DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	DSEA Sep 2020
TITLE OF THE MODULE	**Code**
Technologies for receiving and transmitting medical data	**P11**

Teacher(s)	Department
Coordinating: Serhii Dobriak, PhD **Others:**	Department of Computer and Information Technology (CIT)

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsary/elective)
Bachelor	8th semester (fourth year) for Bachelor	Elective

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, Hands-on Lab Session	18 weeks	Ukrainian / English

Prerequisites	
Prerequisites: the study of disciplines "Physics", "Electronics and computer circuitry", "Components of modern computer systems", "Distributed systems and parallel computing technologies".	**Co-requisites (if necessary):** none

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
7.5	225	144	81

Aim of the module (course unit): competences foreseen by the study programme

Students should be able to:

– understand the principle of operation of micro devices, microcircuits and their use in medicine;

– have the technical knowledge necessary for computer design, manufacture, analysis and characteristics of nanostructured materials, micro-and nano-scale devices for medical use;

– understand the term intelligent sensor; know its characteristics, architecture, software level and usage;

– understand the principle of building a network of sensors; know the topics for sensor networks: communication protocols, data collection and processing, energy management, safety, reliability and resilience to failure for medical use;

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: - acquaintance with the basic theoretical positions of realization of methods of processing random samples and their use in specific tasks; - Familiarization with the definition of different types of models, their use, testing of hypotheses, the difference between model predictions, concepts of suitability and model constraints.	Work with the lecture notes as well as on the available fundamental subject literature	Knowledge test
Skills: - formation of theoretical knowledge and acquiring practical skills for simulation and design of micro and nano scale systems for medical use; - formation of the ability to use smarts sensors and sensors networks for medical use; - development of skills in the use of communication protocols;	Lectures, practical work, consultation	Active attendance on lectures, lab reports
Competences: Study the subject literature, exchange knowledge, working in group	Lectures, practical work, consultation	Lab reports

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practical work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
1. Overview and Introduction. Micro and Nano scale systems. Introduction to Design of MEMS and NEMS. Materials for MEMS for medical use.	4			4			**8**	**4**	Study exam/ Lab report
2. MEMS Fabrication technologies. Microsystem fabrication processes. Packaging.	4			4			**8**	**4**	Study exam/ Lab report
3. Microsensors. MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors.	6			6			**12**	**7**	Study exam/ Lab report
4. Microactuators. Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps for medical use.	6			6			**12**	**7**	Study exam/ Lab report
5. Nanosystems and Quantum Mechanics. Atomic Structures and Quantum Mechanics, Molecular and Nanostructure.	4			4			**8**	**3**	Study exam/ Lab report

6. Smart sensors fundamentals. Basic sensor technolog Sensor systems. Smart sensors definitions.	6			6			**12**	**7**	Study exam/ Lab report
7. Smart sensors. Characteristics; Smart sensors architectures. Smart sensors buses and interfaces. Data acquisition methods for smart sensors. Smart sensors for electrical and non-electrical variables for medical use.	6			6			**12**	**7**	Study exam/ Lab report
8. Sensor networks architectures. Single node architecture. Multi node architectures. Design principles. Energy efficient topologies. Wired sensor networks and wireless sensor networks. Applications.	6			6			**12**	**7**	Study exam/ Lab report
9. Communication protocols. Phisical layer. MAC protocols. Link layer protocols. Localization and positioning. Routing protocols. Transport layer.	6			6			**12**	**7**	Study exam/ Lab report
10. Data gathering and processing. Protocols for gather information. Data processing techniques.	6			6			**12**	**7**	Study exam/ Lab report
11. Energy management. Energy consumption of sensor nodes. Techniques for reducing consumption and communication energy for medical sensors.	6			6			**12**	**7**	Study exam/ Lab report
12. Security, reliability and fault-tolerance. Security and privacy protection. Reliability support. Fault-tolerance. Sensor networks standards.	6			6			**12**	**7**	Study exam/ Lab report
13. Optical sensors for bio-medical applications. Wave Optics. Optical sensors for blood	6			6			**12**	**7**	Study exam/ Lab report

parameter measurement. Photonic Biosensors. Biosensor Microsystems. Biosensors based on Photonic Crystals. Fluorescence based Sensors.									
Total	**72**			**72**			**144**	**81**	

Assessment strategy	**Weight in %**	**Deadlines**	**Assessment criteria**
Products and performance assessments	50%	During the semester	All labs should be passed
Written Exam	50%	Exam	The work is done completely without mistakes

Author	**Year of issue**	**Title**	**No of periodical or volume**	**Place of printing. Printing house or internet link**
Compulsory literature				
Northrop, Robert B.	2001	Introduction to dynamic modeling of neuro-sensory systems		Biomedical engineering series (CRC Press) IISBN 0-8493-0814-3
Andreas Inmann and Diana Hodgins	2013	Implantable sensor systems for medical applications		Woodhead Publishing Limited ISBN 978-1-84569-987-1
Andrea Baschirotto, Kofi A.A. Makinwa, Pieter Harpe	2013	Frequency References, Power Management for SoC, and Smart Wireless Interfaces		Springer ISBN 978-3-319-01079-3
Andrea Baschirotto, Kofi A.A. Makinwa, Pieter Harpe	2017	Hybrid ADCs, Smart Sensors for the IoT, and Sub-1V & Advanced Node Analog Circuit Design		Springer ISBN 978-3-319-61284-3
Richard C. Dorf	2006	Sensors, Nanoscience, Biomedical		CRC Press

		Engineering, and Instruments		ISBN 0-8493-7346-8
Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu, Youn-Long Lin	2017	Smart Sensors and Systems		Springer ISBN 978-3-319-33200-0
Additional literature				
R.S. Muller	1991	Microsensors		IEEEPress
Alan S Morris, Reza Langri	2015	Measurement and Instruments: Theory and Applocation		Elsevier