PROGRAMME

1. SUBJECT DESCRIPTION

Degree:	**Biotechnology**
Subject:	**Cellular Biology**
Module:	**Fundamentals of Biology, Microbiology and Genetics**
Department:	**Physiology, Anatomy and Cell Biology**
Year:	**2014-2015**
Semester:	**Fall**
ECTS credits:	**6**
Course:	**1st year**
Type:	**Basic**
Lenguge:	**English**

Model:	**B1**	
a.	**Basic teaching (EB):**	**60%**
b.	**Practical teaching (EPD):**	**40%**
c.	**Guided Academic Activities (AD):**	

2. PROFESSORS

Coordinator	
Name:	**Claudio Asencio Salcedo**
School:	**Experimental Sciences**
Department:	**Physiology, Anatomy and Cell Biology**
Area:	**Cell Biology**
Category:	**Associate Professor**
Office hours:	**Wednesday 9 am to 1 pm. Friday 9 am to 11 am. Previous appointment required.**
Office:	**Building 22, second floor. Cell Biology office.**
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3. TRAINING PLAN

3.1. Goals

1. To understand the structure and function of the cell and its organelle.

2. To know the mechanisms of cell division.

3. To envisage the response mechanisms of the cell against external stimuli.

3.2. Contributions to training plan

This course is included in the training module # 2 (Fundamentals of Biology, Microbiology and Genetics) of the degree in Biotechnology. This degree consists of a total of eight compulsory basic subjects taught during different courses within the grade. This module contains the introduction to the complexity of the structural and functional design of living organisms (from microorganisms to higher organisms: animals and plants) and the basic properties of these organisms in their energy maintenance and reproduction.

The subject "Cellular Biology" together with the subjects of "Animal and Plant Biology" (Module 2) and "Biochemistry: Biomolecules" (Module 5), give the student the essential foundations for understanding the structures and functions of the cells, tissues and organs of animals and plants. The training received in this area will be useful in other courses along the grade, such as "Plant Physiology", "Animal Physiology", "Plant Biotechnology", "Animal Biotechnology", "Cell Culture "and" Final Project ".

Therefore, "Cellular Biology" is not isolated, but is related to other subjects which the student will enter in contact with, during his/her studies in Biotechnology.

3.3. Recommendations or previous requirements

Essential: Previous knowledge of the concept of cell and its structure

Recommended: Previous reading of a Cell Biology manual (See the recommended literature)

Recommended: Comprehension of scientific texts.

4. COMPETENCES

4.1 Degree competences developed within this subject

GENERAL COMPETENCES

1. To know and understand the general biologic processes of living beings from a molecular, cellular and physiological point of view.
2. To work appropriately in a biological, chemical or biochemical laboratory. To know and apply the regulations and techniques related with health and safety, laboratory animals manipulation and waste management.

4.2. Course competences to be developed

1. To understand the cell theory and to identify the different components of the cell.
2. To understand the cycle of cell division and the regulating factors controlling it.

4.3. Subject-specific competences to be developed

GOALS AND COMPETENCES.

The main goal of the subject is to allow the student to know in-depth the structures of the eukaryotic cell. These structures will be related with their specific functions in the cell and the mechanisms that ensure its division and the response against external stimuli. The following specific goals and competences are required to pass this subject:

a) Cognitive skills (to know):
   1. To understand the concept of cell organization and the two possible alternatives of this organization.
   2. To know the different cell structures and their functions.
   3. To know the molecules and structures involved in the relationship between the cell and the environment and the mechanisms supporting these interactions.
   4. To understand the eukaryotic cell cycle, its regulation and the molecular mechanisms involved.

b) Instrumental skills (to know how)
   5. To learn how to observe cells through the optic and fluorescence microscopes and to distinguish subcellular structures.
   6. To learn subfractionation and biochemical analysis techniques of the structures of the cell: protein electrophoresis.
   7. To identify the different phases of mitosis under the microscope.
   8. To learn cell counting and viability essays.
   9. Being able to give a short talk to a non-specialist audience about a general topic of Cell Biology with a possible impact on society today.

c) Attitudinal skills
   10. Autonomous learning
   11. Applying theoretical concepts to practice.

5. CONTENTS (topics)

THEOTERICAL CONTENTS.

I. FUNDAMENTALS

Topic 1. INTRODUCTION TO THE CELL. THE CELL THEORY. Concept and definitions of cell and tissue. Cell theory. Prokaryotic and eukaryotic cells. General characteristics of the eukaryotic cell: general structure. Comparative study of animal and vegetal cells.

II. ORGANIZATION AND FUNCTIONING OF THE EUKARYOTIC CELL.

Topic 2. CELL AND PLASM MEMBRANES. Concept of membrane. Chemical composition. The lipid bilayer. Membrane asymmetry. Membrane proteins. The fluid mosaic model. Properties and functions. Proteins of the cell membrane. Cell surface: membrane carbohydrates, glycocalyx. Transport across membranes. The membrane as a selective barrier: ionic and molecular gradients. Transport of ions and small molecules: simple diffusion, passive and active transport.

Topic 3. NUCLEUS AND NUCLEOLUS. Structure of the nuclear envelope, the lamina and the nuclear pores. Bidirectional nucleocytoplasmic transport. The nucleolus: Ribosomal synthesis and organization. Chromatin and heterochromatin: Organization during interphase and mitosis.

Topic 4. CYTOSOL. Characteristics and functions. Protein synthesis. Molecular components and mechanisms involved in protein synthesis. Protein maturation and recycling. Protein degradation.

Topic 5. INTRACELLULAR COMPARTMENTS AND PROTEINS DISTRIBUTION. Compartmentalization of the eukaryotic cell. The organelles. Proteins processing and distribution. The signal peptide.

Topic 6. ENDOPLASMIC RETICULUM. VESICULAR TRAFFIC. The endoplasmic reticulum: Structure and composition. Functions of the endoplasmic reticulum: synthesis of lipids and cell detoxification. Functions of the rough endoplasmic reticulum: protein synthesis and modification, quality control and retention of local proteins. The secretory pathway. Bases of the vesicular transport. Types of coated vesicles: formation and fusion with the target membrane.

Topic 7. GOLGI APPARATUS AND EXOCYTOSIS. Concept and structure of the Golgi apparatus. Protein processing and distribution. Exocytosis. Constitutive and

inducible secretion mechanisms.

Topic 8. ENDOCYTOSIS. ENDOSOMES, LYSOSOMES AND VACUOLES. Endocytosis: Endocytic vesicles formation mechanisms. Types of endocytosis. Lysosomes: Definition and characteristics. Synthesis and transport of lysosomal enzymes. Lysosomal digestion.

Topic 9. THE MITOCHODRIA. Cell bioenergetics. Structure, composition and functions of the mitochondria. Ultrastructure: mitochondrial compartments. Origin and biogenesis of the mitochondria. Mitochondrial functions. Role of the cytosol in mitochondrial respiration: the glycolysis. Mitochondrial respiration: Krebs´ cycle and mitochondrial electron transport chain. Oxidative phosphorylation. Energetic yield of glycolysis and mitochondria. Other mechanisms coupled to the mitochondrial electrochemical proton gradient: transport of substances and heat.

Topic 10. PEROXYSOMES. Characteristics and composition. Biogenesis: Lipids and proteins import. Functions: oxidative reactions. Specific functions in vegetal cells.

Topic 11. THE CYTOSKELETON I. General organization and components. Intermediate filaments: structure and organization. Microfilaments: structure and composition. Actin polymerization. Actin associated proteins. Microtubules: structure and composition. Tubulin polymerization. Microtubules associated proteins. Dynamic instability. Centrioles, cilia and flagella: structure, biogenesis and functions.

III. FUNCTIONAL REGULATION OF THE EUKARYOTIC CELL.

Topic 12. CELL SIGNALLING. Cell signaling basic principles. Intracellular receptors. Cell surface receptors: channels, G protein and enzyme associated receptors. Signalling integration.

Topic 13. CELL CYCLE. Phases of the cell cycle. Features of the G1-S and G2-M transitions. Control of the cell cycle: components and checkpoints. Mitosis. Cell division: mitosis and cytokinesis. Phases of the mitosis. The mitotic apparatus. Molecular mechanism of the movement of chromosomes during mitosis. Control of the process of mitosis. The cytokinesis. Meiosis. Sexual reproduction strategy: meiosis. First meiotic division: Meiotic prophase. Synaptonemal complex and genetic recombination. Second meiotic division. Types of cell cycles: gametic and cigotic meiosis.

Topic 14. CELL DEATH. APOPTOSIS. Types of cell death. Apoptosis: extrinsic and intrinsic ways.

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PRACTICAL TEACHING TOPICS.

PRACTISE 1. Introduction to light microscopy.
Theoretical bases and fundamentals of the different types of light microscopes.
Description and usage of the optical and mechanical components of the light microscope. Observation of samples under the light, dark field and phase contrast microscopes.

PRACTISE 2. Electron microscopy and autoradiography.
Theoretical bases and fundamentals of the scanning and transmission electron microscopes. Comparison between light and electron microscopy. Processing, cutting and contrasting of samples for electron microscopy. Observation of electron microscopy micrographies and slides of different organelles and structures from animal and vegetal cells.

PRACTISE 3. Cell fractionation.
Techniques involved in the isolation of subcellular components of biological samples. Basic culture techniques, as a common source of biological research material, will be treated in first place. Different methods used in cell fractionation will be described and discussed.

PRACTISE 4. Proteins electrophoresis and Western Blotting.
Separation of proteins by polyacrylamide gel electrophoresis: Types (SDS-PAGE, non-denaturing electrophoresis, isoelectrofocusing, bidimensional gels). Visualization of proteins in gel: Coomasie and silver stainings. Western-blotting (electrotransfer and immunostaining).

PRACTISE 5. Mitosis.
Spreading and Feulgen staining of meristematic cells and chromosomes of radical meristems from onions. Determination of mitotic and phase indexes.

PRACTISE 6. Fluorescence microscopy.
Fluorochromes. Fluorescence microscopy: Fundamentals and applications. Fluorescent proteins and applications. *In vivo* and *in vitro* observation under the fluorescence microscope of tubulin-GFP positive transfected cells.

6. METHDOLOGY AND RESOURCES

1. Basic teaching (EB): Teaching of theoretical classes will consist in master classes and discussion sessions about the theoretical principles of Cell Biology. Slides, schemes and computer presentations will be used to reinforce the understanding of the concepts to be learnt. The lecturer will solve the questions and doubts raised during the classes and the revision of the subject. The theoretical contents of the

course will be assimilated by the student with the help of the recommended literature and the elaboration of concept maps and/or schemes about the content of each topic.

2. Practical teaching (EPD): During the practical teaching sessions, the lecturer will make a brief introduction to the objective of the practical class and the methodology to be used. The student will reach the objective of the practical class, and will get related to laboratory techniques and different pieces of equipment. Alumni will interpret the obtained results in order to learn from the conclusions and mistakes of the experiments. Students will elaborate a lab book with the contents and results of each practical session. Attendance to the practical lessons and writing of the lab book is mandatory.

3. Training activities uploaded by the students and corrected by the professor will be stored in the learning folder of the virtual campus. This folder will contain the following types of training activities:

    3.1. Concept maps. After each theoretical topic a concept map will be elaborated with a summary of the lesson. After each topic all the concept maps will be composed together to generate a general map of the topic. This activity will also be used to control the attendance to the basic teaching sessions, which will be assessed during the whole course.

    3.2. Specific training activities requested by the professor: review of a specific topic, comments on scientific articles, etc.

    3.3. Lab notebook.

4. Personalized tutorial classes: The lecturer will solve the questions of the students and will guide his/her learning effort. Previous appointment is required. Office hours: Wednesday 9 am to 1 pm. Friday 9 am to 11 am.

7. EVALUATION

A continuous and formative evaluation method, intending to be progressive, motivating and participative will be applied during the whole course.

I. CONTINUOUS EVALUATION. Training activities developed by the students will be corrected and assessed by the professor and stored in a learning folder in the virtual campus. This learning folder will contain:
I.1. After each theoretical topic a concept map with a summary of the lesson. After each topic all the concept maps will be composed together to generate a general map of the topic. This activity will also be used to control the attendance to the basic teaching sessions, which will be assessed during the whole course.

I.2. Assessment of the questions raised by the students during the theoretical lessons and the answers of the students to questions inquired by the lecturer. These questions and answers, upon requirement from the lecturer, may be formulated in written and included in the learning folder.

I.3. Assessment of the contributions of the students in the forum of the subject to discussion topics proposed by the responsible professor.

I.4. Critical reading of a scientific article. The student will send an email with a critical review of the proposed scientific article to the professor, who will evaluate and mark the student´s review.

I.5. Laboratory notebook. The responsible professor will evaluate the student´s laboratory notebooks to assess the understanding of the objective of each practical session and the conclusions that were reached.

II. EVALUATION OF THE PRACTICAL CONTENT OF THE COURSE. The practical part of the course will be assessed by means of a PRACTICAL EXAM to reflect the understanding of the practical lessons´ goals.

III. FINAL EXAM. A written final exam will be done at the end of the semester to prove the minimum knowledge acquire by the student. This exam comprises 3 different parts:

a) True/false questions, with penalty in wrong answers.
b) Questions of middle length to relate theoretical concepts of the course.
c) Problems solving.

III. FINAL EVALUATION. The overall mark of the course derives from the weighted averaged mark of the aforementioned activities. Each of these activities will be assessed according to the following percentages:

- 50% of the final mark corresponds to the final exam in February.
- 20% of the final mark comes from the practical exam in February.
- 25% corresponds to the assessment of the contents of the learning folder.
- 5% reserved to attendance to tutorial lessons as another training activity during the course.

The student who sums a mark of 5 or higher after the assessment of all the evaluation activities will pass the course. Otherwise, this subject follows article 8 of the rules and regulations of assessment activities in this university. This implies that, students that do not pass the continuous evaluation, may sit an exam for those parts that were not accomplished, while keeping the marks of those parts that were accomplished. In addition, students may choose within the first three weeks of the course whether they want to be assessed by the continuous evaluation method or by a final exam in June/July comprising all the competences and skills included in the teaching program. A mark of 5 or higher is required to pass this exam. This test may include a practical test at the laboratory. Those students that do not pass the subject under the continuous evaluation method must sit a second exam in June or July. This exam comprises all the competences and skills included in this teaching programme. A mark of 5 or higher is required to pass this exam. Detailed information can be found in article 8 of the rules and regulations of assessment activities in this university.

8. RECOMMENDED LITERATURE

- ALBERTS, B. et al. (2008) Molecular biology of the cell Garland Science (5th edition), 2008. 978-0-8153-4105-5

- COOPER, G.M. (2006) The Cell. A molecular approach. Fourth edition. ASM Press, Washington. 0-87893-219-4

- KARP, G. (2007) Cell and Molecular Biology. Fourth edition. John Wiley and sons, Inc, New York. 978-0-470-04217-5

- LODISH, H. y otros (2008) Molecular Cell Biology (Sixth edition). W.H. Freeman and Co., New York. 978-0-7167-7601-7

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- POLLARD, D.T. Y OTROS (2008). Cell Biology (Second edition). Saunders. 978-1-4160-2255-8-

- DE ROBERTIS, E.M.F y HIB, J. (2003) Fundamentos de Biologia Celular y Molecular de de Robertis. Editorial El Ateneo. 950-02-0384-7

Additional information, complementary bibliography, presentations and other documents related to the course can be found at the virtual campus.