UNIVERSITY OF PUERTO RICO
MEDICAL SCIENCES CAMPUS
SCHOOL OF MEDICINE

PHYSIOLOGY DEPARTMENT

COURSE DESCRIPTION

COURSE TITLE: BIOPHYSICS

COURSE CODE: FISA 8510

CREDIT HOURS: 3 (54 HOURS TOTAL)

COURSE DURATION**:** 18 WEEKS

NUMBER OF STUDENTS: NO MORE THAN 10 STUDENTS AND NO LESS THAN 2

COORDINATOR NAME: CARLOS A. JIMENEZ-RIVERA, PH.D.

COORDINATOR OFFICE HOURS: BY APPOINTMENT

COORDINATOR OFFICE: A-688

COURSE HOURS: SEE ATTACHED SCHEDULE (1.5 HRS. TWICE/WEEK)

WHEN WILL BE OFFERED: ____ QUATERLY _X_ SEMESTER
____ YEAR ___ SUMMER

PREREQUISITE: FISA 8601: FISA 8602

COURSE DESCRIPTION: THIS COURSE IS AN IN DEPTH LOOK AT THE BIOLOGY AND PHYSICS OF IONIC CHANNELS EMBEDDED ON EXCITABLE MEMBRANES. IONIC CHANNELS ARE INDISPENSABLE FOR THE PRODUCTION AND TRANSDUCTION OF ELECTRICAL SIGNALS IN EXCITABLE CELLS. THIS COURSE

WILL ATTEMPT TO MERGE CLASSICAL PRINCIPLES AND ANALOGIES OF THE BJIOPHYSICS OF IONIC CHANNELS WITH CURRENT AREAS OF PHYSIOLOGICAL RESEARCH, SPECIALLY, IN THE NEUROSCIENCES. THE PROPERTIES AND PHYSIOLOGICAL FUNCTIONS OF CLASSICAL AND NEWLY DISCOVERED CHANNELS WILL BE DISCUSSED AND THEIR SIGNIFICANCE IN THE CENTRAL NERVOUS SYSTEM WILL BE HIGHLIGHTED.

COURSE OBJECTIVES AND EXPECTED OUTCOMES: MODERN BIOPHYSICS OF MEMBRANE CHANNELS REQUIRES A STRONG WORKING KNOWLEDGE OF PHYSICAL LAWS, MOLECULAR APPROACHES, PHYSIOLOGICAL RESPONSES, AND A FAMILIARITY WITH THE EQUIPMENT EMPLOYED TO MEASURE AND ANALYZE THE PHYSICAL PROPERTIES OF IONIC CHANNELS. THE STUDENT WILL LEARN THE MATHEMATICAL, PHYSIOLOGICAL AND MOLECULAR BACKGROUND TO UNDERSTAND IONIC CHANNELS OF EXCITABLE MEMBRANES. THIS KNOWLEDGE WILL HELP THEM TO DEVELOP COMPETITIVE RESEARCH PROJECTS IN THE FIELD.

THE STUDENTS SHOULD PROVIDE PROFICIENCY WITH THE COURSE OBJECTIVES, THAT WILL BE MEASURED BY ANALYSIS, INTEGRATION AND COMPARISON OF THE ABOVE MENTIONED CONCEPTS, THAT WILL BE EVALUATED THROUGH MULTIPLE CHOICE QUESTIONS, ESSAY EXAMS, TERM PAPERS, PRESENTATIONS AND/OR PUBLICATIONS.

COURSE TOPICS AND TIME DISTRIBUTION:

LECTURE #1: DR. JIMENEZ
HISTORICAL INTRODUCION TO CHANNEL BIOPHYSICS (CHAPTER 1)

LECTURE #2: DR. JIMENEZ
HISTORICAL INTRODUCION TO CHANNEL BIOPHYSICS (CHAPTER 2)

LECTURE #3: DR. JIMENEZ
PAPER 1

LECTURE #4: DR. JIMENEZ
PORES AND SELECTIVITY

(CHAPTER 14)

LECTURE #5: DR. JIMENEZ
PORES AND SELECTIVITY
(CHAPTER 11 & 15)

LECTURE #6: DR. JIMENEZ
PAPER 2

LECTURE #7: DR. JIMENEZ
STRUCTURE –FUNCTION RELATIONSHIPS
(CHAPTER 13)

LECTURE #8: DR. JIMENEZ
STRUCTURE –FUNCTION RELATIONSHIPS
(CHAPTER 17)

EXAMINATION #1

LECTURE #9: DR. JIMENEZ
PAPER 3

LECTURE #10: DR. JIMENEZ
DRUGS AND TOXINS
(CHAPTER 16)

LECTURE #11: DR. JIMENEZ
DRUGS AND TOXINS
(CHAPTER 17)

LECTURE #12: DR. JIMENEZ
PAPER 4

LECTURE #13: DR. JIMENEZ
SODIUM AND POTASIUM CHANNELS
(CHAPTER 3)

LECTURE #14: DR. JIMENEZ
SODIUM AND POTASIUM CHANNELS
(CHAPTER 5)

LECTURE #15: DR. JIMENEZ
PAPER 5

LECTURE #16: DR. JIMENEZ
CALCIUM CHANNELS
(CHAPTER 4)

EXAMINATION #2

LECTURE #17:	DR. JIMENEZ PAPER 6
LECTURE #18:	DR. JIMENEZ LIGAND GATED CHANNELS (CHAPTER 6)
LECTURE # 19:	DR. JIMENEZ PAPER 7
LECTURE #20:	DR. JIMENEZ TRIPTOPHAN CHANNELS (CHAPTER 9)
LECTURE #21:	DR. JIMENEZ PAPER 8
LECTUER # 22:	DR. JIMENEZ PHOSPHORYLATION OF V-GATED CHANNELS (CHAPTER 7)
LECTURE #23:	DR. JIMENEZ PAPER 9
LECTURE #24:	DR. JIMENEZ CHANNELOPATHIES (CHAPTER 21)
LECTURE # 25:	DR. JIMENEZ PAPER 10

EXAMINATION #3

PRESENTATION #1	BY: STUDENT MANUSCRIPT & GROUP PRESENTATION
PRESENTATION #2	BY: STUDENT MANUSCRIPT & GROUP PRESENTATION
PRESENTATION #3	BY: STUDENT MANUSCRIPT & GROUP PRESENTATION
PRESENTATION #4	BY: STUDENT MANUSCRIPT & GROUP PRESENTATION

PRESENTATION #5 BY: STUDENT
MANUSCRIPT & GROUP PRESENTATION

PRESENTATION #6 BY: STUDENT
MANUSCRIPT & GROUP PRESENTATION

PRESENTATION #7 BY: STUDENT
MANUSCRIPT & GROUP PRESENTATION

TEACHING STRATEGIES:

METHODS:
- CONFERENCES
- GROUP DISCUSSIONS
- ASSIGNED READINGS

AUDIOVISUAL RESOURCES:
- SLIDES
- TRANSPARENCIES
- ILLUSTRATIONS
- PICTURES
- BLACKBOARD

ESSENTIAL REQUIREMENTS: ATTENDANCE AND PUNCTUALITY

EVALUATION STRATEGIES: THE STUDENTS WILL BE EVALUATED USING THREE WRITTEN MULTIPLE CHOICE TYPE PARTIAL EXAMINATIONS AND AN ORAL PRESENTATION. EACH PARTIAL EXAM WILL COUNT AS 25% OF THE GRADE, 20% THE ORAL PRESENTATION AND 5% FOR ATTENDANCE AND CLASS PARTICIPATION.

EVALUATION SYSTEM:

GRADES WILL BE ADMINISTERED AS FOLLOWS:

A- 99-90
B- 89-80
C- 79-70
F- 69-

BIBLIOGRAFY:

TEXT:

HILLE, B. (2001) ION CHANNELS OF EXCITABLE MEMBRANES, 3RD ED. SINAUER ASSOC. SUNDERLAND MA [**THIS IS THE "BIBLE" SO CALLED AS A TEXT BOOK ON IONIC CHANNELS. UNFORTUNATELY, THERE IS NO NEW EDITION YET. HOWEVER, AS SOON THER IS ONE AVAILABLE IT**

WILL BE ADOPTED IMMEDIATELY. THERE IS NO OTHER TEXTBOOK ON IONIC CHANNELS THAT COVER ALL THE TOPICS INCLUDED HERE].

PAPERS:

1. Hille, B., Armstrong, C.M., MacKinnon, R. (1999) Ion channels: from idea to realtity. *Nature. Med*. 5:1105-1109.

2. Zhou, M., MacKinnon, R. (2004) A mutant KcsA K^+ channel with altered conduction properties and selectivity filter ion distribution. *J. Mol. Biol*. 338:839-846.

3. Glauner, K.S., Mannuzzu, L.M., Gandi, C.S., Isacoff, E.Y. (1999) Spectroscopic mapping of voltage sensor movement in the Shaker potassium channel, *Nature* 402:813-817.

4. Li, R.A., Ennis, I.L., Tomaselli, G.F., Marban, E. (2002) Structural basis of differences in isoform-specific gating and lidocaine block between cardiac and skeletal muscle sodium channels. *Molec. Pharmacol*. 61:136-141.

5. Lu, Z., Klem, A.M., Ramu, Y. (2001) Ion conduction pore is conserved among potassium channels. *Nature* 413:809-813.

6. Dietrich, D., Kirchstein, T., Kukley, M., Pereverzev, A., von der Brelie, C., Schneider, T., Beck, H., (2003) Functional specialization of presynaptic $Ca_V2.3$ Ca^{2+} channels. *Neuron* 39:483

7. Duguid, J.C. Smart, T.G. (2004), Retrograde activation of presynaptic NMDA receptors enhances GABA release at cerebellar interneuron-Purkinje cell synapses *Nature Neuroscience* 7:525-533
8. Jung S, Strotmann R, Schultz G, Plant TD. TRPC6 is a candidate channel involved in receptor-stimulated cation currents in A7r5 smooth muscle cells. *Am J Physiol Cell Physiol*. 2002 Feb;282(2):C347-59.

9. Callaghan B, Koh SD, Keef KD. (2004) Muscarinic M2 receptor stimulation of Cav1.2b requires phosphatidylinositol 3-kinase, protein kinase C, and c-Src. *Circ Res.* 94(5):626-33.

10. Mankodi, A., Takahashi, M.P., Jiang, Hong, J., Beck, C.LO., Bowers, w.J., Moxley, R.T., Cannon, S.C., Thornton, C.A. (2002) Expanded CUG repeats trigger aberant splicing of CIC-1 chloride channel pre-mRNA and hyperexcitability of skeletal muscle in myotonic dystrophia. *Molecular Cell* 10:35-44

REASANOBLE ACCOMODATION STATEMENT:

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 PROCEDURES 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 FACULTY DEANS AS WELL AS IN THE MSC WEB PAGE. THE APPLICATION DOES NOT EXEMPT THE STUDENT FROM COMPLYING WITH THE ACADEMIC REQUIREMENTS PERTAINING TO THE PROGRAMS OF THE MEDICAL SCIENCES CAMPUS.

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.