ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000967 - Biomedical Images

DEGREE PROGRAMME

09AU - Master Universitario En Ingenieria Biomedica

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000967 - Biomedical Images
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09AU - Master Universitario en Ingenieria Biomedica
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Maria Elena Hernando Perez		mariaelena.hernando@upm.es	Sin horario.
Enrique Javier Gomez Aguilera (Subject coordinator)		enriquejavier.gomez@upm.es	- -
Ignacio Oropesa Garcia		i.oropesa@upm.es	Sin horario.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE-MIB09 - Analizar, aplicar y proponer métodos y técnicas de generación y procesamiento de imagen para el análisis, diseño e innovación de sistemas avanzados de imágenes biomédicas

CG-MIB01 - Resolver problemas e integrar conocimiento en temas nuevos o escasamente definidos y en entornos multidisciplinares del área de la Ingeniería Biomédica

CG-MIB02 - Analizar y aplicar la reglamentación correspondiente a la sensibilidad social y ética en los ámbitos de operación que pueden darse en Ingeniería Biomédica

CG-MIB03 - Utilizar la filosofía, el método científico y el método experimental para la búsqueda de innovación, la curiosidad científica y el desarrollo de actitudes creativas

CG-MIB04 - Utilizar las tecnologías de la información y la comunicación para la búsqueda de información, datos bibliográficos y adquisición de nuevo conocimiento para la formación permanente y el trabajo autónomo

CG-MIB05 - Utilizar técnicas de expresión oral y escrita para comunicar trabajos y conclusiones a comunidades de iguales o divulgación científica, elaboración de artículos, manuales de estilo y herramientas de edición para fomentar la capacidad de comunicación y diseminación de resultados

CG-MIB06 - Aplicar técnicas de trabajo colaborativo en equipos multidisciplinares internacionales y liderazgo, así como utilizar métodos para asumir la responsabilidad de orientar y dirigir trabajos científicos en el ámbito de la ingeniería Biomédica

CG-MIB07 - Utilizar la lengua inglesa como herramienta de trabajo

3.2. Learning outcomes

RA77 - Be able to analyze and apply current methods and techniques in image processing for the analysis and design of advanced systems of generation and processing of biomedical images.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

OBJECTIVE

During this course, students will be able to analyse and apply current methods and techniques in image processing for the analysis and design of advanced biomedical imaging processing systems. Course activities include: analyzing of current trends in the design of state-of-the-art systems, as well as the processing techniques used in the current clinical environment and in research.

CONTENTS

0. Introduction to the different acquisition techniques of medical images

1. Physical principles of radiology and nuclear medicine and their influence on the design of imaging systems.

2. Radiology

3. Nuclear Medicine: scintigraphy, design factors, image quality factors, SPECT and its clinical applications; Positron Emission Tomography (PET): design parameters, new applications, hybrid PET-CT, PET-RM system

4. Magnetic resonance imaging: image parameters, pulse sequences, imaging methods, quality factors and main applications in neuroimaging and cardiology.

5. Ultrasound imaging: advanced ultrasound techniques and new clinical applications

6. DICOM standard

7. Advanced processing methods: intensification, enhancement and segmentation of biomedical images.

8. Practical work on image processing

9. Computed tomography: design of CT systems, image quality, reconstruction and new applications.

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4.2. Syllabus

1. 0. Introduction to the different acquisition techniques of medical images
2. 1. Physical principles of radiology and nuclear medicine and their influence on the design of imaging systems.
3. 2. Radiology
4. 3. Nuclear Medicine: scintigraphy, design factors, image quality factors, SPECT and its clinical applications; Positron Emission Tomography (PET): design parameters, new applications, hybrid PET-CT, PET-RM system
5. 4. Magnetic resonance imaging: image parameters, pulse sequences, imaging methods, quality factors and main applications in neuroimaging and cardiology.
6. . Ultrasound imaging: advanced ultrasound techniques and new clinical applications
7. 6. DICOM standard
8. Advanced processing methods: intensification, enhancement and segmentation of biomedical images.
9. 8. Practical work on image processing
10. 9. Computed tomography: design of CT systems, image quality, reconstruction and new applications.

5. Schedule

5.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Course presentation and introduction to medical imaging** Duration: 02:00 Lecture **Unit 1** Duration: 02:00 Lecture			**Lecture attendance and participation** Other assessment Continuous assessment Presential Duration: 00:00
2	**Unit 2** Duration: 02:00 Lecture **Unit 3** Duration: 02:00 Lecture			
3	**Unit 4** Duration: 04:00 Lecture			
4	**Unit 5** Duration: 02:00 Lecture			
5	**Unit 6** Duration: 02:00 Lecture **Unit 7** Duration: 02:00 Lecture			
6		**Practical session** Duration: 01:30 Laboratory assignments		**Practical session 1 - Report** Group work Continuous assessment Presential Duration: 00:30
7	**Unit 9** Duration: 04:00 Lecture			
8				**Written test** Written test Continuous assessment Presential Duration: 02:00 **Group work** Group presentation Continuous assessment Presential Duration: 02:00 **practical session**

				Problem-solving test Final examination Presential Duration: 00:30
9				**Exam** Written test Final examination Presential Duration: 02:00
10				
11				
12				
13				
14				
15				
16				
17				

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Lecture attendance and participation	Other assessment	Face-to-face	00:00	5%	5 / 10	
6	Practical session 1 - Report	Group work	Face-to-face	00:30	15%	4 / 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07 CE-MIB09 CB08 CB09 CB10
8	Written test	Written test	Face-to-face	02:00	60%	4 / 10	CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB07 CG-MIB01 CG-MIB02 CB06 CB07 CB08 CB09 CB10 CE-MIB09
8	Group work	Group presentation	Face-to-face	02:00	20%	5 / 10	CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CB06 CB07 CB09

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
8	practical session	Problem-solving test	Face-to-face	00:30	15%	5 / 10	CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CB06 CB07 CB08 CB09 CB10 CE-MIB09
9	Exam	Written test	Face-to-face	02:00	85%	5 / 10	CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CB06 CB07 CB08 CB09 CB10 CE-MIB09 CG-MIB02

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exam	Written test	Face-to-face	02:00	85%	5 / 10	CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CB06

						CB07 CB08 CB09 CB10 CE-MIB09
practical sessions	Problem-solving test	Face-to-face	00:00	15%	5 / 10	CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CG-MIB03 CB06 CB07 CB08 CB09 CB10 CE-MIB09

6.2. Assessment criteria

Evaluation is based on attendance to classes (5%), written test (60%), practical session (15%), presentation of group work (20%).

General dispositions

Students will be qualified through continuous evaluation by default. According to the Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid, students willing to renounce to continuous evaluation must send an email via Moodle to the coordinator before three weeks after ending the course.

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by Junta de Escuela for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single

exam can be carried out along the semester.

Extraordinary examination will be carried out by the final examination and practical sessions method.

Continuous assessment

Passing score for the whole course is 5/10.

Assistance to lectures and practical session is compulsory unless justified absence.

Global assessment

Global assessment is based on an exam and other practical sessions. Students will need to attain a score of 5 or above to pass the course.

Students who do not reach the passing score via continuous assessment will be able to do so in the extraordinary examination.

Extraordinary assessment

Extraordinary assessment is based on an exam and other practical sessions. Students will need to attain a score of 5 or above to pass the course.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
FÍSICA Y DESCRIPCIÓN DE SISTEMAS DE IMÁGENES MÉDICAS (básica) P. Suetens. Fundamentals of Medical Imaging. Cambridge University Press. 2009 Jerry L. Prince, Jonathan Links, Medical Imaging Signals and Systems, Pearson Prentice Hall, 2013	Bibliography	
PROCESAMIENTO DE IMAGEN MÉDICA (básica) R. C. Gonzalez, R. E. Woods. Digital Image Processing. Pearson Education. 2008	Bibliography	

8. Other information

8.1. Other information about the subject