INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Option - Micro/Nanotechnologies and Biomedical Applications			Field of study	Biomedical Sciences		
Master in	Biomedical Technology - Medical Signals and Instrumentation			School	School of Technology and Management		
Academic Year	2017/2018	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	5025-422-1204-01-17		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tuturial; O - Other

Name(s) of lecturer(s): Diana Margarida Domingues de Pinho, João da Rocha e Silva

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Acquire knowledge and understanding about the main micro and nano-fabrication tecnologies and their application in biomedical sciences,
2. Understand the physical principles and challenges of biomicrofluidics,
3. Acquire knowledge and understanding on the importance of BioMEMS, lab-on-chips and point-of-care systems in biomedical engineering,
4. Acquire knowledge about several fabrication methods to manufacture micro and nano biomedical devices,
5. Acquire knowledge and understanding about nanoparticles to treat oncological and cardiovascular dieseases.

Prerequisites

Before the course unit the learner is expected to be able to:
The students must have basic skills on physics, chemistry and mathematics.

Course contents

Introduction to MEMS and BioMEMS. Physical principles of miniaturizationFluid mechanics overview. Micro- and nano-fabrication technology. Biomicrofluidics and microcirculation fundamentals. Mechanical properties of the blood cells. Microsystems technology: microvalves, micropumps and biosensors. Lab-on-chips for biomedical applications. Nanoparticles for biomedical applications. Biofabrication and bioflow measuring methods in microchannels.

Course contents (extended version)

1. Introduction to MEMS and BioMEMS;
2. Physical principles of miniaturization;
3. Micro- and nano-fabrication technology:
   - Micromachining;
   - Soft-litography;
   - Micromolding;
   - Xurography.
4. Biomicrofluidics and microcirculation fundamentals:
   - Blood flow in arteries;
   - Blood flow in capillaries - microcirculation;
   - Fahraeus-Lindqvist effect;
   - Cell-free layer;
   - Velocity profile.
5. Mechanical properties of the blood cells:
   - Deformation;
   - Interaction between cells.
6. Microsystems technology: microvalves, micropumps and biosensors;
7. Lab-on-chips for biomedical applications;
8. Nanoparticles for biomedical applications;
9. Biofabrication and bioflow measuring methods in microchannels:
   - Drawing geometries, in a CAD software, for plasma layer observation;
   - Drawing geometries, in a CAD software, for separation of blood cells.
10. Techniques for pressure measurements in microchannels:
    - Use of Image J software for measurement and understanding of flow phenomena in microchannels.

Recommended reading

1. Saliterman, S. S. , Fundamentals of BioMEMS and Medical Microdevices, SPIE Press, 2006.
2. Ethier, C. R. , Simmons, C. A. , Introductory Biomechanics: from cells to organisms, Cambridge texts in Biomedical Engineering, 2007.
3. Lee, A. P. , Lee, L. J. , Ferrari, M. , Biological and Biomedical Nanotechnology, Springer, 2006.
4. Caro, C. , Pedley, T. , Schroter, R. , Seed W. , The Mechanics of the Circulation, Oxford University Press, 1978.
5. Beebe, D, Mensing, G. , Walker, G. , Physics and applications of microfluidics in biology. Annu. Rev. Biomed. Eng. 4, 261-286, 2002.

Teaching and learning methods

The unit will be taught using a combination of lectures such as: theoretical exposition, discussion, practical classes, self guided learnig, and laboratory assignments.

A study guide and support material will be provided to the students. The practical assignments will be performed with groups of maximum four students.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
   - Final Written Exam - 40% (Minimum of 7 values in 20.)
   - Experimental Work - 60%
2. Alternative 2 - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

Diana Margarida Domingues de Pinho, João da Rocha e Silva	João Eduardo Pinto Castro Ribeiro	Fernando Jorge Coutinho Monteiro	José Adriano Gomes Pires
07-02-2018	12-02-2018	28-02-2018	28-02-2018