



## Course guides

# 820028 - PIB - Biomedical Image Processig

Last modified: 19/06/2020

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 707 - ESAII - Department of Automatic Control.

**Degree:** BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

**Academic year:** 2020    **ECTS Credits:** 6.0    **Languages:** Catalan

### LECTURER

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**Coordinating lecturer:** ALICIA CASALS GELPI - RAUL BENITEZ IGLESIAS

**Others:** Primer quadrimestre:  
RAUL BENITEZ IGLESIAS - T11  
CRISTIAN MATA MIQUEL - T11

Segon quadrimestre:  
ALICIA CASALS GELPI - M11, M12, M13  
CRISTIAN MATA MIQUEL - M11, M12, M13

### PRIOR SKILLS

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Basic skills in linear algebra.  
Basic level programming (structures if, for, while).  
Abstraction skills

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

2. Apply the techniques for analysing and interpreting biomedical signals and images.

**Transversal:**

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

### TEACHING METHODOLOGY

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In theory sessions the professor will introduce, through explanations and illustrative examples, the concepts, methods and results of the subject. In problem-solving sessions, the professor guides the students in solving exercises and problems related to the subject. In the lab, students will practice the concepts and methods with the help of the profesor and work with actual biomedical images. Students, independently, should study to assimilate the concepts and solve exercises. Students should also develop a case study in group.

### LEARNING OBJECTIVES OF THE SUBJECT

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The aim of the course is to introduce students to different techniques of acquisition and processing of biomedical images, their characteristics and applications. Once students become familiar with biomedical images, the methods to achieve better image quality or contrast will be presented. The course will also include techniques for segmentation, registration, localization, motion analysis and compression.



## STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	15,0	10.00
Hours large group	45,0	30.00

**Total learning time:** 150 h

## CONTENTS

### INTRODUCTION

**Description:**

In the context of different image modalities the structure of an image processing system is explained as well as the application fields in the biomedical area.

**Specific objectives:**

Understanding the need, potential limitations of image processing as well as the structure of a one such system in the biomedical field.

Presentation of the course and its organization.

**Related activities:**

Oral presentation

**Full-or-part-time:** 2h

Theory classes: 2h

### Image pre-processing

**Description:**

This lesson describes the preliminary stages of pre-processing and their purpose, either displaying (enrichment, contrast, enhancement) or as a step previous to a higher level processing. Histogramació, binarization and filtering.

**Specific objectives:**

Understanding the need of preprocessing, its different types (transformation function and techniques) and the suitability of each one according to their finality.

**Related activities:**

Theoretical presentation, exercises and practices in the lab.

**Full-or-part-time:** 16h

Theory classes: 10h

Laboratory classes: 6h



## Features Extraction

### Description:

Presentation of the theory in class of the different types of features in images and the techniques for their extraction from images. Study of the needs in different types of applications.

### Specific objectives:

Understanding the need to extract relevant information from images as data for a later stage of image description or interpretation of the scene. Acquiring criteria for determining what information is relevant, features, in each image depending also of the final application. Learning the techniques for feature extraction.

### Related activities:

Presentation of the theory, exercises on the theme and practices in the laboratory.

**Full-or-part-time:** 6h 30m

Theory classes: 5h

Laboratory classes: 1h 30m

## Image segmentation

### Description:

The concept of segmentation. Description of the various segmentation techniques and study of image segmentation algorithms.

### Specific objectives:

From the image typologies to work on and the needs of the application, determining the type of segmentation to use, or combination of techniques, and learn the different types of algorithms for its implementation.

### Related activities:

Presentation of the theory, exercises on the theme and practices in the laboratory.

**Full-or-part-time:** 3h 30m

Theory classes: 2h

Laboratory classes: 1h 30m

## Pattern recognition

### Description:

Description and concept of training and recognition and learning the techniques to do so.

### Specific objectives:

Understand the concept of classification, techniques and algorithms for its implementation. Understanding the stages of learning and recognition.

### Related activities:

Presentation of the theory, exercises on the theme and practices in the laboratory.

**Full-or-part-time:** 3h 30m

Theory classes: 2h

Laboratory classes: 1h 30m



### Image modalities

**Description:**

Review of the different types of imaging techniques and their characteristics.

**Specific objectives:**

Understanding the different kind of images pointing to their applications.

**Related activities:**

Class of theory and examples.

**Full-or-part-time:** 2h 30m

Theory classes: 2h 30m

### Image registration

**Description:**

Description of techniques, methods and applications.

**Specific objectives:**

Understanding the needs of biomedical registration and implementation techniques.

**Related activities:**

Class of theory and exercises.

**Full-or-part-time:** 2h 30m

Theory classes: 2h 30m

### Application fields.

**Description:**

Description with examples of the application fields.

**Specific objectives:**

Acquire a global view of techniques and applications.

**Related activities:**

Class of theory with examples.

**Full-or-part-time:** 5h

Practical classes: 5h

## GRADING SYSTEM

The evaluation will consider the following activities:

- A partial exam (The score of this test is NEP)
- Practical Laboratory reports (The score of this activity is NPL).
- A final exam (The score of this exam is NEF).

There will be reevaluation exam. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (<https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf>)

The final grade for the course, NF, is calculated using the following expression:

$$NF = 0.4*NEF + 0.3 NPL+ 0.3 NEP$$



## EXAMINATION RULES.

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Exams without books nor notes

## BIBLIOGRAPHY

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### Basic:

- González, Rafael C.; Woods, Richard E. Digital image processing. Fourth edition, Global edition. New York, NY: Pearson Education Internacional, 2018. ISBN 9781292223049].
- Webb, Andrew R. Introduction to biomedical imaging. Hoboken (N.J.): Wiley, cop. 2003. ISBN 0471237663.

### Complementary:

- Bankman, Isaac N.. Handbook of medical imaging : processing and analysis. San Diego [etc.]: Academic Press, cop. 2000. ISBN 0120777908.
- Rangayyan, Rangaraj M. Biomedical image analysis. Boca Raton: CRC cop, cop. 2005. ISBN 0849396956.

## RESOURCES

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### Audiovisual material:

- Series llibres Springer. Resource

### Computer material:

- Computer Vision on Line. <http://homepages.inf.ed.ac.uk/rbf/CVonline/CVentry.htm>
- Xplore IEEE. Collection of IEEE publications
- Revistes Elsevier. Resource

### Other resources:

<http://ieeexplore.ieee.org/Xplore/DynWel> p (from computers in UPC UPC)

[http://www.elsevier.com/wps/find/P05.cws\\_home/main](http://www.elsevier.com/wps/find/P05.cws_home/main) (from computers in UPC) go to Journals and Medical Imaging

· <http://www.springerlink.com>

(from computers in UPC) go to book series: Lecture Notes in Computer Science