GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Internet of Things

Subject Code : ME02062081

Subject Name : Smart Sensors and Systems

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	IoT Architecture, Sensors & Actuators for IoT
Rationale:	This course is designed with aim to study various parts for design and develops of smart sensors and systems. The students will have an exposure to smart sensors and its importance in the real world applications through internet of things. The student will also able to understand how to fabricate some of various sensors. The students will provide knowledge of various sensing techniques, micromachining techniques, semiconductor integration, output characteristics and analysis, integration with MCUs/DSPs and control techniques required for development of smart sensors and systems. After this course, the students is able to design and developments of various smart sensors and systems for real-world IoT applications in various emerging sectors.

Course Outcome:

After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understanding of micromachining, integration techniques for smart sensors	UN
02	Apply semiconductor outputs, sensing technologies for smart sensors	AP
03	Apply integration of sensing techniques using MCUs/DSPs for practical smart sensors and systems	AN
04	Analysis of various communication protocols for real-time smart sensors and systems	AN
05	Evaluate various control techniques for smart sensors and systems	EL

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

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Teaching and Examination Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	00	02	04	70	30	30	20	150

Course Content:

Sr No	Course Content	No of Hours	% of Weightage
1	**Unit 1: Smart Sensor Basics & Micromachining :** Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, integration of micromachining and microelectronics, application examples, Micromachining - Introduction, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques, combining MEMS with IC fabrication, other micro machined materials, MEMS foundry services and software tools, application examples	8	15
2	**Unit 2: The Nature of Semiconductor Sensor Output:** Introduction, sensor output characteristics, other sensing technologies, digital output sensors, noise/interference aspects, low-power low-voltage sensors, analysis of sensitivity improvement, application example	8	20
3	**Unit 3: Getting Sensor Information into the Microcontroller:** Introduction, amplification and signal conditioning, separate Vs integrated signal conditioning, digital converters, on-line tool for evaluating a sensor interface design, application examples	6	15
4	**Unit 4: Using MCUs/DSPs to Increase Sensor IQ:** Introduction, MCU control, MCUs for sensor interface, DSP control, techniques and systems considerations, software, tools and support, sensor integration, application example.	7	15
5	**Unit 5: Communications for Smart Sensors:** Introduction, background and definitions, sources and standards, automotive	9	20

	protocols, industrial networks, protocols in other applications, protocols in Silicon, transitioning between protocols, application example.		
6	**Unit 6: Control Techniques:** Introduction, state machines, fuzzy logic, neural networks, combined fuzzy logic and neural networks, adaptive control, other control areas, impact of artificial intelligence, application protocols.	7	15
	TOTAL	**45**	**100**

Reference Book:

- Randy Frank, Understanding Smart Sensors, Third Edition, Artech House,2013
- Stoyan Nihtianov, Antonio Luque, Smart Sensors and MEMS, WOODHEAD Publishing Series, 2014
- Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu, Youn-Long Lin, Smart Sensors and Systems – Innovations for Medical, Environmental, and IoT Applications, Springer, 2017.

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic session.

List of Laboratory/Learning Resources Required:

- List of Hardware: NIL
- List of Useful websites/MOOCs:
  https://nptel.ac.in/courses/112104251
  https://nptel.ac.in/courses/108108147

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