ChemBio Courses of Interest

Below is a list of courses being offered this year that many of our students have taken in the past.

Online Course Catalog http://www.registrar.fas.harvard.edu/fasro/courses/
Nano and Quarter Courses Website http://idb.med.harvard.edu/node/1

Fall Semester

BCMP 200. Molecular Biology

Catalog Number: 5591
Joseph John Loparo (Medical School), Paul J. Anderson (Medical School), Lee Stirling Churchman (Medical School), Johannes Walter (Medical School), and Timur Yusufzai (Medical School)
Half course (fall term). M., W., F., 10:45-12:15.
An advanced treatment of molecular biology's Central Dogma. Considers the molecular basis of information transfer from DNA to RNA to protein, using examples from eukaryotic and prokaryotic systems. Lectures, discussion groups, and research seminars.
Note: Offered jointly with the Medical School as BP 723.0.
Prerequisite: Intended primarily for graduate students familiar with basic molecular biology or with strong biology/chemistry background.

HBTM 235. Principles of Human Disease: Physiology and Pathology

Catalog Number: 82892 Enrollment: Course enrollment will be limited, with priority given to graduate students and a maximum of 10 undergraduates (priority given to seniors).
Constance L. Cepko (Medical School), and members of the Department
Half course (fall term). M., W., F., 9-10:30.
This course covers the normal physiology and pathophysiology of selected organs, through lectures, readings, tutorials based on clinical cases, and patient presentations. Human biology is emphasized, with some examples also drawn from model organisms.
Prerequisite: Knowledge of introductory biochemistry, molecular biology, and cell biology required (MCB52 and MCB54 or equivalent and one year of organic chemistry for undergraduates).

*Cell Biology 300. Advanced Topics in Cell, Molecular, and Developmental Biology

Catalog Number: 5825
David Lopes Cardozo (Medical School) 5995
A series of reading and discussion seminars, each running for a half term (seven weeks). Different topics are covered each term.
Note: Two seminars, which can be taken in different terms, are required for credit. Non-DMS students must get permission from the Division of Medical Sciences before registering for this course. Please contact us at 617-432-0162 or visit the DMS Office at T-MEC 435, 260 Longwood Avenue, Boston.

***Chemical Biology 300hf. Introduction to Chemical Biology Research**
Catalog Number: 95622 Enrollment: This course is limited to first year students in the Chemical Biology Program.
Suzanne Walker (Medical School) 5087 (spring term only) and members of the Committee
Half course (throughout the year). W., 4:30–6.
Lectures introduce the research areas of current program faculty in Chemical Biology.

Chemistry 101 Organic Synthesis Towards a Genomic Medicine
Catalog Number: 7505
Stuart L. Schreiber
Half course (fall term). Tu., Th., 10–11:30. EXAM GROUP: 12, 13
Organic Synthesis Towards a Genomic Medicine teaches advanced students in chemistry and chemical biology: 1) the principles that underlie modern organic synthesis, chemical biology and genome biology, and 2) the resulting development of a new interdisciplinary field -- genomic medicine. Genomic medicine aims to understand human biology and to transform human health by using small molecules that target the root causes of disease. For example, the course will explore how organic synthesis is enabling patient-based drug discovery, where genetic signatures of disease are related to drug sensitivity in the context of cancer, diabetes, infectious disease and psychiatric disease, among others.
Prerequisite: Chemistry 17/27, Chemistry 20/30, or the equivalent.

***Chemistry 106 Advanced Organic Chemistry**
Catalog Number: 1063
Eugene Elliott Kwan
Half course (fall term). M., W., F., at 10. EXAM GROUP: 3
This course will survey modern organic chemistry from a fundamental perspective. The foundations of structure and bonding, donor-acceptor interactions, and conformational analysis will be considered in the context of pericyclic reactions and cyclic and acyclic stereocontrol. The behavior of reactive intermediates, the basis for enantioselective catalysis, and patterns in functional group reactivity will also be discussed.
Prerequisite: Chemistry 30 or permission of instructor.

***Chemistry 115 (formerly *Chemistry 215). Advanced Organic Chemistry: Synthesis of Complex Molecules**
Catalog Number: 0480
Andrew Myers
Half course (fall term). M., W., 2:30–4. EXAM GROUP: 7, 8
An integrated course in complex synthetic problem solving that focuses on the development of principles and strategies for synthesis design with a concurrent, comprehensive review of modern synthetic transformations.
Prerequisite: A grade of A in Chemistry 30.

Chemistry 163. Frontiers in Biophysics
Catalog Number: 3635
Xiaoliang Sunney Xie
Half course (fall term). M., W., 1–2:30. EXAM GROUP: 6, 7
Emerging physical tools are changing the way biological problems are addressed. This interdisciplinary course will introduce new experimental advances, microscopy and spectroscopy in particular, together with underlying principles, in molecular and cellular biophysics.
Note: Primarily for advanced undergraduate students and graduate students with either biological or physical backgrounds.
Prerequisite: Chemistry 160, Chemistry 161, or permission of the instructor.

Chemistry 171. Biological Synthesis - **Required
Catalog Number: 49031
Emily Patricia Balskus
Half course (fall term). Tu., Th., 1–2:30. EXAM GROUP: 12, 13
This course will examine synthesis from a biological perspective, focusing on how organisms construct and manipulate metabolites, as well as how biological catalysts and systems can be used for small molecule production. Topics to be covered include mechanistic enzymology, biosynthetic pathways and logic, biocatalysis, protein engineering, and synthetic biology.

Genetics 201. Principles of Genetics
Catalog Number: 4225
Fred Winston (Medical School), Thomas G. Bernhardt (Medical School), Maxwell G. Heiman (Medical School), Mitzi I. Kuroda (Medical School), and Steven A. McCarroll (Medical School)
Half course (fall term). M., W., F., 9-10:30.
An in-depth survey of genetics, beginning with basic principles and extending to modern approaches and special topics. We will draw on examples from various systems, including yeast, *Drosophila*, *C. elegans*, mouse, human and bacteria.
Note: Intended for first-year graduate students. Offered jointly with the Medical School as GN 701.0.

MCB 169. Molecular and Cellular Immunology
Catalog Number: 2518
Shiv S. Pillai (Medical School)
Half course (fall term). Tu., Th., 10-11:30, and a 90-minute section to be arranged. EXAM GROUP: 12, 13
The immune system is frontier at which molecular biology, cell biology, and genetics intersect with the pathogenesis of disease. The course examines in depth the cellular and molecular mechanisms involved in the development and function of the immune system and also analyzes the immunological basis of human disease including AIDS and other infectious diseases, autoimmune disorders, allergic disorders, primary immunodeficiency

syndromes, transplantation, and cancer.
Prerequisite: Life and Physical Sciences A or Life Sciences 1a or equivalent. Genetics and cell biology strongly recommended.

Systems Biology 200. Dynamic and Stochastic Processes in Cells
Catalog Number: 8701
Johan M. Paulsson (Medical School) and Jeremy M. Gunawardena (Medical School)
Half course (fall term). Tu., Th., 10-11:30, and a weekly section to be arranged. EXAM GROUP: 12, 13
Rigorous introduction to (i) dynamical systems theory as a tool to understand molecular and cellular biology (ii) stochastic processes in single cells, using tools from statistical physics and information theory.
Note: Students planning to take both quarter courses (SB303 and 304) must enroll in this as a half course on their study card as SysBio200 for now and in the future. Students who take one half of this quarter can NOT ever take the other half for credit.
Prerequisite: College-level calculus.

January Term

***Chemical Biology 2200. Introduction to Chemical Biology** **REQUIRED**
Catalog Number: 3459 Enrollment: Limited to 10. Intended for first-year graduate students in the Chemical Biology Program; permission of the instructor required for all others.
James Elliott Bradner (Medical School) and Ralph Mazitschek
Half course (spring term). M., through F., 8am - 5pm (two weeks in mid January).
This course will provide a survey of major topics, technologies, and themes in Chemical Biology, with hands-on exposure to a variety of experimental approaches.
Note: Intended for first-year graduate students in the Chemical Biology Program; permission of the instructor required for all others.

PyMol Nanocourse
Rachelle Gaudet and Tom Torello
March 18-19, 2014 10:00am – 12:00pm and 2:00pm – 4:00pm
PyMOL is one of the most popular software programs to display and explore high---resolution structures of macromolecules. It is readily used to create publication---quality figures, and movies and animations of structural information. In two days, you will learn the basics of PyMOL and be able to display, explore and present three---dimensional structures of macromolecules. With this basic training, you will be able to generate high--quality images and simple movies, and have the resources to learn more on your own to generate more complex displays.
NOTE: SPACE IS LIMITED TO 45

Spring Semester

Applied Mathematics 111. Introduction to Scientific Computing
Catalog Number: 7000

Thomas Fai
Half course (spring term). Tu., Th., 1–2:30. EXAM GROUP: 12, 13
Many complex physical problems defy simple analytical solutions or even accurate analytical approximations. Scientific computing can address certain of these problems successfully, providing unique insight. This course introduces some of the widely used techniques in scientific computing through examples chosen from physics, chemistry, and biology. The purpose of the course is to introduce methods that are useful in applications and research and to give the students hands-on experience with these methods.
Prerequisite: Applied Mathematics 21a and 21b, or Mathematics 21a and 21b, or permission of instructor.

{BCMP 201. Biological Macromolecules: Structure, Function and Pathways] Not offered this year
Catalog Number: 5068
Stephen C. Blacklow (Medical School), Stephen C. Harrison (Medical School), and Peter K. Sorger (Medical School)
Half course (spring term). Tu., Th., 9:30-11:00 Session: Wed 4:00-5:30
Macromolecular structure with emphasis on biochemistry, interactions and catalysis in cellular processes and pathways. Links between theory and observation will emerge from discussion of fundamental principles, computational approaches and experimental methods.
Note: The course is intended for all Division of Medical Sciences (DMS) graduate students and is open to advanced undergraduates. Offered jointly with the Medical School as BP 714.0.

BCMP 234. Cellular Metabolism and Human Disease
Catalog Number: 9644 Enrollment: May be limited
Thomas Michel (Medical School), Cheryl Denise Vaughan (Medical School) and members of the Department
Half course (spring term). M., W., F., 9-10:30.
Cellular and organismal metabolism, with focus on interrelationships between key metabolic pathways and human disease states. Genetic and acquired metabolic diseases and functional consequences. Interactive lectures and critical reading conferences are integrated with clinical encounters.
Note: Also listed as MCB 234.
Prerequisite: Knowledge of introductory biochemistry, genetics, and cell biology required (MCB 52 and 54 or equivalent); one year of organic chemistry.

Cell Biology 201. Molecular Biology of the Cell
Catalog Number: 1044
Marcia Haigis (Medical School)
Half course (spring term). M., W., 10:30-12, and sections F., at 10:30-12.
Molecular basis of cellular compartmentalization, protein trafficking, cytoskeleton dynamics, mitosis, cell locomotion, cell cycle regulation, signal transduction, cell-cell interaction, cell death, and cellular/biochemical basis of diseases.
Note: Methodological focus on current approaches in cell biology including quantitative

tools. Emphasis on experimental design. Offered jointly with the Medical School as CB 713.0.
Prerequisite: Basic knowledge in biochemistry, genetics and cell biology.

BCMP 236. Modern Drug discovery: from principles to patients (Required)
Catalog Number: 84345
Nathanael Gray (Medical School), Tim Mitchison and members of the Department Half course (spring term). Tu., Th., 3:30-5.

This course will familiarize students with central concepts in drug action and therapeutics at the level of molecules, cells, tissues and patients. These concepts and methods are central to modern drug development and regulatory evaluation. In the 1st half of the course we will cover drug-target interactions, Pharmacokinetics and Pharmacodynamics at a quantitative level, the clinical trials process, biomarkers and new frontiers in Therapeutic development. The 2nd half will focus on modern approaches to therapeutic discovery and development, both small molecules and protein based. Examples are drawn from numerous unmet medical needs including cancer, HIV, neurodegenerative and infectious diseases. The course will include computational exercises and a MATLAB workshop.

Chemistry 135. Experimental Synthetic Chemistry
Catalog Number: 3406
Eugene Elliott Kwan
Half course (spring term). Lecture: M., 1–3. Lab -- 8-16 hours per week: Tu., W., or Th., 12-8, or Sat., 10-8, beginning fourth week of the term. EXAM GROUP: 6, 7
An introduction to experimental problems encountered in the synthesis, isolation, purification, characterization, and identification of inorganic and organic compounds. Each student works on a different sequence of reactions, encouraging technical proficiency and simulating actual research.
Note: Preference given to concentrators in Chemistry. Recommended as an efficient preparation for research in experimental inorganic and organic chemistry and related sciences such as biochemistry and pharmacology. Normally follows Chemistry 27 or 30 and is strongly recommended as preparation for Chemistry 98r and 99r.

Chemistry 205. Advanced Physical Organic Chemistry
Catalog Number: 6636
Eric N. Jacobsen
Half course (spring term). Tu., Th., 10–11:30. EXAM GROUP: 12, 13
An in-depth perspective on mechanistic organic chemistry, with analysis of fundamental organic and organotransition metal reaction mechanisms, reactive intermediates, catalysis, stereochemistry, non-covalent interactions, and molecular recognition. Classical and modern tools of physical-organic chemistry, including reaction kinetics, computer modeling, isotope effects, and linear free-energy relationships will be evaluated in the context of literature case studies.
Note: **Expected to be given in 2012–13.**
Prerequisite: Chem 206 or an equivalent upper-level course in organic chemistry, and

Chem 160/161 or an equivalent sequence in physical chemistry; or permission of the instructor.

Engineering Sciences 228. Biomaterials
Catalog Number: 49617
Neel S. Joshi
Half course (spring term). Tu., Th., 10–11:30. EXAM GROUP: 12
Overview of materials for biomedical devices and therapies. Polysaccharide- and protein-based polymers as building blocks. Biological templating of inorganic structures. Emerging frontiers in protein and DNA self-assembly. Molecular scale origin of materials properties for naturally occurring biological materials and the use of this information to rationally design new biomaterials for specific applications.
Prerequisite: Organic chemistry, cell biology, physics at the level of 11a.b. Suggested courses include molecular biology.

MCB 156. Structural Biology of the Flow of Information in the Cell
Catalog Number: 8543
David Jeruzalmi
Half course (spring term). Tu., Th., 2–3:30. EXAM GROUP: 16, 17
This course presents a detailed examination of macromolecular structure and function based on insights obtained from using modern biophysical techniques. To demonstrate concepts, the course will follow the interplay between the human immunodeficiency virus and its host cell as the virus attempts to complete an infectious cycle.
Prerequisite: MCB 52 and Physics at the level of PS 2/3.

MCB 176. Biochemistry of Membranes
Catalog Number: 3186
Guido Guidotti
Half course (fall term). M., W., 2–4; M., at 4. EXAM GROUP: 7
A course on the properties of biological membranes, essential elements for cell individuality, communication between cells, and energy transduction. Topics include: membrane structure; membrane protein synthesis, insertion in the bilayer and targeting; transporters, pumps and channels; electron transport, H+ gradients and ATP synthesis; membrane receptors, G proteins and signal transduction; membrane fusion.
Prerequisite: MCB 52 and MCB 54 are recommended but not required.

MCB 192. Principles of Drug Discovery and Development
Catalog Number: 2188 Enrollment: Limited to 40.
Vicki L. Sato and Gregory L. Verdine
Half course (spring term). Tu., Th., 11:30–1.
This interdisciplinary course will examine the process of drug discovery and development through disease-driven examples. Topics include: the efficacy/toxicity balance, the differences between drugs and inhibitors, the translation of cellular biochemistry to useful medicine.
Note: May not be taken concurrently with SCRB 192. May not be taken for credit if

SCRB 192 has already been taken.
Prerequisite: MCB 52 and one year of organic chemistry. MCB 54 is recommended.

Microbiology 201. Molecular Biology of the Bacterial Cell
Catalog Number: 38739
David Z. Rudner (Medical School), Thomas G. Bernhardt (Medical School), Simon L. Dove (Medical School), and Ann Hochschild (Medical School)
Half course (spring term). Tu., Th., 10–12.
This course is devoted to bacterial structure, physiology, genetics, and regulatory mechanisms. The class consists of lectures and group discussions emphasizing methods, results, and interpretations of classic and contemporary literature.

Statistics 115. Introduction to Computational Biology and Bioinformatics
Catalog Number: 9776
Xiaole Shirley Liu (Public Health)
Half course (spring term). Tu., Th., 11:30–1. EXAM GROUP: 15
The course will cover basic technology platforms, data analysis problems and algorithms in computational biology. Topics include sequence alignment and search, high throughput experiments for gene expression, transcription factor binding and epigenetic profiling, motif finding, RNA/protein structure prediction, proteomics and genome-wide association studies. Computational algorithms covered include hidden Markov model, Gibbs sampler, clustering and classification methods.
Prerequisite: Good quantitative skills, strong interest in biology, willingness and diligence to learn programming.