

## [GBH202] MEDICAL IMAGING SYSTEMS

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN BIOMEDICAL ENGINEERING		<b>Subject</b>	?
<b>Semester</b>	1	<b>Course</b>	3	<b>Mention / Field of specialisation</b>
<b>Character</b>	COMPULSORY		<b>Language</b>	ENGLISH
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face	<b>Total hours</b>
<b>Credits</b>	6	<b>Hours/week</b>	4.58	82.4 class hours + 67.6 non-class hours = <b>150 total hours</b>

### 2030 AGENDA GOALS



### PROFESSORS

BARRENETXEA CARRASCO, MAITANE

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
MATHEMATICS II	(No previous knowledge required)
MATHEMATICS I	
MATHEMATICS III	
PHYSICS II	
PHYSICS III	
COMPUTER FOUNDATIONS	

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GBR303</b> - To analyze the operation of medical imaging equipment and apply image processing techniques to improve and parameterize the images obtained.			x	5,08
<b>G-RTR1</b> - To develop interdisciplinary projects specific to their specialty and of gradual complexity, - becoming aware of respect for human rights and fundamental rights, and analyzing and assessing the impact of the proposed solutions on the SDGs - to acquire and/or apply basic, advanced and/or avant-garde, demonstrating the ability to work in multidisciplinary teams and/or undertake further studies with a high degree of autonomy		x		0,44
<b>G-RTR2</b> - To express information, ideas and the arguments that support them in an orderly, clear and coherent manner, orally and in writing, based on quality information, self-made or obtained from different sources, using inclusive and non-discriminatory language		x		0,48
<b>Total:</b>				<b>6</b>

KC: Knowledge or Content / SK: Skills / AB: Abilities

### SECONDARY LEARNING RESULTS

#### 1RGB394 (1 sem)

#### LEARNING ACTIVITIES

Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams

CH	NCH	TH
3,75 h.	2,25 h.	6 h.

#### EVALUATION SYSTEM

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

W

100%

#### MAKE-UP MECHANISMS

Observation (technical capacity, attitude and participation)

**CH - Class hours:** 3,75 h.

**NCH - Non-class hours:** 2,25 h.

**TH - Total hours:** 6 h.

**RGB308** [!] *Conoce y comprende el funcionamiento de los equipos de imagen médica basados en ultrasonidos.*

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	1 h.	4 h.	5 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	10 h.	5 h.	15 h.
Carrying out exercises and solving problems individually and/or in teams	2 h.	1 h.	3 h.
Practical work in workshops and/or laboratories, individually and/or in teams	2 h.	1 h.	3 h.

  

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	20%	Individual written and/or oral tests or individual coding/programming tests
Individual written and/or oral tests or individual coding/programming tests	80%	

**CH - Class hours:** 15 h.  
**NCH - Non-class hours:** 11 h.  
**TH - Total hours:** 26 h.

**1RGB392 (1 sem)**

LEARNING ACTIVITIES	CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	1,9 h.	1,1 h.	3 h.

  

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	Observation (technical capacity, attitude and participation)

**CH - Class hours:** 1,9 h.  
**NCH - Non-class hours:** 1,1 h.  
**TH - Total hours:** 3 h.

**1RGB393 (1 sem)**

LEARNING ACTIVITIES	CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	3,75 h.	2,25 h.	6 h.

  

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	Observation (technical capacity, attitude and participation)

**CH - Class hours:** 3,75 h.  
**NCH - Non-class hours:** 2,25 h.  
**TH - Total hours:** 6 h.

**1RGB390 (1 sem)**

LEARNING ACTIVITIES	CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	2,5 h.	1,5 h.	4 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	Observation (technical capacity, attitude and participation)

**CH - Class hours:** 2,5 h.  
**NCH - Non-class hours:** 1,5 h.  
**TH - Total hours:** 4 h.

**1RGB391 (1 sem)**

LEARNING ACTIVITIES	CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	2,5 h.	1,5 h.	4 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Self-assessment	25%	Observation (technical capacity, attitude and participation)
Co-assessment	25%	
Observation (technical capacity, attitude and participation)	50%	

**CH - Class hours:** 2,5 h.  
**NCH - Non-class hours:** 1,5 h.  
**TH - Total hours:** 4 h.

**RGB306 [!]** *Conoce y comprende el funcionamiento de los equipos de imagen médica basados en rayos X.*

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.	6 h.	8 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	20 h.	9,5 h.	29,5 h.
Carrying out exercises and solving problems individually and/or in teams	5 h.	8 h.	13 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	20%	Individual written and/or oral tests or individual coding/programming tests
Individual written and/or oral tests or individual coding/programming tests	80%	

**CH - Class hours:** 27 h.  
**NCH - Non-class hours:** 23,5 h.  
**TH - Total hours:** 50,5 h.

**RGB307 [!]** *Conoce y comprende el funcionamiento de los equipos de imagen médica basados en radiación electromagnética no ionizante.*

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.	6 h.	8 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	20 h.	10 h.	30 h.
Carrying out exercises and solving problems individually and/or in teams	2 h.	2,5 h.	4,5 h.

Practical work in workshops and/or laboratories, individually and/or in teams	2 h.	6 h.	8 h.
<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>	
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	20%	Individual written and/or oral tests or individual coding/programming tests	
Individual written and/or oral tests or individual coding/programming tests	80%		
<b>CH - Class hours:</b> 26 h. <b>NCH - Non-class hours:</b> 24,5 h. <b>TH - Total hours:</b> 50,5 h.			

## CONTENTS

[!]

### 1.- Rayos X

#### 1.1.-Introducción

#### 1.2.-Principios de radiología

#### 1.3.- Generación de rayos X

#### 1.4.-Interacción con la materia

#### 1.5.- Detectores de rayos X

#### 1.6.-Otros usos médicos

#### 1.7.-El riesgo de usar rayos X

### 2.- Tomografía computarizada

#### 2.1.- Introducción

#### 2.2.- Fuente de rayos X y colimación

#### 2.3.- Detectores TC

#### 2.4.- Métodos de reconstrucción TC

### 3.- Imagen mediante ultrasonidos

#### 3.1.-Introducción

#### 3.2.-Conceptos básicos de las imágenes por ultrasonidos

#### 3.3.-La física de los ultrasonidos

#### 3.4.-Transductores

#### 3.5.-Modalidades de imagen

#### 3.6.-Ultrasonidos Doppler

### 4.- Resonancia magnética por imagen

#### 4.1.-Introducción

#### 4.2.-Magnetización microscópica

#### 4.3.-Magnetization macroscópica

#### 4.4.-Precesión y frecuencia de Larmour

4.5.-Magnetización transversal y longitudinal

4.6.-Excitation RF

4.7.-Relajación

4.8.-Spin Echo-s

4.9.-Mecanismos básicos de contraste

4.10.-Instrumentación

4.11.-Adquisición de datos

## LEARNING RESOURCES AND BIBLIOGRAPHY

### Learning resources

[!] *Apuntes de la asignatura*

[!] *Presentaciones en clase*

[!] *Proyección de videos*

[!] *Realización de prácticas en ordenador*

### Bibliography

Medical Imaging, Signals and Systems, second edition; J.L. Prince and J.M.Links. Pearson 2015.

Fundamentals of Medical Imaging, second edition; P. Suetens. Cambridge University Press 2009.

Introduction to Biomedical Engineering; J. Enderle and J. Bronzino. Elsevier 2011.

Encyclopedia of Medical Devices and Instrumentation, Vol. 2; J.G. Webster.

Intermediate Physics for Medicine and Biology; R. Hobbie and B. Roth. Springer 2007