# National Institute of Technology Meghalaya

An Institute of National Importance

**CURRICULUM**

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| Programme | **Bachelor of Technology in Electronics and Communication Engineering** | Year of Regulation | **2018-19** |
| Department | **Electronics and Communication Engineering** | Semester | **V** |

| Course Code | Course Name | Credit Structure | | | | Marks Distribution | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | INT | MID | END | Total |
| **EC313** | **SENSORS & TRANSDUCERS** | **3** | **1** | **0** | **4** | **50** | **50** | **100** | **200** |

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| Course Objectives | To understand the fundamental concepts of sensors and measurement systems | Course Outcomes | CO1 | Fundamental concepts of various sensors, transducers and related electronic circuits. |
| | To make students understand the working principle of resistive, capacitive, piezoelectric and thermal transducers and their applications. | | CO2 | Apply the fundamental principles of resistive, capacitive, piezoelectric and thermal transduction mechanisms for the design of various sensors and transducers. |
| | To understand various types of electronic circuits for resistive, capacitive, piezoelectric and thermal sensors and transducers. | | CO3 | Design of electronic circuits for various sensors and transducers. |

| No. | COs | Mapping with Program Outcomes (POs) | | | | | | | | | | | | Mapping with PSOs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| 1 | CO1 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | - | - |
| 2 | CO2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | - | - |
| 3 | CO3 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | - | - |

SYLLABUS

| No. | Content | Hours | COs |
|---|---|---|---|
| I | **Basics of Sensor and Measurement Systems**<br>General Concepts And Terminology, Sensor Classification, General Input-Output Configuration, Static Characteristics Of Measurement Systems, Dynamic Characteristics, Review of Stress and Strain, Internal Force Analysis, Stress—Strain Relations, Bending Analysis of flexural beams and plates under simple Loading Conditions, Spring Constants, Resonant Frequency, and Quality Factor | **11** | **CO1** |
| II | **Piezoresistive Sensors**<br>Origin and Expression of Piezoresistivity, Piezoresistive Sensor Materials, Metal Strain Gauges, Single Crystal Silicon, Polycrystalline Silicon, Applications of Piezoresistive Sensors:Inertial Sensors, Pressure Sensors. Tactile Sensor, Flow Sensor | **7** | **CO1, CO2** |
| III | **Electrostatic Sensor and Actuator**<br>Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitor, Capacitance of Parallel Plates, Equilibrium Position of Electrostatic Actuator under Bias, Pull-in Effect of Parallel-Plate Actuators, Applications of Electrostatic Sensors and Actuators | **7** | **CO1, CO2** |
| IV | **Piezoelectric Sensor and Actuator**<br>Introduction, Background and Mathematical Description of Piezoelectric Effects, Piezoelectric Sensing/Actuator Model, Properties of Piezoelectric Materials, Applications of Piezoelectric Sensors and Actuators | **7** | **CO1, CO2** |
| V | **Thermal Sensor and Actuator**<br>Thermal Sensors, Thermal Actuators, Fundamentals of Thermal Transfer, Sensors and Actuators Based on Thermal Expansion, Thermal Bimorph Principle, Thermal Actuators with a Single Material, Thermal Couples, Thermal Resistors, Applications of Thermal Sensors and Actuators | **7** | **CO1, CO2** |
| VI | **Electronic Circuits for Sensors and Transducers**<br>DC and AC Bridges: Kelvin bridge and Wheatstone bridge for resistance measurement, Schering bridge and Wien bridge for capacitance measurement, Maxwell bridge and Hay's bridge for inductance measurement, Operational Amplifiers and Signal Conditioning for Sensors and Transducers | **9** | **CO3** |
| | Total Hours | **48** | |

**Essential Readings**


1. Ghosh A. K., “Introduction to Transducers”, Prentice-Hall India, 1st Ed., 2015.
2. Chang Liu, “Foundations of MEMS”, Pearson, 2nd Edition, 2012.
3. H S Kalsi, “Electronic Instrumentation and Measurement”, Mc Graw Hill, 4th Ed, 2019.


**Supplementary Readings**


1. Patranabis D., "Sensors And Transducers", Prentice-Hall India, 2nd Ed., 2004.
2. Webster J.G., "Instrumentation and Sensors Handbook", CRC Press, 1st Ed., 1999.