ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000978 - Biomedical Signals Laboratory

DEGREE PROGRAMME

09AU - Master Universitario En Ingenieria Biomedica

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000978 - Biomedical Signals 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	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Ignacio Oropesa Garcia (Subject coordinator)	D-213, ETSIT	i.oropesa@upm.es	Th - 10:00 - 11:00 Appointments must be made via email with the professor.
Daniel Gonzalez Nieto	035(ETSIT)/CTB	daniel.gonzalez.nieto@upm.es	Tu - 09:00 - 10:00 Appointments must be made via email with the professor.

Maria Fernanda Cabrera Umpierrez		mf.cabrera@upm.es	Sin horario. Appointments must be made via email with the professor.

* 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

- SeÑales BiomÉdicas

3.2. Other recommended learning outcomes

- Basic MATLAB knowledge is necessary to successfully complete the course.

4. Skills and learning outcomes *

4.1. 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.

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

4.2. Learning outcomes

RA29 - Análisis y aplicación de técnicas avanzadas de diagnóstico médico mediante imágenes y señal para obtención no invasiva de información sobre el funcionamiento o actividad biológica de un tejido u órgano. El conocimiento teórico se aplicará de forma práctica en el desarrollo de algoritmos de proceso utilizados en el análisis y visualización de las imágenes y señales biomédicas

* 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 goal of the course is to apply the most important concepts taught in Biomedical Signal Processing using real biomedical signal recordings. The student will work either with their own biomedical registries (acquired during class time using different acquisition systems) or extracted from a physiological signal database. In this way, the student will develop the basic tools to face future challenges related to biomedical signal processing.

The course is structured in 5 laboratory sessions:

Session 1 - Introduction to MATLAB applied to biomedical signal processing: In this session, students will practice on the basic MATLAB commands necessary for signal processing and analysis. For this, students will work both with deterministic signals and EMG signals.

Session 2 - Analysis of conductance / voltage and kinetic relationships activation in ionic channels: This session is aimed at understanding the activation mechanisms of currents in ionic channels sensitive to changes in the potential of cellular membrane.

Session 3 - EEG signal processing: In this session students will learn to apply different signal processing techniques for the resolution of EEG-related problems.

Session 4 - Analysis of somatosensory evoked potentials: This session is aimed at understanding the basic mechanisms of generation of evoked potentials in the somatosensory cortex.

Session 5 - ECG signal processing: In this session students will learn to apply different signal processing techniques for the resolution of ECG-related problems.

5.2. Syllabus

1. Session 1 - Introduction to MATLAB applied to biomedical signal processing
2. Session 2 - Analysis of conductance / voltage and kinetic relationships activation in ionic channels
3. Session 3 - EEG signal processing
4. Session 4 - Analysis of somatosensory evoked potentials
5. Session 5 - ECG signal processing

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Course introduction** Duration: 01:00 Lecture	**Session 1** Duration: 02:00 Laboratory assignments		**Attendance and participation** Other assessment Continuous assessment Not Presential Duration: 00:00
2		**Session 1** Duration: 03:00 Laboratory assignments		
3		**Session 2** Duration: 03:00 Laboratory assignments		**Session 1 report** Group work Continuous assessment Not Presential Duration: 08:00
4		**Session 2** Duration: 03:00 Laboratory assignments		
5		**Session 3** Duration: 03:00 Laboratory assignments		
6		**Session 3** Duration: 03:00 Laboratory assignments		
7		**Session 4** Duration: 03:00 Laboratory assignments		**Session 3 report** Group work Continuous assessment Not Presential Duration: 10:00
8		**Session 4** Duration: 03:00 Laboratory assignments		
9		**Session 5** Duration: 03:00 Laboratory assignments		
10		**Session 5** Duration: 03:00 Laboratory assignments		
11			**Oral presentation of final assignment** Duration: 03:00 Cooperative activities	**Session 5 report** Group work Continuous assessment Not Presential Duration: 10:00 **Written assignment on sessions 2 or 4** Group work Continuous assessment Not Presential Duration: 10:00

				Final assignment: Analysis of a scientific article related with biomedical signal processing Individual work Continuous assessment Not Presential Duration: 10:00
12				**Session 1 report** Individual work Final examination Not Presential Duration: 08:00 **Session 3 report** Individual work Final examination Not Presential Duration: 10:00 **Session 5 report** Individual work Final examination Not Presential Duration: 10:00 **Written assignment on sessions 2 or 4** Individual work Final examination Not Presential Duration: 10:00 **Final assignment: Analysis of a scientific article related with biomedical signal processing** Individual work Final examination Not Presential Duration: 10:00
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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Attendance and participation	Other assessment	No Presential	00:00	5%	/ 10	CG-MIB05 CG-MIB07 CB07
3	Session 1 report	Group work	No Presential	08:00	15%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
7	Session 3 report	Group work	No Presential	10:00	20%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
11	Session 5 report	Group work	No Presential	10:00	20%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
11	Written assignment on sessions 2 or 4	Group work	No Presential	10:00	20%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
11	Final assignment: Analysis of a scientific article related with biomedical signal processing	Individual work	No Presential	10:00	20%	5 / 10	CG-MIB05 CG-MIB06 CG-MIB04 CG-MIB07 CB06 CB08 CB09 CB10

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
12	Session 1 report	Individual work	No Presential	08:00	15%	/ 10	CG-MIB07 CG-MIB03 CG-MIB05 CG-MIB01 CB06 CB07
12	Session 3 report	Individual work	No Presential	10:00	20%	/ 10	CG-MIB05 CG-MIB03 CG-MIB07 CG-MIB01 CB06 CB07
12	Session 5 report	Individual work	No Presential	10:00	20%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
12	Written assignment on sessions 2 or 4	Individual work	No Presential	10:00	20%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07
12	Final assignment: Analysis of a scientific article related with biomedical signal processing	Individual work	No Presential	10:00	25%	5 / 10	CG-MIB06 CG-MIB07 CB06 CB08 CB10 CG-MIB04 CB09 CG-MIB05

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

Final exam	Problem-solving test	Face-to-face	02:00	20%	5 / 10	CB08 CB09 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CB06 CB07
Reports on practical session	Group work	Face-to-face	40:00	80%	/ 10	CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB01 CB06 CB07

7.2. Assessment criteria

General dispositions

The course follows a progressive assessment system.

The course will be passed when a grade greater than or equal to 5 points out of a total of 10 is obtained, according to the rules indicated in this section.

All the assignments that are carried out must be the result of the student's personal work, although discussion and group work will be encouraged to help better understand the problems that are trying to be solved. Copy detection in an activity will mean failing said activity, both for those who copy and for those who allow themselves to be copied.

Progressive assessment activities

Session reports: The student must deliver the 4 reports corresponding to the practical sessions developed during the course within the deadline. The assignments will be carried out in pairs/groups, according to what the teaching staff determines, and in principle they will imply compulsory attendance. Late delivery will be penalized in the final score with up to 2/10 points.

Group work: At the end of the course there will be an activity consisting of preparing and presenting a group work.

This activity will have a weight of 20% in the final grade, and the minimum grade to pass will be 5/10.

Global assessment

Session reports: Those students who cannot attend class during the course may choose to do the assignments individually (unless the teachers indicate otherwise). It is the responsibility of the student to carry out these assignments by their own means.

Final work: Students must carry out an individual work (unless the teachers indicate otherwise) to be presented on the date set by the Head of Studies. This activity will have a weight of 20% in the final grade, and the minimum grade to pass will be 5/10.

Extraordinary call

Session reports will have a weight of 80% in the global score of the course.

There will be a final exam (20% weighting) in which students must defend their reports and demonstrate the skills acquired in them. The exam may consist of an oral part and a written/practical part.

Students must obtain a minimum score of 5/10 in the exam in order to pass the subject.

Block release

Those students who during the ordinary call have not delivered the reports must do so in extraordinary call. Likewise, students who, having delivered the reports in the ordinary call, must attend the extraordinary call, must deliver at least all those reports in which their grade was less than 5.

In case of not passing in extraordinary call, the grades of the reports from one academic year to another will not be saved.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Leif Sörnmo y Pablo Laguna, Bioelectric signal processing in cardiac and neurologic applications, (2005) ISBN-13: 978-0-12-437552-9. Shanbao Tung y NitishV. Thakor, Quantitative EEG Analysis, Methods and Clinical Applications. Eds. Artech	Bibliography	
Rangaraj M. Rangayyan, Biomedical Signal Analysis, 2nd Ed. IEEE Press/Wiley (2015).	Bibliography	
Alan V. Oppenheim y Ronald W. Schafer, Discrete-Time Signal Processing, 3rd Ed., Prentice Hall (2010).	Bibliography	
M.J. Roberts, Signals and Systems Analysis Using Transform Methods and MATLAB®, 2nd Ed, McGraw-Hill (2012).	Bibliography	

9. Other information

9.1. Other information about the subject

The course is related with **Sustainable Development Goals SDG3** (Ensure healthy lives and promote well-being for all at all ages) and **SDG4** (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all).