

## [MMD003] DIGITAL IMAGE PROCESSING

### GENERAL INFORMATION

<b>Studies</b>	MASTER'S DEGREE IN BIOMEDICAL TECHNOLOGIES		<b>Subject</b>	Data analysis
<b>Semester</b>	2	<b>Course</b>	1	<b>Mention / Field of specialisation</b>
<b>Character</b>	COMPULSORY		<b>Language</b>	ENGLISH
<b>Plan</b>	2017	<b>Modality</b>	Adapted Face-to-face	<b>Total hours</b>
<b>Credits</b>	7,5	<b>Hours/week</b>	6.42	115.5 class hours + 72 non-class hours = <b>187.5 total hours</b>

### PROFESSORS

MENDICUTE ERRASTI, MIKEL

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
DIGITAL IMAGE PROCESSING	(No previous knowledge required)
Signal processing	
[!] <i>Imagen Biomédica</i>	

### SKILLS

#### VERIFICA SKILLS

##### SPECIFIC

**MMCE13** - To analyse and design image processing systems applied to biomedical engineering

##### GENERAL

**MMCG03** - Being able to analyse complex situations and making decisions while estimating the social, economic or ethical responsibilities related

**MMCG04** - Providing a practical and useful interprofessional framework relating to end user's safety for the product or service

##### CROSS

**MMCTR1** - To select one measure or idea out of several and implement them in response to the needs or circumstances emerging in the work process

**MMCTR2** - To work with people, getting them involved and guiding them towards the achievement of a common goal, with a global vision of work and its characteristics (quality, deadlines, etc.), taking individual interests into account

##### BASIC

**M\_CB10** - To have learning skills and the capacity for self-guided or independent subsequent learning.

**M\_CB7** - To know how to apply the acquired knowledge and competencies and the ability to solve problems in new or unfamiliar contexts within wider (or multidisciplinary) environments related to their field of study

**M\_CB8** - To be able to integrate different types of knowledge and make complex judgements based on information that, in spite of being partial or limited, includes ideas on the social and ethical responsibilities associated with the application of knowledge

**M\_CB9** - To share knowledge, conclusions and their rationale with specialised and lay audiences in a clear, unambiguous manner

### LEARNING RESULTS

**RMM167** To know the digital image enhancement techniques used for the post-processing of images.

LEARNING ACTIVITIES	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	3 h.	2,5 h.	5,5 h.
Relating to projects/POPBLs carried out individually or in teams			
Individual study and work, tests and evaluations and check points	3 h.	1 h.	4 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	4 h.	2 h.	6 h.
<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>	
Individual written and oral tests to assess technical skills of the subject	30%	Individual written and oral tests to assess technical skills of the subject	
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	70%		

**CH - Class hours:** 10 h.

**NCH - Non-class hours:** 5,5 h.

**TH - Total hours:** 15,5 h.

**RMM168 To select the optimum segmentation and feature extraction techniques for diagnosis using biomedical images.**

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Individual study and work, tests and evaluations and check points	4 h.	2 h.	6 h.
Practices of problem solving and real or simulated context projects	16 h.	8,5 h.	24,5 h.
Individual and team solving of exercises, problems, and practices	12 h.	8 h.	20 h.

**EVALUATION SYSTEM**

*W*

Individual written and oral tests to assess technical skills of the subject	30%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	70%

**MAKE-UP MECHANISMS**

Individual written and oral tests to assess technical skills of the subject

**CH - Class hours:** 32 h.

**NCH - Non-class hours:** 18,5 h.

**TH - Total hours:** 50,5 h.

**RMM169 To specify and apply algorithms for image reconstruction**

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	16 h.	9 h.	25 h.
Individual or team workshop and/or lab practice	4 h.	6 h.	10 h.

**EVALUATION SYSTEM**

*W*

Individual written and oral tests to assess technical skills of the subject	30%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	70%

**MAKE-UP MECHANISMS**

Individual written and oral tests to assess technical skills of the subject

**CH - Class hours:** 20 h.

**NCH - Non-class hours:** 15 h.

**TH - Total hours:** 35 h.

**RMM170 To specify and select suitable algorithms of image processing in a real project.**

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams	9 h.	6 h.	15 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	9 h.	6 h.	15 h.

**EVALUATION SYSTEM**

*W*

Individual written and oral tests to assess technical skills of the subject	30%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	70%

**MAKE-UP MECHANISMS**

Individual written and oral tests to assess technical skills of the subject

**CH - Class hours:** 18 h.

**NCH - Non-class hours:** 12 h.

**TH - Total hours:** 30 h.

**RMM171** To analyze the variables that are part of the solution to a problem, to plan actions in order to reach a stable solution assuming responsibilities in the work group, organizing and planning tasks.

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams	14 h.	8,5 h.	22,5 h.

**EVALUATION SYSTEM**

	<i>W</i>
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

**CH - Class hours:** 14 h.

**NCH - Non-class hours:** 8,5 h.

**TH - Total hours:** 22,5 h.

**RMM172** To know and apply problem solving tools in the field of biomedical engineering with initiative, decision -making, creativity and critical thinking.

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams	14 h.	8,5 h.	22,5 h.

**EVALUATION SYSTEM**

	<i>W</i>
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

**CH - Class hours:** 14 h.

**NCH - Non-class hours:** 8,5 h.

**TH - Total hours:** 22,5 h.

**RMM173** To define the problem, the development of the solution and the conclusions efficiently, arguing and justifying each one of them and using correct written and spoken language.

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams	4 h.	2 h.	6 h.

**EVALUATION SYSTEM**

	<i>W</i>
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

**CH - Class hours:** 4 h.

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

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

**RMM174** To define the objectives, perform the planning for its consecution and to coordinate with the rest of the members of the team.

<b>LEARNING ACTIVITIES</b>	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams	3,5 h.	2 h.	5,5 h.
<b>EVALUATION SYSTEM</b>	<i>W</i>	<b>MAKE-UP MECHANISMS</b>	
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	
<b>CH - Class hours:</b> 3,5 h. <b>NCH - Non-class hours:</b> 2 h. <b>TH - Total hours:</b> 5,5 h.			

## CONTENTS

1. Restoration and Reconstruction (quick review)
  - 1.1 Enhancement
  - 1.2 Reconstruction
  
2. Morphological processing
  - 2.1 Erosion and Dilation
  - 2.2 Opening and Closing
  - 2.3 Hit and Miss transform
  - 2.4 Gray scale transform
  
3. Image segmentation
  - 3.1 Detection of points, lines and edges
  - 3.2 Thresholding
  - 3.3 ROIs detection
  - 3.4 Morphological segmentation
  - 3.5 Movement based segmentation
  
4. Feature extraction
  - 4.1 Texture analysis
  - 4.2 Oriented pattern analysis
  - 4.3 Shape analysis
  
5. Real application practise

## LEARNING RESOURCES AND BIBLIOGRAPHY

### Learning resources

Technical articles  
Slides of the subject  
Moodle Platform  
Class presentations

### Bibliography

Bankman, I. N., & Morcovescu, S. (2002). Handbook of Medical Imaging. Processing and Analysis. Medical Physics  
Prince, J. L., & Links, J. M. (2006). Medical imaging signals and systems. Pearson Prentice Hall  
Rangayyan, R. M. (2004). Biomedical image analysis. CRC press.  
Gonzalez, R.C., & Woods, R.E. (2008). Digital Image Processing. Pearson Prentice Hall  
Gonzalez, R.C., Woods, R.E., Eddins, S.L. (2009). Digital Image Processing Using MATLAB. Gatesmark Publishing