Courses for Fall 2018

Master List 4/5/18

BIOCHEMISTRY:
http://www.biochem.duke.edu/

First Half Semester:
BIOCHEM 658 (SBB 658) Structural Biochemistry I – [Structure of Macromolecules] Principles of modern structural biology. Protein-nucleic acid recognition, enzymatic reactions, viruses, immunoglobulins, signal transduction, and structure-based drug design described in terms of the atomic properties of biological macromolecules. Discussion of methods of structure determination with particular emphasis on macromolecular X-ray crystallography NMR methods, homology modeling, and bioinformatics. Students use molecular graphics tutorials and Internet databases to view and analyze structures. Prerequisites: organic chemistry and introductory biochemistry. *Minicourse, 1st half-semester. MWF 3:20-4:10 pm; Beese; 439 Nanaline Duke Bldg; 2 Units*

Second Half Semester:
BIOCHEM 659 (CELLBIO, IMMUNOL, SBB, UPGEN 659) Structural Biochemistry II – [Molecular Biology I] Continuation of BIOCHEM 658. Structure/function analysis of proteins as enzymes, kinetics of binding, catalysis and allostery, protein folding, stability and design protein-protein interactions. Prerequisite: Biochemistry 658, organic chemistry, physical chemistry, and introductory biochemistry. This is an introductory course to learn how to use quantitative methods to understand biological structure and function. *Minicourse, 2nd half-semester. MWF 3:20-4:10 pm; Zhou; 439 Nanaline Duke Bldg; 2 Units*

BIOCHEM 681 (SBB 681) Physical Biochemistry – A structure-based introduction to the role of thermodynamic driving forces in biology. An overview of experimental sources of structural and dynamic data, and a review of the fundamental concepts of thermodynamics. Both concepts are combined to achieve a structural and quantitative mechanistic understanding of allosteric regulation, and of coupled ligand binding and conformational change. Statistical thermodynamics is used to develop ensemble models of protein and nucleic acid dynamics. This treatment leads into specific examples and general principles of how to interpret structural and dynamic information toward the purposes of other research. Instructor consent required. *TuTh, 10:05-11:20 am; Oas; 147 Nanaline Duke Bldg; 3 Units*

BIOLOGY:
http://www.biology.duke.edu/

BIOLOGY 660 – Coalesence and Evolution – Survey of theoretical and empirical aspects of modern population genetics in the post coalescence era. Coincident with the development of coalescence theory, evolutionary biology began a profound and pervasive transformation. This course presents the basics of coalescence theory. It builds upon this perspective to address an array of summary statistics and inference methods developed for the analysis of genomic data. TuTh 8:30-9:45AM; Uyenoyama; Biological Sciences 113; 3 units

First Half Semester:
BIOLOGY 701 – Succeeding in Graduate School in the Biological Sciences – Weekly lecture and Q&A on choosing a thesis advisor, the grant proposal and scientific manuscript peer review processes, and other topics related to succeeding in graduate school. Also counts for RCR credit. Minicourse, 1st half-semester. W 12:00-1:00PM; Noor; LSRC A247; 0.5 Units

Second Half Semester:
BIOLOGY 702 - Succeeding Beyond Grad School: Career Options with a PhD in the Biological Sciences - Succeeding Beyond Grad School: Career Options with a PhD in the Biological Sciences - Weekly lecture and Q&A on alternative careers in the biological sciences,

preparing job applications, and other topics related to succeeding beyond graduate school. Also counts for RCR credit. Minicourse, 2nd half-semester. W 12:00-1:00PM; Noor; LSRC A247; 0.5 Units

BIOLOGY 790.01 – Special Topics Seminar: Historical Population Genetics. TH 3:05-5:35; Cunningham; Biological Sciences 144; 3 units

BIOLOGY 790.02 – Special Topics Seminar: Graphic Design for Biologists.TH 3:05-5:35; Wray; Location TBA: 3 units

BIOSTATISTICS:
http://biostat.duke.edu

BIOSTAT 701: Introduction to Statistical Theory and Methods I: This course provides a formal introduction to the basic theory and methods of probability and statistics. It covers topics in probability theory with an emphasis on those needed in statistics, including probability and sample spaces, independence, conditional probability, random variables, parametric families of distributions, and sampling distributions. Core concepts are mastered through mathematical exploration and linkage with the applied concepts studied in BIOSTAT 704.
Prerequisite(s): 2 semesters of calculus or its equivalent (multivariate calculus preferred). Familiarity with linear algebras is helpful.
Corequisite(s): BIOSTAT 702, BIOSTAT 703
Credits: 3

BIOSTAT 701L: Introduction to Statistical Theory and Methods I Lab: Students enroll in BIOSTAT 701 may opt to enroll in this advanced lab designed to extend the material presented in BIOS 701. This course will be run as a mixture of lecture and recitation. Each session will start with a short presentation by the instructor of advanced examples that extend the material presented during that week's BIOS 701 lecture. Each session will conclude with students presenting their solutions to advanced problems assigned the prior week. At the end of the semester, students will take a cumulative exam covering the advanced topics covered during the lab session.
Corequisite(s): BIOSTAT 701
Credits: 2

BIOSTAT 702: Applied Biostatistical Methods I: This course provides an introduction to study design, descriptive statistics, and analysis of statistical models with one or two predictor variables. Topics include principles of study design, basic study designs, descriptive statistics, sampling, contingency tables, one- and two-way analysis of variance, simple linear regression, and analysis of covariance. Both parametric and non-parametric techniques are explored. Core concepts are mastered through team-based case studies and analysis of authentic research problems encountered by program faculty and demonstrated in practicum experiences in concert with BIOSTAT 703. Computational exercises will use the R and SAS packages.
Prerequisite(s): 2 semesters of calculus or its equivalent (multivariate calculus preferred). Familiarity with linear algebras is helpful.
Corequisites(s): BIOSTAT 701, BIOSTAT 703, BIOSTAT 721
Credits: 3

BIOSTAT 703: Introduction to the Practice of Biostatistics I: This course provides an introduction to biology at a level suitable for practicing biostatisticians and directed practice in techniques of statistical collaboration and communication. With an emphasis on the connection between biomedical content and statistical approach, this course helps unify the statistical

concepts and applications learned in BIOSTAT 701 and BIOSTAT 702. In addition to didactic sessions on biomedical issues, students are introduced to different areas of biostatistical practice at Duke University Medical Center. Biomedical topics are organized around the fundamental mechanisms of disease from both evolutionary and mechanistic perspectives, illustrated using examples from infectious disease, cancer and chronic /degenerative disease. In addition, students learn how to read and interpret research and clinical trial papers. Core concepts and skills are mastered through individual reading and class discussion of selected biomedical papers, team-based case studies and practical sessions introducing the art of collaborative statistics. Corequisite(s): BIOSTAT 701, BIOSTAT 702 Credits: 3

BIOSTAT 703L: Introduction to the Practice of Biostatistics I Lab: The lab will be an extension of the course. The lab will be run like a journal club. The lab will instruct students how to dissect a research article from a statistical and scientific perspective. The lab will also give students the opportunity to present on material covered in the co-requisite course and to practice the communication skills that are a core tenant of the program.
Co-requisite: BIOSTAT 703 or permission of the Director of Graduate Studies Credits: 0

BIOSTAT 704: Introduction to Statistical Theory and Methods II: This course provides formal introduction to the basic theory and methods of probability and statistics. It covers topics in statistical inference, including classical and Bayesian methods, and statistical models for discrete, continuous and categorical outcomes. Core concepts are mastered through mathematical exploration, simulations, and linkage with the applied concepts studied in BIOSTAT 705. Prerequisite(s): BIOSTAT 701 or its equivalent Corequisite(s): BIOSTAT 705, BIOSTAT 706 Credits: 3

BIOSTAT 704L: Introduction to Statistical Theory and Methods II Lab: Students who enroll in BIOSTAT 704 may opt to enroll in this advanced lab designed to extend the material presented in BIOSTAT 704. This course will be run as a mixture of lecture and recitation. Each session will start with a short presentation by the instructor of advanced examples that extend the material presented during that week's BIOSTAT 704 lecture. Each session will conclude with students presenting their solutions to advanced problems assigned the prior week. At the end of the semester, students will take a cumulative exam covering the advanced topics covered during the lab session. Corequisite(s): BIOSTAT 704 Credits: 2

BIOSTAT 705: Applied Biostatistical Methods II: This course provides an introduction to general linear models and the concept of experimental designs. Topics include linear regression models, analysis of variance, mixed-effects models, generalized linear models (GLM) including binary, multinomial responses and log-linear models, basic models for survival analysis and regression models for censored survival data, and model assessment, validation and prediction. Core concepts are mastered through statistical methods application and analysis of practical research problems encountered by program faculty and demonstrated in practicum experiences in concert with BIOSTAT 706. Computational examples and exercises will use the SAS and R packages. Prerequisite(s): BIOSTAT 702 or its equivalent
Corequisite(s): BIOSTAT 704, BIOSTAT 706, BIOSTAT 722 Credits: 3

BIOSTAT 706: Introduction to the Practice of Biostatistics II: This course revisits the topics covered in BIOSTAT 703 in the context of high-throughput, high-dimensional studies such as genomics and transcriptomics. The course will be based on reading of both the textbook and research papers. Students will learn the biology and technology underlying the generation of "big data", and the computational and statistical challenges associated with the analysis of such data sets. As with BIOSTAT 703, there will be strong emphasis on the development of communication skills via written and oral presentations.
Prerequisite(s): BIOSTAT 703 Corequisite(s): BIOSTAT 704, BIOSTAT 705 Credits: 3

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BIOSTAT 707: Statistical Methods for Learning and Discovery: This course surveys a number of techniques for high dimensional data analysis useful for data mining, machine learning and genomic applications, among others. Topics include principal and independent component analysis, multidimensional scaling, tree based classifiers, clustering techniques, support vector machines and networks, and techniques for model validation. Core concepts are mastered through the analysis and interpretation of several actual high dimensional genomics datasets.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies
Credits: 2

BIOSTAT 708: Clinical Trial Design and Analysis: Topics include: history/background and process for clinical trial, key concepts for good statistics practice (GSP)/good clinical practice (GCP), regulatory requirement for pharmaceutical/clinical development, basic considerations for clinical trials, designs for clinical trials, classification of clinical trials, power analysis for sample size calculation, statistical analysis for efficacy evaluation, statistical analysis for safety assessment, implementation of a clinical protocol, statistical analysis plan, data safety monitoring, adaptive design methods in clinical trials (general concepts, group sequential design, dose finding design, and phase I/II or phase II/III seamless design) and controversial issues in clinical trials.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies
Credits: 2

BIOSTAT 709: Observational Studies: Methods for causal inference, including confounding and selection bias in observational or quasi- experimental research designs, propensity score methodology, instrumental variables, and methods for non-compliance in randomized clinical trials.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies
Credits: 2

BIOSTAT 710: Statistical Genetics and Genetic Epidemiology: Topics from current and classical methods for assessing familiality and heritability, linkage analysis of Mendelian and complex traits, family-based and population-based association studies, genetic heterogeneity, epistasis, and gene-environmental interactions. Computational methods and applications in current research areas. The course will include a simple overview of genetic data, terminology, and essential population genetic results. Topics will include sampling designs in human genetics, gene frequency estimation, segregation analysis, linkage analysis, tests of association, and detection of errors in genetic data.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies
Credits: 2

BIOSTAT 713: Survival Analysis: Introduction to concepts and techniques used in the analysis of time to event data, including censoring, hazard rates, estimation of survival curves, regression techniques, applications to clinical trials. Interval censoring, informative censoring, competing risks, multiple events and multiple endpoints, time dependent covariates; nonparametric and semi-parametric methods.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies
Credits: 2

BIOSTAT 714: Categorical Data Analysis: Topics in categorical modeling and data analysis/contingency tables; measures of association and testing; logistic regression; log-linear models; computational methods including iterative proportional fitting; models for sparse data; Poisson regression; models for ordinal categorical data, and longitudinal analysis.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies Credits: 2

BIOSTAT 718: Analysis of Correlated and Longitudinal Data: Topics include linear and nonlinear mixed models; generalized estimating equations; subject specific versus population average interpretation; and hierarchical model.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies Credits: 2

BIOSTAT 719: Generalized Linear Models: The class introduces the concept of exponential family of distributions and link function, and their use in generalizing the standard linear regression to accommodate various outcome types. Theoretical framework will be presented but detailed practical analyses will be performed as well, including logistic regression and Poisson regression with extensions. Majority of the course will deal with the independent observations framework. However, there will be substantial discussion of longitudinal/clustered data where correlations within clusters are expected. To deal with such data the Generalized Estimating Equations and the Generalized Linear Mixed models will be introduced. An introduction to a Bayesian analysis approach will be presented, time permitting.
Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722 or their equivalents, or permission of the Director of Graduate Studies Credits: 2

BIOSTAT 720: Master's Project: Completed during a student's final year of study, the master's project is performed under the direction of a faculty mentor and is intended to demonstrate general mastery of biostatistical practice.
Prerequisite(s): BIOSTAT 701 through BIOSTAT 706 Credits: 3 in Fall Semester and 3 in Spring Semester

BIOSTAT 721: Introduction to Statistical Programming I (R): This class is an introduction to programming in R, targeted at statistics majors with minimal programming knowledge, which will give them the skills to grasp how statistical software works, tweak it to suit their needs, recombine existing pieces of code, and when needed create their own programs. Students will learn the core of ideas of programming (functions, objects, data structures, input and output, debugging, and logical design) through writing code to assist in numerical and graphical statistical analyses. Students will learn how to write maintainable code, and to test code for correctness. They will then learn how to set up stochastic simulations and how to work with and filter large data sets. Since code is also an important form of communication among scientists, students will learn how to comment and organize code to achieve reproducibility. Programming techniques and their application will be closely connected with the methods and examples presented in the co-requisite course. The primary programming package used in this course will be R.
Prerequisite(s): None; familiarity with linear algebras is helpful Corequisite(s): BIOSTAT 702 Credits: 2

BIOSTAT 722: Introduction to Statistical Programming II (SAS): This class is an introduction to programming in SAS, targeted at statistics majors with minimal programming knowledge, which will give them the skills to grasp how statistical software works, tweak it to suit their needs, recombine existing pieces of code, and when needed create their own programs. Students will learn the core of ideas of programming (data step, procedures, macros, ODS, input and output, debugging, and logical design) through writing code to assist in numerical and

graphical statistical analyses. Students will learn how to write maintainable code, and to test code for correctness. They will then learn how to set up stochastic simulations and how to work with and filter large data sets. Since code is also an important form of communication among scientists, students will learn how to comment and organize code to achieve reproducibility. Programming techniques and their application will be closely connected with the methods and examples presented in the co-requisite course. The primary programming package focus used in this course will be SAS.
Prerequisite(s): None; familiarity with linear algebras is helpful Corequisite(s): BIOSTAT 705 Credits: 2

BIOSTAT 732: Independent Study: Independent Study is a semester long course focused on mentored research in the practice of biostatistics. Students work with an assigned mentor. This course is only open to students by permission of the Director of Graduate Studies. Credits: 1, 2, or 3

BIOSTAT 740: Continuation: Continuation is a semester-based, noncredit bearing enrollment status used when a student is continuing scholarly activities with the same mentor. This course is only open to students by permission of the Director of Graduate Studies. Credits: 0

BIOSTAT 801: Biostatistics Career Preparation and Development I: The purpose of this course is to give the student a holistic view of career choices and development and the tools they will need to succeed as professionals in the world of work. The fall semester will focus on resume development, creating a professional presence, networking techniques, what American employers expect in the workplace, creating and maintaining a professional digital presence and learning how to conduct and succeed at informational interviews. Practicums in this semester include an informational interviewing and networking practicum with invited guests. Students participate in a professional “etiquette dinner” and a “dress for success” module as well an employer panel. Corequisite(s): BIOSTAT 701 through BIOSTAT 703 Credit: 1

BIOSTAT 802: Biostatistics Career Preparation and Development II: The purpose of this course is to further develop the student’s job seeking ability and the practical aspects of job/internship search or interviewing for a PHD program. The goal is to learn these skills once and use them for a lifetime. Modules that will be covered include: Communication skills both written and oral, interviewing with videotaped practice and review, negotiating techniques, potential career choices in the Biostatistics marketplace, and working on a team. This semester includes writing and interviewing practicum, and a panel of relevant industry speakers. Students will leave this course with the knowledge to manage their careers now and in the future.
Prerequisite: BIOSTAT 801 Credit: 1

BIOSTAT 821: Software Tools for Data Science: A data scientist needs to master several different tools to obtain, process, analyze, visualize and interpret large biomedical data sets such as electronic health records, medical images, and genomic sequences. It is also critical that the data scientist masters the best practices associated with using these tools, so that the results are robust and reproducible. The course covers foundational tools that will allow students to assemble a data science toolkit, including the Unix shell, text editors, regular expressions, relational and NoSQL databases, and the Python programming language for data munging, visualization and machine learning. Best practices that students will learn include the Findable, Accessible, Interoperable and Reusable (FAIR) practices for data stewardship, as well as reproducible analysis with literate programming, version control and containerization.
Prerequisite: Permission of the Director of Graduate Studies Credits: 2

BIOSTAT 822: R for Data Science: This course will build on the foundation laid in software tools for data science. The course will explore the flow of a typical data science project from

importing, cleaning, transforming and visualizing datasets to modeling and communicating results, within the context of R programming. While the course will include best practices, syntax and idioms specific to R, the focus will be on the process of conducting analysis in a reproducible fashion, writing readable, well-documented code and creating a coherent presentation of results.
Prerequisite: Permission of the Director of Graduate Studies Credits: 2

BIOSTAT 823: Statistical Program for Big Data: This course will extend the foundation laid in software tools for data science to allow for efficient computing involving very large data sets. This course will explore the use appropriate algorithms and data structures for intensive computations, improving computational performance by use of native code compilation, use of parallel computing to accelerate intensive computations, use appropriate algorithms and data structures for massive data set, and use of distributed computing to process massive data sets.
Prerequisite: BIOSTAT 821 or permission of the Director of Graduate Studies Credits: 2

BIOSTAT 824: Case Studies in Biomedical Data Science: This course will highlight how biomedical data science blends the field of biostatistics with the field of computer science through the introduction of 3 to 5 case studies. Students will be introduced to analytic programs typically encountered in biomedical data science and will implement the data science and statistical skills introduced in their previous course work.
Prerequisite: BIOSTAT 707, 821, 822, and 823 or permission of the Director of Graduate Studies Credits: 2

BIOSTAT 901: Modern Inferential Techniques and Theory: Stochastic processes, random walks, Markov chains, martingales, counting processes, weak convergence and basic empirical process theory and applications. Hilbert spaces for random vectors, semiparametric models, geometry of efficient score functions and efficient influence functions, construction of semiparametric efficient estimators. Applications include the restricted moment model and the proportional hazards model. The theory for M- and Z- estimators. Methods for dealing with missing data including imputation, inverse probability weighting (IPW) and the likelihood method, doubly robust IPW estimators.
Prerequisite: Permission of the Director of Graduate Studies Credits: 3

BIOSTAT 905: Linear Models and Inference: Introduction to linear models and linear inference from the coordinate-free viewpoint. Topics: identifiability and estimability, key properties of and results for finite-dimensional vector spaces, linear transformations, self-adjoint transformations, spectral theorem, properties and geometry of orthogonal projectors, Cochran's theorem, estimation and inference for normal models, distributional properties of quadratic forms, minimum variance linear unbiased estimation, Gauss-Markov theorem and estimation, calculus of differentials, analysis of variance and covariance.
Prerequisite: Biostatistics 702, 704, 705, real analysis, and linear algebra, or consent of the instructor and Director of Graduate Studies Credits: 3

BIOSTAT 906: Statistical Inference: Introduce decision theory and optimality criteria, sufficiency, methods for point estimation, confidence interval and hypothesis testing methods and theory. Prerequisite: Biostatistics 704 or equivalent. Instructor consent required.
Prerequisite: Permission of the Director of Graduate Studies Credits: 3

CELL AND MOLECULAR BIOLOGY:

http://medschool.duke.edu/cmb

CMB 710 A-F - Cell & Molecular Biology Modules
Modules in the CMB 710 series (A – F) are offered sequentially during the Fall semester and

together cover 24 topics. These are the core offerings of the Cell & Molecular Biology Program and allow maximum flexibility for a student-designed curriculum. Four different topics are available during each module and students choose one. Topics reflect the expertise of the corresponding faculty and emphasize either in-depth critical discussion of the primary literature or quantitative/mathematical approaches to addressing biological questions. Each module lasts for 2 weeks, with 3 meetings per week. Students entering through CMB are required to take 6 modules in fall semester of their first year and at least 4 of these modules must be in the CMB 710 series. The other two may be from the UPGEN 778 series. A total of 12 modules are required for the CMB certificate, and 8 of these must be from CMB710. To help you prepare for each module, the instructors have included a listing of required reading that must be completed in advance of the start of each module. *MWF 10:20 – 11:40 am; Fox, Di Talia (Course Directors); 1 Unit each.*
See syllabus here:
https://medschool.duke.edu/sites/medschool.duke.edu/files/field/attachments/cmb710a-f_fall_18_syllabus_3-21-18.pdf

CMB 733.01 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists – See PHARM 333.01

CMB 733.02 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists – See PHARM 333.02

CMB 733.03 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists Statistics – See PHARM 333.03

CMB 764 Cell and Molecular Biology Colloquium – [Student Seminar] Required of all CMB students. Each Monday at noon, presentations by upper-year students: one student talks about ongoing dissertation research and another introduces a research paper relevant to that week's seminar. Students attend the Thursday seminar and can have lunch with the speaker. Credit is based on attendance. *M 11:55-1:00 pm;* Eroglu; 143 Jones Building; 2 Units

CMB 797 Modern Techniques in Molecular Biology - This course introduces the fundamental laboratory techniques used in basic research. It is divided into two sections. One section covers techniques used for protein purification, analysis, and the study of protein-protein interactions. The second covers nucleic acid based techniques, including a review of basic nucleic acid chemistry, enzymatic modification, qualitative and quantitative PCR, nucleic acid sequencing, cloning strategies, vectors, and measurement of transcript expression including microarray techniques. This course is built around a team-based learning model. Course reading material and recorded lectures are provided to students to review before class and class time is spent reinforcing the material through problem sets and group discussion. *8:45-9:45 am; Madan Kwatra; Nan Duke 384; 3 Units*

CELL BIOLOGY:
http://www.cellbio.duke.edu

CELLBIO 701 Human Structure and Function. This core course of the preclinical curriculum presents scientific principles underlying the structure and function of the normal human body. Focus is given to the gross anatomy, microscopic anatomy, and physiology of nine organ systems providing the foundation for the practice of medicine. The course objectives are to ensure that all students possess a conceptual model of the structure and integrated function of the human body as an intact organism and each of its major organ systems, emphasizing their role in the maintenance of the body's homeostasis. Enrollment is restricted to pathologists' assistant students. Course director: Dr. Emma Jakoi. Credit 12 units.

Courses for Fall 2018

CELLBIO 551 Cell and Molecular Biology – This class teaches 24 topics covering a wealth of cell and molecular biology in a flexible modular format. In the course of covering the topic, most modules involve either in-depth critical discussion of primary literature, or an emphasis on developing quantitative/mathematical approaches to the biology, or both. Each module consists of six classes. Students may select any six (non-concurrent) modules to take. Each module contributes to 10% of the final grade. At the end of the class, students pair up and devise a research proposal that is honed over a two-week period with an assigned faculty coach. All proposals are presented orally to the entire class (students and instructors) in a 2-day symposium in mid-December, contributing 40% of the final grade. *MWF 10:20-11:40 am; Nicchitta; Mathey-Prevot, 384 Nanaline Duke Bldg and 437 Nanaline Duke Bldg; 4 Units*

CELLBIO 710 Papers and Grant Writing Workshop [Scientific Writing] – Introduction to grant and fellowship writing; writing assignment of two proposal topics; evaluation and critique of proposal by fellow students. *MWF 8:45–9:35 am; 437 Nanaline Duke Bldg; Erickson; 3 Units (crosslisted with NEURO 710 Writing Grant Proposals)*

First and Second Half Semester:

CHEMISTRY: For a complete listing, please go to:
https://chem.duke.edu/graduate/courses

COMPUTATIONAL BIOLOGY & BIOINFORMATICS:
http://genome.duke.edu/education/CBB

CBB 520 Genome Tools and Technologies - The course introduces the laboratory and computational methodologies for genetic and protein sequencing, mapping and expression measurement. Prerequisites: Students are expected to have some background course work in genetics, molecular biology, biochemistry, and a modern programming language. *TuTh 10:05-11:20 am; Dietrich; Location TBA, 3 Units*

CBB 574 Modeling and Engineering Gene Circuits - This course discusses modeling and engineering gene circuits, such as prokaryotic gene expression, cell signaling dynamics, cell-cell communication, pattern formation, stochastic dynamics in cellular networks and its control by feedback or feedforward regulation, and cellular information processing. The theme is the application of modeling to explore "design principles" of cellular networks, and strategies to engineer such networks. Students need to define an appropriate modeling project. At the end of the course, they're required to write up their results and interpretation in a research-paper style report and give an oral presentation. Prerequisites: Biomedical Engineering 260L or consent of instructor. WF. 11;45a-1:00p; Instructor You, 3 units Not Offered Fall 2018

CBB 634 Geometric Algorithms - Models of computation and lower-bound techniques; storing and manipulating orthogonal objects; orthogonal and simplex range searching, convex hulls, planar point location, proximity problems, arrangements, linear programming and parametric search technique, probabilistic and incremental algorithms. TThu 3:05-4:20p Location TBA; Instructor Pankaj Agarwal, 3 units

CBB 720 Applications of high-throughput sequencing for genomic analysis- High-throughput sequencing has revolutionized our ability to study genomic function. In this class students will learn how to design, perform, and analyze experiments to measure genome-wide changes in chromatin state, transcription factor occupancy, and gene expression. Topics will include approaches for constructing high-throughput sequencing libraries, data quality control, and statistical techniques to measure gene expression and to identify differential activity. Emphasis will be placed on computational analysis and hands on experience. Upon completion,

students will have a strong foundation to design and analyze sequencing-based genomic assays in their own research. Instructor: Reddy TuTh 1:25-2:40p LSRC D243 3 units Not Offered Fall 2018

CBB* 658 Biochem 658 Structural Biochemistry I-*See BIOOCHEM 658
CBB 659 Biochem 659 Structural Biochemistry II –See BIOCHEM 659

IMMUNOLOGY:
http://immunology.mc.duke.edu

IMMUNOL 544 Principles of Immunology - This is a graduate level course that is open to both graduate students and advanced undergraduates. It is an introduction to the molecular and cellular basis of the immune response. Topics include anatomy of the lymphiod system, lymphocyte biology, antigen-antibody interactions, humoral and cellular effector mechanisms, and control of immune responses. The last third of the course focuses on special topics and application such as transplantation, autoimmunity, immunodeficiency, and tumor immunity. On selected days, the class is broken down into small discussion groups of approximately 15 students to discuss material introduced in the lectures or to work on problem sets. Graduate students in the Department of Immunology lead these sections. *MWF 1:30-2:20 pm; Zhang; 143 Jones Bldg; 3 Units*

IMMUNOL 601 Immunology of Human Disease - This advanced course will cover the immune aspect of various human diseases including autoimmune diseases, allergy, tumor, inflammation and infectious diseases. Required course for all students specializing in immunology. Prior course requirement: IMM544.Tues/Thurs 10:05-11:20 am; He & St. Clair; 321Jones Bldg; 3 Units.

IMMUNOL 701D Pillars of Immunology – This course will cover discoveries of historical importance in the field of immunology through student presentations and discussions of classical papers. Intended for students seeking a PhD in Immunology. F 10:20-11:20 am; Tedder & Krangel; Jones 321; 1 Unit

IMMUNOL 735 Topics in Immunology - Focus on current immunology research, emphasizing emerging research areas and new directions in established areas. Students present recent papers in selected subjects. Required course for all students specializing in immunology. *Th 9-10 am; Shinohara & Ciofani; 001 MSRB I; Credit/no credit grading only; 1 Unit.*

IMMUNOL 791A Research in Immunology – This course is the first of two for first year students enrolled in the Immunology Graduate Program designed to introduce bench work in immunology and to expose students to a variety of techniques to increase their proficiency. One to two research rotations will be conducted in training faculty laboratories for periods of 10-12 weeks. Rotations should be approved by the DGS. The second course is IMMUNOL791B offered in the spring. Both courses must be taken in order for the four total credits and grades to post. 2 Units

Second Half Semester:
IMMUNOL 659 / BIOCHEM 659 Structural Biochemistry II - See BIOCHEM 659

INTEGRATED TOXICOLOGY AND ENVIRONMENTAL HEALTH (CERTIFICATE):
http://sites.nicholas.duke.edu/envhealth/

CMB 551 Cell and Molecular Biology – See CMB 551

ENVIRON 501 Environmental Toxicology – Study of environmental contaminants from a broad perspective encompassing biochemical, ecological, and toxicological principles and methodologies. Discussion of sources, environmental transport and transformation phenomena, accumulation in biota and ecosystems. Impacts at various levels of organization, particularly biochemical and physiological effects. Prerequisites: organic chemistry and vertebrate physiology or consent of instructor.
MW 10:05 – 11:20 am, LSRC A155; 3 units; Instructors: Di Giulio, Meyer
ENVIRON 540 Chemical Fate of Organic Compounds – Equilibrium, kinetic, and analytical approaches applied to quantitative description of processes affecting the distribution and fate of anthropogenic and natural organic compounds in surface and groundwaters, including chemical transfers between air, water, soils/sediments, and biota; and thermochemical and photochemical transformations. Emphasis is on the relationships between organic compound structure and environmental behavior. Sampling, detection, identification, and quantification of organic compounds in the environment. Prerequisites: university-level general chemistry and organic chemistry within last four years.
TuTh 3:05 – 4:20 pm, LSRC A156; 3 units; Instructors: Stapleton, Butt

ENVIRON 847S Seminar in Toxicology – See PHARM 847S-01 (required class for certificate). A weekly research seminar throughout the year is required of participants in the Toxicology Program, but open to students in related fields as well. Students, faculty and invited national speakers present their latest research findings concerning neurotoxicology, molecular biology, teratology, environmental toxicology, public policy of environmental regulation and related fields.
F 11:45 am – 1:25 pm; EH 1112 OR LSRC B101; 1 Unit; Instructor: Meyer.

PHARM 533 Essentials of Pharmacology and Toxicology - (required) See PHARM 533

PHARM 554 Mammalian Toxicology - See PHARM 554

MEDICAL PHYSICS
http://medicalphysics.duke.edu

MEDPHY 500 Radiation Physics - A course covering the basics of ionizing and non-ionizing radiation, atomic and nuclear structure, basic nuclear and atomic physics, radioactive decay, interaction of radiation with matter, and radiation detection and dosimetry. *MW 10:05-11:20 am; Turkington; 1032 Hock Plaza; 3 Units.*

MEDPHY 505 Anatomy and Physiology for Medical Physicists - A course focused on medical terminology, biochemistry pertaining to MP, basic Anatomy and physiology, elementary tumor and cancer biology, and overview of disease in general. Upon completion, the student should: (a) understand anatomic structures, their relationships, their cross-sectional and planar projections, and how they are modified by attenuation and artifacts in the final images; (b) understand the physiology underlying radionuclide images, (c) understand how (a) – (b) are modified by disease, (d) identify anatomical entities in medical images (different modalities), and (e).identify basic disease features in medical images (e.g., Pneumothorax in chest radiographs, microcalcoifications in mammograms). *MW 8:30 – 9:45 am; Reiman; 1032 Hock Plaza, 3 units*

MEDPHY 530 Modern Medical Diagnostic Imaging System - A course describing basics of imaging science, x-ray imaging modalities including basic principles, detectors, scattered radiation, planar imaging, CT, fluoroscopic imaging, nuclear medicine imaging, US and MRI, and computers in imaging. *TuThu 10:05-11:20 am; MacFall; 1032 Hock Plaza; 3 Units.*

MEDPHY 722 Advanced Photon Beam Radiation Therapy. This course will cover the physics and clinical application of advanced external beam photon therapies with special emphasis on IMRT. Prerequisite: MP 220*. Tu Thu 8:30am – 9:45 am,* Q. Wu.*; 1032 Hock Plaza*, 3 units

MEDPHY 726 Practicum on Monte Carlo method in Medical Physics - This course focuses on the fundamentals of Monte-Carlo simulations and provides hands-on experience with clinical Monte-Carlo codes used in medical dosimetry. The course will introduce software such as MCNP, EGS, FLUKA, GEANT and Penelope and companion data analysis software ROOT, PAW and CERNLIB. Students will study at least one major code and will perform two or more projects based on a clinically relevant task. Prerequisites: Calculus, modern physics, and programming. Knowledge of C, C++, or Fortran would be a plus. *Th 1:15–4:05 pm, Gunasingha, 1-3 Units.*

MEDPHY 751-1 Medical Physics Basic Research Topics - This seminar provides an overview of research projects conducted by medical physics faculty through a series of invited talks. The aim of the seminar is to help first year students identify their research interests and career/training orientation*. M 11:45 am – 1 pm; Kapadia; 1 Unit.*

MEDPHY 751-3 Professional Development Skills for Medical Physicists - This seminar provides important skills for students' professional development through a series of presentations on relevant topics that include public speaking, effective scientific and professional communication, interviewing skills, entrepreneurship, etc. Designed for second year Medical Physics students. *Thu 1:25 – 2:40 pm; Wilson; 1 Unit.*

MEDPHY 781 Clinical Shadowing for Medical Physicists - This course provides an opportunity to shadow clinical medical physicists in a wide range of clinical tasks that include quality assurance of imaging and radiotherapy machines, treatment planning, radiation measurement, patient treatment, etc. *Samei, Yin; 1 Unit.*

MOLECULAR CANCER BIOLOGY

https://pharmacology.duke.edu/training/graduate/molecular-cancer-bio

MOLCAN 780 (PHARM 780) Advances in Cancer Research - [Student Seminar] A presentation and discussion course in which program faculty and graduate students review the recent progress in areas of cancer research being investigated at Duke University. Provides an important avenue for evaluation and feedback for graduate student research and is required each year for all students pursuing their Ph.D. degree in molecular cancer biology. *Th 4:20-5:30 pm; Thiele and Li; C144 LSRC; 2 Units*

MOLCAN 818 (PHARM 818) Molecular Mechanisms of Oncogenesis - This course is a lecture presentation and discussion course on the molecular mechanisms underlying cancer development in which students complete periodic tests, present a paper, and work in a group to write and defend a grant proposal. The objective of the course is to provide an opportunity for in-depth discussions of molecular mechanisms underlying the development of human cancers. The course is intended for second-year students who have already taken the course of Cell Signaling. *TuTh 10:05-11:20 am; Wood and Yao; C335 LSRC; 3 Units*

MOLECULAR GENETICS & MICROBIOLOGY

http://mgm.duke.edu

MGM 701 Foundations of MGM – **NEW Fall 2016** – This core course is open to MGM first year students with exposure to research interests in the department. MGM faculty will provide an

overview of their research along with important historical context. Credit grading only. *F 4:00-5:30pm; Luftig; TBD; 1 unit*

MGM 702 Papers and Grant Writing Workshop [Scientific Writing] – This course is an introduction to grant and fellowship writing; writing assignment of two proposal topics; evaluation and critique of proposal by fellow students. This course is a requirement for MGM students. *Prerequisite: consent of instructor – contact the DGSA*; *MWF 8:45–9:45 am; 001 MSRB1; Marchuk; 3 Units (crosslisted with UPGEN 702 Writing Grant Proposals)*

MGM 703 Advanced Topics in Infection Biology – This course will be a literature based course taught by 3-4 faculty on emerging themes in host pathogens. The class size will be limited to approximately 6 and the main concept is to highlight research that is paradigm changing. Class meets two times per week. *TuTh 10:05-11:20 am; Coers; 0040 CARL, 3 units* (Not Offered Fall 2018)

MGM 720 Computational Tools in Next Generation Genomic Analysis – NEW Fall 2015 – This course is an intensive, one semester course in computer skills necessary to carry out analysis of next generation genomic data. The philosophy for this course is that we are training PhD students, and they should have a fairly in-depth understanding of how this analysis is carried out. This course offers that understanding. The course will involve only a small amount of lecture, and be primarily a hands-on laboratory with extensive discussion. Permission number from Instructor required for registration. Class size is limited to 6 students. *TuTh 1:25-2:40pm and lab of 3:05-4:20pm; Dietrich; 289 CARL, 3 units*

MGM 778 (CMB, UPGEN 778) - Genetic Approaches to the Solution of Biological Problems – See UPGEN 778

NEUROBIOLOGY
http://www.neuro.duke.edu

NEUROBIO 710 (CELLBIO 710) – Scientific Writing: Papers and Grant Writing Workshop – Introduction to grant and fellowship writing; writing assignment of two proposal topics; evaluation and critique of proposal by fellow students.
MWF 8:45 – 9:35 am; Erickson, Lisberger, McDonnell and Soderling; Room TBD; 3 Units

NEUROBIO 719-01 Concepts in Neuroscience I: Cellular and Molecular Neurobiology - The goal of this course is for you to gain in depth knowledge of cellular and molecular neurobiology and for you to learn to critically evaluate the associated primary scientific literature. This is a required core course for Neurobiology program graduate students. The course is also frequently taken by other graduate students with research interests in neuroscience including (but not limited to) those in Cognitive Neuroscience, Cell Biology, Developmental Biology, Pharmacology, Genetics, Biology, Psychology, and Biomedical Engineering.

The course is comprised of five, two-week long modules. Each module covers one core topic area (Neuronal Excitability, Synaptic Transmission, Cell Biology of the Neuron, Neuronal Development, and Neuronal Plasticity). Most students will take all five modules, but some students will be enrolled in a subset of the modules. All modules are comprised of both didactic lectures and paper discussion sessions. The relative emphasis on different learning activities within each module is determined by the module directors and will vary.
Start date Sept 11 – Dec 15; MWF 8:45 am-11:00pm; Grandl / West; 301 Bryan Research; 5 Units.

Courses for Fall 2018

NEUROBIO 719A-01 Neuronal Excitability: The electric excitability of neurons is mediated by ion channels. First, we will give an overview of the human ion channel set and discuss the basic structure and functions of ion channels. We will show how the function of ion channels is measured and analyzed. We will analyze the 3D crystal structures of a few ion channels in greater detail. In the second week we will begin with a review of the basic electrical properties of cell membranes, and then focus in-depth on what remains the archetypal study of neuronal excitability in the field: that of the axonal action potential by Alan Hodgkin and Andrew Huxley in a series of papers published in 1952. ***Jorg Grandl/Don Lo; Sept 11 – Sept 22***

NEUROBIO 719B-01 Cell Biology of the Neuron: This module will cover the fundamentals of basic cell biology as well as focusing on cellular specializations that are exaggerated in neurons. Topics include polarized protein trafficking, organelle motility, cytoskeleton organization, synaptic scaffolds, intracellular signaling cascades and cell-to-cell communication, including communication between neurons and non-neuronal cells. We will cover genetic methods for the study of molecular function in neurons and finally we will have a class project to discuss how neurotrophic factors promote cell survival and the molecular mechanisms of neuronal death. ***Anne West; Sept 25 – Oct 6 (No class Fri Sept 29).***

NEUROBIO 719C-01 Synaptic Transmission: As the focal point of communication between neurons, the synapse is an essential adaptation of the nervous system that contains a wide variety of unique proteins and functional specializations. In this module, we will cover the structure and function of the synapse, from the dynamics of presynaptic vesicle release through the postsynaptic response to neurotransmitter, and the essential proteins and molecules that mediate these processes. Finally, we will discuss how these elements can be tailored to fit the needs of different circuits. ***Kevin Franks/Court Hull; Oct 11 – 20 (No class Mon Oct 9).***

NEUROBIO 719D-01 Neuronal Development: How the brain is wired during development is a fundamental question of neurobiology. In this module we will discuss the molecular mechanisms that sculpt brain patterning and axon guidance, we will discuss the regulation of neurogenesis, we will cover how the synapse is formed, and we will talk about how sensory information guides the development of the brain in early postnatal life. ***Jeremy Kay; Oct 23 – Nov 3.***

NEUROBIO 719E-01 Neuronal Plasticity: Plasticity is one of the most unique features of the brain, mediating the ability of this organ to learn from its environment. In this module we will explore molecular and cellular mechanisms of experience-dependent neural plasticity. Emphasis will be given to synaptic plasticity, a major mechanism for learning and memory, but this module will also introduce the various forms of plasticity that lie under the "plasticity" umbrella. Upon completing this module students will be familiar with the major forms of synaptic plasticity and their molecular mechanisms, be able to identify experimental approaches to study synaptic plasticity, and learn of examples that illustrate how plasticity modifies circuit function and behavior. ***Nicole Calakos; Nov 6 – 20 (No class Nov 13 and 15).***

NEUROBIO 726S.001 Neurobiology Journal Club (Seminar) – Once a month, first and second year neurobiology graduate students meet to hold a student-run journal club to discuss the work of an invited seminar speaker from an outside institution. On the following Tuesday, the students attend the seminar then have lunch with the speaker.
Tu 11:45 am – 2:00 pm; West; Bryan 301; 1 Unit

NEUROBIO 733.01 (CMB, PHARM 733.01) Experimental Design and Biostatistics for Basic Biomedical Scientists - See PHARM 733.01
NEUROBIO 733.02 (CMB, PHARM 733.02) Experimental Design and Biostatistics for Basic Biomedical Scientists - See PHARM 733.02

Courses for Fall 2018

NEUROBIO 733.03 (CMB, PHARM 733.03) Experimental Design and Biostatistics for Basic Biomedical Scientists - See PHARM 733.03

NEUROBIO 751 (NEUROSCI 751) Neuroscience Boot Camp - Neuroscience Bootcamp is a two week immersive lecture, discussion and laboratory course for graduate students in the Neurobiology Graduate Program and the Cognitive Neuroscience Admitting Program, and graduate students in allied programs at the discretion of the instructors. The Duke Neuroscience Bootcamp is designed to (1) provide a common knowledge base of neuroscience fundamentals; (2) demystify the tools of the discipline - providing hands-on experience with techniques that are commonly used to explore cellular/molecular, circuits and cognitive neuroscience. Instructor: Mooney. *Permission number from Instructor required for registration.* ***August 28-September 8, MTWThF; varies but approx. 9:00am-7:00pm; R. Mooney; Levine Science Research Building, Room B035*; *2 Units.***

NEUROBIO 759S (PSY 759S, PHIL 753S) Principles in Cognitive Neuroscience I- Introduction to the cognitive neuroscience of emotion, social cognition, executive function, development, and consciousness. Topics also include cognitive disorders, and computer modeling. Highlights current theories, methodological advances, and controversies. Students evaluate and synthesize findings across a variety of research techniques. Consent of instructor required. ***T Th 1:25-2:40 pm; Cabeza; A156 LSRC; 3 Units.***

NEUROBIO 790 Student Seminar – Preparation and presentation of seminars to students and faculty on topics of broad interest in neurobiology. Required of all first – and second-year students. *W 12:00 – 2:00 pm; Rebecca Yang/Jeremy Kay; Bryan 301; 1 unit*

NEUROBIO 793 Research in Neurobiology (Independent Study)- This course acquaints students with research in neuroscience and allows them to become proficient in a variety of techniques. It is an independent study in one of the laboratories of the training faculty. Students are expected to do three rotations in three semesters. *(Laboratory Rotations) (up to 12 Units)*

NEUROSCIENCE
http://www.dibs.duke.edu/education/graduate

PATHOLOGY
http://pathology.mc.duke.edu

PATHOL 725 Introduction to Systemic Histology - The purpose of this course is to teach students how to identify a variety of normal tissues and cell types in standard histologic sections. Structure/function relationships will be emphasized, using an organ system approach. The scheduled class time includes both lecture and laboratory using “virtual microscopy”, where scanned glass slides are viewed on the screen of your laptop/tablet computer. The course is open to graduate students and advanced undergraduates and is recommended for students whose research requires examination of tissue sections. *MWF 1:25-2:40 pm, Hale; TSLC (room to be determined); 3 Units*

Courses for Fall 2018

PHARMACOLOGY

https://pharmacology.duke.edu/training/graduate/pharmacology

PHARM 533 Essentials of Pharmacology & Toxicology - Drug absorption, distribution, excretion and metabolism. Structure and activity relationships; drug and hormone receptors and target cell responses. Consent of instructor required. *Prerequisite: introductory biology; Chemistry 151L; Mathematics 31 and 32. Instructor: Slotkin and staff, MWF 3:20-4:40 pm; C144 LSRC; 4 Units*. ***NOTE:*** **CMB Students in Pharmacology are currently required to take PHR 533 Essentials in Pharmacology & Toxicology. This is also a core course for the Environmental Health Certificate.**

PHARM 554 Mammalian Toxicology - Principles of toxicology as related to humans. Emphasis on the molecular basis for toxicity of chemical and toxicokinetics, toxicologic evaluation, toxic agents, target organs, toxic effects, environmental toxicity, management of poisoning, epidemiology, risk assessment, and regulatory toxicology, *Prerequisite: introductory biology, and Chemistry 151L, or consent of instructor. Instructor: Abou Donia; TuTh 1:25-3:00pm; LSRC C144; 4 Units.*

PHARM 733.01 (CMB, NEUROBIO, BME, MOLCAN 733.01) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *T 8:30-10:15am; C144 LSRC; Slotkin (Runs concurrently with Section 733.02 & 733.03) 2 Units.*

PHARM 733.02 (CMB, NEUROBIO, BME, MOLCAN 733.02) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *W 8:30-10:15 am; C144 LSRC; Slotkin (Runs concurrently with Section 733.01 & 733.03) 2 Units*

PHARM 733.03 (CMB, NEUROBIO, BME, MOLCAN 733.03) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *Th 8:30-10:15 am; C144 LSRC; Slotkin (Runs concurrently with Section 733.01 & 733.02) 2 Units*

PHARM 780 (MOLCAN 780) Advances in Cancer Research – See MOLCAN 780

PHARM 818 (MOLCAN 818) Molecular Mechanisms of Oncogenesis - See MOLCAN 818

PHARM 847S Seminar in Toxicology – (ENVIRON 847S-01 - required class for certificate). A weekly research seminar throughout the year is required of participants in the Toxicology Program, but open to students in related fields as well. Students, faculty and invited national speakers present their latest research findings concerning neurotoxicology, molecular biology, teratology, environmental toxicology, public policy of environmental regulation and related fields. *F 12N-1:30 pm; Meyer; Field Auditorium, Environment Hall or B101; 1 Unit.*

STRUCTURAL BIOLOGY & BIOPHYSICS:
http://sbb.duke.edu

SBB 546S SBB Seminar. Required of all SBB certificate students. Each week a student presents a paper on their research. Attendance is open to all graduate students, faculty and postdoctoral students who have an interest in structural biology.

SBB 658 (BIOCHEM 658) Structural Biochemistry I - See BIOCHEM 658

SBB 659 (BIOCHEM 659) Structural Biochemistry II - See BIOCHEM 659

SBB 681 (BIOCHEM 681) Physical Biochemistry – A structure-based introduction to the role of thermodynamic driving forces in biology. An overview of experimental sources of structural and dynamic data, and a review of the fundamental concepts of thermodynamics. Both concepts are combined to achieve a structural and quantitative mechanistic understanding of allosteric regulation, and of coupled ligand binding and conformational change. Statistical thermodynamics is used to develop ensemble models of protein and nucleic acid dynamics. This treatment leads into specific examples and general principles of how to interpret structural and dynamic information toward the purposes of other research. Instructor consent required*. TuTh, 10:05-11:20 am; Oas; 147 Nanaline Duke Bldg; 3 Units*

SBB 682T Advanced Physical Biochemistry - Transient kinetics, computational methods, multi-dimensional NMR, x-ray crystallography, thermodynamics of association. Prerequisite: Consent of instructor. *Oas; TBA; 3 Units*

UNIVERSITY PROGRAM IN GENETICS AND GENOMICS
http://upg.duke.edu

UPGEN 659 / BIOCHEM 659 Structural Biochemistry II - See BIOCHEM 659

UPGEN 658/ BIOHEM 658 Structural Biochemistry 1-See BIOCHEM 658

UPGEN 701 Advanced Topics in Genetics and Genomics - This course is open only to first year UPGG graduate class. Weekly discussion of current literature in genetics (Fall semester) and genomics (Spring Semester). This is course is meant to fill two objectives. The first objective is to ground each of the members of the UPGG first year class, regardless of their interest, in the two areas of focus of the program - namely, genetics and genomics. The second objective is to facilitate interactions among the diverse student body by bringing the class together once a week for discussion. *W 4:00-6:00 Instructor TBA*; Location TBA
3 units

Courses for Fall 2018

Master List 4/5/18

UPGEN 711 (BIOLOGY 701) - Succeeding in Graduate School in the Biological 0Sciences- Weekly lecture and Q&A on choosing a thesis advisor, the grant proposal and scientific manuscript peer review processes, and other topics related to succeeding in graduate school. Also counts for RCR credit. Minicourse, 1st half-semester. *W 12:00-1:00PM; Noor; LSRC A247; 0.5 Units*

UPGEN 712 (BIOLOGY 702) - Succeeding Beyond Grad School: Career Options with a PhD in the Biological Sciences - Weekly lecture and Q&A on alternative careers in the biological sciences, preparing job applications, and other topics related to succeeding beyond graduate school. Also counts for RCR credit. Minicourse, 2nd half-semester. *W 12:00-1:00PM; Noor; LSRC A247; 0.5 Units*

UPGEN 702 Scientific Writing (Writing Grant Proposals) - This course is for students interested in learning tools for writing grant proposals. (Same Class Content as MGM 702 Scientific Writing) *MWF 8:45 -9:35 am; Location TBA; Marchuk; 3 units*

UPGEN 716 Genetics Student Research - Presentations by genetics students on their current research. Required course for all graduate students specializing in genetics. Credit grading only. *F 4:00-5:30 pm; MacAlpine 001 Location TBA; 1 Unit*

UPGEN 750 Genetics Colloquium - Lectures, discussion sections, and seminars on selected topics of current interest in genetics. Required of all students specializing in genetics. *Tu 12:30-1:30; Steve Haase; 147 Nanaline Duke Bldg; 1 Unit*

UPGEN 778A-F Genetic Approaches to the Solution of Biological Problems (MGM 778) UPGEN 778A-F are six mini-courses offered sequentially during the fall semester and together cover 23 topics. These courses are part of the core offerings of the University Program in Genetics and Genomics and allow maximum flexibility for a student-designed curriculum. Multiple topics are available during each mini-course and students choose one. The topics address everything from fundamentals of genetics to modern molecular genetic and genomic strategies for the analysis of a variety of biological systems. Each mini-course consists of six classes. *MWF 2:00-3:30 pm; Daniel Lew; Multiple locations TBA; Full list of topics available at* https://upg.duke.edu/current-students/courses 6 *Units*