SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VI

Subject Name: **Sensors and Signal conditioning** **Subject Code: BTEC14605**

Type of course: PEC

Prerequisite: Engineering Physics, Electronic circuits

Rationale: Sensors are used everywhere in real time applications in the area of biomedical instruments, industries, education, household appliances etc. This course will help to understand the basic principles used in making sensors, characteristics, interfacing and their applications.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
2	0	2	3	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Introduction to Electronics Measurement and Instrumentation:** Transducers and sensors- Static and Dynamic Characteristics, Errors.	3	8
2.	**Physical Principles of Sensing :** Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements.	4	12
3.	**Interface Electronic Circuits:** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.	5	15
4.	**Sensors**: Potentiometric Sensors, Gravitational Sensors, Capacitive Sensors Inductive and Magnetic Sensors, Optical Sensors , Velocity and Acceleration sensor, Force, Strain, and Tactile Sensors, Pressure Sensors ,Moisture Sensors Light Detectors Temperature Sensors .	5	20

5.	**Measurements:** Significance of Measurements, Methods of Measurement, performance of Measurement System, Errors in Measurements. Power, energy, resistance, capacitance, inductance measurements.	5	15
6.	**Signal Conditioning:** Signal conditioning for resistive and reactive sensor: Voltage Dividers, Wheatstone Bridge, Sensor bridge calibration and balance, Interference, Specific Signal Conditioners for Capacitive Sensors.	5	20
7.	**Sensors in Different Application Area:** Motion Detectors, GPS, Bluetooth, Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors. Touch screen sensor, Heading Sensors – Compass, Gyroscope, Inclinometers, Applications of sensors in drone.	3	10

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	30	20	20	10	0

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Course In Electrical and Electronics Measurements and Instrumentation	Shawhney A. K.	DhanpatRai	2015.	11th
2.	Electronic Instrumentation and Measurements	Bell David A	Oxford	2013	3rd
3.	Electronic instrumentation	H S. Kalsi	McGraw Hill	2015	Latest
4.	Sensors and Signal Conditioning	Ramon Pallas-Areny, John G.	John Wiley	2000	2nd
5.	Electronics Handbook of Modern Sensors Physics Designs and Applications-	Jacob Fraden	Springer	2003	Latest

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to,	Marks % weightage
CO-1	Analyze the types of errors for measuring instrument	10
CO-2	Describe the principles of various sensors for measurement and instrumentation	25
CO-3	Evaluate various measurements techniques for industrial applications	20
CO-4	Apply the signal conditioning methods for real time applications	25
CO-5	Simulate working of various sensors for different real time application	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	2	2	-	3	-	3	2	2	1	-	2	2	2
CO-2	3	1	2	2	-	-	-	-	-	-	2	-	3	-	1
CO-3	3	2	3	2	2	3	3	2	-	-	3	2	3	2	2
CO-4	3	2	3	2	2	3	2	-	-	2	3	2	3	2	3
CO-5	2	2	2	-	3	2	-	-	-	-	2	-	2	3	2

List of practical:

1. To verify and plot the static and dynamic characteristics of RTD for different material.
2. To study the change in characteristics of thermocouple in response to the processing temperature.
3. To measure unknown capacitance and inductance using Maxwell's bridge circuit.
4. To understand working principle of LVDT on virtual lab
5. To study I/O characteristics of LVDT to determine linear range and sensitivity
6.To measure unknown capacitance using Win bridge using(i) series and (ii) parallel configuration
7. To study resistive strain gauge and measure its strain due to apply load
8. Design signal conditioning circuit using Op-Amp and temperature sensor
9. To find the value of unknown resistor using Wheatstone bridge
10. To measure temperature change using RTD.
11. Mini project

List of Open Source/learning websites:

- https://nptel.ac.in/courses/108108147-Sensors and Actuators

List of Open Source software:

- **Python, SCilab**