ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000979 - Medical Imaging Laboratory

DEGREE PROGRAMME

09AU - Master Universitario En Ingenieria Biomedica

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000979 - Medical Imaging Laboratory
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	09AU - Master Universitario en Ingenieria Biomedica
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Patricia Sanchez Gonzalez (Subject coordinator)	D-213	p.sanchez@upm.es	M - 11:00 - 12:00 Para acudir a tutoría se ha de concertar la cita previamente por correo electrónico
Alexander Peter Seiffert	D213	ap.seiffert@upm.es	Sin horario. Previa solicitud por correo

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

member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- MATLAB programming experience

4. Skills and learning outcomes *

4.1. Skills to be learned

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.

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

4.2. Learning outcomes

RA32 - Análisis y aplicación de técnicas avanzadas de diagnóstico médico por imagen y señal para obtención no invasiva de información sobre el funcionamiento o actividad biológica de un tejido u órgano, con especial énfasis en el diagnóstico de patologías cardiovasculares y cerebrales. El conocimiento teórico se aplicará de forma práctica en el desarrollo de algoritmos de procesamiento utilizados en el análisis y visualización de las imágenes

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The course is focused on the application of the main methods of medical image processing using MATLAB. The structure of the subject is established in 5 guided practices:

- P1: Introduction to MATLAB. The objective of this P1 is to make known to the student the main basic methods of processing and representation of biomedical images in MATLAB.

- P2: Global processing. Enhancement and intensification of medical imaging. The aim is to apply the main global processing techniques based on the adjustment of the image histogram.

- P3: Local processing. Enhancement and intensification of medical imaging. The aim is to apply the main global processing techniques based on convolution matrices.

- P4: Morphological Image Processing. The objective of P4 is to identify and apply morphological operators such as erotion and dilation, openning and closing.

- P5: Image segmentation. The aim of P5 is to present some segmentation techniques for medical imaging.

5.2. Syllabus

1. P1: Introduction to MATLAB

   1.1. Matlab - Images classification- Medical imaging reading - Images visualization

2. P2: Global processing. Enhancement and intensification of medical imaging

   2.1. Histogram: concept, calculus and filtering - Aplication in TC imaging: histogram based segmentation - Contrast enhancement: linear and non-linear - Histogram equalization

3. P3: Local processing. Enhancement and intensification of medical imaging

   3.1. - Convolution and mask concepts -Smoothing: average, median and gaussian filtering - Edges detection: Sobel, Roberts and zerocross - Laplacian filter - Aplication on retinophaty images

4. P4: Morphological Image Processing.

   4.1. - Structuring elements - Erosion and dilation- Opening and closing -Reconstruction filtering

5. P5: Image segmentation.

   5.1. - Thresholding - Multiple thresholds - Adaptive thresholds - Otsu algorithm- Region growing

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Course introduction** Duration: 02:00 Lecture			
2		**P1** Duration: 03:00 Laboratory assignments		
3		**P2** Duration: 03:00 Laboratory assignments		
4		**P2** Duration: 03:00 Laboratory assignments		
5		**P3** Duration: 03:00 Laboratory assignments		**P2** Group work Continuous assessment Not Presential Duration: 00:00
6		**P3** Duration: 03:00 Laboratory assignments		
7		**P4** Duration: 03:00 Laboratory assignments		**P3** Group work Continuous assessment Not Presential Duration: 00:00
8		**P4** Duration: 03:00 Laboratory assignments		
9		**P5** Duration: 03:00 Laboratory assignments		**P4** Group work Continuous assessment Not Presential Duration: 00:00
10		**P5** Duration: 03:00 Laboratory assignments		
11		**Group projects** Duration: 03:00 Laboratory assignments		**P5** Group work Continuous assessment Not Presential Duration: 00:00

12		**Group projects** Duration: 03:00 Laboratory assignments		**Final project** Other assessment Continuous assessment Not Presential Duration: 00:00
13		**Group projects presentations** Duration: 03:00 Additional activities		
14		**Group projects presentations** Duration: 03:00 Additional activities		
15				
16				
17				**Exam** Written test Final examination Presential Duration: 01:00 **Individual project** Individual presentation Final examination Presential Duration: 02:00 **P2** Individual work Final examination Not Presential Duration: 00:00 **P3** Individual work Final examination Not Presential Duration: 00:00 **P4** Individual work Final examination Not Presential Duration: 00:00 **P5** Individual work Final examination Not Presential Duration: 00:00

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	P2	Group work	No Presential	00:00	20%	4 / 10	CB09 CB10 CG-MIB07
7	P3	Group work	No Presential	00:00	20%	4 / 10	CB09 CB10 CG-MIB07
9	P4	Group work	No Presential	00:00	20%	4 / 10	CB09 CB10 CG-MIB07
11	P5	Group work	No Presential	00:00	20%	4 / 10	CB09 CB10 CG-MIB07
12	Final project	Other assessment	No Presential	00:00	20%	5 / 10	CB09 CB10 CG-MIB07

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Exam	Written test	Face-to-face	01:00	20%	4 / 10	CB09 CB10 CG-MIB07
17	Individual project	Individual presentation	Face-to-face	02:00	40%	5 / 10	CB09 CB10 CG-MIB07
17	P2	Individual work	No Presential	00:00	10%	4 / 10	CB09 CB10 CG-MIB07
17	P3	Individual work	No Presential	00:00	10%	4 / 10	CB09 CB10 CG-MIB07

17	P4	Individual work	No Presential	00:00	10%	4 / 10	CB09 CB10 CG-MIB07
17	P5	Individual work	No Presential	00:00	10%	4 / 10	

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
P2-P5	Individual work	No Presential	40:00	40%	4 / 10	CB09 CB10 CG-MIB07
Practical exam	Problem-solving test	Face-to-face	02:00	20%	4 / 10	CB09 CB10 CG-MIB07
Individual project	Individual work	Face-to-face	02:00	40%	5 / 10	CB09 CB10 CG-MIB07

7.2. Assessment criteria

General dispositions

Evaluation will assess if students have acquired all the competences of the subject. Thus, extraordinary evaluation 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.

- In order to pass the course, students must obtain a minimum grade of 5/10, according to the dispositions hereby explained.

- All assignments must reflect the personal work of the student, although discussion and teamwork will be encouraged in order to better understand the problems to be solved. Detected copies will automatically mean failing the course both for the person who copies and the person who is copied.

- Any assessment or delivery made may require a complementary oral assessment by the teacher to validate that it has been made by the student without the aid of IA systems

Progressive evaluation

- In order to pass the course, students must hand over the three session assignments. Submissions after deadline will be penalised with up to 2/10 points.

- Students must obtain a minimum score of 4/10 per report in order to pass the course.

- Students must obtain a minimum score of 5/10 in the final assignment to pass the course.

Global evaluation

- In order to pass the course, students must hand over the four session assignments (including session 1). Students will be responsible of doing the assignments with their own means.

- Students will carry out a final project individually, which will be defended orally in the final exam day assigned by the Junta de Escuela.

- Students must obtain a minimum score of 4/10 per report in order to pass the course.

- Students must obtain a minimum score of 5/10 in the final assignment to pass the course.

- Students must obtain a minimum score of 4/10 in the individual project 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 examination

- In order to pass, students must hand in reports hand over the four session assignments and a final individual project. On those assignments on which the students already have a passing score (4/10 per practical session and 5/10 for the individual project), they may choose whether to hand in a new report or keep their current score. For failed reports, students will need to hand in new versions.

- In order to pass, students will perform a final examination in which they will be asked to defend their reports and demonstrate practically the knowledge acquired in them. The exam may be constituted both from oral and written parts.

- Students must obtain a minimum score of 5/10 in the final examination to pass the course.

- Students failed in the extraordinary examination, practical sessions assignment scores will only be transferred from one academic year to the next.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
R. C. Gonzalez, R. E. Woods. Digital Image Processing. Pearson Education. 2008	Bibliography	
G. Dougherty. Digital Image Processing for Medical Applications. , Cambridge University Press. 2009	Bibliography	
Insight into Images: Principles and Practice for Segmentation, Registration and Image Analysis, 1st Edition, Terry S. Yoo, 978-1568812175, 2004	Bibliography	

9. Other information

9.1. Other information about the subject

This course is related to United Nations' Sustainable Development Goals SDG3 (Good health and well-being).