

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

Code	34504
Name	New technologies in biomedicine
Cycle	Grade
ECTS Credits	4.5
Academic year	2022 - 2023

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, 3D printing, etc., are established. 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

OUTCOMES

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

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 enginry.

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 lasers.

UNIT 8. Laser applications in medicine and surgery. Fields of laser application in medicine. Laser surgical application.

UNIT 9. Foundations of 3D printing.

3. BASES OF TISSUE ENGINEERING

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

UNIT 11. Extracellular matrix in tissue engineering.

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

UNIT 13. Tissue engineering of the cardiovascular system.

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

UNIT 15. Tissue engineering of the digestive system.

UNIT 16. Tissue engineering of the nervous system.

UNIT 17.- Tissue engineering 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. Visit to the research laboratory in laser techniques.
5. 3D printing.
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: electron 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 engineering. Supports and substrates for cell cultures.
10. Microscope visualization of tissues and constructs obtained by techniques of tissue engineering.

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.

Written test (9 points): 36 test questions with 4 answers, only one valid. 18 questions from each part of the subject.

Continuous evaluation, valuable in the attendance to classes and practices (1 point).

The subject will be passes with a mark equal or superior to 5 points.

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

Students are reminded of the importance of carrying out evaluation surveys on all the teaching staff of the degree subjects.



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.
- Recursos-e Salud: ClinicalKey Student. Elsevier (Scopus, ScienceDirect).
uv-es.libguides.com/RecursosSalut/BibliotecaSalut

Additional

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