

Course Specification Document

Title	Sensors
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Credits	3.5 ECTS
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Aims	<p>This course aims to provide the student with the basic concepts of sensors related to various forms of energy (mechanical, thermal, radiation, chemical, electrical, magnetic) and the physical phenomena on which the sensor is based, its working principle, equations, factors limiting its performance, methods to overcome these limitations, basic conditioning circuits and important sensor applications. This will enable the student to choose the appropriate sensor for the physical phenomenon to be measured, in accordance with the specified specifications, and to design the appropriate measurement and conditioning circuit.</p>
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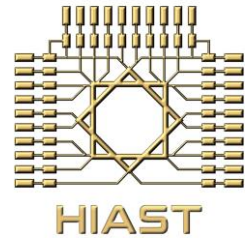
Intended learning outcomes

On successful completion of this course, the student will be able to:

- Understand the principle of sensor operation, its connection methods and power supply.
- Identify sensor-conditioning circuits.
- Understand the impact of environmental conditions on sensor response and compensation methods.
- Identify the basic applications of sensors.
- Perform error calculations and select the necessary electronic components suitable for specific requirements.
- Design sensor-conditioning circuits.
- Use appropriate circuits and measurement methods for sensors.

Syllabus

- **Basic principles in sensors:** Types of sensors and methods of classifying them, the general structure of the sensor as an input output element to a measuring system, the various physical phenomena used to manufacture silicon sensors according the six energy types Ra, Me, Ele, Ma, Th, Ch, basic specifications of sensors, influencing surrounding factors on sensor response, adaptation and amplification circuits.
- **Force and weight sensors:** The strain sensor and its applications, general definitions, description of the sensor, equation of the sensor, properties and features of the sensor, measurement methods, comparison between the general specifications of metal and silicon semiconductor sensors, weight cell.



- **Position, displacement and proximity sensors:** Inductive sensors, general principles and properties, sensors with a variable self-induction factor, inductive sensors with a variable air gap, sensors with a moving magnetic core, measurement methods, inductive sensors with a differential transformer, capacitive sensors, capacitive sensors with a variable surface, variable distance capacitive sensor, measurement circuits, optical encoders, inductive and capacitive proximity sensors, electromechanical rotational displacement sensors (their types and applications).
- **Temperature sensors:** Measuring temperature using thermal resistance, linear thermal sensitivity, correcting linearity using a parallel or series resistor, correcting linearity of a voltage divider, correcting the linearity of the output voltage of a Wheatstone bridge, measurement methods, sensor response function, effect of measuring current, sensor equation, measuring temperature using thermistance, conductivity of thermistance, sensor equation, measuring temperature using a thermoelectric coupler, general specifications (thermal sensitivity), thermoelectric phenomena, measurement methods, linearity, compensation lines, measuring temperature using a diode or transistor, general properties (thermal sensitivity), voltage and temperature relationship, measurement Temperature by sensor AD590, LM35.
- **Photoelectric sensors:** Basic properties of light, photoelectric cell, photoconductivity, properties of photoelectric cells, applications, photodiode, modes of operation, properties of photoelectric diode, photoelectric diode circuits, bipolar photoelectric transistor, structure of photoelectric transistor and its working principle, properties of photoelectric transistor.