GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ELECTRICAL & ELECTRONICAL ENGINEERING
SUBJECT NAME: Sensor Networks & Instrumentation
SUBJECT CODE: 2170808
B.E. 7th SEMESTER

Type of course: Electrical Engineering

Prerequisite: Fundamental of Electrical Measurement, Analog Electronics, 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. The course will be useful to gain knowledge of the latest developments in measurement theory and practice, and also helps to learn typical characteristics and capabilities of the range of sensors and instruments that are currently in use.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weight
1	**Sensors Fundamental:** Sensor classification, Thermal sensors, Humidity sensors, Capacitive sensors, Electromagnetic sensors, Light sensing technology, Moisture sensing technology, Carbon dioxide (CO2) sensing technology, Sensors parameters, Selection of sensors.	6	15-20%
2	**Interfacing of Sensors and Signal Conditioning:** Change of bios and level of signals, Loading effects on Sensor's output, Potential divider, Low-Pass RC filter, High-Pass RC filter, practical issues of designing passive filters.	6	15-20%
3	**Op-amp based Instrumentation:** Op-Amp Fundamentals, Basic op-amp configurations, Ideal op-amp circuit analysis, Negative feedback, Feedback in op amp circuits, Loop gain, Op amp powering.	6	15-20%
4	**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.	4	10-15%
5	**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.	4	10-15%
6	**Wireless sensors and sensors network:** Introduction, Frequency of wireless communication, Development of wireless sensor network based project, Wireless sensor network based on only Zigbee.	6	15-20%

7	**Smart Transducers:** Smart Sensors, Components of Smart Sensors, General Architecture of Smart Sensors, Evolution of Smart Sensors, Advantages, Application area of Smart Sensors,	**6**	15-20%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**25**	**15**	**10**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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

Reference Books:

1. Smart Sensors, Measurement and Instrumentation by Subhas Chandra Mukhopadhyay, Springer publication
2. Measurement and Instrumentation: Theory and ApplicationcBy Alan S Morris, Reza Langari, Academic Press, Elsevier, 2015
3. Operational Amplifiers and Analog Integrated Circuits by Franco S. McGraw Hill International Edition, 1988
4. Understanding Smart Sensors by Randy Frank, Artech House sensors library.
5. Analog Circuit Design by John Marcus, PH
6. 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 the 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.

List of Experiments:

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

Design based Problems (DP)/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

Major Equipment: Data acquisition hardware to interface between the computer and the sensor signal. National Instruments (NI) promoted Academic Laboratory setup or such DAQ facility should be available to facilitate practical knowledge.

List of Open Source Software/learning website: NPTEL, Multisim, PSpice, Orcade, LabVIEW (NI),

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.