Name of the university	List of courses - II semester	ECTS	Compulsory/ elective	Links to Departments websites
University of Salamanca - USAL	*Intracellular signaling in cancer*	*3*	**Compulsory**	https://cicweb2.cicancer.org/uploads/master/Optativas/2Semestre
	Signaling by Growth Factor Receptors in Cancer	*3*	**Compulsory**	
	Angiogenesis Regulatory Mechanisms: Role in The Development of Tumors	*3*	**Compulsory**	
	Anti-Tumor Immunotherapy: From Biology to Clinical Applications	*3*	**Compulsory**	
	Advances in neurology and neuropsychology: neurodegenerative diseases	*6*	**Compulsory**	
	Molecular Bases of Tumoral Variability: Modifier Genes of The Susceptibility and Evolution of Cancer	*3*	**Compulsory**	
	Bioinformatics and Computational Genomics in Cancer Research	*3*	**Compulsory**	
	Practicum in biology and clinic of cancer	*6*	**Compulsory**	
TOT ECTS		***30***		

Per ogni ulteriore domanda al bando e per la conoscenza linguistica scrivete ad:
outgoing.erasmus@unipv.it

INTRACELLULAR SIGNALING IN CANCER

1.- Course details

Code	303028	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Institute of Molecular and Cell Biology of Cancer. CIC				
Virtual Platform	Platform:	CICLOUD			
	Acces URL:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Teacher details

Teacher (Coordinator)	Dr. Alberto Fernández Medarde		
Department	Bioquemistry and Molecular Biology		
Research area	Role for Ras Guanine Nucleotide Exchange Factors RasGrf1 and RasGrf2 in Central Nervous System		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 1		
Office hours	To be arranged by email		
Web Address	https://www.cicancer.org/investigador?id=c6ac8867-1ceb-4c8b-b641-e3dd57d9e01b		
E-mail	afm@usa.es	Telehone	+34 923 294801

Teacher	Dr. Eugenio Santos de Dios		
Department	Microbiology and Genetics		
Research area	Ras gene products in proliferation and differentiation signalling pathways		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 1		
Office hours	To be arranged by email		
Web Address	https://www.cicancer.org/investigador?id=1eb0199f-f5bd-44c4-abef-4b40034e7477		
E-mail	cicancer@usal.es	Telephone	+34 923 294720

Teacher	Dr. Fernando Calvo Baltanas		
Department	Microbiology and Genetics		
Area	Ras gene products in proliferation and differentiation signalling pathways		
Centre	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 1		
Office hours	To be arranged via email		
Web address	https://www.cicancer.org/investigador?id=9a4ec952-28a0-40d6-baf5-80ca2a5fde56		
E-mail	baltanas@usal.es	Telephone	+34 923294801

2.-Purpose of the course within the study plan

Treaning Module to which the course belongs
Fifth block of t of five comprising the academic year. 2nd Semester..

Role of the course within the teaching module and study plan
In this course, the molecular alterations that transform a normal cell into a cancerous one will be analysed. In the different topics proposed, the main signalling routes responsible for the control of the cellular processes affected in cancer will be analysed. This will allow students to understand how changes in intracellular signalling give rise to many of the alterations they have studied in other courses of the master's degree such as changes in the cell cycle; induction of angiogenesis; migration; invasion; and metastasis processes etc.

Professional profile
Students interested in any field of oncology, especially those with an interest in basic and applied research.

3.- Preliminary recommendations

To have taken one of the optional courses on cell cycle, migration and angiogenesis, but especially the course on tyrosine kinase receptors.

4.- Course objectives

To know the main signalling routes that are altered in tumour processes. To study the interactions between them and the mechanisms of cross regulation. To understand how alterations in these pathways modify cells during tumorigenesis, as well as the assignment of specific molecular alterations to types of specific cancer.
To analyse the therapeutic approaches that use specific signalling molecules as targets and their success.

5.- Contents

The subject is distributed into two blocks. The first focuses on master classes in which teachers will give the necessary information to understand the main cell signalling routes, and will cover all the points mentioned in the course objectives.

Course programme:
1- Introduction to cancer signalling.
2- The small intracellular GTPases of the Ras family.
2.1- The Rho family's GTPases and the control of the cytoskeleton.
2.2- Canonical RTPases and their central role in tumour processes.
3- Signalling by other PWGs of the Ras family.
4- PI3K signalling. Lipids as second messengers.
5- The Wnt-β-catenin signalling route.
6- The TGF-β superfamily in cancer.
7- NPT and inflammatory processes in cancer. 8- Alterations in cancer signalling.
9- Targeted therapies as the future in cancer treatment.

Seminars:
In the second block the students will choose a series of articles to be discussed (change/update year by year):
Each year a series of topics and an appropriate number of articles relevant to this field will be selected, either for their seminal nature or for their novelty reflecting recent developments in the field. Each student will be required to prepare at least one of these seminars, based on the presentation and critique 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 competencies described should be related to the general and specific competencies of the degree. It is recommended that the competences are codified (GC xx1, CEyy2, CTzz2) to facilitate reference to them throughout the guide.

Basic/General
- Basic knowledge about the different signalling routes, the alterations they present in cancer and their usefulness as a therapeutic target..

Specific
- To learn about the different families of Ras GTPases, the signalling routes controlled by these GTPases, as well as the cellular functions they regulate and their role in tumour development. - To have an understanding of the role of PI3K signalling in the control of protein synthesis, cell metabolism and survival, as well as the alterations that make this route a therapeutic target in many types of cancer. - To know the Wnt signalling route -> β-Catenin and its role in tumour processes. - To understand the physiological function of TGFb in a normal cell and its interaction with other signalling pathways, as well as its involvement in tumour development. - Understanding the role of inflammation in cancer and the role of the TNF family in the regulation of inflammatory processes. - Relate the different cancer signalling routes, understand that they are not isolated entities and understand the concept of signalling networks. - To learn about the latest developments in targeted therapy, the trend towards specific therapeutic targets in cancer treatment and future prospects

Transversal
To relate the signalling pathways studied with that learnt in other courses of the master's degree: regulation of the cell cycle, control of migration, invasion and metastasis, of angiogenesis processes, of cell metabolism and of the immune response.

7.- Teaching methods

Students must attend the theory classes (14 hours), having previously read and understood the recommended literature. During the first session there will be a brief introduction to the course programme and a description of the approach that will be taken for the different sessions, their organization and the answering of any doubts or comments.
The student must attend the seminars (18 hours) in which each group (or student) will present a published research paper or a line of research (like a Journal Club), and participate in a critical discussion which will be assessed.

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		14		10	24
Practices Training	- In the classroom				
	- In the laboratory				
	- In the computer classroom				
	- Fieldwork				
	- Observational (Ob)				
Seminars-Scientific talks		18		10	28
Presentations and debates					
Tutorials		10			10
Online follow-up activities					
Assignment preparation				10	10
Other activities: Scientific talks					
Exams		3			3
TOTAL		**45**		**30**	**75**

9.- Resources

Student reference books
The required literature will be available to the students together with the presentations via Studium

Other bibliographic or electronic references and resources
PubMED

10.- Assessment

General considerations.
Attendance will be considered, as well as active participation in the classes. The scientific discussion following the presentation of the scientific articles of the "Journal club" will be evaluated d.

Criteria
Written exam (80% of the final mark). Seminars presented by the students on topics included in the course (20% of the final mark).

Tools
The result of the written exam, which will be a test with some short questions. Assessment of the quality of the presentation of the "Journal club", including the student's knowledge about the topic being presented, its structure and clarity, and the student's ability to respond to the questions raised during the discussion

Recommendations.
Study the topic well and prepare the seminar correctly.

Recommendations for remedial action.
Review of the subject and querying any doubts that may arise with the teacher responsible.

SIGNALING BY GROWTH FACTOR RECEPTORS IN CANCER

1.- Course details

Code	303027	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Cancer Research Center				
Virtual Platform	Platform:	CICLOUD			
	Access URL:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Teacher details

Teacher (Coordinator)	Dr. Dionisio Martín Zanca		
Department	Gene Regulation and Cell Differentiation		
Center	Institute of Functional Biology and Genomics (IBFG). CSIC/USAL		
Office	P 1.6		
Office hours	Thursdays 12-15 h		
E-mail	marzan@usal.es	Telephone	923294896, Ext. 4896

Teacher	Dr. Marina Holgado Madruga		
Department	Physiology and Pharmacology		
Research area	Pharmacology		
Centre	School of Medicine		
Office hours	Fridays 16 h		
E-mail	mholgado@usal.es	Telephone	+34 923 294720

2.- Purpose of the course within the study plan

Teaching module to which the couse belongs
Fourth module out of five comprising the academic year. See the academic calendar of activities.

Role of the couse within the teaching module and study plan
To describe, from a historical perspective, the structure and function of growth factor receptors, their importance in the physiological control of cell proliferation, differentiation and survival, and their deregulation in cancer. To present tyrosine kinase receptors as targets for personalised anti-tumour therapies, with their advantages and limitations.

Professional profile
Translational research.

3.- Preliminary recommendations

None

4.- Course objectives

• Acquire knowledge of the biology, structure and function of tyrosine kinase (RTK) receptors and their ligands.

• Acquire knowledge about the role of RTK and RTK-derived oncogenes in cancer.

• Acquire knowledge about the importance of RTKs as targets for anti-tumour treatment.

5.- Contents

Course planning

Theory classes:
• Growth factors.
• Growth factor families.
• Growth factors in cancer.
• Growth factor receptors.
• Structure of tyrosine kinase receptors. Families.
• Functioning of RTKs. Activation by ligand binding. Dimerization.
• Signal transduction from RTKs to the cell nucleus.
• RTKs as nodes in signalling networks. Cross regulation.
• Negative regulation: dephosphorylation, internalisation, ubiquitination, etc…
• RTKs as a target for anti-tumour therapies. Tyrosine kinase activity inhibitors, antibodies that interfere with RTK activation

Seminars:
• The students, in groups of two or three, will choose a recent article directly related to the content of the course, critically analyse its results and conclusions in detail and present it to the rest of the class for approximately one and a half hours

Bibliography
Students will be provided with the following at the beginning of the theory classes.

6.- Competences to be acquired

Basic/General

- Acquiring basic theoretical and practical knowledge.

Learning how to prepare and present research seminars, answer questions, comments, etc.

Resolving problems; helping to prepare seminars, etc.

Learning to search, select and obtain relevant references, and to critically evaluate research results..

7.- Teaching methods

• Students must attend the theory sessions of the course (12 hours) having previously read and understood part of the recommended literature; the active participation of the students in the theory classes will be encouraged.
• Students will be organized in work groups of two or three people for the selection and study of an article from the bibliography directly related to the course content.
• These work groups will present a critical review of the article chosen to the teacher and his or her classmates.
• The rest of the students must attend the above-mentioned presentations and actively participate, in a constructive way, with questions and/or comments. This activity will be evaluated.

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		12	20		32
Practical Training	- In the classroom				
	- In the laboratory				
	- In the computer lab				
	- Fieldwork				
	- Observational (Ob)				
Seminars-Scientific talks					
Presentations and debates		12			12
Tutorials		3			3
Online follow-up activities					
Assignment preparation				27	27
Other activities: Scientific talks					
Exams		1			1
TOTAL		**28**	**20**	**27**	**75**

9.- Resources

Students reference books

Other bibliographical, electronic references or any other type of resource
This will be provided at the beginning of the master classes.

10.- Assessment

The assessment tests that are designed must evaluate whether the described competencies have been acquired. Therefore, it is recommended that when describing the tests, the competencies and learning outcomes that are being assesed be indicated.

Criteria
•Final written exam, 70% of the final mark
•Evaluation of participation in the theory classes and seminars: 30% of the final mark

ANGIOGENESIS REGULATORY MECHANISMS: ROLE IN THE DEVELOPMENT OF TUMORS

1.- Course details

Code	303017	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Institute of Molecular and Cell Biology of Cancer				
Virtual Platform	Platform:	CICLOUD			
	Access URL:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Faculty

Teacher (Coordinator)	Dra. Alicia Rodríguez Barbero		
Department	Department of Physiology and Pharmacology		
Area	Physiology		
Center	School of medicine		
Office	Departmental Building 227		
Office hours	In person: Mon. – Fri. 9-13 h & 16-19 (By appointment). Online: via e-mail		
Web address	http://m.usal.es/webusal/en/node/25607		
E-mail	barberoa@usal.es	Telephone	+34 677555071

Teacher	Dr. Miguel Pericacho Bustos		
Department	Department of Physiology and Pharmacology		
Area	Physiology		
Center	School of Medicine		
Office	Departmental building. laboratory S19		
Office hours	In person: Mon. – Fri. 9-13 h & 16-19 (By appointment). Online: via e-mail		
Web address	https://ibsal.es/en/vascular-and-kidney-pathophysiology		
E-mail	pericacho@usal.es	Telephone	+34 92329500 EXT:1875

2.- Purpose of the course within the study plan

Teaching module to which the course belongs
Fourth module out of five comprising the academic year. See the academic calendar of activities.

Role of the course within the teaching module and study plan
The course provides insight into the stimulation and regulation of angiogenesis and its close relationship to the development of cancer.

Professional profile
Bachelor's degree in the area of Biomedicine (Biology, Biotechnology, Pharmacy, Medicine or Computer Science) or Licentiate degree in Biology, Biochemistry, Biotechnology, Pharmacy, Medicine or Computer Science.

3.- Preliminary recommendations

Interest in scientific research. Good level of English

4.- Course objectives

The objective of the course is to understand the physiological significance of the process of angiogenesis and its close relationship to the development of cancer. To know which are the signals that trigger angiogenesis and to understand the cellular and molecular mechanisms that are set in motion during angiogenesis, as well as their regulatory mechanisms.

The specific objectives are:

- To know the role of different cell types (endothelial cells, pericytes, vascular smooth muscle cells, lymphocytes, tissue parenchyma cells) in the process of the formation of different types of vessels (arteries, veins, capillaries, lymphatics).
- Understand the role of different hormones and autacoids in the induction and regulation of the process and the signals to halt it.
- To know how the different signalling pathways regulating the different cellular processes are involved in angiogenesis (activation, proliferation, invasion, migration, cell adhesion, recognition of other cell types, formation of complexes and multicellular structures).
- To know the characteristics of tumour angiogenesis and understand the similarities and differences with physiological angiogenesis.
- To know the tumour signals that induce angiogenesis and the regulatory factors that are involved in it.
- Understand the importance of angiogenesis in tumour development
- To analyse the basic processes on which therapies aimed at destroying the vessels of the tumour are based, as well as those aimed at preventing angiogenesis (antiangiogenic therapies).
- To know which are the appropriate pharmacological targets, depending on the type of tumour and the process to be blocked.
- To know the side effects of this type of therap.

In addition, as a complementary training, the students will become familiar with the main articles that have contributed to clarifying what is currently known about the cell cycle.

5.- Contents

Theory classes:

- Concept of angiogenesis. Physiological role of angiogenesis. Cell types involved in angiogenesis.
- Signals that trigger angiogenesis. Hypoxia, endothelial angiogenic factors, parenchymal angiogenic factors.
- Cellular and molecular processes that are set in motion during angiogenesis, as well as their regulatory mechanisms.
- Role of different cell types (endothelial cells, pericytes, vascular smooth muscle cells, lymphocytes, tissue parenchyma cells) in the process of the formation of different types of vessels (arteries, veins, capillaries, lymphatics).
- Hormones and autacoids that induce or regulate the process of angiogenesis and the signals to halt it.
- Signalling pathways that regulate the different cellular processes involved in angiogenesis: activation, proliferation, invasion, migration, cell adhesion, recognition of other cell types, formation of complexes and multicellular structures
- Characteristics of tumour angiogenesis. Similarities and differences with physiological angiogenesis. Importance of angiogenesis in the development of tumours.
- Tumour signals that induce tumour angiogenesis and the regulatory factors involved in it.
- Theoretical basis of antiangiogenic therapy.
- Pharmacological basis of antiangiogenic therapy. Side effects and complications of using this type of therapy.

Practical training:

Practical 1. Evaluation of in vitro angiogenesis. Techniques for cell proliferation, migration and microtubule formation in endothelial cells in culture.

Practical 2. Evaluation of angiogenesis in vivo. Comparison between physiological angiogenesis and tumour angiogenesis in a mouse model.

6.- Competences to be acquired

To identify the elements that form part of the angiogenic process and their particularities in cancer

Basic/General
Knowing how to interpret the results of this type of study

Specific
-. Recognize the physiological and pathological situations that induce angiogenesis and anti-angiogenesis. - Knowing how to interpret plasma markers of angiogenesis and antiangiogenesis. - Recognize a process of angiogenesis or antiangiogenesis in a histological section. - Know how to design a study to determine the angiogenic or anti-angiogenic effect of different substances, both endogenous and pharmacological. To know how to carry out in vitro and in vivo angiogenesis studies - Recognize the phases of the cell cycle in the different cell types involved in angiogenesis (endothelial cells, pericytes, vascular smooth muscle cells, lymphocytes, tissue parenchyma cells).

Transversal
- Organize and distribute group work efficiently. - Know how to discriminate, analyse and organize an information search. - Comply with the basic rules of a cell culture laboratory and an animal physiology laboratory.

7.- Teaching methods

-**Theoretical classes**: 8 lessons, each with a duration of 1.5 hours, which will explain in depth the content of each of the topics included in the course. Previously, the student will have access, through the platform STUDIUM, to the content and presentations used. For each topic, the recommended literature will be provided, of which the student can access through STUDIUM.
-**Practical classes**: 3 practical classes. In these sessions, the student will follow the development of physiological and tumoral angiogenesis in two different systems, in vivo and in vitro.
-**Seminar**: The students, organized in groups of 3-4 people, will undertake research work related to the content of the theory classes. The articles or lines of work to be discussed may be chosen by the students or provided by the teacher. In each session, the participation of all students will be encouraged, and a critical discussion will be undertaken and evaluated.
- **Tutorials:** Students will be able to access personalized or group tutoring whenever necessary. The preparation of the work to be carried out in groups will require at least one group tutoring session.

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		12	3	15	30
Practical Training	- In the classroom				
	- In the laboratory			9	
	- In thecomputer classroom				
	- Fieldwork				
	- Observational (Ob)				
Seminars Scientific talks					
Presentations and debates		3	3	9	15
Tutorials		6			6
Online follow-up activities			1	2	3
Assignment preparation		9			9
Other activities: Scientific talks					
Exams		3			3
TOTAL		**42**	**7**	**26**	**75**

9.- Resources

Student reference books

Other bibliographic or electronic references and resources
All references and resources will be provided by the teachers during the course.

10.- Assessment

The assessment tests that are designed must evaluate whether the described competencies have been acquired. Therefore, it is recommended that when describing the tests, the competencies and learning outcomes that are being assesed be indicated.

General considerations
Assessment is a fundamental element of the teaching and learning process as it consists of a monitorization that occurs throughout this process, obtaining information on how the process is being carried out. This in turn, allows the educational intervention to be modified according to the data obtained.

Criteria
Identification of the elements related to the angiogenic process. Ability to discuss and integrate concepts related to the program. Ability to differentiate physiological and tumour angiogenesis..

Tools
Evaluation of participation in the theory and practical classes (30% of the final mark) Evaluation of the presentation and defence of the group work (understanding the work, how it is connected with the knowledge acquired, discussion, capacity of synthesis and presentation) (40% of the final mark). Written test: theoretical knowledge acquired in the classes and seminars will be evaluated (30% of the final mark)..

Recommendations
A good understanding of the subject matter taught in the theory and practical classes. Studying the recommended literature and texts.

Recommendations for remedial action
Review and analysis of the subject matter taught in the theory and practical classes. Use of the tutorials.

ANTI-TUMOR IMMUNOTHERAPY: FROM BIOLOGY TO CLINICAL APPLICATIONS

1.- Course details

Code	303023	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Institute of Molecular and Cell Biology of Cancer				
Virtual Platform	Platform:	moodle.usal.es			
	URL de Acces:	https://moodle2.usal.es/			

Teacher details

Teacher (Coordinator 1)	Dr. Julia Mª Almeida Parra		
Department	Medicine		
Research area	Immunology and Cancer		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Wed. & Thur. 8-9 h (appointment request via email)		
Web address	https://www.cicancer.org/grupo?id=79		
E-mail	jalmeida@usal.es	Telephone	+34 923294811

Professor Coordinator 2	Dr. Alberto Orfao de Matos Correia e Vale		
Department	Medicine		
Research area	Medicine		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Mon. & Tue. 8-9 h (appointment request via email)		
Web address	https://www.cicancer.org/grupo?id=27		
E-mail	orfao@usal.es	Phone	+34 923294811

Teacher	Dr. Miguel Vicente Manzanares		
Department	Spanish National Research Council		
Research area	Biofísica tumoral		
Center	Cancer Research Center		
Office	Laboratory 6		
Office hours	Appointment request via email		
Web address	https://www.cicancer.org/grupo?id=69		
E-mail	miguel.vicente@usal.es	Telephone	+34 923294806

Teacher	Dr. Manuel Fuentes García		
Department	Medicine		
Research area	Molecular Biology, Proteomics, Nanotechnology and Immunotechnology		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Appointment request via email		
Web address	https://www.cicancer.org/grupo?id=81		
E-mail	jmfuentes@usal.es	Telephone	+34 923294811

Teacher	Dr. Dolores Caballero Barrigón		
Department	Medicine		
Research area	Oncohaematology		
Center	Institute of Molecular and Cell Biology of Cancer and University Hospital of Salamanca		
Office	Service of Hematology (University Hospital of Salamanca)		
Office hours	Appointment request via email		
E-mail	cabarri@usal.es	Telephone	+34 923294812

Teacher	Dr. Juan Jesús Cruz Hernández		
Department	Medicine		
Research area	Diagnosis and treatment of oncology patients. Clinical research in medical oncology		
Center	Institute of Molecular and Cell Biology of Cancer and University Hospital of Salamanca		
Office	Oncology Service (4th floor of University Hospital)		
Office hours	Appointment request via email		
Web address	http://www.cicancer.org/es/investigador/84/dr-juan-jesuscruz		
E-mail	jjcruz@usal.es	Telephone	+34 923294812

Teacher	Dr. Martín Pérez de Andrés		
Department	Medicine		
Research area	Immunology		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Appointment request via email		
E-mail	jmmmar@usal.es	Telephone	+34 923294811

Teacher	Dra. Mª Aránzazu Rodríguez Caballero		
Department	Medicine		
Research area	Immunology		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Appointment request via email		
E-mail	arocab@usal.es	Telephone	+34 923294811

Teacher	Dr. Enrique Montalvilllo Álvarez		
Department	Medicine		
Research area	Immunology		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 11		
Office hours	Appointment request via email		
E-mail	emontalvillo@usal.es	Tlephone	+34 923294811

2.- Purpose of the course within the study plan

Teaching module to which the course belongs
Fifth module out of six comprising the academic year.

Role of the course within the teaching module and study plan
To contribute to providing comprehensive training to students in the field of Cell Biology so as to begin a research career and facilitate their enrolment in a PhD program, through the acquisition of **all the transversal competences of the Master (CG1 to CG4) and the following specific competences:** • Students will understand how a clinical trial is planned and its basic parameters: susceptible population, inclusion and exclusion criteria, efficacy and toxicity assessment methods. • Students will recognize at a general level the genes and proteins involved in all tumour processes and their basic mechanisms of functioning. • Students will be able to interpret basic biological data on tumour genes and proteins for use in the assessment of tumours at the clinical level and in the development of diagnostic, prognostic or therapeutic applications. • Students will be able to recognize the specific clinical and molecular characteristics of different types of cancers, diagnostic methods and therapeutic approaches. • The students will know in a broad sense the methods that are used in the diagnosis and treatment of the different types of cancers. • Students will know how to access information and data on specialized biological research areas affecting the Molecular and Cellular Biology of Cancer. • Students will be able to integrate new knowledge in the field (Molecular Biology of Cancer) and develop their capacity for self-learning. • Students will discriminate between cause and effect through the use of biological experimentation. • Students will recognize the contents and mode of access to the main sources of biological resources and main biomolecular databases.

Professional profile
Master Degree on Health Sciences.

3.- Preliminary recommendations

Comply with the following recommended characteristics and general training requirements for enrolment in the Master in Biology and Clinic of Cancer: i) have completed at least one degree in the area of Biomedicine (Biology, Biotechnology, Pharmacy, Medicine) or be a graduate in Biology, Biochemistry, Biotechnology, Pharmacy or Medicine); ii) interest in scientific research; and iii) have a good command of the English language.

4.- Course objetives

To develop the foundations for the current and future application of oncological treatments based on immunotherapy, defined as the set of therapeutic strategies aimed at boosting or improving the patient's immune system so that it attacks and destroys the tumour.

The course will be developed in three thematic blocks. In the first one, the cellular and molecular mechanisms that intervene in the relationship between the immune system and the tumor will be studied in depth; in the second thematic block, the new strategies proposed to strengthen the response of the immune system against the tumor and to identify new biomarkers and cellular and molecular targets will be developed; and finally, in the third thematic block, information will be provided about the latest advances in immunological therapies in different solid and hematological tumors and about other relevant aspects in the clinical management of patients submitted to anti-tumor immunotherapy.

The specific objectives are as follows:

To explore the biological basis of the immune response in the context of tumor immunology.

Know the components of the immune system involved in the anti-tumor immune response and its mode of action.

Understand the mechanisms of tumor avoidance toward immune control and the value of the tumor microenvironment in this regard.

Understand the basics of immune anti-tumor therapies.
To know the main results derived from the application of new anti-tumor immunotherapy strategies..

5.- Contents

Theory classes::

I – IMMUNE SYSTEM AND CANCER: GENERAL PRINCIPLES OF TUMOR IMMUNITY:
Topic 1.- Anti-tumour immune surveillance: the role of the immune system in the anti-tumour response
Topic 2.- Molecular mechanisms of the immune response: molecules that mediate co-stimulatory
and inhibitory signals of the immune response of interest as therapeutic targets in cancer
Topic 3.- Tumour antigens
Topic 4.- Tumour avoidance mechanisms of the immune response
Topic 5.- Role of the tumour microenvironment in local tumour progression
Topic 6.- Role of the tumour microenvironment in the metastatic capacity of the tumour.

II – STRATEGIES AND FUNDAMENTALS OF ANTI-TUMOR IMMUNOTHERAPY:
Topic 7.- Anti-tumour immunotherapy: overview and classification of strategies used in cancer immunotherapy.
Topic 8.- Therapeutic applications of the modulation of regulatory molecules ("immune

checkpoint") of the anti-tumour immune response
Topic 9.- Monoclonal and bi-specific antibodies: cellular and molecular bases for their application in anti-tumour therapy
Topic 10.- Fundamentals of tumour antigen and/or dendritic cell vaccination
Topic 11.- Cell therapy in cancer: from TIL to NK cells and T-CAR cells
Topic 12.- Tumour microenvironment: future perspectives as an immunotherapeutic target
Topic 13.- Proteomic strategies for biomarker identification in anti-tumour immunotherapy
Topic 14.- Proteomics strategies for molecular target identification in anti-tumour immunotherapy.

III – CLINICAL APPLICATIONS OF ANTI-TUMOR IMMUNOTHERAPY:
Topic 15.- Integration of immunotherapy with conventional therapies (surgery, radiotherapy and chemotherapy)
Topic 16.- Toxicity associated with anti-tumour immunotherapy Topic 17.- Clinical trials using Immunotherapy in solid tumours
Topic 18.- Immunotherapy using monoclonal antibodies in haematological tumours
Topic 19.- Adoptive cellular immunotherapy in haematological cancer: current and future status of T-CAR cell use
Topic 20.- Assessment and monitoring of the response to new immunotherapeutic tools used in cancer treatment.

Practical training / data analysis using computer programs:
Practical 1. Flow cytometer. Techniques for marking membrane molecules in cells of the immune system.
Practical 2. Software for the analysis of data obtained by flow cytometry and its use in monitoring the immune response.
Practical 3: Immunohistochemistry and its use in the diagnosis of cancer.
Practical 4: Proteomics.

Seminars:
Students will be encouraged to submit individual scientific articles on current and/or controversial topics in the field of "Immunology and Cancer", which will be discussed jointly, or on relevant aspects (related to the contents of the subject) of interest for their end-of-master's projects..

Scientific talks:
Attendance and use (evaluable) of at least one scientific talk on "Antitumoral Immunotherapy" given by prestigious speakers invited by the faculty responsible for the course.

6.- Competences to be acquired

Basic/General

- To understand the basics of tumour immunology and to acquire the essential knowledge of the basics of immunotherapy and its application in the treatment of tumours. Ability to understand and critique scientific information on tumour immunology and immunotherapy. Ability to integrate knowledge in order to evaluate the results derived from the application of immunotherapies in oncology.
- Ability to critically analyse, summarize and discuss relevant research published in the field of tumour immunology and anti-tumour immunotherapy.

Specific

Acquisition of skills and ability to interpret laboratory results derived from the study of tumor cells, of interest in the field on immunotherapy.

7.- Teaching methods

The student must attend the evaluable theory classes having previously read and understood the recommended literature. The first class will focus on the structure of the lessons and on providing an overview of the course contents. The student must also attend the practical sessions.

The student must attend the seminars in which each student will present a recent or controversial work published in a scientific journal of interest according to the contents of the course. At this time a critical discussion will take place with the other students and the teacher, which will be evaluated.

Likewise, the student must attend and participate in organized scientific talks that focus on a specific aspect related to the objectives of the course.

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		15		30	45
Practical Training	- In the classroom				
	- In thelaboratory	3		1	4
	- In the computer classroom	1			1
	- Fieldwork				
	- Observational (Ob)				
Seminars-Scientific talks					
Presentations and debates		1			1
Tutorials		0.5	0.5		1
Online follow-up activities				6	6
Assignment preparation				5	5
Other activities: Scientific talks		1			1
Exams		1		10	11
TOTAL		**22.5**	**0.5**	**52**	**75**

9.- Student reference books

Books

None

Other bibliographic or electronic references and resources

- Almagro JC, Daniels-Wells TR, Perez-Tapia SM *et at*. Progress and challenges in the design and clinical development of antibodies for cancer therapy. Front Immunol 2018; 8: art 01751.
- Borst J, Ahrends T, Babala N, *et al*. CD4+ T cell helper in cancer immunology and immunotherapy. Nat Rev Immunol 2018; 18: 635.
- Cuesta-Mateos C, Alcaraz-Serna A, Somovilla-Crespo B, *et al*. Monoclonal antibody therapies for hematological malignancies: not just lineage-specific targets. Front Immunol 2018; 8: art 01936.
- Farhood B, Najafi M, Mortezaee K. CD8+ cytotoxic T lymphocytes in cancer

immunotherapy: A review. J Cell Physiol 2019; 234: 8509.

- Gao J, Bernatchez C, Sharma P *et al*. Advances in the development of cancer immunotherapies. Trends in Immunology 2013; 34: 90.
- Kartikasari A, Prakash M, Cox M, *et al*. Therapeutic cancer vaccines - T cell responses and epigenetic modulation. Front Immunol 2019; 9: art 03109
- Koury J, Lucero M, Cato C *et al*. Immunotherapies: exploiting the immune system for cancer treatment. J Immunol Res 2018; Vol 2018, art ID 9585614, 16 pages, 2018.
- Marabelle A, Tselikas L, de Baere T, *et al*. Intratumoral immunotherapy: using the tumor as the remedy. Ann Oncol 2017; 28: xii33.
- Mohme M, Riethdorf S, Pantel K. Circulating and disseminated tumour cells – mechanisms of immune surveillance and scape. Nat Rev Clin Oncol 2017; 14: 155.
- Spranger S. Mechanisms of tumor escape in the context of the T-cell-inflamed and the non-T-cell-inflamed tumor microenvironment. Int Immunol 2016; 28: 383

10.- Assessment

The assessment tests that are designed must evaluate whether the described competencies have been acquired. Therefore, it is recommended that when describing the tests, the competencies and learning outcomes that are being assesed be indicated.

Assessments on the performance of the student
Continuous assessment system: -Attendance to theory clases, seminars, practical and tutorials. -Participation and discussion in classes/seminars/practicals -Continuous evaluation Written test (main exam): Test consisting of multiple-choice questions. Individual preparation and oral presentation critiquing published reviews.

Criteria
Final written exam on the contents presented in the theory classes: (45% of the final mark). Evaluation of active participation in the theory classes, practicals and seminars (20% of the final mark). Preparation and presentation of a review on a topic of interest within the scope of the course objectives, based on the discussion of a published article (directed and advised by the tutor) (30% of the final mark). Written exam (5% of the final mark).

Recommendations for remedial action
If a student has not passed the course (a minimum mark of 5 out of 10), the marks obtained in the continuous evaluation and in the preparation and presentation of the article review will be taken into account. The student must then take a new written exam on the theory and practical contents included in the course.

ADVANCES IN NEUROLOGY AND NEUROPSYCHOLOGY: NEURODEGENERATIVE DISEASES

1.-Course details

Code		Plan		ECTS	6
Type	Compulsory	Year	2021/2022	Timing	2nd Semester
Center	Faculty of Medicine				
Virtual platform	Platform:	Studium: moodle			
	Access URL:	http://moodle.usal.es			

2.- Teacher details

Teacher (Coordinator)	Eva Mª Arroyo Anlló	Group	1
Department	Basic Psychology, Psychobiology and Methodology of the C.C.		
Area	Psychobiology		
Center	Faculty of Psychology	Office	215
Office hours	To be determined		
URL Web	http://moodle.usal.es		
E-mail	anlloa@usal.es	Phone	923-294500 #3263

Teacher	M.ª Esther Ramos Araque	Group	1
Department	SACyL - CAUSA		
Area	Neurology		
Center	Virgen Vega Hospital - Neurology Service 8th Floor		
Office	Neurology Office		
Office hours	To be determined by email		
URL Web	http://moodle.usal.es		
E-mail	ramosmaryesther@usal.es	Phone	923 291100 #55465

Teacher	Sandra Martínez Peralta	Group	1
Department	IBSAL		
Area	-		
Center	IBFG -		
Office	Molecular Neurobiology Laboratory - 2.8.		
Office hours	To be determined by email		
URL Web	http://moodle.usal.es		
E-mail	sandramperalta@usal.es	Phone	923 294900 #5468

3.-Purpose of the course within the study plan

Teaching module to which the course belongs
Elective subjects

Role of the course within the teaching module and study plan

Professional profile

4.- Preliminary recommendations

Subjects that are recommended to have taken
None

Subjects that are recommended to be taken simultaneously

Subjects that are continuation

5.- Course objectives

There are several objectives: on the one hand, the aim is to train specialized and trained professionals in the evaluation, diagnosis and therapy of cognitive and behavioral alterations mainly due to Alzheimer's disease and other neurodegenerative processes.
On the other hand, a general approach to neurodegeneration, as well as a familiarization with the electro-neurodiagnostic techniques of motor degenerative processes, and neuroimaging in dementias.
Understanding of the etiopathogenetic foundations of the mental pathology associated with these processes and acquiring basic skills for their recognition and management.

6.- Contents

- Ethiopathogenesis of neurodegeneration: general concepts
- Etiopathogenesis of neurodegeneration: Alzheimer's disease, amyotrophic lateral sclerosis, Lewy body disease, frontal dementia, prion, taupathies and ubiquinopathies.
- Cognitive alterations in neurodegenerative diseases
- Diagnosis of the main neurodegenerative diseases
- Treatment of neurodegenerative diseases: preventive measures
- Updating the neuropharmacological treatment of neurodegenerative diseases.

- Neuropsychology of normal brain aging.
- Risk factors and protective factors
- Detection of early diagnostic neuropsychological markers
- Neuropsychological exploration techniques in neurodegenerative diseases.

- General notions of neuropsychological interventions.
- Bio-psycho-social bases of non-pharmacological therapies.
- Classic techniques of cognitive interventions in dementias.
- Cognitive intervention techniques in dementias with mild and mild-moderate severity.
- Non-pharmacological therapies for dementia behavior alterations.

7.- Competences to be acquired

- Study the concept of normal and pathological brain aging.
- Know the early neuropsychological markers in the detection of neurodegenerative diseases.
- Know the risk and protective factors for dementias.
- Know the implications of genetic alterations in the current classifications and types of degenerative dementias.
- Know the lesional mechanisms of dementias such as "deposit diseases"
- Know the neuropsychological and motor symptoms of neurodegenerative diseases.

• Know the neurological manifestations and the clinical evolution of neurodegenerative diseases.
• Know the means of electro-neurophysiological and neuroimaging diagnosis in neurodegenerative diseases.
• Know the advances in neuropharmacological therapies for neurodegenerative diseases.
• Analyze current trends in interdisciplinary care for patients with neurodegenerative diseases.
• Analyze neuropsychological advances in normal brain aging and neurodegenerative diseases.
• Acquisition of the necessary skills to manipulate and interpret tools neuropsychological.
• Ability to write, expose and discuss basic concepts of the subject.
• Recognize and use texts and documentary sources for neuropsychology.
• Develop competencies and skills to apply this knowledge in the neuroscientist professional and research practice.

Specific

• Understand the etiopathogenic mechanisms of motor neuron degeneration, the techniques for its diagnosis and advances in treatment.
• Study current concepts about the brain bases of higher mental functions.
• Know the main neuropsychological methods for evaluating these functions.
• Know the main methods of neuropsychological rehabilitation / stimulation of cognitive and behavioral abilities in dementias.
• Know the concepts of psychotic syndromes, as the main psychiatric disorders of higher functions.
• Know the mechanisms of action of psychotropic drugs.
• Acquire a detailed knowledge of the inheritance of mental pathologies.
• Know the interactions between genetic predispositions and the environment.
• Know the fundamentals of the main neuroimaging techniques and their analysis.
• Know the main brain alterations in mental pathologies.
• Being able to differentiate psychotic mental activity from variations in normality.
• Know the fundamental causes that produce these alterations.
• Know the main study methods in human genetics.
• Know the methods related to animal models of psychosis.
• Acquisition of the necessary skills for the behavioral study in laboratory animals.
• Know the histological methods applicable to the study of psychiatric pathologies and, in general, to higher functions.

Transversal

• Capacity for analysis and synthesis.

• Ability to search and analyze information from different sources.

• Critical and self-critical capacity.

• Acquisition of skills for information management and use of basic computer tools for research.

• Research skills.

• Promotion of multidisciplinary teamwork.

Competences to be acquired in theoretical and practical classes:

• Mastery of the theoretical notions included in the programs of each subject.

• Ability to offer appropriate definitions of the concepts and terms specific to each subject. Ability to compare and evaluate alternative definitions.

• Ability to apply theory to practice in a laboratory.

Competences to acquire in discussion sessions and seminars:

• Recognize and use the bibliography and the most appropriate documentary sources for each subject.

• Ability to write, expose and discuss the basic concepts of each subject.

• Acquisition of skills for information management.

8.- Teaching methods

Theoretical classes: constitute one of the fundamental vehicles for transmitting knowledge to students, clarifying their difficulties and doubts, as well as promoting and guiding them towards the use of resources that allow expanding the contents developed in the classes. At the beginning of each class, the objectives to be covered will be briefly discussed, also presenting a general outline of the contents to be developed, as well as the basic bibliography.

Practical classes: they will allow the student to know and discuss the applications of the knowledge acquired in theoretical classes.

Specialized Tutorials: Through specialized tutorials, we can teach students to use a set of resources, documentary sources, facilitating an approach to research through the search, analysis and interpretation of scientific works, allowing to establish a relationship more personalized with the students, allowing clarification of doubts, or supervising the work in progress.

9.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Introductory activities				90	90
Master sessions		30			30
Scientific events					
Practical Training	- In the classroom				
	- In the laboratory				
	- In the computer lab				
	- Fieldwork				
	- Observational (Ob)				
Practicum					
External internships					
Seminars					
Debates					
Tutorials					
Online monitoring activities					
Assignment preparation					
Assignment presentations		20			20
Problem resolution					
Study of cases		10			10
Discussion forums					
Objective multiple choice tests					
Objective tests of short questions					
Objective tests of long questions					

Practical tests				
Oral tests				
TOTAL	60		90	150

10.- Resources

Students reference books

Other bibliographical, electronic references or any other type of resource
Alberca, R, López Pousa,S. (2010). Enfermedad de Alzheimer y otras demencias. Editorial Médica Panamericana. 4ª Ed. Madrid.
Ballesteros, S. (2004). Gerontología: Un saber multidisciplinar. S. Ballesteros (Ed.). Universitas-UNED. Madrid.
Blennow K, de Leon MJ, Zetterberg H. Alzheimer's disease Lancet 2006; 368: 387–403
Bonuccelli U, Del Dotto P. New pharmacologic horizons in the treatment of Parkinson disease. Neurology 2006; 67(7) Suppl 2, pp S30-S38.
Gauthier. S. Clinical, diagnosis and management of Alzheimer's disease (2007). Ed. Serge Gauthier
Gil, R. (2020). Manual de Neuropsicología. Barcelona: Masson.
Grieve, J. (2001). Neuropsicología para terapeutas ocupacionales. Evaluación de la Percepción y la Cognición. Madrid: Médica Panamericana.
Guyton, A. C. (1989). Anatomía y Fisiología del Sistema Nervioso. Neurociencias Básicas. Buenos Aires: Editorial Médica Panamericana
Haines, D.E. (2003). Principios de Neurociencia. Madrid: Elsevier Science.
Hipkiss AR. Biological aspects of ageing. Psychiatry 2004; 3: 1-4.
Junqué C. y Barroso J. Neuropsicología (última re-impresión). Madrid: Síntesis.
Kandel, E., J. H. Schwartz y T. M. Jessell (1997). Neurociencia y Conducta. Madrid: Prentice Hall
Kolb, B. y Whishaw, I.Q (1986) Fundamentos de Neuropsicología Humana. Labor.
León-Carrión, J. (1995). Manual de neuropsicología. Madrid: Siglo XXI de España.
Martínez Lage, N., Del Ser Quijano, T. (2004). Alzheimer 2004: La Pragmática Necesaria. J. M. Martínez Lage, T. Del Ser Quijano (eds.). Aula Médica Ediciones. Madrid.
Mora Pardina JS. Esclerosis lateral amiotrófica: Una enfermedad tratable. Prous Science. Barcelona,1999. Libre acceso en: http://www.fundela.info/libroELA.php
Orphanet J Rare Dis 2009, 4:3
Parkin, A.J. (1996) Exploraciones en Neuropsicología Cognitiva. Madrid: Editorial Médica Panamericana.
Peña Casanova, J. (2001). Manual de Logopedia. Barcelona: Masson.
Roberson, E. (2010). Alzheimer's disease and frontotemporal dementia. Method and protocols.Ed. Humans Press.
Sachder, P. (2003). The Ageing Brain. The Neurobiology and Neuropsychiatry of Ageing. P. S. Sachder (Ed.). Swets & Zeitlinger. Lisse.
Sacks, O. (1987). El hombre que confundió a su mujer con un sombrero. Barcelona: Muchnik.
Sinopsis de Psiquiatría, 10ª edición. B. J. Sadock y V.A. Sadock. (2004), Wolters Kluver
Springer, S.P. & deutsch, G. (2001). Cerebro izquierdo-cerebro derecho (3ª ed. en castellano y la 5ª en inglés). Barcelona: Ariel.
Vincent AM, Sakowski SA, Schuyler A, Feldman EL. Strategic approaches to developing drug treatments for ALS. Drug Discov Today 2008, 13:67-72. Free article from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2259461/?tool=pubmed
Wijesekera LC, Leigh PN. Amyotrophic lateral sclerosis
Wijesekera LC, Leigh PN. Amyotrophic lateral sclerosis. Orphanet J Rare Dis. 2009, 4:3.
Wilson, B. A. (1999). Case studies in Neuropsychological Rehabilitation. New York: Oxford University Press.

11.- Assessment

The assessment tests that are designed must evaluate whether the described competencies have been acquired. Therefore, it is recommended that when describing the tests, the competencies and learning outcomes that are being assesed be indicated.

General considerations

Evaluation criteria

Evaluation instruments

EVALUATION METHODOLOGIES		
Methodology	Type of test to be used	Qualification
Attendance at class sessions	Attendance control	40% (4 points out of 10)
Preparation of one or more works, requested by the teaching staff, on resolution of cases or assessment of practical situations	Presentation of the works	60% (6 points out of 10)

Observations

- In **extraordinary examination sessions** the student must carry out a work on the contents of the subject.

- In case of **alarm or similar situations**, the teaching methodology would be carried out online, through the following instruments:
- **Tasks monitored online**.
- **Forums.**
- **Individualized online tutorials**.

And the **evaluation system** would be carried out continuously and through the following instruments:
- Works on the contents of the subject: 100%

Evaluation criteria:
- Sum of the scores of the works.

-

Recommendations for evaluation
Attendance to theoretical classes, practices and seminars. Tutorial attendance.

Recommendations for the recovery of grades
Provide the student with the necessary tutorials to resolve the doubts generated in order to pass the subject

MOLECULAR BASES OF TUMORAL VARIABILITY: MODIFIER GENES OF THE SUSCEPTIBILITY AND EVOLUTION OF CANCER

1.- Course details

Code	303012	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Institute of Molecular and Cell Biology of Cancer				
Virtual Platform	Platform:	CICLOUD			
	Acces URL:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Teacher details

Teacher (Coordinator)	Dr. Jesús Pérez Losada		
Department	Institute of Molecular and Cell Biology of Cancer (IBMCC)		
Research area	Genetic determinants of the cancer susceptibility, evolution and treatment response		
Center	Centre for Cancer Research, CIC. University of Salamanca/Spanish National Research Council		
Office	Laboratory 7		
Office hours	Monday to Friday, Appointment request via email		
Web address	https://www.cicancer.org/grupo?id=60		
E-mail	jperezlosada@usal.es	Telephone	+34 923294807

Teacher	Dr. Mª Purificación Galindo Villardón		
Departmente	School of Medicine. University of Salamanca		
Area	Department de Statistics		
Center	School of Medicine		
Web address	https://www.usal.es/departamento-de-estadistica		
E-mail	pgalindo@usal.es	Telephone	+34 923291921

Teacher	Dr. Manuel A. Sánchez Martín		
Department	Medicine		
Research Area	Medicine		
Center	School of Medicine, Department of Medicine.		
Office	Transgenesis Laboratory, Basement-3 CIC.		
Office hours	Monday to Friday 16-18 h		
Web adress	http://www.cicancer.org/uploads/master/Optativas/1Semestre/modelos_cancer_ratones.pdf		
E-mail	adolsan@usal.es	Telephone	+34 923294500-3015

Teacher	Dr. Javier Cañueto Álvarez		
Department	Department of Medicine, University Hospital of Salamanca		
Research area	Dermatology Service		
Center	University Hospital of Salamanca		
Office hours	Monday to Friday, Appointment request via email		
E-mail	canueto@yahoo.es	Telephone	+34 923294807

Teacher	Dr. Isidro Sánchez-García		
Department	Institute of Molecular and Cell Biology of Cancer (IBMCC)		
Research area	Experimental and Translational Oncology Laboratory: Stem Cells, Cancer Stem Cells and Cancer		
Center	Centre for Cancer Research, CIC. University of Salamanca/Spanish National Research Council		
Office	Laboratory 13		
Office hours	Appointment request via email		
Web address	https://www.cicancer.org/grupo?id=53		
E-mail	isg@usal.es	Telephone	+34 923294813

Teacher	Dr. Mª del Carmen Patino Alonso		
Departmente	Department de Statistics		
Research area	Statistics		
Center	Medicine Faculty		
Office	School of Medicine. University of Salamanca.		
Web address	https://www.usal.es/departamento-de-estadistica		
E-mail	carpatino@usal.es	Telephone	+34 923291921

Teacher	Dr. Carlos Prieto		
Department	Bioinformatics Service. Nucleus		
Area	Bioinformatics		
Center	Nucleus.Bioinformatics Unit. University of Salamanca		
Office	Bioinformatics Unit		
Web address	http://bioinfo.usal.es/		
E-mail	Bioinformatica@usal.es	Telephone	+34 923291921

Teacher	Dr. Marina Mendiburu-Eliçabe		
Department	Institute of Molecular and Cell Biology of Cancer (IBMCC)		
Area	Molecular and cell biology		
Center	Centre for Cancer Research, University of Salamanca		
Office	Laboratory 7		
URL Web	http://www.cicancer.org/es/investigador/514/dr-jesusperez-losada		
E-mail	marinamendiburu@usal.es	Telephone	+34 923294807

2.- Purpose of the course within the study plan

Teaching module to which the course belongs
Fifth module out of five comprising the academic year. See the academic calendar of activities.

3.- Preliminary recommendations

None.

4.- Course objectives

- Understand cancer as a systemic disease of complex origin which develops in the context of a complex organism. As a complex feature, understand that there are multiple intermediate phenotypes or subphenotypes at different levels (molecular, cellular, tissue and systemic) that participate in its pathogenesis and physiopathology.
- Understand there is a continuous molecular and physiological interaction (or crosstalk) between the tumour and the organism in which it is generated. Cancer destabilises the physiology of the organism (physiopathology) producing the disease; and, simultaneously, the evolution of the tumour is greatly influenced and sometimes determined by the organism's own physiology. This contributes to generating clinical and disease progression variability between patients.
- To understand the concept of interaction between different compartments of the organism (at a physiological and molecular level) and their role in the variability of susceptibility and tumour development.
- Understand the relationship between different physiological (e.g. age, menopause, etc.) and physiopathological states (e.g. obesity, pro-inflammatory states, etc.) and different tumour evolution.
- To understand the concept of systems biology and the main strategies of biostatistics that allow the integration of variables from different molecular and cellular levels, etc., and to explain a complex phenotype.
- Understand the concept of polygenic control (and intergenic interaction) of tumour development. Understand the concept of Quantitative Trait Loci (QTL) and expression-QTL (eQTL) and their role in the evolutionary variability of cancer. Understand the concept of cancer modifying genes and their role in the susceptibility and evolution of cancer. Understand the role of genetic variants of major effect genes and the concept of low-penetrance genes and their role in tumour evolution

5.- Contents

Theory classes

-Topic 1. Cancer as a complex trait disease I: Cancer as a systemic disease in the context of the physiology and pathology of the body. Systems biology and cancer. Interaction between environment and genetic background. Polygenic influence of susceptibility and tumour evolution. Quantitative Trait Loci (QTL). Modifying genes: allelic forms of genes of major effect and low penetrance. Intrinsic or autonomous-cellular and extrinsic or non-autonomous-cellular gene modifiers. Duration: 1 hour.
- Topic 2. Cancer as a complex trait disease II. Cancer as a consequence of the interaction between the genome and the environment. Strategies for the identification of tumour modifying genes. Cancer as an evolutionary and adaptive process under selection pressure. Intrinsic modifier genes of tumour evolution. Allele-specific mutations. Intrinsic modifier genes according to the intracellular functional compartment. Duration: 1 hour.
- Topic 3. Mouse models for the generation of controlled high genetic variability models in mice. Genetic background. Intercross and backcross concepts. Studies on single mice. Genetic standardisation. Collaborative cross, etc. Duration: 2 hours.
- Topic 4. Main biostatistical strategies to integrate variables from different levels and explain complex features. Duration: 4 hours.
- Topic 5. The stem cell and tumour origin and variability. Role of reprogramming in the origin of cancer. Duration: 1 hour.
- Topic 6. Strategies for the identification of genetic and molecular determinants of tumour development at different levels: molecular, cellular, tissue and systemic. Identification of part of the lost heritability. Duration: 1 hour.
- Topic 7. Strategies to identify intrinsic and extrinsic genetic and molecular determinants of response to chemotherapy. Duration: 1 hour.
- Topic 8. Influence of physiological states on tumour susceptibility and evolution. Identification of genetic and molecular determinants of cancer and ageing. Duration: 1 hour.
- Topic 9. Integration of different semiological, histopathological and molecular levels to define cardiotoxicity by chemotherapy. Duration: 1 hour
- Topic 10. Bioinformatic applications for the study of complex traits.
- Topic 11. Integration of different semiological, histopathological and molecular levels to define the prognosis of squamous cell skin cancer in patients. Duration: 1 hour.

Practical training:
-Practical 1: Design and organization of a backcross. Evaluation of genotype and tumour distribution in a breast cancer backcross.
-Practical 2: Multi-phenotype distribution analysis in a genotyping backcross using the Illumina platform. Identification of QTLs.

Seminars:
The articles to be discussed and presented by the students will be chosen from among the classic works in the field that best illustrate the concepts included in the course.

Tutorials:
The teacher responsible for the course will be available to the students in Laboratory 7 at the CIC, by appointment request via email.

6.- Competences to be acquired

Specific
-To be able to design and organize a genetic and phenotypic variability model using a mouse backcross for the analysis of tumoral and multiphenotypic evolutionary variability between individuals. Identification of QTLs. To interpret allele-specific mutation studies in the context of tumour variability for the analysis of intrinsic modifier genes. Interpret works where genetic and molecular determinants of tumour variability are being studied

7.- Teaching methods

-Students must attend the evaluable theory classes (13 hours), having previously read and understood the recommended literature.
-Students must attend the seminars (12 hours) in which each student will present a published research paper or a line of research and a critical and evaluable discussion will be undertaken.
-Attendance at the evaluable practical sessions (4 hours organised over 2 days), consisting of the evaluation of a backcross and identification of QTL. This work will take place in Laboratory 7 at the Institute of Molecular and Cell Biology of Cancer and in the relevant computer room..

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		13		20	33
Practices Training	- In the classroom				
	- In the laboratory	4			4
	- In the computer classroom				
	- Fieldwork				
	- Observational				
Seminars		12		12	24
Presentations and debates					
Tutorials		5			5
Online follow-up activities					
Assignment preparation				8	8
Other activities: Scientific talks					
Exams - evaluation		1			1
TOTAL		**35**		**40**	**75**

9.- Resources

Student reference books

Other bibliographic or electronic references and resources

10.- Assessment

The assessment tests designed must evaluate whether the described competences have been acquired. Therefore, it is recommended that when describing the tests the competences and learning outcomes to be assessed are indicated.

Criteria
Discussion of a research paper taken from the field (to be decided in class) using a PowerPoint presentation (20 slides maximum). The quality of the presentation and the manner in which it is delivered will be evaluated. In addition, the following will be taken into account: identifying the problem to be solved, preceded by the introduction that justifies it, the working hypothesis, the objectives of the hypothesis, the results and how they are discussed together with new questions, and finally the conclusions (50% of the final note). -Attendance and participation in the theory and practical classes and seminars (30% of the final mark) -Multiple-choice test (20% of the final mark).

BIOINFORMATICS AND COMPUTATIONAL GENOMICS IN CANCER RESEARCH

1.- Course details

Code	303011	Plan		ECTS	3
Type	Elective	Year	2020/2021	Timing	2nd Semester
Department	Institute of Molecular and Cell Biology of Cancer				
Virtual Platform	Platform:	CICLOUD			
	Acces URL:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Teacher details

Teacher (Coordinator)	Dr. Javier De las Rivas Sanz		
Department	Bioinformatics and Functional Genomics		
Area	Molecular Biology and Biochemistry		
Center	Institute of Molecular and Cell Biology of Cancer		
Office	Laboratory 19		
Office hours	Mon.,Tue. & Wed. 13-14 h		
Web address	https://www.cicancer.org/grupo?id=42		
E-mail	jrivas@usal.es	Telephone	+34 923294819

2.- Purpose of the course within the study plan

Teaching module to which the course belongs
Fourth module out of five comprising the academic year. See the academic calendar of activities.

Role of the course within the teaching module and study plan
Although the Bioinformatics course is optional, it plays a central role in the syllabus, especially in the case where students are to carry out omics data analysis and protein structure functional studies.

Professional profile
Students usually have little prior knowledge of the subject and therefore the course, which is 100% practical training using computers, will provide them with a good introduction to the use of bioinformatics tools and methods, as well as the management of cancer-related databases.

3.- Preliminary recommendations

None

4.- Course objectives

This course focuses on the new area of Bioinformatics and Computational Biology and aims to teach students the use of tools, algorithms and strategies for bioinformatic analysis of "omic" (i.e. "global") biological data derived from genomic and proteomic techniques, etc. The course will be specially focused on the study of data obtained mainly in cancer studies, both in human clinical studies with patients and in more basic biomolecular studies focused on certain oncogenes or anti-cancer agents. In addition, special emphasis will be placed on integrative biology approaches and methods in order to generate and explore sets and networks of biological entities (genes, proteins, etc.) derived from and related to the study conditions.

To become familiar with
The main sources of biological resources and biomolecular databases:
- Genome Databases.
- Sequence Databases (genes and proteins).
- Structural Databases (proteins, nucleic acids, etc).
- Promoter / Regulatory Databases.
- Genomic and Proteomic Databases.
- Metabolism and Pathways Databases.
- Publications Databases.
- Visual biological databases.
- Integrated biological resources.

The main sources of biological resources and databases on oncogenes and cancer:
– Cancer Genes
– Cancer Cell Map
– Cancer Gene Census

To learn
The main bioinformatic tools used for the analysis of biomolecular data:
– Sequence alignment tools.
– Tools for multiple alignment and phylogenetics.
– Tools for motif and domain finding and prediction.
– Primary, secondary and tertiary protein structure analysis and prediction.
– Protein structure visualization tools.
– Expression analysis tools (transcriptomics).
– Functional annotation and enrichment tools.
– Molecular network analysis tools

5.- Contents

Theory-practical classes:
- –Course introduction
Databases:
– Primary sequence databases (genes and proteins), access and file characteristics: GenBank, RefSeq, EMBL, UniProt.
– Integrated search systems for biological data: SRS, Entrez, etc.
– Homologous sequence search systems: FASTA, BLAST, Psi-BLAST, HMMer.
– Genomes (with special emphasis on human and mouse): genome navigation in ENSEMBL and other Genome Browsers.
– Genomic and proteomic databases: GEO, ProteinAtlas, GATE.
– Ontological and functional databases: Gene Ontology, GenCards. Bioinformatics and Genomics:
– Genomic, transcriptomic, proteomic microarrays and biochips: types of microarrays, molecular basis, functioning Microarray data and data from new large scale sequencing methods (DNA-seq, RNA-seq).
– Results of gene expression microarrays: basic concepts and parameters. Analysis of data provided by Affymetrix microarrays and its meaning. Use of some R methods for integrated representation and analysis of genomic results (BioC).
– Practical search for highly expressed genes in databases: identification of isoforms, identification of orthotists and parallels, identification of homologues.
– Practical search for lists of genes and proteins in bioinformatic systems of biological-functional annotation: functional enrichment analyses.

Bioinformatics and Proteomics:
– Protein data analysis: sequences, motifs, domains, three-dimensional structures (UniProt, Expasy, PROSITE, Pfam, InterPro, PDB, PDBsum).
– Multiple protein sequence alignment methods: family profiles, recognition and significance. Construction of multiple alignments with CLUSTALX.
– Molecular and structural analysis of protein families with tree creation and evolutionary implications.
– Analysis and prediction of protein structure by bioinformatic methods: secondary structure and tertiary structure (threading).
– 3D structure visualisation and analysis methods (RASMOL, SwissPDB viewer, VMD).
– Protein-Ligand Interaction: docking (basic use of AutoDock).
– Construction of Se biomolecular protein interaction networks (use of Cytoscape and Ingenuity).

Seminars:
Each student working in a team comprised of one or two classmates (3 maximum) will be required to prepare a 30-minute presentation-seminar in which they will describe a database or a selected bioinformatics application found in the journal Nucleic Acids Research (database or web server issues, see website http://nar.oxfordjournals.org/), including a concrete example of its use and showing the utilities and functions of the bioinformatics too.

6.- Competences to be acquired

Specific
- To be familiar with the contents and modes of access to the main sources of biological resources and biomolecular databases. - To know how to use the main bioinformatic tools for analysing biomolecular data of both single genes and proteins and groups or families of genes and proteins of interest in a study.

- Know how to interpret and identify global (omics) data, present in main computer servers, for the analysis of genes and proteins.

7.- Teaching methods

Most of the course is theory based and practical, as classes take place in a classroom equipped with computers (one computer for one or two students) with internet access and a range of bioinformatics tools installed. The student must attend all the theory and practical sessions of the course (30 hours), having read and understood the recommended literature. The first session will focus on the course approach, the different sessions and their organization will be explained, as well as the tasks the students will be required to carry out both individually and in teams.
Students will be organised into groups or work groups (3 or 4 persons) to prepare a seminar with a theoretical-practical presentation of a work topic, chosen from a series proposed by the teacher.
The student must attend the seminars (2 sessions of 3 hours each) in which each group will carry out their presentation, usually based on one or more published studies involving current research in the area of Bioinformatics.
Each student will have the possibility for individualized tutoring with respect to the progress of the course, the preparation of their seminar and other topics included within the course.

8.- Planned teaching method distribution

		Teacher-led hours		Hours of independent work	TOTAL HOURS
		Face-to-face	Online		
Master Classes		15		15	30
Practical Training	- In the classroom				
	- In the laboratory				
	- In thecomputer classroom			15	15
	- Fieldwork				
	- Observational (Ob)				
Seminars Scientific talks		6		9	15
Presentations and debates					
Tutorials		3			3
Online follow-up activities		9			9
Assignment preparation					
Other activities: Scientific talks					
Exams		3			3
TOTAL		**51**		**24**	**75**

9.- Resources

Student reference books

Other bibliographic or electronic references and resources

10.- Assessment

The assessment tests that are designed must evaluate whether the described competencies have been acquired. Therefore, it is recommended that when describing the tests, the competencies and learning outcomes that are being assesed be indicated.

General considerations

Criteria
-Evaluation of the presentation of the seminar prepared by each student (40% of the final grade). -Final Evaluation, depending on the number of students: (i) written exam with the responses corresponding to the resolution of some bioinformatics practical problems; (ii) presentation of a written report (max. 20 pages) including a full bioinformatic analysis of a selected omic dataset or a full structural-functional analysis of a query protein or family of proteins (60% of the final grade).

Course unit name: PRACTICUM IN BIOLOGY AND CLINIC OF CANCER

1.- General information

Code		Plan		ECTS	6
Type	Compulsory	Course	2021/2022	Periodicity	semester
Department	Cancer Research Center				
Virtual Platform	Platform:	CICLOUD			
	URL de Acces:	http://cicloud.dep.usal.es/index.php/s/Gp0vghR305Y6glo/authenticate			

Faculty

Professors		
	ALMEIDA PARRA, Julia (PDI, USAL)	LLANO CUADRA, Elena (PDI, USAL)
	BLANCO VENAVENTE, Sandra (Científico titular, CSIC)	MARTÍN PENDÁS, Alberto (Científico Titular, CSIC)
	BUENO NÚÑEZ, Andrés Avelino (Catedrñatico USAL)	MARTÍN ZANCA, Dionisio (Científico Titular, CSIC)
	CASTELLANO SÁNCHEZ, Esther (Científico titular, CSIC)	MORENO PÉREZ, Sergio (Profesor investigación, CSIC)
	DOSIL CASTRO, Mercedes (PDI, USAL)	ORFAO DE MATOS, Alberto (Catedrático, USAL)
	DROSTEN, Matthias (Investigador, CSIC)	PANDIELLA ALONSO, Atanasio (Profesor Investigación,CSIC)
	ÉSPARIS OGANDO, Azucena (Contratado doctor ISCIII)	PEREDA VEGA, José María de (Científico Titular, CSIC)
	FERNÁNDEZ MEDARDE Alberto (PDI, USAL)	PÉREZ LOSADA, Jesús (Científico Titular, CSIC)
	FUENTES GARCÍA, Manuel (PDI, USAL)	PERICACHO BURGOS, Miguel (Profesor Contratado Doctor)
	GARCÍA BUSTELO Xosé Ramón (Profesor Investigación, CSIC)	RIVAS SANZ, Javier de las (Investigador, CSIC)
	GARCÍA SÁNCHEZ, Mª José (Catedrática, USAL)	RODRÍGUEZ BARBERO Alicia (PDI, USAL)
	GONZÁLEZ DÍAZ, Marcos (Catedrático, USAL)	SACRISTÁN MARTÍN, María de la Paz (PDI, USAL)
	GONZÁLEZ SARMIENTO, Rogelio (Catedrático, USAL)	SÁNCHEZ GARCÍA, Isidro (Investigador, CSIC).
	GUERRERO ARROYO, Carmen (PDI, USAL)	SANCHEZ–GUIJO MARTÍN, Fermín(Profesor USAL)
	HERNANDEZ RIVAS, Jesús María (Catedrático, USAL)	SÁNCHEZ MARTÍN, MANUEL A. (PDI, USAL)
	HOLGADO MADRUGA, Marina (PDI, USAL)	SANTAMARÍA, DAVID (Investigador, CSIC)
	HURTADO RODRÍGUEZ, Antoni (Investigador CSIC)	SANTOS DE DIOS, Eugenio (Catedrático, USAL)
	LAZO-ZBIKOWSKI TARACENA, Pedro (Profesor investigación, CSIC)	VICENTE MANZANARES, Miguel (Científico Titular, CSIC)
Center	Cancer Research Center	

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

Treaning Module
Second semester

General aim of the subject
The students carry out, throughout the second semester and under the direct supervision of a tutor, a research work in the field. It constitutes a starting point in the scientific career preparing students for their Master project.

Professional specialization
Researchers specialized in molecular, cellular and/or clinical oncology aspects.

3.- Previous recommendations

Degree in Biology, Biochemistry, Biomedicine, Biotechnology or Pharmacy.

4.- Aims of the subject

To offer an suitable experimental framework, where students can acquire the theoretical-practical knowledge and technical skills necessary to choose and develop both independently and in collaboration a competitive scientific project in the field of cancer molecular biology.

5.- Contents

The student will choose one of the following research projects. The assignment of students to the different laboratories will depend on the availability of laboratory space at that time and will be done through an interview with the responsible professors.

These themes of work will be evaluated and adapted every academic year according to the availability and supply of researchers.

RESEARCH PROJECT	RESEARCH GROUP
“Cancer epitranscriptomics”	Sandra Blanco Benavente
“Genomic stability: Regulation of replication and the DNA Damage Tolerance”	Andrés Avelino Bueno Núñez María Sacristán Martín
“Molecular mechanisms mediating tumour:stroma crosstalk”	M. Esther Castellano Sáchez
“Deregulation of ribosome production in cancer cells”	Mercedes Dosil Castro
“Characterization of oncoproteins involved is early signal transduction	Xosé R. García

events” “Role of Rho GTPases in cancer” “Dissection of oncogenic pathways using in silico, genetic, and signaling approaches”	Bustelo
“Clinical Pharmacokinetics of methotrexate”	María José García Sánchez
“Hereditary cancer and epigenetic modifiers in the treatment of cancer”	Rogelio González Sarmiento
“New treatments in hemopathies: from the laboratory to the clinic”	Marcos González Díaz
“Microenvironment in multiple myeloma: role in the disease pathology and in the response to targeted drugs and immunotherapeutic treatments”	Mercedes Garayoa Berrueta María Teresa Paíno Gómez
“Role of C3G in the biology of platelets and megakaryocytes. Contribution of C3G protein to pathological neoangiogenesis and tumor metastasis”	Carmen Guerrero Arroyo
“Molecular Cytogenetics in Oncology” “NGS and Big Data in hematological malignancies”	Jesús María Hernández Rivas
“Epigenetic regulation of chromatin and its implication in cancer, neurodegeneration and rare diseases”	Pedro Lazo-Zbikowski Taracena
“Development and characterization of new murine models of chromosomal instability and their involvement in cancer, aging and fertility”	Elena Llano Cuadra Alberto Martín Pendás
“Role of endoglin in angiogenesis and tumor angiogenesis”	Alicia Rodríguz Barbero Miguel Pericacho Bustos
“Role of the NGF/TrkA signaling pathway in pain, identification of potential therapeutic targets” “The Gab1 docking protein in breast cancer and its possible use as a therapeutic target”	Dionisio Martín Zanca Marina Holgado
“Molecular mechanisms regulating cell growth and division: implications in cancer and aging”	Sergio Moreno Pérez
“Characterization of the genetic alterations and signaling pathways involved in the clonal development and neoplastic transformation of B cells of subjects with clonal B lymphocytosis (MBL) vs patients with chronic lymphatic leukemia (LLC)”	Alberto Orfao de Matos Julia Almeida Parra Manuel Fuentes García
“Signaling by ErbB/HER receptors in cancer”	Atanasio Pandiella Azucena Ésparis Ogando
“Structural biology of cell adhesion and signaling”	José María de Pereda Vega
“Identification of the genetic components responsible for the influence of stem cells on the response to breast cancer treatment”	Jesús Pérez Losada
”Bioinformatics and Functional Genomics in Cancer: discovery of biomarkers, gene signatures and regulators in omic data”	Javier de las Rivas Sanz
“Mechanisms responsible for clonal evolution with the aim of leukemia prevention”	Isidro Sánchez García
“Bone marrow-derived stem cells. biological characteristics & potential role in the development of hematological malignancies”	Fermín Sánchez-Guijo Martín Sandra Muntión
“Genome editing by CRISPR-Cas9 technology: generation of mouse models of human cancer and correction of human leukaemic stem cells”	Manuel A. Sánchez Martín

“Structure and function of Ras oncogenes and their molecular regulators”	**Eugenio Santos de Dios**
-“Force generation and mechanotransduction during metastasis and the anti-tumor immune response” “Epigenetics of force generation” “Biophysics of the cellular responses to chemotherapy and immunotherapy”	**Miguel Vicente Manzanares**
"Understanding KRAS behaviour at the inner membrane: implications for oncogenic output and therapeutic inhibition"	**David Santamaría**
"Mechanisms of hormone resistance and breast cancer"	**Toni Hurtado**
“Molecular characterization of resistance mechanisms to targeted therapies in lung cáncer”	**Matthias Drosten**

6.- Skills to be acquired

Basic skills

- Capacity for analysis, global visions, synthesis and practical application of knowledge
- Understand the meaning and achieve of each of the basic experimental techniques in molecular biology in advancing knowledge of cancer.

Specific skills

- To adquire the technical skills necessary to develop a scientific project in the area.
- To develop the ability to design relevant experiments to confirm raised hypothesis.
- Students will be able to apply the scientific method to the experimental approaches that are used in cancer research.
- Know how to plan a clinical trial: susceptible population, inclusion and exclusion criteria, efficacy and toxicity assessment methods.
- Critical thinking and understanding the importance of multidisciplinary research for the knowledge of cancer.

7.- Teaching methodology

The eminently practical nature of this mandatory subject implies that students carry out their projects in the laboratory under the direct supervision and teaching of their researchers.

8.- Estimated learning time

		Hours tutored by the teacher		Individual work (hours)	TOTAL HOURS
		Attendance required (hours)	Distance learning (hours)		
Lectures					
Practices	- In classroom				
	- In laboratory	67			67
	- In computer classroom				
	- Countryside				
	- Visualization classroom				
Seminars					
Work presentations and debates					
Tutorials		8			8
Online activities					
Work preparation				25	25
Other activities					
Exams - evaluation					
TOTAL		**75**		**25**	**100**

9.- Materials

Books

Other bibliographical, electronic references or any other type of resource

10.- Assessment

Assessments on the performance of the student

- Attendance at the designated laboratory will be evaluated always in accordance with the work program proposed by the tutor. (10% of the final grade)
- Ability to learn the laboratory techniques necessary to carry out the practical work assigned by the subject´s tutor. (30% of the final grade)
- Professional interaction of the students with the members of the assigned laboratory and their ability to carry out teamwork. Attendance and capacity for interaction and participation in the seminars of the assigned group, understanding that both participation and the establishment of a critical dialogue are evaluable. (30% of the final grade)
- Ability to design and elaborate relevant experiments autonomously, as well as their ability to select scientific works and assess their contribution to the research topic; it is therefore about evaluating the maturity and critical capacity acquired by the student. (30% of the final grade).