GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Internet of Things

Course / Subject Code : ME01062061

Course / Subject Name: Sensor, Actuator for IoT

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC– II

Prerequisite:	Basic knowledge of signalling and electrical and electronics devices
Rationale:	To provide in-depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed, to explore fundamental knowledge on the basic laws and phenomena on the operations of the sensor, and to understand the principle of theory, measurement of optical sensing devices, mechanical sensing devices.

Course 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- I: Sensor fundamentals and characteristics:** Sensor Classification, Performance and Types, Error Analysis characteristics.	04	10
2	**UNIT-II: Optical Sources and Detectors:** Electronic and Optical properties of semiconductors as sensors, LED,	08	15

	Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photomultipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.		
3	**UNIT-III: Intensity Polarization and Interferometric Sensors:** Intensity sensor, Micro bending concept, Interferometers, Mach Zehnder, Michelson, Fabry-Perot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers.	08	15
4	**UNIT-IV: Strain, Force, Torque and Pressure Sensors:** Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors	06	15
5	**UNIT-V: Humidity, Moisture Chemical and Biological Sensors:** Concept of humidity, Capacitive Humidity Sensors, Resistive Humidity Sensors, Thermal Conductivity Sensors, Optical Hygrometers, Oscillating Hygrometer, Soil Moisture, Chemical Sensor Characteristics, Electrical and Electrochemical Sensors, Photoionization Detectors, Physical Transducers, Spectrometers	06	15
6	**UNIT-VI: Velocity and Acceleration sensors:** Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.	05	15
7	**UNIT-VII: Current Trends in sensors and Technology:** Smart Sensors: Introduction, Primary sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, **The Automation Sensor Technologies:** Introduction, Film Sensors, Thick Film Sensors, Thin Film Sensors, Semiconductor IC Technology— Standard Methods, Micro electromechanical Systems (MEMS). Nano-sensors Sensor Applications: Onboard Automobile sensors,	05	15

	Home appliances sensors, Aerospace Sensors		

Reference Book:

1. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs and Applications", 2015, 3rd Edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st Edition, Elsevier, Netherland.
3. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd Edition, CRC Press, Florida.
4. Eric Udd and W.B. Spillman, "Fibre-optic sensors: An introduction for engineers and scientists", 2013, 2nd Edition, Wiley, New Jersey.

Course Outcome:

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

No	Course Outcomes	RBT Level*
01	Understand concepts of converting a physical parameter into an electrical quantity through various principles.	UN
02	Apply various principles to choose an appropriate sensor for specific requirements	AP
03	Analysis performance characteristics of different types of sensors	AP
04	Analyse of various analytical design and development solutions for sensors and actuators	AN
05	Analyse of performance of various advance semiconductor	AN

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

Suggested Course Practical List:

At least 10-12 practicals based on topics of the syllabus have to perform either in tools or in hardware kits.

List of Laboratory/Learning Resouces Required:

- List of Hardware: SCIENTECH IoT Builder, SCIENTECH Sensor Kits, Various Sensors
- List of Software: Python Programming, Assembly Programming

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