

# GUJARAT TECHNOLOGICAL UNIVERSITY

**MECHATRONICS**  
**SUBJECT NAME: SENSOR TECHNOLOGY**  
**SUBJECT CODE: 3714703**  
**M.E. 1<sup>st</sup> SEMESTER**

**Type of course:** Engineering

**Prerequisite:** N.A.

**Rationale:** This course gives idea about variety of sensors available and its applications in various fields. Student will learn to design a sensor for a given application at the end of this course. Students also learn about the sensor characteristics and data acquisition for a system under investigation.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
					ESE	OEP	PA	RP		
3	0	2	4	70	30	20	10	10	10	150

**Content:**

Sr. No.	Content	Total Hrs	%Weightage
1	<b>INTRODUCTION</b> Sensor classification, Sensor characteristics: Transfer function, calibration, hysteresis, non-linearity, repeatability, resolution, dynamic impedance, excitation, dynamic characteristics, reliability, etc	6	15
2	<b>PHYSICAL PRINCIPLES OF SENSING</b> Electric charges, fields and potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric effect; pyroelectric effect; Hall effects; seeback and Peltier effects; Sound waves; Temperature and thermal properties of materials; Heat transfer; Light	10	25
3	<b>POSITION, DISPLACEMENT AND LEVEL SENSORS</b> Potentiometric sensors; Capacitive sensors; Inductive and Magnetic sensors: LVDT, RVDT, Eddy current sensors, Hall effect, magnetostrictive, magnetoresistive sensors; Ultrasonic sensors.	8	20
4	<b>ANGLE MEASURING SENSORS</b> Incremental and absolute encoders; Synchros and resolvers.	6	15
5	<b>FORCE, STRAIN AND TACTILE SENSORS</b> Strain gauges, Tactile sensors and Piezoelectric force sensors	6	15

<b>6</b>	<b>SENSOR MATERIALS AND SURFACE PROCESSING</b> Materials like Silicon, Plastic, Metals, Ceramics and Glasses; Surface processing like spin-casting, vacuum deposition, sputtering, chemical vapor deposition; Nanotechnology: photolithography, micro machining, etching, wafer bonding.	2	5
<b>7</b>	<b>APPLICATIONS OF SENSORS IN MANUFACTURING</b> Various proximity sensors like capacitive, inductive, laser, microwave, etc.; Fibre Optics in sensors.	2	5

### Reference Books:

1. Handbook of Modern sensors: Physics, Designs and Applications, 3 rd Edition, Jacob Fraden, Springer
2. Measurement, Instrumentation and Sensors Handbook, John G. Webster (Editor-in-Chief), CRC Press
3. Sensors and Control Systems in Manufacturing, SabrieSoloman, McGraw Hill Publisher
4. Sensors and Transducers, D. Patranabis, Wheeler Publishing

### Course Outcome:

After learning the course the students should be able to:

- Integrate working of sensors and actuators with computer for data acquisition and characterizing purpose.
- Automate mechanical device to make them intelligent using network of sensors as a part of multidisciplinary branch of engineering.
- Represent the technical / engineering working of sensors by schematic diagrams and oral / written expressions.

### List of Experiments:

1. Introduction to LabVIEW or any other software available for data acquisition.
2. Programming using addition, subtraction, multiplication and division tools available with the software to manipulate the sensor data acquired.
3. Study of different data types available with the software to handle various inputs through interfacing devices.
4. Handling mathematical formulas and presenting the outputs with the help of different graphs.
5. Understanding Boolean operator for 'AND' and 'OR' operation of logical sensors such as switches, which gives output in the form of 'ON' or 'OFF'.
6. Display random numbers between any two given numbers on Y-axis of X-Y graph with the interval of time on X-axis (0-1 sec) to understand the sampling rate of a given sensor to acquire data.
7. Present the input data of sensors on computer monitor screen using 1-D and 2-D array format. Formula node programming and running average presentation using graphs as output produced by sensor.
8. Interface strain gauge sensor with computer for data acquisition and characterize the sensor for its input and output.

9. Interface pressure sensor with computer for data acquisition and characterize the sensor for its input and output.
10. Interface encoder sensor with computer for data acquisition and characterize the sensor for its input and output.

**Major Equipment:**

- Various sensors
- Interfacing devices for data communication and acquisition
- Appropriate software (MATLAB, LabVIEW, etc.) compatible with interfacing device

**List of Open Source Software/learning website:**

Demo versions of MATLAB and LabVIEW are available for limited periods. Student versions are also available free of cost.