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TOMOGRAPHY AND 3D IMAGING APPLIED TO BIOMEDICAL SAMPLES

1. SYLLABUS INFORMATION

1.1. Course title

Tomography and 3D Imaging Applied to Biomedical Samples

1.2. University

Universidad Autónoma de Madrid

1.3. Semester

First year, second semester

2. COURSE DETAILS

2.1. Course nature

Optional

2.2. ECTS Credit allotment

6

2.3. Recommendations

Basic knowledge of image processing will be useful to follow the course (image filtering, Fourier transform, quantification…). Basic experience with Matlab is required to follow the lab assignments.

Subjects related to this course are:

- Biomedical Signal Processing
- Basic Image Processing Algorithms (IPCV Master programme)

2.4. Faculty data

Theory

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3. COMPETENCES AND LEARNING OUTCOMES

3.1. Course objectives

This course introduces a set of widely used medical imaging technologies which allows obtaining tridimensional images with diagnostic information of the patients. Specifically, the course provides the basics of anatomical imaging (e.g. X-Ray imaging), which provides structural information, and radionuclide imaging, which comprises a set of technologies capable of obtaining functional information of organs and tissues and the molecular and cellular level. Students will gain basic understanding of the physics of image acquisition, the instrumentation, the algorithms required for image processing the data and the most important biomedical applications.

3.2. Course contents

UNIT 1: X-Ray Imaging
1.1. Fundamentals and biological effects of X-Rays
1.2. Basic instrumentation for X-Ray generation and detection
1.3. 2D and 3D X-Ray Imaging Systems
1.4. Data processing and corrections
1.5. Basics of Tomography and image reconstruction
1.6. Clinical applications and research trends

UNIT 2: Radionuclide Imaging
2.1. Basic Physics
2.2. The Gamma Camera basic principles
2.3. SPECT: Single Photon Emission computed Tomography
2.4. PET: Positron Emission Tomography
2.5. Multimodality Systems
2.6. Clinical applications and research trends

UNIT 3: Other Imaging Modalities
3.1. Basic Physics
3.2. Instrumentation
3.3. Data processing
3.4. Applications

3.3. Course bibliography

1. Cherry, Sorenson & Phelps. Physics in Nuclear Medicine, 4th Edition, Saunders Editorial, 2012

2. Martz, Logan et al. X-Ray Imaging: Fundamentals Industrial Techniques and Aplications, 1st

Edition, CRC 2017

3. Biomedical Imaging, Applications and Advances, Edited by Peter Morris, 2014, Woodhead Publishing

4. TEACHING-AND-LEARNING METHODOLOGIES AND STUDENT WORKLOAD

4.1. Contact hours

Any time during the course with previous agreement among students and the course instructors.

4.2. List of training activities

Activity		Hours	%	Hours	%
In-class work	Theoretical lectures	26	17,3	55	36,6
	Practical lectures	26	17,3		
	Exams	3	2		
Out-of-class work	Practical activities in the lab (2h x 13 weeks)	45	30	95	63,3
	Regulated individual work and study	0	0		
	Unregulated individual work and study to prepare for the final test	50	33,3		
TOTAL WORKLOAD: 25 hours x 6 ECTS		150			

5. EVALUATION PROCEDURES AND WEIGHT OF COMPONENTS IN THE FINAL GRADE

5.1. Regular assessment

The grading range is from 0.0 to 10.0. The maximum grade is 10.0 and each of the parts (labs and exam) will be also graded with the same grading range. In order to pass the course, it is necessary to have a pass grade (equal or greater than 5.0) in the overall evaluation, as well as a pass grade (equal or greater than 4.0) in the two individual parts (Theory, TH and Practice, PR).

During the ordinary period there will 2 exams, a midterm exam and Final exam with contents from lab and theory. In both exams the final score will be computed as

Exam Mark= (TH+ PR) / 2

If some student don pass any of the part from the midterm exam, it will be possible to recover in the Final ordinary exam. If the student passes the midterm exam, it will be only required to perform the part of the exam related to the remaining part of the course.
In the case the student pass the midterm and the final exam the score will be computed

Final Mark = 2/3 x ((Exam 1 Mark + Exam 2 Mark)/2) + 1/3 (Average score obtained in the lab assignments)

In the case the student don't pass the midterm exam the final the score will be computed as
Final Mark = 2/3 x (Exam 2 Mark) + 1/3 (Average score obtained in the lab assignments)

5.2. List of evaluation activities

Evaluatory activity	%
Midterm evaluation	33,33
Final exam	33,33
Lab assignments	33,33