Level: Undergraduate

# **SYLLABUS**

1. Course name: Sensor Technology

2. Course code: SETE321963

**3.** Credits: 3 (3/0/6)

Duration: 15 weeks (45h main course and 90h self-study)

#### 4. Instructors:

1- Nguyen Truong Duy, MEng.

2- Vo Duc Dung, MEng.

#### 5. Course conditions

Prerequisites: Signals and Systems

Corequisites: N/A

## 6. Course description

The use of many types of sensors rapidly increases in the modern technology. Currently a lot of applications related to sensors found in many different fields such as environmental technology, fabrication techniques, industrial automation and biomedical technology. Course content focuses on the theoretical basis, working principles and application of the sensors. This course also refers to the technique of measurement, sensor signal processing and sensor measurement systems.

#### 7. Course Goals

Goals	Goal description (This course provides students:)	ELOs
G1	Expertise in the field of sensor and measurement techniques using sensors	01 (H) 07 (M)
G2	An ability to collect and process signals from the sensors.	02 (M), 03 (M)
G3	An ability to analyze, design and operate the sensor measurement systems.	10 (L) 11 (H)

<sup>\*</sup> Note: High: H; Medium: M; Low: L

## 8. Course Learning Outcomes (CLOs)

CLOs		Description	
		(After completing this course, students can have:)	
	G1.1	Presented the structure and principles of the sensors.	01, 07
G1	G1.2	Presented by the principle of measuring the position, pressure, fluid flow, pressure and acceleration	01, 07
	G1.3	Presented by measurement of the sensor signal.	01, 07
G2	G2.1	Analyze operational principles of some type of sensor	02, 03
GZ	G2.1	Analyze operational principle of the measurement circuit and sensor	02, 03

		applications	
G3	G3.1	Design of signal measurement and application circuits of sensors	11, 10, 03

# 9. Study materials

## - Textbooks:

[1] Nguyen Truong Duy, Bai giang Công nghệ Cảm biến, ĐH SPKT Tp.HCM 2017.

### - References:

[2] Le Chi Kien, Giao trinh Do luong cam bien, NXB ĐHQG Tp.HCM 2013

## 10. Student Assessments

- Grading points: 10

- Planning for students assessment is followed:

Туре	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
	Midterms				50
Exam01	Classification sensor. Inductive sensor principles. Acceleration measurement principles. The principle of ultrasonic sensors.	Weeks 2, 4, 8 and 12	Quizes	G1.1 G1.2	10
Exam02	The basic concepts and principles of sensor fabrication.	week 6	Individual paper assessment in class	G1.1 G2.1	20
Exam03	Photoelectric sensors and temperature sensors	week 10	Individual paper assessment in class	G1.3 G2.1	20
	Final exam				50
Final Exam	- The exam covers all contents related to the expected learning outcomes of the course.		Individual paper assessment in class	G1.3 G2.2 G3.1	50

## 11. Course details:

Weeks	Contents	CLOs
	Chapter 1: < THE BASIC CONCEPT OF SENSORS> (3/0/6)	
	A/Contents and teaching methods: (3)	
	Contents:	
	1.1 Mechanical sensors	
1	1.2 Optical sensors	G1.1
	1.3 Using semiconductor sensors	
	1.4 Electrochemical sensors	
	1.5 Biosensors	
	1.6 Characteristics of the sensor	

	1.7 Sensor applications	
	Teaching methods:	
	+ Traditional lectures	
	+ Slideshow	
	B/Self-study contents: (6)	G1.1
	+ Look at the name and classification sensor.	G1.1
	Chapter 2: < PRINCIPLE OF SENSOR FABRICATION AND MEASUREMENT CIRCUITS > (3/0/6)	
	A/Contents and teaching methods: (3)	
	Contents:	
	2.1 General Principles manufacture sensors	01.2
	2.2 Measuring Circuits	G1.3
2	2.3 Measuring instruments and techniques	G2.2
	Teaching methods:	
	+ Theoretical lectures	
	+ Slideshow	
	B/Self-study contents: (6)	
	+ Analysis of the operating principles of the measuring circuits	G2.2
	Chapter 3: < OPTICAL SENSORS > (3/0/6)	
	A/Contents and teaching methods:(3)	
	Contents:	
	3.1 Luminescent sources	G1.1
	3.2 Photoresistors, photoelectric cells	G1.1
	3.3 Classification of optical sensors	G2.1
3	Teaching methods:	G3.3
3	+ Theoretical lectures	
	+ Questions	
	+ Slideshow	
	B/Self- study contents: (6)	
	+ Look up the kinds of optical sensors.	G2.1
	+ Circuit design for optical sensor applications	G3.1
	Chapter 4: < TEMPERATURE SENSORS > (6/0/12)	
	A/Contents and teaching methods: (3)	
	Contents:	
	4.1 Basic concepts	
,	4.2 Temperature scale, standard temperature points	G1.3
4	4.3 Thermistor sensors	G1.3 G2.1
	4.4 Thermocouple Sensors	G2.1 G3.1
	Teaching methods:	U3.1
	+ Theoretical lectures	
	+ Questions	
	+ Slideshow	

	B/Self-study contents: (6)	
	+ Look up the type of temperature sensors	G2.1
	+ Circuit design for temperature sensor applications	
	Chapter 4: < TEMPERATURE SENSORS (cont.) > (6/0/12)	
	A/Contents and teaching methods: (3) Contents:	
	4.5 The pyrometer, radiation thermometer 4.6 The pressure thermometer liquid and gaseous 4.7 Temperature sensor applications	G1.3
5	Teaching methods: + Theoretical lectures + Questions + Slideshow	G2.1
	<ul><li>B/ Self- study contents: (6)</li><li>+ Circuit design applications for certain types of temperature sensors</li></ul>	G3.1
	< EXERCISES AND TESTS > (3/0/6)	
	A/Contents and teaching methods: (3) Contents:	
	1. Guided exercises	G1.1
6	2. Tests 1	G1.3
	Teaching methods:	G2.1
	<ul><li>+ Questions and answers</li><li>+ Guide to do exercises</li></ul>	
	B/ Self- study contents: (6)	G1.3
	+ Reinforce the knowledge learned	G2.1
	Chapter 5: < POSITION MEASUREMENT SENSORS > (6/0/12)	
	A/Contents and teaching methods: (3)	
	Contents:  5.1 Principle of position measurement	
	5.2 Inductive sensors	G2.1
	5.3 Capacitive sensors	G2.1 G2.2
7	5.4 Difference between the capacitive and inductive sensors.	G3.1
/	5.5 Capacitive and inductive sensors applications	
	Teaching methods: + Theoretical lectures	
	+ Theoretical lectures + Questions	
	+ Slideshow	
	B/ Self- study contents: (6)	G1 1
	+ Look up the types of position measurement sensors	G1.1
8	Chapter 5: < POSITION MEASUREMENT SENSORS (cont.) > (6/0/12)	

Contents:  5.6 Mutual sensors 5.7 Hall sensors 5.8 Displacement measurement method using elastic waves G2.2  Teaching methods: H Theoretical lectures Question Slideshow  B/Self-study contents: (6) H Analysis of position measurement applications circuits  Chapter 6: < STRAIN GAUGE SENSORS > (3/0/6)  A/Contents and teaching methods: (3) Contents: 6.1 Transfiguration and measurement methods 6.2 Resistive metal probe 6.3 Piezoresistive silicon sensors G2.2  Teaching methods: H Theoretical lectures Questions Slideshow  B/Self-study contents: (6) H Look up the type of sensor used to measure the deformation H Design of application circuits  CEXERCISES AND TESTS > (3/0/6) A/Contents and teaching methods: (3) Contents:  1. Guided exercises 2. Tests 2 Teaching methods: Questions and answers G1.3 Questions and answers G1.3 Questions and answers G1.3 Contents: G1.4 Contents and teaching methods: (3) Contents: G1.2 Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6) A/Contents and teaching methods: (3) Contents: G1.2 Contents: G1.3 Contents: G1.3 Contents: G1.3 Contents: G1.3 Contents: G1.3 Contents: G1.4 Contents: G1.5 Contents: G1.7 Conten		A/Contents and teaching methods: (3)	
5.7 Hall sensors 5.8 Displacement measurement method using elastic waves Teaching methods: 4 Theoretical lectures 4 Question 4 Slideshow  B/Self-study contents: (6) 4 Analysis of position measurement applications circuits  Chapter 6: < STRAIN GAUGE SENSORS > (3/0/6)  A/Contents and teaching methods: (3) Contents: 6.1 Transfiguration and measurement methods 6.2 Resistive metal probe 6.3 Piezoresistive silicon sensors G2.2  Teaching methods: 4 Theoretical lectures 4 Questions 5 Slideshow  B/Self-study contents: (6) 4 Look up the type of sensor used to measure the deformation 4 Design of application circuits  <		Contents:	
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Teaching methods:		5.7 Hall sensors	G2.1
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# Slideshow  B/ Self- study contents: (6) + Analysis of position measurement applications circuits  Chapter 6: < STRAIN GAUGE SENSORS > (3/0/6)  A/ Contents and teaching methods: (3)  Contents:  6.1 Transfiguration and measurement methods 6.2 Resistive metal probe 6.3 Piezoresistive silicon sensors 6.2 Teaching methods: 4 Theoretical lectures 4 Questions + Slideshow  B/ Self- study contents: (6) + Look up the type of sensor used to measure the deformation + Design of application circuits  <		+ Theoretical lectures	
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+ Analysis of position measurement applications circuits  Chapter 6: < STRAIN GAUGE SENSORS > (3/0/6)  A/ Contents and teaching methods: (3)  Contents:  6.1 Transfiguration and measurement methods 6.2 Resistive metal probe 6.3 Piczoresistive silicon sensors G2.2  Teaching methods: 4 Theoretical lectures 4 Questions 4 Slideshow  B/ Self- study contents: (6) 4 Look up the type of sensor used to measure the deformation 4 Design of application circuits  Contents:  1. Guided exercises 2. Tests 2 G2.2  Teaching methods: 4 Questions and teaching methods: (3)  Contents: 6 G1.3  Contents  Contents: 6 G1.3  Contents  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/ Contents and teaching methods: (3)  Contents: 7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors		+ Slideshow	
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Contents:   6.1 Transfiguration and measurement methods   6.2 Resistive metal probe   G1.3     6.3 Piezoresistive silicon sensors   G2.2     Teaching methods:   G3.1     + Theoretical lectures     + Questions     + Slideshow     B/Self-study contents: (6)     + Look up the type of sensor used to measure the deformation     + Design of application circuits     Contents     4/Contents and teaching methods: (3)     Contents:     1. Guided exercises   G1.3     2. Tests 2   G2.2     Teaching methods:     4 Questions and answers     5 Guide to do exercises     6 FSelf-study contents: (6)     7 Reinforce the knowledge learned.     Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)     A/Contents and teaching methods: (3)     Contents:     7.1 Pressure and pressure measurement principles     7.2 The types of pressure sensors     7.3 Piezoelectric sensors     7.3 Piezoelectric sensors     63.1     7.4 Pressure sensors     7.5 Piezoelectric sensors     7.6 Piezoelectric sensors     63.1     64.2     65.2     66.2     67.2     67.2     67.3     67.2     67.3     67.3     67.3     67.4     67.5     67.6     67.7     67.7     67.8     67.8     67.9     67.9     67.9     67.1     67.1     67.2     67.2     67.3     67.3     67.3     67.3     67.4     67.5     67.6     67.7     67.8     67.8     67.9     67.		Chapter 6: < STRAIN GAUGE SENSORS > (3/0/6)	
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+ Theoretical lectures + Questions + Slideshow  B/Self- study contents: (6) + Look up the type of sensor used to measure the deformation + Design of application circuits		6.3 Piezoresistive silicon sensors	G2.2
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B/Self- study contents: (6) + Look up the type of sensor used to measure the deformation + Design of application circuits		+ Questions	
+ Look up the type of sensor used to measure the deformation + Design of application circuits		+ Slideshow	
+ Look up the type of sensor used to measure the deformation + Design of application circuits		B/Self- study contents: (6)	G1.1
+ Design of application circuits		+ Look up the type of sensor used to measure the deformation	
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Paching methods:   G3.1     + Questions and answers     + Guide to do exercises     B/Self-study contents: (6)   G1.3     + Reinforce the knowledge learned.   G2.2     Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)     A/Contents and teaching methods: (3)     Contents:   G1.2     7.1 Pressure and pressure measurement principles     7.2 The types of pressure sensors     7.3 Piezoelectric sensors     7.3 Piezoelectric sensors     G3.1     G1.3     G2.2     G2.1     G3.1     G3.1		2. Tests 2	~ • •
+ Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/Contents and teaching methods: (3)  Contents:  7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors  G1.2  G2.1  G3.1	10		G2.2
## Reinforce the knowledge learned.    Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)    A/Contents and teaching methods: (3)   Contents:   7.1 Pressure and pressure measurement principles   7.2 The types of pressure sensors   7.3 Piezoelectric sensors	10	Teaching methods:	
+ Reinforce the knowledge learned.    Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)     A/Contents and teaching methods: (3)     Contents:	10		
Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/ Contents and teaching methods: (3)  Contents:  7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors  G1.2  G2.1  G3.1	10	+ Questions and answers	
A/Contents and teaching methods: (3)  Contents:  7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors  G1.2  G2.1  G3.1	10	+ Questions and answers + Guide to do exercises	G3.1
Contents: 7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors G1.2 G2.1 G3.1	10	+ Questions and answers + Guide to do exercises  B/ Self- study contents: (6)	G3.1 G1.3
7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors G1.2 G2.1 G3.1	10	+ Questions and answers + Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.	G3.1 G1.3
7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors 7.3 Piezoelectric sensors G2.1 G3.1	10	+ Questions and answers + Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)	G3.1 G1.3
7.2 The types of pressure sensors 7.3 Piezoelectric sensors G3.1		+ Questions and answers + Guide to do exercises  B/ Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/ Contents and teaching methods: (3)	G3.1 G1.3 G2.2
7.3 Piezoelectric sensors		+ Questions and answers + Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/Contents and teaching methods: (3)  Contents:	G3.1 G1.3 G2.2 G1.2
		+ Questions and answers + Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/Contents and teaching methods: (3)  Contents: 7.1 Pressure and pressure measurement principles	G3.1 G1.3 G2.2 G1.2 G2.1
7.4 Magnetostrictive sensors		+ Questions and answers + Guide to do exercises  B/Self- study contents: (6) + Reinforce the knowledge learned.  Chapter 7: < PRESSURE MEASUREMENT SENSORS > (3/0/6)  A/Contents and teaching methods: (3)  Contents:  7.1 Pressure and pressure measurement principles 7.2 The types of pressure sensors	G3.1 G1.3 G2.2 G1.2 G2.1

	7.5 Pressure sensor based on deformation measurements	
	7.6 Characteristics of pressure sensors	
	7.7 Pressure measurment sensor applications	
	Teaching methods: + Theoretical lectures	
	+ Questions + Slideshow	
	<ul><li>B/ Self- study contents: (6)</li><li>+ Look up the type of sensor used to measure the pressure</li></ul>	G1.1
	+ Design of application circuits	G3.1
	Chapter 8: < FLUID FLOW MEASUREMENT SENSORS > (3/0/6)	
	A/Contents and teaching methods: (3)	
	Contents:	
	8.1 Flow measurement methods.	
	8.2 The types of sensors used to measure fluid flows	
	8.3 Level sensors	G1.2
	8.4 Differential manometer is based on the principle of hydrostatic	G1.2 G2.2
12	equilibrium.	
	8.5 Flow measurement by pressure difference.	G3.1
	Teaching methods:	
	+ Theoretical lectures	
	+ Questions	
	+ Slideshow	
	B/Self- study contents: (6)	G1.2
	+ Analysis of the principle of fluid flow measurement circuits	G2.2
	Chapter 9: < VELOCITY, ACCELERATION, AND VIBRATION SENSOR > (3/0/6)	
	A/Contents and teaching methods: (3)	
	Contents:	
	9.1 Overview of MEMS	
	9.2 Technology MEMS fabrication products	C1 2
	9.3 Applications	G1.3 G2.1
13	Teaching methods:	G2.1
13	+ Theoretical lectures	
	+ Questions	
	+ Slideshow	
	B/Self- study contents: (6)	
	+ Presentation principles measure the velocity, acceleration and vibration.	G1.3 G3.1
	+ Design of MEMS application circuits	
14	Chapter 10: < PROXIMITY SENSORS > (3/0/6)	

	A/Contents and teaching methods: (3)	
	Contents:	
	10.1 Introduction	
	10.2 Inductive proximity sensors	
	10.3 Capacitive Proximity Sensors	G1.3
	10.4 Optical Proximity Sensors	G1.3 G2.1
	10.5 Ultrasonic Proximity Sensors	G2.1
	Teaching methods:	
	+ Theoretical lectures	
	+ Question	
	+ Slideshow	
	B/Self- study contents: (6)	
	+ Look up the types of proximity sensors	G1.1 G3.1
	+ Design of the application circuits	G3.1
	< REVIEW > (3/0/6)	
	A/Contents and teaching methods: (3)	
	Contents:	G1.1
	+ Review all content	G2.1
15	Teaching methods:	G2.2
	+ Theoretical lectures	G3.1
	+ Question	
	B/Self- study contents: (6)	
	+ Analyzing the operation of all types of sensors	G2.1
	+ Presenting principles of measurement circuits and sensor applications	G2.2

# 11 Learning ethics:

- Home assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get zero point

# 12 First approved date: January 01 2017

# 13 Approval level:

Dean Department Instructor

# 14 Syllabus updated process

1 <sup>st</sup> time: Updated content dated	Instructors
2 <sup>st</sup> time: Updated content dated	Head of department