

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	SCHOOL OF ENGINEERING		
<b>ACADEMIC UNIT</b>	DEPARTMENT OF ELECTRONICS ENGINEERING		
<b>LEVEL OF STUDIES</b>	GRADUATE		
<b>COURSE CODE</b>	8002006	<b>SEMESTER</b>	2
<b>COURSE TITLE</b>	Sensors and Micronets (BAN, PAN, LAN)		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS (ECTS)</b>	
Lectures	4	9	
E-learning	2		
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
<b>COURSE TYPE</b> <i>general background, special background, specialised general knowledge, skills development</i>	Scientific Area		
<b>PREREQUISITE COURSES:</b>	None		
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	Greek and English		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	YES		
<b>COURSE WEBSITE (URL)</b>	<a href="http://ies.teipir.gr">http://ies.teipir.gr</a>		

### (2) LEARNING OUTCOMES

#### Learning outcomes

*The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

*Consult Appendix A*

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of this course, the students possess advanced knowledge, skills and competences that enable them to:

- Know, understand, explain and discuss the role of sensors in the field of Electronics and their usefulness in various aspects of the economy and every-day life (e.g. Industry, Transportation, Medicine, Commercial Electronics, etc);
- Know, understand, name and classify the various types of modern and innovative applications of Sensors;
- Know, understand, explain by drawing diagrams and distinguish among the various types modern sensor system technologies;
- State and describe in detail using diagrams the implementation of a sensor system such as

- Micromechanics and the modern methods of implementing electronic devices;
- Know, understand, name and classify innovative networks for the transmission and exchange of sensor data; classify according to specs, protocol, range and autonomy; discuss relative merits and select appropriate architectures for given problems;
  - Design and simulate sensor networks using software tools.

<p><b>General Competences</b></p> <p><i>Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?</i></p>	
<p><i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i></p> <p><i>Adapting to new situations</i></p> <p><i>Decision-making</i></p> <p><i>Working independently</i></p> <p><i>Team work</i></p> <p><i>Working in an international environment</i></p> <p><i>Working in an interdisciplinary environment</i></p> <p><i>Production of new research ideas</i></p>	<p><i>Project planning and management</i></p> <p><i>Respect for difference and multiculturalism</i></p> <p><i>Respect for the natural environment</i></p> <p><i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i></p> <p><i>Criticism and self-criticism</i></p> <p><i>Production of free, creative and inductive thinking</i></p> <p>.....</p> <p><i>Others...</i></p> <p>.....</p>

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Production of free, creative and inductive thinking

**(3) COURSE CONTENT**

The course presents modern sensors as well as modern and innovative implementation fields. The course covers the following topics:

- Micro-Electro-Mechanical-Systems & Micro-Opto-Electro-Mechanical-Systems
- Electronic circuits connected to sensors and digital (wired and wireless) transmission of the collected data
- Wireless networks of sensors (BAN, PAN, LAN)
- Modern and innovative fields of implementation of sensor networks.

The course consists of six (6) sessions:

<b>1</b>	4 x 2-hours	<p><b>Introduction – Types of Sensors</b></p> <p>In the introduction the basic components of sensors and sensors’ systems are presented. The types of sensors according to the measured physical quantity, as well as the general functionalities of each type, are dealt with. Finally this section also deals with “classical” approximations of their implementation.</p>
<b>2</b>	6 x 2- hours	<p><b>Micromechanics – New technologies of technical implementation</b></p> <p>In the second section novel implementation methods of Micromechanical sensor structures are presented. Furthermore, the advantages of those techniques versus the classical methods of implementation are analyzed according to the validity, the size, the cost and the capability of their implementation into new and</p>

		innovative fields.
<b>3</b>	4 x 2-hours	<b>Sensor signal conditioning, calibration and readout</b>
		The third section analyzes the signal conditioning, the calibration circuits and methods, as well as analog to digital conversion systems.
<b>4</b>	6x 2-hours	<b>Wired sensor networks, data transmission and software of data acquisition and data analysis</b>
		The fourth section analyzes: a) the basic data digital transmission such as RS-232, SPI, I2C, IEEE-488 and their hardware and software implementation b) industrial wired nets of sensors such as RS-485, Ethernet, FieldBus and c) data acquisition and data analysis software such as LabView.
<b>5</b>	2x 2-hours	<b>Wireless Sensor Networks</b>
		The fifth section presents and analyzes the following topics: a) implementation of Wireless sensors' networks b) their physical layer c) the transmission protocols d) advanced topics such as the management of network energy, the re-distribution of data, its dynamical re-implementation etc.
<b>6</b>	4x 2-hours	<b>Wireless Sensor Networks implementation</b>
		Finally, the last section presents the fields of wireless sensor network implementation and the horizons that they open with emphasis on research and development projects.

In parallel to the theoretical course and within the framework of laboratory exercises and projects, students are familiarized with the procedure of Measurement-Calibration and Data acquisition from various sensors (i.e. thermal, optical, pressure, location, radiation etc). Furthermore, laboratory exercises for the development, functionality and management of wireless sensor networks are given. A visit is organized to a laboratory or industry that designs, constructs and/or calibrates sensors.

#### (4) TEACHING and LEARNING METHODS - EVALUATION

<b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i>	<ul style="list-style-type: none"> <li>● Face to face lectures in class</li> <li>● E-learning</li> </ul>
<b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> <li>● Use of electronic presentation with multimedia content in class,</li> <li>● Student support through the course webpage and the departmental e-learning platform (moodle),</li> <li>● Electronic communication of instructors and students, through the course webpage and by e-mail.</li> </ul>
<b>TEACHING METHODS</b> <i>The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography,</i>	Lectures, lab practice, homework assignments / project, study.

<p>tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</p> <p>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</p>	<b>Activity</b>	<b>Semester workload (hours)</b>
	Lectures	52
	E-learning	26
	Study lecture material	52
	Lab practice	26
	Report on lab practice	26
	Homework assignments or project and report (individual or group)	50
	Study and preparation for the exams	36
	Visit a company / production plant / institution	2
	<b>Course Total</b>	<b>270</b>
<p style="text-align: center;"><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Students are evaluated on the basis of both written and oral examinations, including personal reports and homework assignments on the work done in their practice / lab session.</p> <ul style="list-style-type: none"> <li>• Homework assignments / project reports (30%)</li> <li>• Oral grade (practice / lab) (20%)</li> <li>• Final written exam (50%)</li> </ul>	

## (5) ATTACHED BIBLIOGRAPHY

### -Recommended Books:

1. Sabrie Soloman, "Sensors Handbook", McGraw-Hill, 1998. ISBN10: 0070596301, ISBN13: 9780070596306
2. Pavel Ripka, Alois Tipek, "Modern Sensors", ISTE, 2007. ISBN10: 1905209665, ISBN13: 9781905209668
3. C.S. Raghavendra, Krishna M. Sivalingam, Taieb Znati, "Wireless Sensor Networks", Springer-Verlag, 2004. ISBN10: 1402078838, ISBN13: 9781402078835
4. Imad Mahgoub, Mohammad Ilyas, "Sensor Network Protocols", Taylor & Francis Inc, 2006. ISBN10: 0849370361, ISBN13: 9780849370366
5. Yueh-Min Ray Huang, "Sensors", Springer-Verlag, 2008. ISBN10: 3540690301, ISBN13: 9783540690306

### -Relevant Journals:

1. IEEE Sensors Journal
2. Elsevier Sensors and Actuators A: Physical
3. Elsevier Sensors and Actuators B: Chemical

4. Elsevier Sensing and Bio-Sensing Research
5. IEEE Transactions on Wireless Communications
6. ACM Transactions on Sensor Networks