BIOCHEMISTRY AND MOLECULAR BIOPHYSICS (MD) {BMB}

508. Macromolecular Biophysics: Principles and Methods. (A) Sharp.Prerequisite(s): Senior undergraduate or graduate level biochemistry or biophysics.

This course introduces students to the physical and chemical properties of biological macromolecules, including proteins and nucleic acids. It surveys the biophysical techniques used to study the structure and thermodynamics of macromolecules. It is intended to be a first course for graduate students with an undergraduate background in either physics, chemistry or biology,and no necessary background in biochemistry.

509. Structural and Mechanistic Biochemistry. (B) Van Duyne.Prerequisite(s): BMB 508 and BIOM 600 or permission of course director.

The course will focus on the key biochemical task areas of living cells. The course progresses from primarily molecular level events, such as storage and tralslation of genetic information, creation, control and removal of proteins, to higher organization levels such as metabolic pathways, signaling pathways, regulation and homeostasis. Each section will cover structure details of the relevant molecules, appropriate binding/catalysis events, regulatory aspects, and how they fit into the relevant pathway(s) and cell function. Material will be covered with a combination of formal lectures and student presentations.

518. (CAMB615, NGG 615) Protein Conformation Diseases. (I) Argon and Ischiropoulos.Prerequisite(s): BIOM 600 or equivalent.

Protein misfolding and aggregation has been associated with over 40 human diseases, ranging from Alzheimer's disease, Parkinson's disease,amyotrophic lateral sclerosis, prion diseases, alpha(1)-antitrysin deficiency, inclusion body myopathy, and systemic amyloidoses. This course will include lectures, directed readings and student presentations to cover seminal and current papers on the cell biology of conformational diseases including topics such as protein folding and misfolding, protein degradation pathways, effects of protein aggregation on cell function, model systems to study protein aggregation and novel approaches to prevent protein aggregation.

554. (CHEM555) Macromolecular Crystallography: Methods and Applications. (A) Marmorstein and Skordalakes.Prerequisite(s): Undergraduate calculus and trigonometry.

This is an introductory course on methods and applications of macromolecular structure determination using X-ray crystallography. The course will be broken up into three parts: 1) Principles of X-ray crystallography involving didactic lectures on the technique with weekly problem sets; 2) Workshops on macromolecular structure determination involving hands-on experience with the technology; 3) Student "journal club" presentations on current high impact publications involving X-ray crystal structure determination.

560. Methods of Scientific Inquiry in Biological Systems. (B) Wilson and Domotor.Prerequisite(s): Graduate students in biological sciences or permission of instructors.

The foundational, social and methodological aspects of scientific reasoning in biomedical disciplines are discussed, including: 1) theories, laws, causal/functional explanation and experimental methodology in biology and medicine; 2) case studies in selected fields of biomedical sciences with special regards to strategies in concept and hypothesis formation, discovery, gathering evidence and testing, and 3) social and moral factors pertinent to the research enterprise.

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567. (CHEM567) Bioinorganic Chemistry. (C) Dmochowski.

This course covers selected topics in bioinorganic chemistry. Special emphasis is placed on dioxygen chemistry and electron transfer processes. Course topics include: 1) oxygen uptake and utilization; 2) oxygen transport; 3) oxygen and O atom incorporation into substrates; 4) metalloenzyme-catalyzed C-C bond formation; 5) the metallobiochemistry of DNA; 6) metal-sulfide proteins; 7) manganese containing metalloproteins; 8) photosystem II, light-driven electron transfer and the biological water-splitting reaction; 9) biological electron transfer; 10) electron transfer theory; 11) mechanisms of energy storage and release; and 12) long-distance electron transfer reactions.

581. (BE 581) Techniques of Magnetic Resonance Imaging. (K) Song and Wehrli.

Detailed introduction to the physics and engineering of magnetic resonance imaging as applied to medical diagnosis. Covered are magnetism, spatial encoding principles, Fourier analysis, spin relaxation, imaging pulse sequences and pulse design, contrast mechanisms, chemical shift, flow encoding, diffusion and perfusion and a discussion of the most relevant clinical applications.

585. (GCB 585) Wistar Institute Cancer Biology Course: Signaling Pathways in Cancer. (A) Skordalakes and Murphy.Prerequisite(s): Undergraduates and Master's degree candidates require permission from the course directors.

This course is intended to provide foundational information about the molecular basis of cancer. When necessary the significance of this information for clinical aspects of cancer is also discussed. The main theme centers around cell cycle checkpoints with specific emphasis on the biochemistry and genetics of DNA damage signaling pathways, DNA damage checkpoints, mitotic checkpoints and their relevance to human cancer. The course is taught by the organizers and guest lecturers from universities and research institutions in the Northeast.Following every lecture, students present a research paper related to the topic of that lecture. The course is intended for first and second year graduate students but all graduate students are welcome to attend.

598. Tutorial. (S) Kim Sharp and staff.

The tutorial course is designed for in-depth study of a specific topic thorugh one-on-one meetings and discussions between the student and a selected BMB faculty member. The intent of the course is to broaden the students knowledge, thus the tutorial may not be taken with the student's current rotation advisor or thesis advisor. Choice of faculty member and topic is by prior mutual agreement between the student and faculty member, subject to approval by the course director. Student and faculty member will typically meet for an hour or so 2 - 3 times per week. The course may take the form of literature study, or where appropriate, a mini-project (typically computer-based) A tutorial can be used by students to become more deeply acquainted with the literature related to their thesis project or to help prepare students for their Candidacy Exam. Upon completion of the tutorial, students must prepare a written description of the area studied (5-10 typewritten pages)

601. Fundamentals of Magnetic Resonance. (I) Reddy.

This course introduces basic theoretical and experimental concepts of magnetic resonance and its applications in biochemistry, biology and medicine. Topics covered include description of the phenomenon of magnetic resonance, and classical and quantum strategies to compute nuclear spin responses in liquids,solids and biological tissues, polarization transfer and multiple quantum effects and their applications in biomedicine. Nuclear spin relaxation in solid-state materials and in biological systems will be discussed. Concepts of magnetic resonance imaging, imaging strategies, image contrast, and diagnostic applications are discussed. The course includes several practicals dealing with the demonstration of NMR hardware and experiments to compute basic NMR parameters on high resolution and clinical MRI scanners. For further details of this course,visit www.mmrrcc.upenn.edu

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602. Imaging Biomarkers. (K) Reddy (course director), Borthakur, Elliot, Hariharan.Prerequisite(s): BMB 601 or permission of course director; students with prior NMR and MRI background will be given priority. Course meets for eight weeks (1/2 credit)

Introduction to principles of imaging based biomarkers for studying metabolic and functional integrity of biological tissues in vivo. Topics covered include a general overview of multimodal imaging biomarkers and a special emphasis on theoretical and practical aspects of MRI biomarkers based on magnetic resonance relaxation, chemical exchange, and metabolic spectroscopy as well as functional responses and their applications in diagnostic imaging of different diseases.

624. Molecular and Physical Basis of Ion Channels. (K) Kallen. Course meets all semester (half time) for 1/2 credit.

The course is a journal club format, targeted to graduate and MD/PhD students interested in ion channels from graduate programs in Physiology, Pathology, Neuroscience, Pharmacology, Biochemistry & Molecular Biophysics. It meets for one hour, once a week on alternate weeks and is coupled to the Ion Channel Journal Club, which also meets for one hour on the same alternate weeks (9:30-10:30 a.m., Thursdays, B400 Richards Building). A faculty member meets with students to discuss and review the contents of each selected article early in the week in preparation for the subsequent Journal Club presentation. This elective course is meant to introduce students to the latest advances in ion channel research and includes topics extending from biophysics, structure, and physiology to cell biology and medical applications.

618. Applications of High Resolution NMR Spectroscopy to Problems in Structural Biology. (I) Wand.Prerequisite(s): Undergraduate biochemistry and physical chemistry and BMB 601, or permission of instructor. Course meets for 8 weeks and is offered for 1/2 credit

A lecture-based course designed to introduce graduate students to applications of modern high-resolution multinuclear and multidimensional NMR spectroscopy to problems in structural biology. The course will first introduce classical definitions and descriptions of nuclear magnetic resonance and a convenient formalism for the analysis of advanced NMR experiments. Concepts and applications of multidimensional homonuclear 1H NMR and multidimensional heteronuclear spectroscopy of proteins and nucleic acids will be described. Resonance assignment strategies including analysis of triple resonance spectroscopy will be covered. The origin, measurement and extraction of structural restraints and their use in structure determination will be surveyed and illustrated with recent examples.

619. Protein Folding. (J) Axelsen and Englander. Course meets for 8 weeks and is offered for 1/2 credit.

Introduction to the folding of mainly soluble proteins but also membrane proteins. Critical readings in the current literature and important earlier literature. Class discussion of papers from the literature with didactic lectures as required. Exposure to principles and use of equilibrium, kinetics, thermodynamics and the range of biophysical technologies as they occur in the scientific literature.

622. Physical Principles of Mechano-Enzymes. (J) Dominguez, Goldman, Grishchuk and Ostap.Prerequisite(s): Biochemistry. Course meets for 8 weeks and is offered for 1/2 credit.

This course will provide an introduction to the biochemical, structural, and mehanical properties of energy-transducing enzymes. We will emphasize the relationships of mechanical, thermal, and chemical forces in mechano-enzyme function.

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626. Mass Spectrometry and Proteomics. (J) Speicher and Garcia. Course meets for 8 weeks and is offered for 1/2 credit

This course will provide a detailed introduction to proteomics and mass spectrometry. The role of mass spectrometry in both characterizing proteins for traditional protein structure-function studies and identification of proteins in proteome studies will be emphasized. Targeted and global proteomes, quantitative protein profiling and compositional proteomics, and applications of proteome studies will be discussed. Intended for first and second year graduate students and others with an interest in proteomics and mass spectrometry.

627. Computer Programming for Biochemists and Biophysicists. (J) Sharp and Van Duyne.Prerequisite(s): Permission of instructor for nonBMB students. Course meets for eight weeks and is offered for 1/2 credit.

An introductory course on programming and algorithms for scientists with an emphasis on applications to biophysics. Students will learn to write, debug, and execute basic programs through lectures, in-class workshops, and programming projects outside of class.

628. Principles of Scientific Instruments. (J) Liebman. Course meets for eight weeks and is offered for 1/2 credit.

Proper use of the tools of one's trade is essential to quality assurance. General confidence in the infallibility of even simple scientific instruments (SI) can be the cause of serious misapplication of research effort. This course teaches how to think about and use all SI's intelligently. It reviews first principles of instrument detection, selection, operation, calibration, truth-testing, trouble shooting and data analysis. Error appraisal and avoidance are analyzed using common laboratory examples. Anyone who cares is welcome. And we should all care. Emphasis sculpted to student needs.

629. Quantitative Problems in Biochemistry. (H) Kallen. Course meets for 8 weeks for 1/2 credit

Students will be assigned problems in a range of topics, including thermodynamics, enzyme kinetics, redox potentials, and will present their answers in class. This course is intended to complement material covered in BMB 508 and 509, providing a rigorous review of quantitative methods.

632. Probing Structure and Function of Complex RNA-Protein Machines. (H) Lynch.

RNA-Protein complexes or RNPs can range from simple assemblies to megadalton enzymatic machines.The latter include two of the most abundant and essential enzymatic complexes for converting genes to functional protein -the ribosome and the spliceosome. Understanding the molecular interactions that hold these RNPs together and how these complexes function has required the development of new techniques and pushed the boundaries of quantitative biochemistry. In this course we will take an in-depth look at general concepts common to many RNA binding proteins, the methods used to study protein-RNA and RNA-RNA interactions, and how the complex nature of large RNPs uniquely allow them to achieve their precise functions. The course will be a combination of both lectures and student-lead discussion of recent literature. Students will be evaluated based on their presentations of primary literature and their participation in class discussion.

SM 650. (CAMB702, PHRM650) Current Biochemical Topics. (S) Black and Shorter.Prerequisite(s): Permission needed from Department.

Participation in the "Dr. George W. Raiziss Biochemical Rounds", a weekly seminar program sponsored by the Department of Biochemistry and Biophysics. Program deals with a wide range of modern biochemical and biophysical topics presented by established investigators selected from our faculty, and by leading scientists from other institutions.

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699. Laboratory Rotation. (S) Kohli.

Supervised "mini-projects" for graduate students in Biochemistry and Molecular Biophysics. End of the semester requirements are 1) poster presentations; 2) written rotation summaries; or 3) talks. Course is offered fall, winter, spring, and summer semesters.

700. (CHEM700, PHRM630) Selected Topics in Chemistry. (B) Petersson.Prerequisite(s): Strong background in undergraduate chemistry required and at least one semester of biological chemistry desirable.

The course will focus on current topics in chemical biology, particularly experiments in which 1) chemical synthesis enables one to probe or control biological systems in novel ways or 2) manipulation of biological systems facilitates novel chemical syntheses. As the goal of the course is to familiarize students with innovative recent experimental approaches and to stimulate them to conceive of their own new methodology, students will be responsible for delivering presentations on topics selected from the literature and generating several novel research proposal ideas, one of which will be elaborated into a full proposal. The prepared seminar will allow students to explore topics not covered in Professor Petersson's lectures or to research one of those topics in more depth. The proposal will be evaluated for creativity, feasibility and impact.

SM 705. Candidacy Exam Preparation Course. (B) Marmorstein, Lynch and Nelson. Course meets for 8 weeks at the beginning of the spring semester, for 1/2 credit.

This course is designed for second year BMB students to prepare them for the Candidacy Examination, which must be completed in the spring semester of the second year.

799. Independent Study (Yrs 1 - 2). Staff.

990. Master's Thesis Research. (C) Staff. See Department for section numbers

995. Dissertation Research. Staff. See Department for section numbers