

GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION AND CONTROL (APPLIED INSTRUMENTATION) (03) INTELLIGENT SENSOR AND INSTRUMENTATION SUBJECT CODE: 2720312 SEMESTER: II

Type of course: types of sensors and its signal conditioning

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 C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
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	0-15%
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	0-15%
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	10-25%
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	15-20%
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	15-20%
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	15-20%
7	Wireless sensors and sensors network Introduction, Frequency of wireless communication, Development of	2	0-10%

	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	0-10%

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 ...

- select op amp for the sensor interface.
- design signal conditioning circuit for sensor interface to digital computer.
- design intelligent sensors as per IEEE standard.
- interface wireless sensors with computer network.

Experiments:

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

Open Ended Problem: Solutions of the open ended problem(s) and mini project on signal conditioning/interfacing of sensors in guidance of the course instructor is mandatory. Few problems are specified as under.

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

Review Presentation(RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.