INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

SENSOR TECHNOLOGIES AND MEMS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESE28	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Sensors and Actuators.								

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. COURSES 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 The materials used for fabrication processes of MEMS technology and acquire knowledge on polymer and optical MEMS.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Classify the electromechanical sensors for the conversion of physical to nonphysical quantity

CO2 Illustrate the characteristics of sensors to perform a required measurement.

CO3 Demonstrate the working principles of electro analytical sensors for the automatic sensor applications.

CO4 List the different types of smart sensors for the performance of analog and digital communication systems.

CO5 Examine the appropriate automotive sensors for the measurement of electro mechanical parameters to solvereal time world problems.

CO6 Select an appropriate sensor to monitor the environmental conditions.

IV. COURSE CONTENT:

MODULE - I: SENSORS / TRANSDUCERS (9)

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 (9)

Introduction, basic characteristics, types of photoresistors / 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 (9)

Introduction, primary sensors, excitation, amplification, filters, converters, compensation, i nformation coding/processing, data communication, standards for smart sensor interface, the automation sensors.

Applications: Introduction, on-board automobile sensors (Automotive Sensors), home appliance sensors, aerospacesensors, sensors for manufacturing, sensors for environmental monitoring.

MODULE –IV: INTRODUCTION TO MEMS (9)

Introduction, development of MEMS technology, present, future and challenges, fabrication processes: fundamentals of material science, substrates: single crystal substrates, silicon on insulator substrate, physical vapor deposition, chemical vapor deposition, etching processes, patterning, wafer bonding, annealing, chemical mechanical polishing, material doping, MEMS application in life sciences.

MODULE –V: POLYMER AND OPTICAL MEMS (9)

Polymers in MEMS, Polyimide - SU-8 - Liquid Crystal Polymer (LCP), PDMS, PMMA, perylene, fluorocarbon,application to acceleration, pressure, flow and Tactile sensors, optical MEMS, lenses.

V. TEXT BOOKS:

1. D. Patra Nabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, person education Limited.

VI. REFERENCE BOOKS:

1. Patra Nabis, “Sensors and Actuators”, second edition, PHI, 2013. Allen James J, Micro Electromechanical
   SystemDesign, first edition, Taylor and Francis, FL (USA), 2005.
2. Maluf Nadim and Williams Kirt, an Introduction to Micro electromechanical Systems Engineering, ARTECHHouse, MA (USA), 2nd edition, 2004.
3. N. Maluf, “An Introduction to Micro-electro Mechanical System Engineering", artech. House.

VII. WEB RESOURCES:

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/

VII. 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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations
8. Early Lecture Readiness Videos