# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 43078 |
| **Name** | Physical aspects of radiotherapy |
| **Cycle** | Master's degree |
| **ECTS Credits** | 5.0 |
| **Academic year** | 2022 - 2023 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 2140 - M.D. in Medical Physics | Faculty of Physics | 1 | Second term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 2140 - M.D. in Medical Physics | 3 - The physics of diagnosis and therapy | Obligatory |

**Coordination**

| Name | Department |
|---|---|
| CIBRIAN ORTIZ DE ANDA, ROSA MARIA | 190 - Physiology |

# SUMMARY

This subject provides the theoretical bases and the necessary practices to have an overview of radiotherapy, very suitable when choosing to dedicate yourself professionally to this activity and learn the specialty. We try to give a very broad vision with the latest advances in this medical field. It allows us to understand the relationship between the physical aspects of radiation oncologist treatments and their relationship with the success or failure of the fight against cancer. Radiation therapy is the clinical process that uses ionizing radiation to treat cancer. It is also used, and very selectively, in some benign lesion treatments. Radiation emitting procedures and sources are used in a very special way and in accordance with the objective of the treatment. These sources are used alone or in combination with other treatment modalities (use of various radiotherapy techniques, surgery, chemotherapy, etc.). The objective of this subject is to offer a global vision of these modalities and their role in the management of cancer treatment.

# 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

## 2140 - M.D. in Medical Physics

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Be able to access to information tools in other areas of knowledge and use them properly.
- Use the different exhibition techniques oral, written, presentations, panels, etc., to communicate the knowledge, proposals and positions.
- Project the knowledge on specific problems and know how to summarize and extract the most relevant arguments and conclusions for their resolution.
- To acquire a critical attitude that allows you to make reasoned judgments and defend them with rigor and tolerance.
- Critically analyze both his/her work and that of the colleagues.
- Acceder a herramientas en el área de Física que puedan ser susceptibles de aplicación a la Medicina y valorar su aplicabilidad e interés.
- Planificar y gestionar la utilización de las técnicas físico-médicas teniendo en cuenta los principios básicos de control de calidad, prevención de riesgos, seguridad y sostenibilidad.
- Seleccionar la instrumentación apropiada para el estudio a realizar y aplicar sus conocimientos para utilizarla de manera correcta.

- Valorar el binomio riesgo-beneficio asociado a las técnicas físicas aplicadas al diagnóstico y la terapia, buscando optimizar el beneficio y minimizar el riesgo.

- Manejar los métodos matemáticos de procesamiento de señales para la obtención de las diferentes modalidades de imágenes.
- Relacionar el fundamento físico con cada técnica de adquisición de imágenes y distinguir las peculiaridades de la información diagnóstica que permite obtener cada modalidad.
- Manejar las técnicas básicas de control de calidad de las diferentes modalidades de obtención de imágenes.
- Medir campos electromagnéticos en diferentes ambientes.

- Elaborar una memoria clara y concisa de los resultados de su trabajo y de las conclusiones obtenidas.
- Saber redactar y preparar presentaciones para posteriormente exponerlas y defenderlas en público.

## LEARNING OUTCOMES

At the end of the learning process the student will have acquired:

Knowledge of the physical foundations of radiotherapy

Knowledge of the technology involved in the production and subsequent application of ionizing radiation in cancer treatment.

Knowledge of the physical models of dose calculation

Knowledge of methods of using medical images in radiotherapy

Knowledge of basic quality control techniques

It will also allow the student to acquire social skills by

Get in touch and adapt to a specific work environment such as healthcare.

Promote teamwork and participation in the multidisciplinary group.

Analysis of systems failures and their importance

## DESCRIPTION OF CONTENTS

### 0. Introduction to the subject

### 1. Cancer epidemiology and clinic

1.1 Situation of cancer in Spain
1.2 Risk Factors
1.3 Principles of clinical oncology

### 2. Radiobiology

Tumor control and normal tissue tolerance (therapeutic index)
Repair, fractionation, organ tolerances
Mathematical aspects of survival curves

### 3. Photon beams

3.1 Physical characteristics of photon beams.
3.2 Treatment parameters in photon beams.
3.3 Profiles of treatment beams.
3.4 Isodose curves.
3.5 Corrections in patients.
3.6 Calculation of monitor units.

### 4. Electron beams

4.1 Physical characteristics of electron beams.
4.2 Treatment parameters in electron beams.
4.3 Profiles of treatment beams.
4.4 Isodose curves.
4.5 Corrections in patients.
4.6 Calculation of monitor units.

### 5. Beam calibration

5.1 Doismetric protocols. TRS-398 protocol.
5.2 Determination of absorbed dose using ionization chambers.
5.3 Corrections for magnitudes of influence.
5.4 Correction factor for beam quality.
5.5 Measurement of the reference dose. Practical examples.

### 6. Volumetric imaging systems and registration in 3D space

### 7. Special techniques

7.1 Radiosurgery
7.2 Total Body Irradiation (TBI)

### 8. Interrelation Radiophysics and Radiotherapy Oncology: Role of each specialist in treatment planning

8.1 Quality Indicators in Radiotherapy
8.2 Importance of Radiotherapy currently in the treatment of Cancer

### 10. Nuevos haces para nuevos tratamientos

### 11. Practical classes

1. Exercises on photon and electron beams
2. Neutron dosimetry
3. Design of a 3D Radiotherapy treatment with PLUNC
4 3D Printting

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 30,00 | 100 |
| Laboratory practices | 20,00 | 100 |
| Development of group work | 5,00 | 0 |
| Development of individual work | 5,00 | 0 |
| Study and independent work | 20,00 | 0 |
| Readings supplementary material | 5,00 | 0 |
| Preparation of evaluation activities | 10,00 | 0 |
| Preparing lectures | 10,00 | 0 |
| Preparation of practical classes and problem | 10,00 | 0 |
| Resolution of case studies | 10,00 | 0 |
| **TOTAL** | **125,00** | |

## TEACHING METHODOLOGY

MD1.- Theoretical classes will be in the form of a master class recorded and viewed online.

MD2.- Practical laboratory classes will be held in hospitals

MD3.- Videoconferences of kinds of problems.

MD4.- Videoconferences of experts in the subjects.

MD5.- Videoconferences to resolve doubts about the issues

After the practicals each student will present a memory of the same

## EVALUATION

Written exam on the contents developed in the theoretical and practical classes of the subject. 70%

Evaluation of the written memories of works and practices. 30%

## REFERENCES

### Basic

- Faiz M. Khan, The Physics of Radiation Therapy, Fouth edition, Wolkers Kluwer-Lippincott Williams $ Wilkins, 2010

### Additional

- Harold E. Johns y John R. Cunningham, The Physics of Radiology. 4ª edición. Charles C. Thomas Publisher. 1983.
- E.J.N. Wilson An Introduction to Particle Accelerators (Oxford University Press, 2001)
- Harold E. Johns y John R. Cunningham, The Physics of Radiology. 4ª edición. Charles C. Thomas Publisher. 1983.