



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Electronics and Communication

Subject Code: BE05000401

Subject Name: Sensors and Transducers

WEF Academic Year :	2025-26
Semester :	5
Category of the Course :	Professional Elective Course - 2

### Course Outcome:

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Understand the principles of various sensors and transducers for measurement and instrumentation.	UN
02	Evaluate various measurements techniques for industrial applications	EL
03	Apply signal conditioning for measurements	AP
04	Implement the principles and signal conditioning for measurement for real life applications.	CR

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

### Teaching and Examination Scheme

Teaching/Learning Scheme in hrs/semester					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH	TH/30	Theory		Practical			
						ESE (E)	PA (M)	PA (I)	PBL(I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

\* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

### Course Content :

Sr. No.	Content	Total Hrs
1	<b>Introduction to Electronics Measurement and Instrumentation:</b> Transducers and sensors- Static and Dynamic Characteristics Static characteristics: Accuracy, repeatability, reproducibility, range/span, linearity, threshold, sensitivity, resolution, hysteresis, precision, drift etc. Dynamic characteristics: Speed of response, settling time, fidelity, lag etc. Errors: Types of errors, statistical analysis, probability of errors, limiting errors, performance measures of sensors Classification of sensors, Sensor calibration techniques	9



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2	<b>Temperature Sensors:</b> Resistance Vs Temperature characteristics for different materials, Thermistors, Thermocouples - thermoelectric effects for thermocouples, thermocouple tables, RTD, Other Thermal Sensors. Radiation temperature sensors, Pyro-electric type Temperature Sensor	9
3	<b>Motion, Proximity And Ranging Sensors:</b> Motion Sensors – Potentiometers, Resolver, Encoders – Optical, LVDT – RVDT, Accelerometer, Proximity Sensors - Magnetic, Inductive, Capacitive, Optical, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).	9
4	<b>Pressure, Force, Displacement And Weight Measurement, Magnetic Sensor:</b> Capacitive and inductive transducers, Piezo-electric sensors, Tactile sensor, Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor	9
5	<b>Flow Measurement, Power Measurement, Optical Sensors:</b> Flow Measurement - Magnetic and ultrasonic flow meter, Power Measurement - Electrodynamometer type of wattmeter and power factor meter, Single-phase induction and Electronic energy meters, Optical Sensors - Photo conductive cell, photo voltaic, Photo resistive, IR sensor, LDR,	9

## This syllabus is mapped with following United Nation's Sustainable Development Goals:

SDG 3 - Good Health and Well-being

SDG 4 - Quality Education.

SDG 7 – Clean and affordable energy,

SDG 8 - Decent Work and Economic Growth,

SDG 9 - Industry, Innovation and Infrastructure,

SDG 11 - Sustainable Cities and Communities,

SDG 12 - Responsible Consumption and Production,

SDG 13 -Climate Action

## Relevant BIS standards:

IS 9000 Series – Environmental testing standards

IS/IEC 61010 Series – Safety requirements for electrical equipment for measurement, control, and laboratory use

IS 616 – Safety of Electrical Equipment

IS 7358 – Industrial Platinum Resistance Thermometers (RTD)

IS 8784 – Thermocouples specifications

IS 11383 – Industrial thermometers

IS 6784 – Flow measurement using orifice plates

IS 11747 – Electromagnetic flow meters

IS 9281 – Load Cells

IS 14399 – Weighing Instruments



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Also explore other relevant Indian and international standards.

## Reference Book :

1. Rangan & Mani “Instrumentation: Devices and Systems”, McGraw Hill
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall India
3. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
4. D.V.S. Murty, “Transducers and Instrumentation”, Prentice Hall India.
5. Helfrick Albert D. and Cooper W. D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India.
6. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
7. Kalsi H. S. "Electronic Instrumentation", Tata McGraw-Hill Education.
8. Shawhney A. K. "A Course In Electrical and Electronics Measurements and Instrumentation”, DhanpatRai& Sons, 11th Ed., 1999.
9. Bell David A. "Electronic Instrumentation and Measurements", PHI / Pearson Education.
10. Sensors and Signal Conditioning By Ramón Pallás-Areny, John G. Webster, Wiley Interscience

## Suggested Course Practical List :

Sr.No.	Experiment Title
1.	To find the value of unknown resistor using Wheatstone bridge
2.	To find the value of unknown capacitance and inductance using Maxwell's bridge
3.	Design signal conditioning circuit using Op-Amp and temperature sensor
4.	Verify characteristic of RTD and find out sensitivity
5.	Verify characteristic of Thermocouple and design signal conditioning circuit
6.	Verify characteristic of variable resistor transducer (strain gauge).
7.	Measurement of distance using LVDT plot ac and dc characteristics
8.	Interface Load Cell with Arduino and display weight
9.	Interface accelerometer with Arduino
10.	Interface gyroscope with Arduino
11.	Interface Tilt Sensor with Arduino
12.	Presentation on latest topics



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## Major Equipment/software:

1. <https://www.tinkercad.com/>
2. Arduino
3. Various sensor and actuators

## Laboratory/Learning Resources Required:

1. <https://nptel.ac.in/courses/108/108/108108147/>

## Activities suggested under Self-learning/Team Work:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8.	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills



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10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/ any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

Note:

1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.

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