# [MMA101] BIOMEDICAL IMAGING

## GENERAL INFORMATION

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|---|---|---|---|---|---|
| **Studies** | MASTER'S DEGREE IN BIOMEDICAL TECHNOLOGIES | | | **Subject** | ? |
| **Semester** | 1 | **Course** | 1 | **Mention / Field of specialisation** | |
| **Character** | COMPULSORY | | | | |
| **Plan** | 2023 | **Modality** | Face-to-face | **Language** | ENGLISH |
| **Credits** | 3 | **Hours/week** | 2.54 | **Total hours** | 45.8 class hours + 29.2 non-class hours = **75 total hours** |

## PROFESSORS

CILLA UGARTE, RODRIGO

## REQUIRED PREVIOUS KNOWLEDGE

| Subjects | Knowledge |
|---|---|
| SIGNAL AND BIOMEDICAL IMAGES PROCESSING | Fundamentals of image processing |
| Biomedical imageprocessing | |

## LEARNING RESULTS

| LEARNING RESULTS | *KC* | *SK* | *AB* | *ECTS* |
|---|---|---|---|---|
| **MMRA04** - To choose technical imaging solutions used in different medical specialties, collaborating in the taking of | | *x* | | 2,1 |
| **MMRA26** - To apply the knowledge acquired and your problem-solving skills in new, little-known or changing environments within broader (or multidisciplinary) contexts related to your area of study | | *x* | | 0,72 |
| **MMRA28** - To communicate your conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way | | *x* | | 0,18 |
| | | | **Total:** | 3 |

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

## SECONDARY LEARNING RESULTS

**RMM108** **[!]** ***Distinguir las distintas tecnologías de adquisición de imagen médica y su marco de aplicación.***

| LEARNING ACTIVITIES | *CH* | *NCH* | *TH* |
|---|---|---|---|
| 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 | 2 h. | 4 h. | 6 h. |
| Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects | 8 h. | | 8 h. |
| Carrying out exercises and solving problems individually and/or in teams | 2 h. | 4 h. | 6 h. |

| EVALUATION SYSTEM | *W* |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 25% |
| 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 | 25% |
| Individual written and/or oral tests or individual coding/programming tests | 50% |

**Comments:** : If the score of the exam is lower than 4, this evaluation item will be evaluated in its entirety (%100) with the score of the exam.

| MAKE-UP MECHANISMS |
|---|
| Individual written and/or oral tests or individual coding/programming tests |

**Comments:** If the score of the exam is lower than 5, it Will be mandatory to repeat the exam

**CH - Class hours:** 12 h.
**NCH - Non-class hours:** 8 h.
**TH - Total hours:** 20 h.

**RMM109** **[!]** ***Seleccionar y aplicar técnicas de filtrado idóneas para la eliminación de interferencias.***

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects | 14 h. | | 14 h. |
| Carrying out exercises and solving problems individually and/or in teams | 6 h. | 12,5 h. | 18,5 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 50% |
| Individual written and/or oral tests or individual coding/programming tests | 50% |

**Comments:** If the score of the exam is lower than 4, this evaluation item will be evaluated in its entirety (%100) with the score of the exam.

**MAKE-UP MECHANISMS**

Individual written and/or oral tests or individual coding/programming tests

**Comments:** If the score of the exam is lower than 5, it Will be mandatory to repeat the exam

**CH - Class hours:** 20 h.
**NCH - Non-class hours:** 12,5 h.
**TH - Total hours:** 32,5 h.

**RMM147** **[!]** ***Define los objetivos, realiza la planificación para su consecución y su seguimiento sistemático coordinando su trabajo con los demás miembros del equipo.***

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| 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 | 1,3 h. | ,7 h. | 2 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 50% |
| 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 | 50% |

**MAKE-UP MECHANISMS**

Observation (technical capacity, attitude and participation)

**CH - Class hours:** 1,3 h.
**NCH - Non-class hours:** ,7 h.
**TH - Total hours:** 2 h.

**RMM145** **[!]** ***Conoce y es capaz de aplicar las herramientas de resolución de problemas en el campo de la Ingeniería Biomédica con iniciativa, toma de decisiones, creatividad y razonamiento crítico.***

| 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 | 5,5 h. | 3,5 h. | 9 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Individual written and/or oral tests or individual coding/programming tests | 40% |
| Co-assessment | 5% |
| Prototype / Product | 55% |

**Comments:** : If the score of the defense is lower than 5, this evaluation item will be evaluated in its entirety (%100) with the score of the defense. A co-evaluation system will be implemented to adjust the score of the student based on his or her participation in the Project.

**MAKE-UP MECHANISMS**

Observation (technical capacity, attitude and participation)

**CH - Class hours:** 5,5 h.

**NCH - Non-class hours:** 3,5 h.
**TH - Total hours:** 9 h.

**RMM144** **[!]** ***Analiza las variables intervinientes en la solución de los problemas y plantea acciones para lograr una situación estable asumiendo responsabilidades en el equipo de trabajo, afrontando contingencias y organizando y planificando tareas.***

| 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 | 5,5 h. | 3,5 h. | 9 h. |

| EVALUATION SYSTEM | *W* |
|---|---|
| Individual written and/or oral tests or individual coding/programming tests | 40% |
| Co-assessment | 5% |
| Prototype / Product | 55% |

**Comments:** If the score of the defense is lower than 5, this evaluation item will be evaluated in its entirety (%100) with the score of the defense. A co-evaluation system will be implemented to adjust the score of the student based on his or her participation in the Project.

| MAKE-UP MECHANISMS |
|---|
| Observation (technical capacity, attitude and participation) |

**CH - Class hours:** 5,5 h.
**NCH - Non-class hours:** 3,5 h.
**TH - Total hours:** 9 h.

**RMM146** **[!]** ***Define el problema, el desarrollo de la solución, así como las conclusiones de manera eficaz, argumentando y justificando cada una de ellas, y haciendo un uso correcto del lenguaje, por escrito y de manera oral.***

| LEARNING ACTIVITIES | *CH* | *NCH* | *TH* |
|---|---|---|---|
| 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 | 1,5 h. | 1 h. | 2,5 h. |

| EVALUATION SYSTEM | *W* |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 50% |
| 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 | 50% |

| MAKE-UP MECHANISMS |
|---|
| Observation (technical capacity, attitude and participation) |

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

## CONTENTS

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1. Nature of biomedical Images
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1.1. Introduction
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1.2. Biomedical image modalities
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2. Preprocessing fundamentals

2.1. Basic techniques

2.2. Quality and information content

3. Compression, storage and communications

3.1. PACS

3.2. Dicom

3.3. HL7

4. Advanced preprocesing

4.1. Spatial filtering

4.2. Frequency filtering: (2DFFT, smoothing, sharpening)

4.3. Image restoration

## LEARNING RESOURCES AND BIBLIOGRAPHY

| Learning resources | Bibliography |
|---|---|
| Technical articles | Bankman, I. N., & Morcovescu, S. (2002). Handbook of Medical Imaging. Processing and Analysis. Medical Physics |
| Moodle Platform | Prince, J. L., & Links, J. M. (2006). Medical imaging signals and systems. Pearson Prentice Hall |
| Slides of the subject | Rangayyan, R. M. (2004). Biomedical image analysis. CRC press<br>Gonzalez, R.C., & Woods, R.E. (2008). Digital Image Processing. Pearson Prentice Hall |
| Computer practical training | Gonzalez, R.C., Woods, R.E., Eddins, S.L. (2009). Digital Image Processing Using MATLAB. Gatesmark Publishing |