Course Change Request **Indiana University** Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit ☐ Graduate credit ☒ Professional credit ☐

1. School/Division Medicine/Graduate
2. Academic Subject Code Grad-G 3. Current Course Number G761 4. Current Credit Hours 1
5. Current Title Molecular & Cellular Physiology of Ion Transport
6. Effective Semester/Year for changes listed below: Fall 2009 7. Instructor: Obukhov

Type of Change Requested (Check appropriate boxes and indicate changes)

☒ 8. Change course number to: G761 (must be cleared with University Enrollment Services)

☐ 9. Current course title: _____
Change to: _____
Recommended abbreviation (optional) _____
(Limited to 32 Characters including spaces)

☐ 10. Current credit hours fixed at: _____ or variable from: _____ to _____
Change to credit hours fixed at: _____ or variable from: _____ to _____

☐ 11. Current lecture contact hours fixed at: _____ or variable from: _____ to _____
Change to lecture contact hours fixed at: _____ or variable from: _____ to _____

☐ 12. Current non-lecture contact hours fixed at: _____ or variable from: _____ to _____
Change to non-lecture contact hours fixed at: _____ or variable from: _____ to _____

☐ 13. Is this course currently graded with S-F (only) grades? Yes _____ No _____
Change to S-F (only) grading? Yes _____ No _____

☐ 14. Does this course presently have variable title approval? Yes _____ No _____
Is variable title approval being requested? Yes _____ No _____

☐ 15. Is this course being discontinued? For all campuses _____ or for this campus only _____

☐ 16. Current course description _____

Change course description to (not to exceed 50 words) _____

17. Justification for change Consistency with available PhD minors.
(Use additional paper if necessary)

18. Are the necessary reading materials currently available in the appropriate library? yes

19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of this course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by: Michael Stuebe Date 6/2/09
Department Chairman/Division Director

Approved by: D.J. Rhodes Date 6/2/09
Dean

_____ Date _____
Dean of Graduate School (when required)

_____ Date _____
Chancellor/Vice-President

_____ Date _____
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 725

University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White

SYLLABUS: G761

I. COURSE TITLE: Molecular Physiology of Ion Channels and Transporters
COURSE NUMBER: G761 (1 cr.)
INSTRUCTOR: Alexander G. Obukhov, PhD
PREREQUISITES: Fundamental Electrical Signaling & Ion Channel Biology (G743) or Engineering Principles of Cellular Electrophysiology (BME595) or consent of the instructor.

II. COURSE DESCRIPTION AND RATIONALE
Ion channels and transporters are crucial for multiple cellular functions. Ion transporters help mediate pericellular ion flow and maintain proper ion gradients in a cell. Ion channels represent "communication channels" between a cell and its environment. They are converting chemical and physical signals in the language of ion flow. In this course, students will study the advanced concepts of molecular physiology of ion channels and transporters. The emphasis will be on the electrophysiological and optical methods used for investigating ion transport proteins. Two lab demonstrations will help students to master learned concepts in a real experimental setting. Specific topics will include ion channel biophysical characteristics, and ion channel/transporter modulation and function. **FORMAT:** interactive discussions and laboratory demonstrations.

III. EDUCATIONAL OBJECTIVES

A. Overall objective
Acquire advanced knowledge of ion channels, pumps, and exchangers. Students will learn specific transporter molecular structure-function relationships, gating mechanisms, or modulation by second messenger molecules.

B. Primary
1. Review concepts of electrophysiology and biophysics
2. Understand how ion channels and transporters function.
2. Learn the diversity of ion channels and transporters (pumps and exchangers).
3. Strengthen the knowledge of approaches used for studying ion channels and transporters.
4. Define the role of ion transport relevant to the student's current area of research interest.

C. Secondary
Interpret the cellular and molecular mechanisms of ion channels and transporters.

IV. COURSE CONTENT

Session I:
1. Overview of ion transport proteins; major electrophysiological and optical methods used for studying ion transport
2. Voltage-gated channels in muscle cells

Session II:
3. ENaC in the kidney
5. Nicotinic receptor-channels in skeletal muscle (ligand-gated)

Session III:
6. Lab demonstration 1: patch-clamp setup and experiments

Session IV:
7. P2X (ATP-activated) receptor channels (ligand-gated)
8. Cyclic Nucleotide Gated Channels

Session V:
10. Chloride transporting proteins
11. Mechanosensitive channels

Session VI:
12. Store-operated and receptor-operated channels
13. Intracellular ion channels (IP3-receptors, Ryanodine receptors)

Session VII:
13. Lab demonstration 2: fluorescence imaging in living cells (calcium signaling)
14. The Na+/Ca2+-exchanger and the Na+/K+-ATPase

Session IX:
15. The Interplay of ion channels, exchanges and transporters in the heart (review)
Session X:
16. Student presentations of assigned projects
The course will be offered from November 15, 2009 to December 22, 2009 and will contain 10 sessions (1.5 hours each).

V. REQUIRED AND RECOMMENDED TEXTS

1. Books:
   a. Boron, W.F., and E.L. Boulpaep. *Medical Physiology*. Philadelphia: Elsevier Saunders, 2005
   b. Hille B. *Ionic Channels of Excitable Membranes*. 3rd Edition, Sunderland, MA: Sinauer Associates, Inc., 2000.
   c. Chung S-H, Andersen O.S., Krishnamurthy. *Biological Membrane Ion Channels. Dynamics, Structure, and Applications*, Springer, 2007.
2. Original research articles
   a. Berkefeld H, Sailer CA, Bildl W, Rohde V, Thumfart JO, Eble S, Klugbauer N, Reisinger E, Bischofberger J, Oliver D, Knaus HG, Schulte U, Fakler B. BKCa-Cav channel complexes mediate rapid and localized Ca^{2+}-activated K^+ signaling. Science. 2006 Oct 27; 314 (5799): 615-620.
   http://www.sciencemag.org/cgi/reprint/314/5799/615.pdf
   b. Esguerra M, Wang J, Foster CD, Adelman JP, North RA, Levitan IB. Cloned Ca^{2+}-dependent K^+ channel modulated by a functionally associated protein kinase. Nature. 1994, 369 (6481): 563-565.
   http://www.nature.com/nature/journal/v369/n6481/pdf/369563a0.pdf
   c. Gulbis JM, Zhou M, Mann S, MacKinnon R. 2000. Structure of the cytoplasmic subunit - T1 assembly of voltage-dependent K^+ channels. *Science* 289:123-7.
   http://www.sciencemag.org/cgi/reprint/289/5476/123.pdf
   d. Vallet V, Chraibi A, Gaeggeler HP, Horisberger JD, Rossier BC. An epithelial serine protease activates the amiloride-sensitive sodium channel. Nature. 1997 Oct 9; 389 (6651): 607-10.
   http://www.nature.com/nature/journal/v389/n6651/pdf/389607a0.pdf
   e. Lee WY, Sine SM. Principal pathway coupling agonist binding to channel gating in nicotinic receptors. Nature. 2005 Nov 10; 438 (7065): 243-7.
   http://www.nature.com/nature/journal/v438/n7065/pdf/nature04156.pdf
   f. Mulryan K, Gitterman DP, Lewis CJ, Vial C, Leckie BJ, Cobb AL, Brown JE, Conley EC, Buell G, Pritchard CA, Evans RJ. Reduced vas deferens contraction and male infertility in mice lacking P2X1 receptors. Nature. 2000 Jan 6; 403 (6765): 86-9.
   http://www.nature.com/nature/journal/v403/n6765/pdf/403086a0.pdf
   g. Perozo E, Cortes DM, Sompornpisut P, Kloda A, Martinac B. Open channel structure of MscL and the gating mechanism of mechanosensitive channels. Nature. 2002 Aug 29; 418 (6901): 942-948.
   http://www.nature.com/nature/journal/v418/n6901/pdf/nature00992.pdf
   h. Sukharev S, Betanzos M, Chiang CS, Guy HR. The gating mechanism of the large mechanosensitive channel MscL. Nature. 2001 Feb 8; 409 (6821): 720-4.
   http://www.nature.com/nature/journal/v409/n6821/pdf/409720a0.pdf
   i. Vergani P, Lockless SW, Nairn AC, Gadsby DC. CFTR channel opening by ATP-driven tight dimerization of its nucleotide-binding domains. Nature. 2005 Feb 24; 433 (7028): 876-80.
   http://www.nature.com/nature/journal/v433/n7028/pdf/nature03313.pdf
   j. Bradley J, Reuter D, Frings S. Facilitation of calmodulin-mediated odor adaptation by cAMP-gated channel subunits. Science. 2001 Dec 7; 294 (5549): 2176-8.
   http://www.sciencemag.org/cgi/reprint/294/5549/2176.pdf
   k. Jayaraman T, Ondrias K, Ondriasová E, Marks AR. Regulation of the inositol 1,4,5-trisphosphate receptor by tyrosine phosphorylation. Science. 1996 Jun 7; 272 (5267): 1492-4.
   http://www.jstor.org/cgi-bin/jstor/printpage/00368075/di002370/00p1240z/0.pdf?backcontext=page&dowhat=Acrobat&config=jstor&userID=864438e3@iupui.edu/01c0a8346b00501cf17c1&0.pdf

l. Feske S, Gwack Y, Prakriya M, Srikanth S, Puppel SH, Tanasa B, Hogan PG, Lewis RS, Daly M, Rao A. A mutation in Orai1 causes immune deficiency by abrogating CRAC channel function. Nature. 2006 May 11; 441 (7090): 179-85. http://www.nature.com/nature/journal/v441/n7090/pdf/nature04702.pdf

m. Macpherson LJ, Dubin AE, Evans MJ, Marr F, Schultz PG, Cravatt BF, Patapoutian A. Noxious compounds activate TRPA1 ion channels through covalent modification of cysteines. Nature. 2007 Feb 1; 445 (7127): 541-5. http://www.nature.com/nature/journal/v445/n7127/pdf/nature05544.pdf

n. Kang TM, Hilgemann DW. Multiple transport modes of the cardiac Na^+/Ca^{2+} exchanger. Nature. 2004 Feb 5; 427(6974): 544-8. http://www.nature.com/nature/journal/v427/n6974/pdf/nature02271.pdf

o. Pavlović D, Fuller W, Shattock MJ. The intracellular region of FXYD1 is sufficient to regulate cardiac Na/K ATPase. FASEB J. 2007 May; 21(7): 1539-46. http://www.fasebj.org/cgi/reprint/21/7/1539

Note that the original research articles may change from year to year based on current literature available.

VI. EVALUATION AND GRADING

DESCRIPTION	WEIGHT
Participation in class	25%
Presentation and critique of original research articles	25%
Design and presentation of an experimental strategy to address a specific ion transport problem assigned by the instructor	50%

VII. CHEATING AND PLAGIARISM

Students are instructed to make themselves aware of University regulations concerning plagiarism, the maintenance of academic honesty and the definitions of unacceptable behavior and cheating. Academic misconduct of any sort will not be tolerated and will be dealt with as outlined in the ***IU/IUPUI Code of Student Rights, Responsibilities, and Conduct***, which can be viewed at:

http://www.iupui.edu/code/

Examples of misconduct include but are not limited to:

1. Cheating
   A student must not use or attempt to use unauthorized assistance, materials, information, or study aids in any academic exercise
2. Fabrication
   A student must not falsify or invent any information or data in an academic exercise including, but not limited to, records or reports, laboratory results, and citations to the sources of information.
3. Plagiarism
   A student must not adopt or reproduce ideas, words, or statements of another person without appropriate acknowledgment. A student must give credit to the originality of others and acknowledge an indebtedness whenever he or she does any of the following:
   a. Quotes another person's actual words, either oral or written
   b. Paraphrases another person's words, either oral or written
   c. Uses another person's idea, opinion, or theory; or
   d. Borrows facts, statistics, or other illustrative material, unless the information is common knowledge.
4. Interference
   a. A student must not steal, change, destroy, or impede another student's work.
   b. A student must not give or offer a bribe, promise favors, or make threats with the intention of affecting a grade or the evaluation of academic performance.

Potential consequences for academic misconduct:

If the instructor has information that one of his/her students committed an act of academic misconduct, the faculty member will hold an informal conference with the student. The conference will be prompt and private. If the faculty member concludes that the student is responsible for the misconduct, then the faculty member will impose an appropriate academic sanction (i.e., lower or failing grade on the assignment, assessing a lower or failing grade for the course).

VIII. AMERICANS WITH DISABILITIES ACT:

If you need any special accommodations due to a disability, please contact Adaptive Educational Services at (317)-274-3241.