SENSOR TECHNOLOGIES AND MEMS

III Semester: **ECE(ES)**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESC28	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:45**		

I. COURSE OVERVIEW:

This course introduces the fundamental characteristics of the advanced sensor systems,the operating principles of transducers and development of MEMS Technology. It focuses on the mechanical and electromechanical Sensors, fabrication processes of MEMS and the recent advances in sensor technologies. The application aspects of sensors used in several fields such as automobiles, manufacturing, medical, environment and also designed to serve the needs of the engineering disciplines such as instrumentation, chemical, mechanical, and electrical.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The operating principles, parameters and characteristics of electromechanical sensors and transducers.
II. The different types of techniques for design and develop sensors and their applications.
III. To analyze materials used for fabrication processes of MEMS technology and acquire knowledge on polymer and optical MEMS

III. COURSEOUTCOMES:

After successful completion of the course, students should be able to:

CO1	**Classify** the electromechanical sensors for the conversion of physical to non-physical quantity.	Understand
CO2	**Illustrate** the characteristics of sensors to perform a required measurement.	Understand
CO3	**Demonstrate** the working principles of electro analytical sensors for the automatic sensor applications.	Understand
CO4	**List** the different types of smart sensors for the performance of analog and digital communication systems.	Apply
CO5	**Examine** the appropriate automotive sensors for the measurement of electro mechanical parameters to solve real time world problems.	Apply
CO6	**Select** an appropriate sensor to monitor the environmental conditions.	Understand

IV. SYLLABUS:

MODULE – I: Sensors / Transducers:

Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor. Types- Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors

MODULE – II: Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors / Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. Electro Analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes – Sensor Electrodes – Electro ceramics in Gas Media .

MODULE – III: Smart Sensors:
Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors

Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

MODULE – IV: Introduction to MEMS :
Introduction, Development of MEMS Technology, Present, Future and Challenges, Fabrication Processes: Fundamentals of Material Science, Substrates: Single crystal substrates, Silicon on Insulator Substrate, Physical vapour deposition, Chemical vapour Deposition, Etching Processes, patterning, wafer bonding, annealing, chemical mechanical polishing, material doping, MEMS application in life sciences

MODULE – V:Polymer and Optical MEMS :
Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses

V. TEXT BOOKS:

1. D. Patranabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, Pearson Education Limited

VI. REFERENCE BOOKS:

1. Patranabis, “Sensors and Actuators”, 2nd Edition, PHI, 2013
2. Allen James J, Micro Electromechanical System Design, First edition, Taylor and Farancis, FL (USA), 2005.
3. Maluf Nadim and Williams Kirt, An Introduction to Micro electromechanical Systems Engineering, ARTECH House, MA (USA), 2nd Edition, 2004.
4. N. Maluf, “An Introduction to Micro-electro Mechanical System Engineering", Artech. House.

VII. WEB REFERENCES:

1. https://www.youtube.com/watch?v=sCTgZv33tuA
2. https://www.youtube.com/watch?v=oRydUfgMdgA
3. https://www.youtube.com/watch?v=1uPTyjxZzyo\
4. https://www.yokogawa.com/special/sensing-technology/definition/
5. http://www.http//mail.vdivde-it.de/ut/EMSTO
6. https://nptel.ac.in/courses/117105082/

VIII. E-TEXTBOOKS:

1. http://bookboon.com/en/communication-ebooks-zip
2. https://bookauthority.org/books/new-electronic-sensors-books
3. https://www.elsevier.com/books/sensor-technology-handbook/wilson