

**COURSE DATA****Data Subject**

Code	34504
Name	New technologies in biomedicine
Cycle	Grade
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1204 - Degree in Medicine	Faculty of Medicine and Odontology	2	Second term

Subject-matter

Degree	Subject-matter	Character
1204 - Degree in Medicine	18 - Optional subjects	Optional

Coordination

Name	Department
CIBRIAN ORTIZ DE ANDA, ROSA MARIA	190 - Physiology
MILIAN MEDINA, LARA	285 - Pathology

SUMMARY

The first part of the subject introduces and develops the more relevant aspects of image analysis to understand the bases of the image techniques used in Medicine. Thus, the principles of use of laser, thermography, ultrasounds, etc. are established and the different types of microscopes are analyzed which are used in researches since the optic and phase microscope until the electronic and confocal one.

The second part of the subject is focused on the design and technology to build artificial tissues. Different methods to obtain these tissues are studied, as well as the specific revision of their application to the different systems that form the human body.



PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1204 - Degree in Medicine

- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Know how to use IT in clinical, therapeutic and preventive activities, and those of research.
- Proper organisation and planning of the workload and timing in professional activities.
- Team-working skills and engaging with other people in the same line of work or different.
- Criticism and self-criticism skills.
- Capacity for communicating with professional circles from other domains.
- Acknowledge diversity and multiculturality.
- Consideration of ethics as a fundamental value in the professional practise.
- Working capacity to function in an international context.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

Once the subject is finished the student will know:

- How to fulfill the storage of a digital image and the differences between the 8 bits, 16 bits and 32 bits images.
- The algorithms of decrease and increase of the size of a digital image and the highlight of structures.
- The principles of laser radiation and the importance of the coherence of this kind of light in its use in medicine.



- The technical bases of useful images en medicine.
- The differences and applicability of the different kinds of microscopes.
- The recognition of structures to optical and electronic microscopy.
- Morphometric studies.
- Experimental models to obtain precursor cells.
- The cell cultures.
- The microscopic visualization and tissues and constructs obtained by tissue enginery.

DESCRIPTION OF CONTENTS

1. INTRODUCTION

UNIT 1. Introduction to the subject.

2. IMAGES BASES AND TECHNIQUES OF USE IN MEDICINE

UNIT 2.- Information digitalization.

Generalities about the automatic treatment of information. Concept of pixel, voxel, texel. Intensification and restoration of image. Storage, black and white, color and pseudo-color images.

UNIT 3.-Techniques of image improvement.

Image compression. Preprocessed. Histograms. Segmentation. Characteristics extraction. Visualization improvement. Information extraction. Advanced techniques.

UNIT 4. Properties of ultrasounds.

Concept of ultrasound (US). Frequency and intensity ranges of the US in medical applications. Directivity and orientation of the US. Production and detection of the US: direct and inverse piezoelectric effect. Ultrasonic transducers.

UNIT 5. Physical principles of Ultrasonography.

General principle of the echography. Echography techniques: A, B and TM. Ultrasonic Doppler. Echographies 3D and 4D.

UNIT 6. Thermography.

General characteristics of the thermal radiation (TR). Laws that rule the emission of the TR. Detection of the TR. Characteristics of the obtained image.

UNIT 7. Principles of the laser for medical use.

Introduction to laser. Practical consecution of the laser emission. Types of laser.

UNIT 8. Laser applications in medicine and surgery.



Fields of laser application in medicine. Laser surgical application.

UNIT 9.- Foundations of the Nuclear Magnetic Resonance (NMR) General principle of the NMR, signification of the relaxation times T1 and T2.

3. BASES IN TISUE ENIGNERY

UNIT 10.-Foundations of the tissue enginery.
Restorative medicine. Concept. Antecedents. Ethical and legal aspects.

UNIT 11.- Extra cell matrix in tissue enginery.

UNIT 12.- Technology and design for the construction of artificial tissues.

UNIT 13.- Tissue enginery of the cardiovascular system.

UNIT 14.- Tissue enginery of the muscle-skeletal system.

UNIT 15.- Tissue enginery of the digestive system.

UNIT 16.- Tissue enginery of the nervous system.

UNIT 17.- Tissue enginery of the skin and other ectodermic structures.

4. LABORATORY PRACTICES

1. Digital capture and processing of images: use of systems of image captures. Storage, black and white, color and pseudo-color images. Image compression. Preprocessing. Histograms. Segmentation. Characteristics extraction.

2. Image restoration. Improvement in the image visualization. Information extraction. Advanced techniques.

3. Thermography: use of thermographic camera and specific software to determine the map of corporal temperature.

4. Use of excel for the problem solving.

5. Topography of surfaces. Obtaining the representation by contour lines of surface topography by structured light.

6. The laboratory of structural study. Handling of biological samples. Use of essential equipment of sample processing. Visualization techniques in the histological routine. Special techniques of processing and study: electronic microscopy.



7. Morphometric studies. Processing techniques of the samples. Parameters to be quantified in the histological studies of tissues and constructs.

8. handling of experimental models and obtaining precursor cells.

9. Types of cell cultures. General aspects of eukaryote cell cultures. Cell cultures in tissue enginery. Supports and subtracts for cell cultures.

10. Microscope visualization of tissues and constructs obtained by techniques of tissue enginery.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	20,00	100
Theory classes	19,00	100
Seminars	6,00	100
Study and independent work	40,00	0
Readings supplementary material	2,50	0
Preparation of evaluation activities	9,00	0
Preparing lectures	6,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	112,50	

TEACHING METHODOLOGY

In the **theoretical lessons**, the teacher will expose, through master class, the most important concepts and contents in a structured way, to obtain the knowledge and skills that the students must acquire. The students' participation will be encouraged. The teaching materials used by the professor will be available, if he considers it appropriate, through the electronic resource Aula Virtual.

Classroom practices: **seminars**. In reduced groups, the professor will set specialized topics in depth, cases studies, bibliography management, current topics... the group work and the oral presentation will be encouraged. It could be understood as "cooperative learning".

Laboratory practices in reduced groups. They are focused on the consolidation of the theoretical knowledge through the practical application of this knowledge. The professor will set the objectives, will inform about the material management, will supervise the realization of the work and will help in the results interpretation.



EVALUATION

Exam assessment of the subject:

60% corresponds to theoretical content of the subject and the 40% of the practical content.

Questions in the exam related with the practices 44%. Questions related with the theoretical content 50%.

Written test (9,4 points): With 27 multiple choice questions (0,2 points), 8 short questions of reasoning and/or numerical questions (0,5 points). Memory and practices attendance (0,6 points).

The subject will be passed with a mark equal or superior to 5 points, taking into account that the students must acquire at least the 20% of the theoretical content and the 20% of the practical content.

The attendance to the 80% of the practices is compulsory.

In order to access to an advance on the call of this subject, it is a requirement that the student has coursed all his/her practices.

Attendance to practical sessions is mandatory. Unjustified non-attendance to more than 20% of the sessions will make it impossible to pass the course.

REFERENCES

Basic

- Física. Catalá J, ed. Cometa SA, Madrid. 1988.
- Biophysique. Gremy F, ed. Ed. Flammarion Medicine-Sciences. 1982.
- Principios de Ingeniería Tisular, 3ª ed. Lanza R, Lange R, Vacanti J, eds. 2011.

Additional

- Scientific basis of medical imaging. Wells PNT (Ed.) Longman Group Limited. 2009.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Siguiendo las recomendaciones del Ministerio, la Consellería y el Rectorado de nuestra Universidad, para el período de la "nueva normalidad", la organización de la docencia para el segundo cuatrimestre del curso 2021-22, seguirá un modelo híbrido, donde tanto la docencia teórica como práctica se ajustará a los horarios aprobados por la CAT pero siguiendo un modelo de Presencialidad / No presencialidad en la medida en que las circunstancias sanitarias y la normativa lo permitan y teniendo en cuenta el aforo de las



aulas y laboratorios docentes. Se procurará la máxima presencialidad posible y la modalidad no presencial se podrá realizar mediante videoconferencia cuando el número de estudiantes supere el coeficiente de ocupación requerido por las medidas sanitarias. De manera rotatoria y equilibrada los estudiantes que no puedan entrar en las aulas por las limitaciones de aforo asistirán a las clases de manera no presencial mediante la transmisión de las mismas de manera síncrona/asíncrona via “on line”.

