this course the students should be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understanding Op amp for sensor interface	40
CO-2	Apply knowledge of signal conditioning circuit for sensor interface to digital computer.	30
CO-3	Design intelligent sensors as per IEEE standard.	30

Experiments:

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 open source software/learning website: NPTEL, Multisim, PSpice, Orcade