SENSORS AND ACTUATORS

I Semester: ECE(ES)									
Course Code	**Category**	\multicolumn{3}{c}{**Hours / Week**}			**Credits**	\multicolumn{3}{c}{**Maximum Marks**}		
BESC09	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	\multicolumn{4}{c}{**Practical Classes: Nil**}				\multicolumn{3}{c}{**Total Classes:60**}		

I. COURSE OVERVIEW:
This course introduces the students to Comprehensive fundamental and technical knowledge of advanced sensor systems and instrumentation and Use Numerical modeling for sensors Understand the problem and select a sensor and design, model the system. understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based.

II. COURSE OBJECTIVES:
The students will try to learn:
  I.   The constructions and working principle of different types of sensors and transducers.
  II. The measuring instruments and the methods of measurement and the use of different transducers.
  III. The concepts of Electro analytic and smart sensors.

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

CO1	Illustrate fundamental physical and technical base of sensors and actuators	Understand
CO2	Distinguish basic laws and phenomena that define behavior of sensors and actuators	Knowledge
CO3	Analyze various premises, approaches, procedures and results related to sensors and actuators	Analyze
CO4	Create analytical design and development solutions for sensors and actuators	Create
CO5	Utilize the acquired data and measured results for sensors in IOT	Apply
CO 6	Interpret fundamental physical and technical base of sensors and actuators	Understand

IV. SYLLABUS:
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: Thermal Sensors(9)
Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermo-sensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo-EMF Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermo-electric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors. Magnetic Sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive

Sensors, Anisotropic Magneto-resistive Sensing, Semiconductor Magneto-resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros, Synchroresolvers, Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors, SQUID Sensors.

MODULE – III: Radiation Sensors(9)
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 – IV: Smart Sensors(9)
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 – V: Actuators(9)
Pneumatic and Hydraulic Actuation Systems- Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators, Mechanical Actuation Systems Types of motion, Kinematic chains, Cams, Gears, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection, Electrical Actuation Systems, Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

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", PHI, 2nd Edition, 2013
2. Evgeni Gusev and Eric Garfunkel. "Advanced Materials and Technologies for Micro/Nano-Devices, Sensors and Actuators". 3nd Edition, 2010.

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://engineering.nyu.edu/mechatronics/Control_Lab/Criag/Craig_RPI/2001/Hydraulic_and_Pneumatic_Actuators_1

VIII. E-TEXT BOOKS:
1. https://content.kopykitab.com/ebooks/2016/06/7440/sample/sample_7440.pdf
2.https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/The%20Mechatronics%20Handbook.pdf