COURSE SYLLABUS

University	**Alexandru Ioan Cuza University of Iaşi**	**Course title**	
Faculty	**Physics**	**NANO- AND MICROTECHNOLOGIES IN SENSORS AND ACTUATORS MANUFACTURING**	
Department	**Physics**		
Domain	**Physics**	**Course category** (FC/SC/CC[1]): SC	**Term** (1-4): 1
Level	**Postgraduate (MA)**	**Course type** (Co/El/F[2]): El	

I. Course structure

Number of hours/week				Credits	Total class hours/ semester	Total hours of individual activity	Examination type (C/Ex/CE[3])	Teaching language
Course	Seminar	Lab.	Project	**6**	**56**	**124**	**C**	**English**
2		**2**						

II. Instructors

	Academic degree[4]	Scientific degree	Name and surname	Faculty position (tenure/ associate - organization)
Course	Associate professor	Ph.D.	Brinza Florin	tenure
Seminar				
Laboratory	Associate professor	Ph.D.	Brinza Florin	tenure

III. Prerequisites

Solid state physics, Circuit devices or Electricity and Magnetism, Materials engineering and technology

IV. Course objectives

The main objective is to create a base of knowledge in the field of sensors and actuators. This base include suitable physical properties of materials used in sensor manufacturing, basic technologies of materials engineering, specific technologies for circuit devices manufacturing. The knowledge is extended to possibilities to translate sensor and actuators categories to micro- and nanoscale. After course, students are able to design, prepare and testing a sensor structure.

V. Course content

Course	**A review of mains materials used in sensor and actuators manufacturing.** Metals, semiconductors and dielectrics. Structural properties. Electric and magnetic properties. **Technologies in materials processing and engineering.** Single crystal growth. Thin films deposition. Epitaxial growth. Photolithography, selective etching. Nanotechnologies in materials processing. **Sensor and actuators characteristics.** Transfer function. Accuracy. Calibration. Nonlinearity. Hysteresis. Resolution. Environmental factors. **Temperature sensors.** Basic principles. Types. Temperature micro sensors. Thermal conduction sensors. Areas of thermal radiation nanosensors. **Force and Pressure sensors. Physics of pressure measurement.** Classification. MEMS technologies in pressure sensors. Piezoresistive sensors. Capacitive sensors. **Gas sensors.** Basics of operating. Manufacturing technologies. Materials used for various gases. Methods used in dimensionality decrease. **Optical radiation sensors.** Physics of optical radiation sensing devices. Technologies in micro- and nano-manufacturing. Optical sensors areas. **Actuators.** Classification. Physical principles of actuators. Actuators manufacturing. MEMS. Nanoactuators.
Seminar	

[1] FC – fundamental course, SC – specialty course, CC – complementary course
[2] Co – compulsory, El – elective, F – facultative
[3] C – colloquium, Ex – exam, CE – colloquium AND exam
[4] Professor / Associate professor / Lecturer / Assistant professor / Teaching assistant

Laboratory	1. Preparation of thin films using thermal evaporation and magnetron sputtering. 2. Preparation of thin films and nanostructured matrix using electrochemical methods. 3. Obtaining of photolithographic structures. 4. Experimental study upon structure and properties of thermal sensors. 5. Experimental study upon structure and properties of pressure sensors. 6. Experimental study upon structure and properties of gas sensors. 7. Experimental study upon structure and properties of humidity sensors. 8. Experimental study upon structure and properties of piezoelectric actuators. 9-13. Manufacture and sensing characteristics for a sensor structure - SM (assisted individual activity). 14. Communication of obtained results.

VI. Minimal required references

1. Charles Kittel, Introduction to solid state physics, 8-th edition, John Wiley and Sons, 2004.
2. Stephen Beeby, Graham Ensell, Michael Kraft, Neil White, MEMS Mechanical Sensors, 2004, ARTECH HOUSE, INC., Norwood.
3. Fraden, Jacob, Handbook of modern sensors: physics, designs, and applications–3rd ed., 2004, Springer-Verlag New York.

VII. Didactic methods

Course: multimedia assisted exposition and conversation
Laboratory: lecture and active methods (research and exploitation activity)

VIII. Assessment

Pre-conditions	Attendance (all activities), active participation to laboratory activities	
Exam dates	**1st Assessment**	November
	2nd Assessment	January

	Assessment means and methods	**Percentage of the final grade**
Exam/Colloquium	colloquium	60%
Seminar		
Laboratory	Communication of obtained results in SM	40%