

SYLLABUS: SENSOR AND INSTRUMENTATION TECHNOLOGY

Date / Revision 23 May 2015 / 02 May 2017 / PP
Faculty Engineering
Study Programm Mechatronik

SUBJECT: Sensor and Instrumentation Technology

1 Basic Information

1.01	Subject Name	Sensor and Instrumentation Technology
1.02	Semester	4
1.03	Level	1
1.04	SKS	3
1.05	Mandatory / Curriculum	Mandatory / D-05
1.06	Subject Code	SENS
1.07	Subject Code	MTE-D-4105
1.08	Year	2017 (7)
1.09	Quality Control	Final Test, OFSE, see evaluation
1.10	Limitations	Min 12 and Max 32 students in one class
1.11	Combined with	ELE, BME
1.12	Perquisite	Electronic Devices and Circuit 1
1.13	Responsible	Mr. Dipl. Ing.- Maralo Sinaga
1.14	Revision	21-08-2017/MaS

2 Description of Subject

This course introduce the various types of sensors, technology, and their applications The lectures cover the principles and operation of a variety of sensor architectures and modalities, including sensors used for mechanical quantities such as pressure, strain, displacement, proximity, and thermal, electric and magnetic field, optical, acoustic. Simple sensor signal processing algorithms and wired are also discussed. Additionally, the lecture also introduces the methods of interfacing sensors to electronic systems.

3 Objectives

- Introduce the sensor used in the industries and their characteristics, properties, interfaces connection
- Students learn how to analyze, design, build and troubleshoot a variety of sensor circuit

4 Competency

After having the course, students are expected have to:

- Explain the principles of operation of the main types of sensors
- Utilise the merits of various types of sensors for a wide range of applications
- Understand the limitations in the performance of instrumentation systems
- Analyse the specifications of various types of sensors
- Understand the main characteristics of sensors
- Integrate instrumentation systems
- Select appropriate sensors for a given application and design simple electronic sensor interface systems
- Select components for instrumentation systems

5 Learning Approach / Methodology

- Lectures/ Class contact (time-tabled) supplemented with interactive questions and answers;
- Circuit simulation using Electronic Workbench Software or similar;
- Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing;
- Student Study Effort: homework/assignment; preparation for test/quizzes/ examination.

6 Evaluation

5.1	Absence maximum	25%
5.2	Participation in Discussion	05 Points
5.3	Homework / Classwork	05 Points
5.4	Presentation /Simulation	10 Poin
5.5	Daily Quiz	20 Points
5.6	Final Examination	60 Points
	Total	100 Points

7 Text Book and Reference

1	Main Text Book: “Process Control Instrumentation Technology, 6 th Edition”, Author: Curtis D. Johnson, Publisher: Prentice Hall International Edition, ISBN: 0-13-978-200-3
2	Supplementary Text books:

<ul style="list-style-type: none"> • “Measurement, Instrumentation, and Sensors Handbook”, Author/Chief Editor: John G. Webster., Publisher: CRC – Press – Taylor and Francis Group, ISBN: xxx-xxx-xxxx • “Introduction to Instrumentation and Measurement, 3rd Edition”, Authors: Robert B. Northrop, Publisher: CRC – Press – Taylor and Francis Group, ISBN: 13: 978-1-4665-9679
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8 Content / Topics of Lecture

Week	Content/ Topics of Lecturing	Text Book	Remark
1	Review of Measurements and instrumentation: <ul style="list-style-type: none"> • Review of Static characteristics of Instrument systems, dynamic characteristics of Instrument systems • Review of Op-Amp Circuit, passive-, and active-filters 		
2-3	Analog Signal Conditioning: <ul style="list-style-type: none"> • Principles of analog signal conditioning • Signal-Level and Bias Changes • Linearization, Conversions • Filtering and Impedance Matching • Concept of Loading • PASSIVE CIRCUITS: Voltage Divider, Bridge Circuits, Bridge Resolution , Bridge Applications 	Ch-2	Quiz 1 on week 3
4-5	Digital Signal Conditioning: <ul style="list-style-type: none"> • Review of Digital Electronics: Digital Information, Fractional Binary Numbers, Boolean Algebra, • Digital Electronics Circuits: comparator, converter, • Digital-to-Analog Converters (DACs) • Analog-to-Digital Converters (ADCs) : Flash-, SAR, Dual Slope 	Ch-3	Quiz 2 on week 5
6	Digital Signal Conditioning: <ul style="list-style-type: none"> • Sensor-to-Frequency Conversion • Data-Acquisition Systems: Hardware and Software of Data Aquisition System (DAS) • Characteristics of digital data: Digitized Value, Sampled Data Systems, Linearization, 	Ch-3	
7	Thermal Sensors: <ul style="list-style-type: none"> • Definition of Temperature: Thermal Energy, absolute and relative Temperature, • Metal resistance versus temperature devices: Resistance versus Temperature Approximations, • Resistance-Temperature Detectors (RTD) 	Ch-4	Quiz 3 on week 5
8	MIDTERM SEMESTER BREAK		

9-10	<p>Thermal Sensors:</p> <ul style="list-style-type: none"> • Thermistors: Semiconductor Resistance versus Temperature, Thermistor Characteristics, • THERMOCOUPLES: Thermoelectric Effects, Thermocouple Characteristics, Thermocouple Sensors • Other thermal sensor: Bimetal Strips, Gas Thermometers, Vapor-Pressure Thermometers, Liquid-Expansion Thermometers • Solid-State Temperature Sensors • Design considerations 	Ch-4	
11-12	<p>Mechanical Sensors:</p> <ul style="list-style-type: none"> • Displacement, Location, or Position Sensors: Resistive-, Capacitive-, and Inductive Sensors • Variable-Reluctance Sensors, LVDT • Level Sensors • Metal Strain Gauges and Semiconductor Strain Gauges (SGs) • Load Cells 	Ch-5	Quiz-4
12-13	<p>Mechanical Sensors:</p> <ul style="list-style-type: none"> • Motion sensors: Types of Motion, Accelerometer Principles, Types of Accelerometers • Pressure sensors: Pressure Principles, • Pressure Sensors ($p > 1$ atmosphere), • Pressure Sensors ($p < 1$ atmosphere) • Flow sensors: Solid-Flow – and Liquid Flow Measurement • Pipe Flow Principles, Restriction Flow Sensors, Obstruction Flow Sensor • Magnetic Flow Meter 	Ch-5	Quiz-5
14-15	<p>Optical Sensors:</p> <ul style="list-style-type: none"> • Fundamentals of EM radiation • Nature of EM Radiation, Characteristics of Light, • Photometry • Photodetectors: Characteristics, Photoconductive Detectors, Photovoltaic Detectors, • Photodiode Detectors • Photoemissive Detectors • PYROMETRY: Thermal Radiation, Broadband Pyrometers, Narrowband Pyrometers, 	Ch-6	
16	Final Examination		