

**Course unit name: INTRACELLULAR SIGNALING IN CANCER**

**1.- General information**

Code	303028	Plan		ECTS	3
Type	Elective	Course	2024/2025	Periodicity	1 <sup>st</sup> Semester
Department	<a href="#">Cancer Research Center</a>				
Virtual Platform	Platform:	CICLOUD			
	URL de Acces:	<a href="https://cicloud.dep.usal.es/">https://cicloud.dep.usal.es/</a>			
Language	This subject is taught in English				

**Faculty**

Professor Coordinator	Dr. Alberto Fernández Medarde				
Research area	Screening of inhibitors of Ras activation and signaling for cancer treatment				
Center	Bioquemistry and Molecular Biology				
Office	Cancer Research Center				
Tutorials	To be arranged by email				
URL Web	<a href="https://www.cicancer.org/investigador?id=c6ac8867-1ceb-4c8b-b641-e3dd57d9e01b">https://www.cicancer.org/investigador?id=c6ac8867-1ceb-4c8b-b641-e3dd57d9e01b</a>				
E-mail	<a href="mailto:afm@usa.es">afm@usa.es</a>	Phone	+34 923 294801		

Professor	Dra. María Elena Díaz Rodríguez				
Research area	New therapies in breast cancer therapy. Mechanisms of action and resistance.				
Center	Biochemistry and Molecular Biology				
Office	Cancer Research Center, Lab 15				
URL Web	<a href="https://produccioncientifica.usal.es/investigadores/148141/detalle">https://produccioncientifica.usal.es/investigadores/148141/detalle</a>				
E-mail	<a href="mailto:ediaz@usal.es">ediaz@usal.es</a>	Phone	+34 923 294815		

## 2.- The course in the context of the Master's Program

### Training Module

First block of the academic year of the five in which it is divided.  
First term.

### General aim of the subject

This subject deals with the different signaling pathways involved in cancer. Alterations to intracellular signaling are decisive in tumor development, and their knowledge allows the design of therapeutic approaches aimed at blocking different key components in signal transduction. This subject is very important to understand how processes such as cell division or apoptosis are regulated and the information received during the classes will help to better understand the content of many of the other subjects taught in the master's degree.

### Professional specialization

Recommended for those students who want to work in the field of basic cancer research or those who want to work in studies involving solid tumors, both at a clinical and translational level.

## 3.- Previous recommendations

It is recommended to take this course together with the tyrosine receptor kinase, some of those analyzing the cell cycle and migration. Proficiency in English is recommended, since the subject will be taught in that language.

## 4.- Aims of the subject

To know the main signaling pathways that are altered in tumor processes, their components, activation mechanisms as well as their function in normal and pathological situations. Study the interactions between signaling pathways and understand that they are not linear processes, but are part of extensive signaling networks. Understand the mechanisms that regulate the different pathways and how they are coordinated. To understand how alterations in these pathways modify cells during tumorigenesis, as well as the assignment of specific molecular alterations to specific types of cancer. Analyze therapeutic approaches that target specific signaling molecules and their success.

## 5.- Contents

The subject is divided into two blocks. The first focuses on lectures in which the teacher will give the necessary notions to know the main cellular signaling pathways and will cover all the points mentioned in the objectives of the subject.

### Topics discussed:

- 1- Introduction to signaling in cancer.
- 2- The small intracellular GTPases of the Ras family.
  - 2.1- The GTPases of the Rho family and the control of the cytoskeleton.
  - 2.2- Canonical Ras GTPases and their central role in tumor processes.
- 3- Signaling by other GTPases of the Ras family.
- 4- Signaling by PI3K. Lipids as Second Messengers.
- 5- The signaling path of Wnt-bCatenina.
- 6- The TGF $\beta$  superfamily in cancer.
- 7- TNF and inflammatory processes in cancer.
- 8- Other signaling pathways implicated in cancer (Notch, Jak/Stat, SHH, Hippo, etc.)
- 8- Alterations in signaling in cancer.
- 9- Targeted therapies as a future in cancer treatment.

### Seminars:

In the second block, students will choose a series of articles for debate (change / update year by year):

A series of topics and an appropriate number of articles relevant to this field will be selected annually, either because of their seminal nature or because of their novelty, reflecting recent advances in the topic. Each student must prepare at least one of these seminars, based on the presentation and criticism of one or more selected articles. The other students must attend all these seminars and actively participate in their presentation and discussion.

## 6.- Skills to be acquired

The skills that are described must be related to the general and specific skills of the degree. It is recommended to code the competences (CG xx1, CEyy2, CTzz2) to facilitate references to them throughout the guide.

### Basic skills

Basic knowledge of the different signaling pathways (CG001), the alterations they present in cancer (CG002) and their usefulness as a therapeutic target (CG003).

### Specific skills

- To know the different families of Ras GTPases, the signaling pathways controlled by these GTPases, as well as the cellular functions they regulate and their role in tumor development (CE001).
- to have an understanding of the role of PI3K signaling in the control of protein synthesis, cell metabolism and survival, as well as the alterations that make this pathway a therapeutic target in many types of cancer (CE002).
- To know the signaling pathway of Wnt ->  $\beta$ -Catenin and its role in tumor processes (CE003).
- To understand the physiological function of TGF $\beta$  in a normal cell and the interaction with other signaling pathways, as well as its implication in tumor development (CE004).
- To understand the role of inflammation in cancer and the role of the TNF family in the regulation of inflammatory processes (CE005).
- To understand the signaling that leads to apoptosis and its regulation (CE006).
- To study and understand the role of calcium signaling in cell physiology (CE007).
- To know the role of NF $\kappa$ B in survival and its interaction with other signaling pathways

(CE008). - To know and understand the role of signaling routes activated by Sonic Hedgehog, Jak / Stat, Notch or Hippo (CE009). - To associate the different signaling routes in cancer, understand that they are not isolated entities and understand the concept of signaling networks (CE010). - To know the latest developments in targeted therapy, learn about the tendency to seek specific therapeutic targets in cancer treatment and future prospects (CE011).
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**7.- Teaching methodology**

The student must attend the assessable theoretical sessions of the course (14 hours) having previously read and understood the recommended bibliography; During the first session there will be a brief introduction to the program of the subject, but also the how the sessions will be organized. In addition, doubts and comments from the students will be discussed.

The student must attend the seminars (18 hours) in which each group (or student) will present a published research work or a line of research (Journal Club type), a critical dialogue will be established in which all students must ask questions and discuss on the work previously presented.

**8.- Estimated learning time**

		Hours tutored by the teacher		Individual work (hours)	TOTAL HOURS
		Attendance required (hours)	Distance learning (hours)		
Lectures		14		10	24
Practices	- In classroom				
	- In laboratory				
	- In computer classroom				
	- Countryside				
	- Visualization classroom				
Seminars				10	10
Work presentations and debates		18			18
Tutorials		10			10
Online activities					
Work preparation				10	10
Other activities					
Exams - evaluation		3			3
<b>TOTAL</b>		<b>45</b>		<b>30</b>	<b>75</b>

**9.- Materials**

<b>Books</b>
The bibliography will be provided for each individual topic during the theoretical sessions.
<b>Other bibliographical, electronic references or any other type of resource</b>
PubMed bibliographic search.

## 10.- Assessment

### **Assessments on the performance of the student**

Final exam: Test and short answers (80% of the final grade).

Seminars presented by students on the subject (20% of the final grade).

To stimulate the critical discussion and understanding of the subject, the questions asked by the students during the seminars and during the theoretical sessions will also be valued. The absence to the theoretical sessions without justification will be considered at the time of the final evaluation.

### **Recommendations**

The questions included in the evaluation process will cover the complete content of the subject. Nevertheless, during the theoretical sessions the aspects that the teacher considers most important for the students will be emphasized.

Recommendations after failing to reach the evaluation criteria A second exam will be prepared. Grades from the seminars will also be considered.