Fall 2016 Course Descriptions

Block II

8006 Biology of Aging

COURSE DESCRIPTION: Why do we get old? Is aging a disease or a physiological stage in life? As the percentage of aging population grows, under what has been termed as “global aging”, the need to understand the peculiarities of the aging process increases and has become a priority for public health. The common goal of aging researchers is being able to extend the healthy active years of life. Research in **Biology of Aging** is in exponential expansion because this field has benefit in recent years from the advances in many other areas of research going from genetics to cell biology, biochemistry of proteins, systems biology, etc. Furthermore, classical studies of genetics of longevity in laboratory species are now escalating to humans, thus making possible a better understanding of both physiological aging and age-related diseases.

This course presents an in-depth analysis of the biology of aging, building up from changes occurring at the molecular and cellular level and analyzing the consequences at the organism level. In addition, the influence of these age-related changes in what are commonly considered a disease of aging, such as neurodegeneration, diabetes, etc., will also be discussed. Topics will include: theories of aging, experimental models used to study of aging and longevity, impact of oxidative stress in cell and organ function, the metabolic syndrome of aging, functional changes in the immune and central nervous systems, genetic instability and genetics of aging and longevity.

REQUIRED MATERIALS: Molecular and Cellular Biology of Aging (J. Vijg, J. Campisi, G. Lithgow) 2105, Published by the Gerontological Society of America (Text book available here: Link)

Other resources (selected chapters): The Encyclopedia of Aging (Schulz,R, Noelker LS, Rockwood K and Sprott R.), 2006*; Aging and age-related diseases: the basics (Karasek, M), 2006*; ISBN-10: 0826148433; ISBN-13: 9780826148438

PREREQUISITES: Undergraduate courses in Biochemistry, Cell Biology, Genetics and Statistics highly advisable. Students who have taken graduate Cell Biology and Genetics will be able to get the most out of this course.

STUDENT PREPARATION: Biochemistry, Cell Biology, Genetics and Statistics

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: The goal of this course is to motivate an interest among our graduates for problems in biology of aging and to prepare them for the growing demand for future generations of aging researchers.

STUDENT ASSESSMENTS: In class participation; Final exam (5-10 questions take-home test)

CREDIT HOURS: 2.0

7018 Computational Biology of Proteins

COURSE DESCRIPTION: It is an introductory course to Protein Bioinformatics. We provide a systematic introduction to the major techniques, algorithms and tools used in Bioinformatics (for sequence alignments, classifications, secondary and tertiary structure predictions, modeling, sampling of conformations, energy functions, prediction of various functional and structural features of proteins, docking etc.).

REQUIRED MATERIALS: Not required, but suggested: Computational Biochemistry and Biophysics, Marcel Dekker, New York, NY, ISBN 978-0824704551. M. Watanabe, B. Roux, A. MacKerell, and O. Becker; Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by R. Durbin, S. R. Eddy, A. Krogh, G. Mitchison ISBN 978-0521629713; Bioinformatics: The Machine Learning Approach, Second Edition by: P. Baldi ISBN 978-0262025065; Protein Structure Prediction: A Practical Approach by MJE Sternberg 978-0199634965; From Protein Structure to Function with Bioinformatics. Ed. Daniel John Rigden, Publisher: Springer; 2009 edition ISBN-13: 978-1402090578.

PREREQUISITES: No

STUDENT PREPARATION: Clear understanding of basic biochemical and biophysical concepts are expected. i.e. Biochemistry course in first Block is advised.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSESSMENTS: A midterm and a final exam.

CREDIT HOURS: 2.0

7507 Design and Conduct of Clinical Research

COURSE DESCRIPTION: This seminar course aims to introduce students to clinical research with a focus on epidemiology and study design. The course uses an introductory clinical research text, along with a critical assessment of papers from the scientific (clinical and epidemiologic) literature, in order to learn about study designs: their strengths and weaknesses and how such studies are conducted. Topics to be covered include: basic epidemiology, measures of association, basic statistics, cohort studies, case control studies, clinical trials, causal inference, and research ethics.

REQUIRED MATERIALS: Designing Clinical Research, Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB., 4th Ed. Lippincott Williams & Wilkins; Philadelphia: 2013. ISBN-10: 1608318044 | ISBN-13: 978-1608318049

PREREQUISITES: None.

STUDENT PREPARATION: Interest in and some familiarity with clinical research preferred (Clinical Research 101 lecture series recommended)

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: Follows up on concepts introduced in the Clinical Research 101 lecture series, and provides a deeper dive into study design and interpretation.

STUDENT ASSESSMENTS: Final exam (multiple choice/short answer); preparation and participation in class.

CREDIT HOURS: 2.0

7007 Gene Expression: Beyond the Double Helix

COURSE DESCRIPTION: This course deals with molecular mechanisms of biological information content. Specifically the course will tackle the question of how the information contained within DNA, RNA, and chromatin is stored and used in different biological contexts. The major focus is on the molecular mechanisms of the regulation of gene expression and their impact on cellular functions. Topics include: the genome and DNA, the biochemistry of DNA replication and DNA transcription into RNA, biochemistry of chromatin and the histone code, regulation of transcription and of chromatin structure, its modification and role in epigenetic phenomena; metabolism of the major cellular classes of RNA, emphasizing transcription, processing, stability/degradation, and translation of messenger RNA into protein and control at each of these steps; the role of RNA-mediated catalysis in biology and evolution; the biology and biochemistry of non-coding RNA and the use of RNAi as an experimental and therapeutic tool.

REQUIRED MATERIALS: Computer.

PREREQUISITES: Undergraduate course in molecular biology at the level of Alberts “Molecular Biology of the Cell” and 1st Block Graduate Biochemistry.

STUDENT PREPARATION: Students should be familiar with nucleic acid structure, college-level genetics, graduate biochemistry level protein structure/function.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: This course uniquely targets molecular mechanisms of the *storage* of biological information in nucleic acids and chromatin and the *utilization* of this biological information through transcription, RNA processing, and translation. Modest overlap with graduate biochemistry and molecular genetics is expected and useful.

STUDENT ASSESSMENTS: Two take-home exams (40% each), student-led paper discussions and problem sets (15%), and assigned lecture summaries to be posted on ANGEL (5%).

CREDIT HOURS: 4.0

7022 Immunology

COURSE DESCRIPTION: This course will provide students with a broad overview of basic immunology, while also delving deeply into cellular and molecular details in areas of central importance to this field. The course will consider both innate and adaptive immunity and include the structure and function of key receptors including immunoglobulins, T cell receptors and innate pattern recognition receptors. The mechanisms of antibody formation and molecular aspects of cellular immunity, including T and B cell interactions and lymphocyte memory formation, will be emphasized, and connections to modern biomedical science will be highlighted. These will include presentations and discussions on autoimmunity, immunity against major microbial pathogens (viruses and bacteria), transplantation and tumor immunology. Advance preparation for class session will involve assigned reading (selected textbook chapters, cutting edge review articles and didactic videos). Successful completion of the course will provide students with strong fundamental knowledge in basic immunology, and assist them in deepening their knowledge of current research and developments in modern immunology.

REQUIRED MATERIALS: Janeway's Immunobiology 8th edition Kenneth P. Murphy, ISBN 978-0-8153-4243-4 Published by Garland Science, Taylor & Francis Group, LLC ; computer access; internet access

PREREQUISITES: None.

STUDENT PREPARATION: Gene expression; protein structure; cell structure and organization

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: Immunology training is provided by this course and no other. The course will also cover methods used extensively in immunology research and applicable to other fields.

STUDENT ASSESSMENTS: Exams; Class and Discussion Participation, Basic Concept Homework

CREDIT HOURS: 4.0

7008 Membrane Potentials and Transport

COURSE DESCRIPTION: Thermodynamics is briefly reviewed with special emphasis on the concept of chemical potential and its relation to the Boltzman Distribution. The gradient of chemical potential is then introduced as the driving force in transport phenomena. With these concepts established, the problems of equilibria and transport across membranes are taken up. These include diffusion, Donnan equilibrium, diffusion potentials, membrane potentials, fixed charge membranes, electrical excitability, and the analysis of single-channel records.

REQUIRED MATERIALS: N/A

PREREQUISITES: Basic knowledge of calculus and elementary thermodynamics

STUDENT PREPARATION: None

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: See course description above

STUDENT ASSIGNMENTS: Problem sets, final oral exam

CREDIT HOURS: 2.0

8004 Mini-Workshop On Modern Techniques Applied To Biomedical Research

COURSE DESCRIPTION: The field of Biomedical research has been enormously influenced by advances in techniques, with vast array of different technical approaches and analytical methods now being used to address biological questions. The aim of this course is to provide students with a rigorous "hands-on" experience in a number of the most recent methods that have revolutionized biomedical research in this last decade such as confocal and super-resolution imaging, genetically engineered optical probes, proteomics, bio-informatics, organ imaging and activity. Because the course involves mainly laboratory work, it will be offered to a limited number of students (maximum of six and minimum of three), and will be given one day a week for 8 weeks. Classes will be 3 - 6 hrs each. Students will be graded (Pass - Fail) according to their participation during the course and elaboration of a brief project that will be presented at the end of the classes (January 31, 2017).

REQUIRED MATERIALS: N/A

PREREQUISITES: None

STUDENT PREPARATION: N/A

SUITABLE FOR 1ST YEAR STUDENTS: First year student may register after consulting course leader.

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSIGNMENTS: N/A

CREDIT HOURS: 2 semester hours: one 6 hour session per week for a total of eight sessions.

7003 Molecular Biophysics for the Life Sciences

COURSE DESCRIPTION: This interdisciplinary course will provide students with the tools and knowledge needed to understand the molecular and physical basis of biological systems and their regulatory mechanisms. The course will explore the physical principles that underlie biology and consider the contemporary approaches to investigate cellular and organismal structure and function. We will study molecular processes such as protein folding/stability, protein-protein and protein-ligand interaction, RNA and DNA structure, molecular mechanisms of catalytic and force-generating enzymes as well as the molecular mechanisms underlying cell division, muscle function and transport across membranes.

REQUIRED MATERIALS: Access to internet by tablet, computer.

PREREQUISITES: None

STUDENT PREPARATION: None

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: This course uniquely offers a strong quantitative approach to a number of biological topics and methods. The course will extend the content of the Biochemistry course. The course or its equivalent will be a requirement for Prof. Gennrich's methods course.

STUDENT ASSESSMENTS: There will mid-course and final multiple choice tests. Attendance and participation will be 33% of evaluation.

CREDIT HOURS: 3.0

7005A Molecular Cell Biology

Molecular Cell Biology is a single course with two parts (A & B). Part A is offered in Course Block II (3 credits) and Part B is offered in Course Block III (3 credits). Both parts A and B of the course must be taken in order to satisfy the course requirement.

COURSE DESCRIPTION: This course will cover basic areas in cell biology with emphasis on selected topics of current interest. The three main areas will be intracellular protein transport, the nucleus, and the cytoskeleton. Topics will include: membrane structure and biogenesis, functions of intracellular membranes and the signal hypothesis, protein trafficking and intracellular sorting, glycosylation, exocytosis, endocytosis and membrane fusion, nuclear structure and organization, nuclear transport, mRNA localization, self assembly of cytoskeletal structures, actin, microtubules, intermediate filaments, molecular motors, mitosis, cell junctions and extracellular matrix, cytoskeleton and signal transduction, calcium as second messenger, and cilia.

REQUIRED MATERIALS: “Lewin’s CELLS” 2015, Third edition (ISBN: 978-1-284-02939-0); eds. G. Plopper, D. Sharp, and E. Sikorski; Jones and Bartlett Publishers; Sudbury, MA. http://go.jblearning.com/CELLS3e

Reading the relevant chapter(s) prior to the lecture is required and essential for understanding the lectures. Several copies are on closed reserve in the library. The cheapest source for the book is Amazon. An electronic version is available from CourseSmart. Go to http://www.coursesmart.com, type in “cells” in the search field and follow the instructions.

PREREQUISITES: This is a demanding course involving a substantial amount of reading and should only be taken by those first year students with a background in biochemistry and cell biology.

STUDENT PREPARATION: N/A

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSESSMENTS: 4 exams and 4TBL sessions

CREDIT HOURS: 6.0

7020 Responsible Conduct of Research

COURSE DESCRIPTION: This course fulfills an NIH mandated training requirement and is required for all 1st year PhD and MSTP students and pre-and post-doctoral students.

Topics:

- Overview of RCR
- Research Misconduct
- Protection of Human Subjects
- Welfare of Laboratory Animals
- Conflicts of Interest
- Data Management Practices
- Mentor & Trainee Responsibilities
- Collaborative Research
- Authorship & Publication
- Peer Review

REQUIRED MATERIALS: Course readings will be distributed or made available as pdf files.

PREREQUISITES: N/A

STUDENT PREPARATION: N/A

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSESSMENTS: No class session may be missed in order to receive credit. An incomplete grade for the course will require retaking missed sessions the following semester.

CREDIT HOURS: 1.0

7403 Systems Neuroscience

COURSE DESCRIPTION:

Scope: The course will explore how complex neural systems integrate afferent information and direct efferent outflow. The overall goal will be to explore higher order functions, such as the structure and function of neural systems underlying sensation and movement, learning and memory at the sensory and motor levels, as well as higher-level cognitive processes including object perception and attention. At every stage we will build on a firm understanding of the underlying physiology and anatomical structure. Principal areas of interest will be on hierarchical neural systems, the plasticity of neural networks, serial and parallel neural processing, cognition and computational modeling.

Format: The course will be divided into four modules: 1) Principles of neural systems, 2) Neural bases of sensation 3) Neural bases of behavior and 4) Higher order functions and cognition. Each module will contain an initial series of didactic lectures introducing key facts and concepts, as well as class participation sessions focused on pre-assigned questions and relevant research papers. Techniques will be illustrated by demonstration.

REQUIRED MATERIALS: Access to internet by tablet, computer.

REQUIRED MATERIALS: N/A

PREREQUISITES: Must have completed and passed the Cellular and Molecular Neuroscience course (special cases should contact course leaders).

STUDENT PREPARATION: Recommended Textbook/Background Reading: Principles of Neural Science (Kandel, Schwartz & Jessell, Eds.), The Cognitive Neurosciences III (Gazzaniga, Ed.), Theoretical Neuroscience (Dayan & Abbott, Eds.).

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: No significant overlap noted with other courses.

STUDENT ASSESSMENTS: The grade will be based on class participation and a term paper in the form of a grant proposal. The midterm exam will involve critiquing classmates' grant proposals.

CREDIT HOURS: 6.0