INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

SENSORS AND ACTUATORS								
VIII Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD66	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Analog and Digital Electronics, Linear algebra, Statistics and Probability.								

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. COURSES OBJECTIVES:

The students will try to learn

I. Develop a basic understanding of different sensor types.
II. Know the different types of mechanical and electrical sensors.
III. Know the principles of various sensors and their characteristics.
IV. Know the fundamental principles which can be applied to develop the present and future sensor systems.
V. Know the characterization (static and dynamic) of sensors.

III. COURSE OUTCOMES:

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

CO 1 Understanding the basics of sensors, actuators, and their operating principles.

CO 2 Knowledge of interfacing of sensors and signal conditioning circuits to establish any control system or monitoring system.

CO 3 Ability to select appropriate actuators to drive mechatronics systems.

CO 4 Understanding of the development and application of sensors and actuators.

CO 5 Ability to Analyze various premises, approaches, procedures, and results related to sensors and actuators.

CO 6 Knowledge of the working of various types of actuators.

IV. COURSE CONTENT:

MODULE - I: SENSOR PRINCIPLES AND CHARACTERISTICS (10)
Basic sensor technology, sensor characteristics, static and dynamic, principles of sensing, capacitance, magnetic and electromagnetic induction, resistance, piezoelectric effect, pyro electric effect, hall effect, see beck and Peltier effect, heat transfer, light, analysis of experimental data, causes and types of experimental errors, statistical analysis of experimental data, method of least squares, correlation coefficient, multivariable regression, graphical analysis and curve fitting; stress, strain, hook‘s law, Poisson‘s ratio, tensile strength, yield strength, bending stress and yielding, vibration definitions and terminology.

MODULE –II: ACTIVE AND PASSIVE SENSORS-I (09)
Potentiometric and capacitive sensors, inductive and magnetic sensors, LVDT, RVDT, eddy current, transverse inductive, magneto-resistive, hall effect, ultrasonic sensors, thickness and level sensors, ablation, thin film, liquid level sensor, linear velocity sensors, doppler shift, light interference method, seismic devices, angular velocity sensors, dc and ac tachometer, counter types, hall effect, Wieg and effect, absolute angular rate sensors, gyroscopes, magnetic speed and direction sensor, accelerometer dynamics, capacitive, piezoresistive, piezoelectric accelerometers, thermal accelerometer, heated plate, heated gas accelerometers, force balance accelerometer.

MODULE –III: ACTIVE AND PASSIVE SENSORS-II (10)
Strain gages, tactile sensor, piezoelectric force sensor, torque sensor, thrust measurement, bellows, membranes, thin plates, piezo resistive, capacitive sensors, vacuum sensors, thermal conductivity gages, Pirani gage, thermistor gage, thermocouple gage, convection gage, ionization gage, gas drag gage.

flow sensors, pressure gradient technique, turbine and vane flow meter, thermal mass flow sensors, ultrasonic sensors, electromagnetic flow sensors, micro flow sensors, breeze sensors, Coriolis mass flow sensors, drag force flow sensors, laser doppler anemometer.

MODULE –IV: ACOUSTIC AND TEMPERATURE SENSORS (09)
Resistive Microphones, condenser microphones, fiber optic microphone, piezoelectric microphones, electret microphones, solid state acoustic detectors, surface acoustic wave sensor, bulk acoustic Wav sensor, acoustic resonance, thermosensitive, thermoelectric, semiconductor PN Junction, optical, acoustic, piezoelectric temperature sensors.

MODULE –V: ACTUATORS (10)
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. Jacob Fardeen, Hand Book of Modern Sensors: physics, Designs and Applications, springer, 3rd edition, 2003.
2. Jon. S. Wilson, Sensor Technology Hand Book, Elsevier, 1st edition, 2004.
3. D. Patra Nabis, Sensors and Transducers, PHI Learning Private Limited, 2nd edition, 2003.

VI. REFERENCE BOOKS:

1. W. Bolton, Mechatronics‖, Pearson Education Limited, 4th edition, 2008.
2. D. Patra Nabis," Sensors and Actuators", PHI, 2nd edition 2013.
3. John G Webster, Measurement, Instrumentation and sensors Handbook, CRC press, 2nd edition, 2014.

VII. WEB RESOURCES:

1. http://www.elsevier.com
2. http://www.sciencedirect.com
3. http://www.electrical4u.com
4. http://www.edn.com

VIII. E-TEXT BOOKS:

1. http://www.e-booksdirectory.com
2. http://www.ebooks.com
3. https://en.wikibooks.org
4. http://jntu-ebooks.blogspot.in

IX. ELECTRONICS RESOURCES:

1. NPTEL: Sensors And Actuators
2. NPTEL: ADS
3. https://nptel.ac.in/courses/108108147
4. NPTE: Control and instrumentation robotics.

X. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations