

**University of Puerto Rico  
Medical Sciences Campus  
Department of Physiology  
School of Medicine  
Second Semester  
Academic Year 2016-2017**

**Course Syllabus**

**COURSE TITLE: ADVANCED PHYSIOLOGY**

**CODIFICATION: FISA 8215**

**CONTACT HOURS: 5 CREDITS (90 HOURS)**

**DURATION: 18 WEEKS**

**NUMBER OF STUDENTS ACCEPTED: MINIMUM 3, MAXIMUM 15**

**NAME OF COORDINATOR: MARIA J. CRESPO, PH.D. (maria.crespo3@upr.edu)**

**COORDINATOR'S OFFICE: A-667**

**COORDINATOR'S OFFICE PHONE: (787) 758-2525 EXT 5078**

**MEETING PLACE: A-657 (MEETING ROOM, DEPARTMENT OF PHYSIOLOGY)**

**HORARIO DEL CURSO: TO BE DETERMINED**

**PERIOD: SECOND SEMESTER**

**PRE-REQUISITES: FISA 8105**

**DESCRIPTION:** This course is designed to provide graduate students with advanced knowledge in the area of vertebrate physiology, with emphasis on the physiology of human organs and systems. The course is a requirement for the master and doctoral students of the Physiology Department. Students from other graduate programs may take this course provided that they comply with the course prerequisites.

The course consists of the following sections: Cell and Membrane Physiology, Neurophysiology, Cardiovascular Physiology, Respiratory Physiology, Renal Physiology, Gastrointestinal Physiology, Endocrine and Reproductive Physiology. The ultimate goal of the course is to enable students to understand complex physiological processes of vertebrates, in particular, humans, from the molecular to the organismal levels.

## COURSE OBJECTIVES:

At the end of this course, students should have an understanding of the following aspects of each system:

### **I. Membrane Physiology and Neurophysiology**

1. General organization of the nervous system
2. Principles involved in the transmission of a nerve impulse including neurotransmitters and receptors
3. Physiological basis of membrane, action and synaptic potentials
4. Organization of the autonomic nervous
5. Sensory systems: from stimuli to interpretation

### **II. Muscle Physiology**

1. The morphological and functional characteristics of skeletal muscle.
2. The morphological and functional characteristics of cardiac muscle.
3. The morphological and functional characteristics of smooth muscle.

### **III. Cardiovascular Physiology**

1. The regulatory principles involved in muscular development and adaptation.
2. The role of the heart as a pump.
3. The Cardiac Cycle
4. The circulatory system.
5. The regulation and function the different parts of the circulatory system.
6. Coupling of the Heart and Blood Vessels

### **IV. Respiratory Physiology**

1. The laws of gases.
2. The mechanisms involved in gas transport.
3. Pulmonary Mechanics and Alveolar Ventilation
4. The ventilation and perfusion processes.
5. Regulation of Breathing

### **V. Renal Physiology**

1. Fundamentals of renal function.
2. Glomerular filtration rate
3. Tubular Transport Mechanisms
4. Sodium and Water Balance
5. Concentration and Dilution of Urine
6. Acid-base balance and potassium balance

### **VI. Gastrointestinal Physiology**

1. The general structure and function of the gastrointestinal system.
2. The processes of chewing and swallowing.

3. The processes of motility and gastric secretion.
4. Pancreatic and biliary secretions.
5. The processes of intestinal motility, secretion, and absorption.

### **VII. Endocrine Physiology**

1. Chemical composition of hormones, and how they are synthesized and secreted
2. Mechanisms of hormone action
3. Interactions between hormones and receptors
4. Interaction between the brain, pituitary and target glands in the regulation of hormonal secretion.
5. Anterior pituitary
6. Posterior pituitary
7. Role of hormones in the maintenance of homeostatic balance of:  $\text{Ca}^{++}$ , glucose, lipids, other nutrients, water and electrolytes.
8. Role of the endocrine system in response to stress.

### **VIII. Reproductive Physiology**

1. Interplay between genes and hormones in the expression of male and female phenotypes.
2. Reproductive systems of male and female vertebrates.
3. Sexual behavior of male and female mammals
4. Fertilization, implantation and labor.
5. Mechanisms by which "the pill", "RU486" and Norplant act as "contraceptives".
6. Hormonal regulation of lactation.

The course objectives and outcomes will be measured by analyzing, integrating and comparing the above mentioned concepts, which will be evaluated through objective or multiple choice and discussion questions.

### **TEACHING STRATEGIES:**

The course is lecture and discussion-based. The students will meet with the faculty in charge to receive the specific objectives of the section, and the assigned readings. Course material includes the textbook of the course, illustrations, slides, and handouts prepared by the staff.

### **LEARNING RESOURCES:**

1. Teaching Faculty of the Physiology Department
2. Access to laboratories and facilities of the Physiology Department
3. Course Syllabus, and power point presentations, books and scientific papers.

**MANDATORY REQUISITES:** Attendance and punctuality

## COURSE EVALUATION

There will be a total of four (4) exams. The relative distribution of questions and topics covered during these exams are depicted in the Table below.

Exam	Topics	% Weigh
1	Membrane Physiology and Nervous System	15
2	Muscle, Cardiovascular and Respiratory Physiology	30
3	Renal and GI Physiology	30
4	Endocrine and Repro	25

## GRADING SYSTEM:

A quantifiable grading system will be used, assigning a letter grade (A-F) at the end of the course. Letter grades will be determined using the following breakdown of numeric scores:

- A: 90 – 100%
- B: 80 – 89%
- C: 70 – 79%
- F: 0 – 69%

**Final grades of 70% or above will be considered passing grades. A passing grade of 80% or above is required for all Graduate Students from the Physiology Department.**

If the student fails the course FISA 8215, the opportunity to take a reposition exam will be evaluated and considered by the department. STUDENTS TAKING AND PASSING THE REPOSITION TEST WITH A GRADE OF AT LEAST 80% (**that will cover the material of all the course**) WILL BE GIVEN A MAXIMUM GRADE OF "**B**" IN THE COURSE. A grade in the reposition test between 70-79% will represent a final grade of "C" in the course and students in the Physiology department will retake the course the following year and pass it with "B" or higher grade to remain in the Physiology graduate program.

THE FACULTY OF THE COURSE RESERVES THE RIGHT TO MAKE CHANGES IN THE GRADING SYSTEM, IN THE CASE OF UNANTICIPATED EVENTS.

AN ABSENCE TO ANY EXAMINATION MUST BE ACCOMPANIED WITH AN APPROPRIATE JUSTIFICATION UPON THE REVIEW OF THE JUSTIFICATION BY THE COURSE COORDINATOR AND ACCEPTANCE OF THE JUSTIFICATION BY THE DEPARTMENT. THE STUDENT MAY BE ALLOWED TO TAKE A MAKEUP EXAM AT A DATE ARRANGED WITH THE COORDINATOR OR TO COUNT TWICE ANY OF THE OTHER TESTS, AT THE DISCRETION OF THE DEPARTMENT.

NO STUDENT WILL BE ALLOWED TO TAKE AN EXAM IF THE STUDENT ARRIVES 30 MINUTES AFTER THE START OF THE EXAMINATION. LATE ARRIVAL TO AN EXAM

DOES NOT MEAN THAT THE STUDENT WILL BE ALLOWED TO REMAIN EXTRA TIME TO FINISH THE EXAM. THE STUDENT WILL HAVE ONLY THE REMAINING ALLOTTED TIME FOR THE EXAMINATION AND THE EXAM WILL BE COLLECTED AT THE END OF THE ESTABLISHED EXAM PERIOD.

### **STATEMENT ON ETHICS:**

The written examinations are the means utilized by the Department to measure the student's performance in their educational experiences. It is our intention to guarantee that all students have the opportunity to demonstrate their academic achievements under the same circumstances, eliminating all possibility for unfair or unethical behavior. To attain this goal, we trust in our students' commitment to honesty and professional ethics. Should unethical behavior be observed, appropriate measures will be taken.

***Should knowledge become available that dishonesty regarding any particular examination has occurred; the faculty of the course reserves the right to cancel the examination before or after it has been administered and to require a repeat exam or to completely disregard the exam from the course evaluation.***

### **BIBLIOGRAFY:**

#### **Reference Books:**

##### Required:

Physiology; R.M. Berne and M.N. Levy. Sixth Edition. Mosby, Inc. N.Y. 2010  
Respiratory Physiology-The Essentials, J.B. West. Ninth Edition, 2012

##### Recommended:

Medical Physiology (2<sup>st</sup> edition, by Boron, and Boulpaep, 2009)  
Medical Physiology (4<sup>nd</sup> edition, by Rhoades and Bell, 2013)  
Human Physiology (8<sup>th</sup> edition, by Vander, Sherman and Luciano, 2001)

NOTE: ADDITIONAL TEXTBOOKS COULD BE REQUIRED OR SUGGESTED BY EACH FACULTATIVE.

#### **Websites:**

1. American Physiological Association website  
<http://www.the-aps.org/>
2. Pubmed  
<http://www.ncbi.nlm.nih.gov/sites/entrez?myncbishare=bibrbcm&holding=uprmslib>
3. Endocrine Physiology: ([www.hormone.org](http://www.hormone.org)) ([www.endo-society.org](http://www.endo-society.org)) and ([www.endocrinology.org](http://www.endocrinology.org))
4. Reproductive Physiology:  
<http://www.nlm.nih.gov/medlineplus/femalereproductivesystem.html>
5. [http://en.wikibooks.org/w/index.php?title=Human\\_Physiology/The\\_female\\_reproductive\\_system&stable=0](http://en.wikibooks.org/w/index.php?title=Human_Physiology/The_female_reproductive_system&stable=0)

6. Endomembrane System: <http://genomasur.com/lecturas/Guia05.htm>
7. Action Potential: <http://www.monografias.com/trabajos41/potencial-membrana/potencial-membrana.shtml>
8. Somatosensory System: [http://wn.com/somatosensory\\_system](http://wn.com/somatosensory_system)
9. Somatosensory System: <http://www.bing.com/videos/search?q=Somatosensory+System&view=detail&mid=356079382DEB9335741E356079382DEB9335741E&first=0&FORM=NVPFVR&qvpt=Somatosensory+System>
10. Motor System: <http://www.bing.com/videos/search?q=motor+system&view=detail&mid=F2F7CCC6CBA90B7E60ECF2F7CCC6CBA90B7E60EC&first=0&FORM=NVPFVR&qvpt=motor+system>
11. Signal Transduction: [http://www.wiley.com/college/pratt/0471393878/instructor/animations/signal\\_transduction/index.html](http://www.wiley.com/college/pratt/0471393878/instructor/animations/signal_transduction/index.html)

## ACOMODO RAZONABLE

Todo estudiante que presente una condición o situación de salud que lo cualifique ante la ley para recibir acomodo razonable, tiene el derecho de hacer su solicitud por escrito al profesor y al Decano de la Facultad, siguiendo el procedimiento establecido en el documento **Proceso de Tramitación de Acomodo Razonable del Recinto de Ciencias Médicas**. Copia de este documento se obtiene libre de costo en el Decanato de Estudiantes localizado en el segundo piso del edificio de Farmacia, cuyo número de teléfono es el 758-2525 extensión 5203, en cada facultad, y en la página cibernética del RCM. La solicitud no exime al estudiante de cumplir con los requisitos académicos de los programas de estudio en el Recinto de Ciencias Médicas.

## REASONABLE ACCOMMODATION

Students with a health condition or situation that, according to the law, makes them eligible for reasonable accommodation have the right to submit a written application to the professor and the Dean of their Faculty, according to the procedure established in the document **Submittal Process for Reasonable Accommodation of the Medical Sciences Campus**. A free copy of this document may be obtained at the Office of the Dean for student Affairs, second floor of the School of Pharmacy building; phone 787-758-2525 ext. 5203. A copy may also be obtained at the Office of the Dean of each faculty, as well as in the MSC web page. The application does not exempt students from complying with the academic requirements pertaining to the programs of the Medical Sciences Campus.

## **INTEGRIDAD ACADEMICA**

La Universidad de Puerto Rico promueve los más altos estándares de integridad académica y científica. El Artículo 6.2 del Reglamento General de Estudiantes de la UPR (Certificación JS 2009-2010) establece que “la deshonestidad académica incluye, pero no se limita a: acciones fraudulentas, la obtención de notas o grados académicos valiéndose de falsas o fraudulentas simulaciones, copiar total o parcialmente la labor académica de otra persona, plagiar total o parcialmente el trabajo de otra persona, copiar total o parcialmente las respuestas de otra persona a las preguntas de un examen, haciendo o consiguiendo que otro tome en su nombre cualquier prueba o examen oral o escrito, así como la ayuda o facilitación para que otra persona incurra en la referida conducta”. Asimismo, la conducta fraudulenta se refiere a, la alteración maliciosa o falsificación de calificaciones, expedientes, tarjetas de identificación, u otros documentos oficiales de la UPR o de cualquier otra institución”. Cualquiera de estas acciones estará sujeta a sanciones disciplinarias en conformidad con el procedimiento disciplinario establecido en el Reglamento General de Estudiantes de la UPR vigente.

## **ACADEMIC INTEGRITY**

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Student Bylaws (Certification JS 13 2009–2010) states that "academic dishonesty includes but is not limited to: fraudulent actions, obtaining grades or academic degrees using false or fraudulent simulations, copying totally or partially academic work from another person, plagiarizing totally or partially the work of another person, copying totally or partially responses from another person to examination questions, making another person to take any test, oral or written examination on his/hers behalf, as well as assisting or facilitating any person to incur in the aforementioned conduct". Fraudulent conduct refers to "behavior with the intent to defraud, including but not limited to, malicious alteration or falsification of grades, records, identification cards or other official documents of the UPR or any other institution." Any of these actions shall be subject to disciplinary sanctions in accordance with the disciplinary procedure, as stated in the existing UPR Student Bylaws.

***DISCLAIMER:*** *The above statement is an English translation, prepared at the Deanship of Academic Affairs of the Medical Sciences Campus, of certain parts of Article 6.2 of the UPR Student Bylaws “Reglamento General de Estudiantes de la Universidad de Puerto Rico”, (Certificación JS 13 2009-2010). It is in no way intended to be a legal substitute for the original document, written in Spanish.*

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**Participating Faculty:**

Dr. Maria J. Crespo, Lab. A667, Ext. 5078	maria.crespo3@upr.edu
Dr. Nelson Escobales Lab. A-663 Ext 1612	nelson.escobales@upr.edu
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Dr. Annabell Segarra. Lab. A-691 Ext. 1965	annabell.segarra@upr.edu
Dr. Walter Silva, Lab. A-688 Ext.1611	walter.silva@upr.edu
Dr. Carlos Torres. Lab. A-661 Ext. 1393	carlos.torres27@upr.edu

**Office Hours**

All of the above laboratories are located in the 6th floor of the Medical Sciences Building.  
All professors will be available for consultation during the week by prior appointment



**DEPARTMENT OF PHYSIOLOGY  
ADVANCED PHYSIOLOGY (FISA 8215)  
COURSE SCHEDULE  
JANUARY-MAY 2017**

**Time: Tuesdays and Thursdays (9:00-11:30 AM)**

**Room: A-657**

**Course Coordinator: Dr. Maria J. Crespo (maria.crespo3@upr.edu) (X5078)**

January 12 (Thursday) Introduction (Dr. Maria J. Crespo)

**Membrane Physiology (Dr. Nelson Escobales)**

January 17 (Tuesday) Membrane physiology, Diffusion of non-electrolytes and electrolytes  
Osmosis and carrier mediated processes

January 19 (Thursday) Pump leak model and Gibbs Donnan  
Epithelial physiology, water and osmotic regulation

**General Characteristics of the Nervous System**

January 24 (Tuesday)

9:00-10:00 AM **Dr. Annabell Segarra.** Cells and Characteristics of the Nervous System

10:00-11:30 AM **Dr. Carlos A. Jiménez.** Resting Membrane Potential of Excitable Cells; Action Potentials

January 26 (Thursday) **Dr. Walter Silva.** Synthesis, storage and release of neurotransmitters; Receptors

January 31 (Tuesday)

9:00-10:00 AM **Dr. Walter Silva.** Autonomic Nervous system

10:00-11:30 AM **Dr. Jorge D. Miranda** Somatosensory System

February 2 (Thursday) **EXAM 1 (Membrane Physiology and Nervous System)**

**Muscle and Cardiovascular Physiology (Dr. Guido Santacana)**

February 7 (Tuesday) Skeletal Muscle; Skeletal Muscle Mechanics

February 9 (Thursday)	Heart Electrophysiology
February 14 (Tuesday)	Heart Mechanics / The Cardiac Cycle
February 16 (Thursday)	The Arterial System
February 21 (Tuesday)	Cardiac Regulation
February 23(Thursday)	Coupling of the Heart and Blood Vessels

### **Respiratory Physiology (Dr. Maria J. Crespo)**

February 28 (Tuesday)	Composition of the Air/ Laws of Gases Pulmonary Mechanics
March 7 (Tuesday)	Alveolar Ventilation
March 9 (Thursday)	Oxygen and CO <sub>2</sub> Transport in Blood
March 14 (Tuesday)	Ventilation/Perfusion and Shunts
March 16 (Thursday)	Regulation of Breathing

March 21 (Tuesday) **EXAM 2 (Muscle, Cardiovascular and Respiratory)**

### **Renal Physiology (Dr. Nelson Escobales)**

March 23 (Thursday)	The Nephron / Clearance
March 28 (Tuesday)	Tubular Transport Mechanisms and Hemodynamic
March 30 (Thursday)	Sodium and Water Balance
April 4 (Tuesday)	Concentration and Dilution of Urine
April 6 (Thursday)	Acid-base balance and Potassium Balance; Diuretics

### **Acid Base Physiology (Dr. Maria J. Crespo)**

April 11 (Tuesday)	Acid Base Physiology
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### **Gastrointestinal Physiology (Dr. Walter Silva)**

April 18 (Tuesday)	Chewing, Salivary Secretion, Swallowing and Vomiting
April 20 (Thursday)	Gastric Secretion and Motility Absorption of Water and Electrolytes
April 27 (Tuesday)	Digestion and Absorption of Carbohydrates
April 27 (Thursday)	Digestion and Absorption of Proteins and Fats

May 2 (Tuesday) **EXAM 3 (Renal, Acid-base and Gastrointestinal)**

**Endocrine Physiology**

- May 4 (Thursday) **Dr. Annabell C. Segarra** . The hypothalamus. The pituitary gland
- May 9 (Tuesday) **Dr. Annabell C. Segarra** . Adrenals and the stress response
- May 11 (Thursday) **Dr. Carlos Torres**. Pancreas and glucose regulation
- May 16 (Tuesday) **Dr. Carlos Torres**. The thyroid gland and metabolism; Ca<sup>2+</sup> homeostasis

**Reproductive Physiology (Dr. Annabell Segarra)**

- May 18 (Thursday) Sexual differentiation
- May 23 (Tuesday) Male reproductive system/ Female reproductive system
- May 25 (Thursday) Sexual behavior, contraceptives, pregnancy and lactation

**Special Topics**

- May 30 (Tuesday)
- 9:00-10:00 AM **Dr. Carlos Jiménez**. Thermoregulation
- 10:00-11:30 AM **Dr. Anita Rivera-Brown**. Exercise Physiology

June 1 (Thursday) **EXAM 4 (Endo, Repro and Special Topics)**