# Subject Description Form

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| **Subject Code** | EE549 |
| **Subject Title** | Modern Sensor Technologies |
| **Credit Value** | 3 |
| **Level** | 5 |
| **Pre-requisite/ Co-requisite/ Exclusion** | Undergraduate-level circuit and electromagnetic theory |
| **Objectives** | 1. To acquire the fundamentals of advanced sensor technologies.<br>2. To make the students to understand the structures and working principles of resistive, capacitive, piezoelectric, acoustic, electric and magnetic sensors.<br>3. To enable the students to understand and design thermal and mechanical sensors, optical sensors, optical fiber sensors and micro-electromechanical system (MEMS) sensor technologies.<br>4. To know the applications of sensors in various industrial applications. |
| **Intended Learning Outcomes** | Upon completion of the subject, students will be able to:<br>a. Acquire the operation principles and recent developments of sensors and transducer technologies, including thermal and mechanical sensors, electric and magnetic sensors, optical sensors as well as MEMS sensors technologies.<br>b. Understand the structures and working principles of thermal sensors, mechanical sensors, acoustic sensors, electric and magnetic sensors for practical applications.<br>c. Select the most appropriate optoelectronic components and optical fiber devices to design optical sensors and optical fiber sensor systems.<br>d. Comprehend the structures and multidisciplinary working principles of MEMS-technology and sensor networks.<br>e. Have hands-on experience in the assembling and testing of electric/optical sensors or MEMS sensors. |
| **Subject Synopsis/ Indicative Syllabus** | 1. ***Introduction to sensor fundamentals***. Definition of sensors; sensor and information; physical quantities; relation between quantities; sensor classification; uncertainty aspects.<br>2. ***Thermal, mechanical and acoustic sensors***. Thermoresistive and thermoelectric sensors; construction, general properties and applications of force sensors, accelerometer, pressure sensors, velocity sensors, and inertial sensors; microphones, ultrasonic sensors and their applications.<br>3. ***Electric and magnetic sensors***. Magnetic induction, permeability and magnetostriction; electric and magnetic field sensor; Hall effect and magnetometers; voltage and current sensors and applications.<br>4. ***Optical sensors and optical fiber sensors.*** Classification of optical sensors; quantum-based optical sensors; photoelectric sensors; charge-coupled device (CCD) sensors; optical fiber interferometer sensors; optical fiber grating sensors and applications.<br>5. ***MEMS and optical MEMS sensors.*** Production of MEMS; MEMS-based pressure sensors, accelerometers, hot-wire anemometry and gyroscopes; optical MEMS sensors. |

**Laboratory Experiments:**
Testing and calibration of force sensors and on-board MEMS accelerometers.

**Teaching/Learning Methodology**

Lectures, quizzes, tests, laboratory experiments, mini-projects, and examination.

| Teaching/Learning Methodology | Outcomes | | | | |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| Lectures | √ | √ | √ | √ | |
| Tutorials | √ | √ | √ | √ | |
| Experiments/Mini-project | √ | | √ | | √ |

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed | | | | |
|---|---|---|---|---|---|---|
| | | a | b | c | d | e |
| 1.Tests/Quizzes | 18% | √ | √ | √ | √ | |
| 2. Assignments | 6% | √ | √ | √ | √ | |
| 3. Lab and mini-project | 16% | √ | | √ | | √ |
| 4. Examination | 60% | √ | √ | √ | √ | |
| Total | 100% | | | | | |

This subject introduces the structures, working principles and applications of electrical/optical sensor technologies. Tests/assignments/examination will be used to assess the outcomes about the structures and operation principles and applications of various electrical/magnetic/optical sensors. Experiments/mini-project will be used to assess the hands-on experience in electrical/optical sensors and MEMS devices.

**Student Study Effort Expected**

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| Class contact: | |
| ▪ Lectures/Tutorials/Laboratory demo | 39 Hrs. |
| Other student study effort: | |
| ▪ Mini-project and report | 20 Hrs. |
| ▪ Self-study and assignments | 46 Hrs. |
| Total student study effort | 105 Hrs. |

**Reading List and References**


1. Sensors for Mechatronics, 2nd edition, Paul P. L Regtien, Edwin Dertien, Elsevier, 2018.
2. Sensors, actuators, and their interfaces: a multidisciplinary introduction, Nathan Ida, SciTech Publishing, 2014.
3. Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, Springer International Publishing AG, 2015.
4. Sensors handbook, 2nd edition, Sabrie Soloman, McGraw-Hill, 2010.