Albert Einstein College of Medicine

Graduate Programs in the Biomedical Sciences

COURSE CATALOG

Fall 2022 Block I

Fall 2022 Courses

Block I

Subject to change

BIOS 7001 – Biochemistry

COURSE LEADER:
Jonathan R. Lai, PhD

COURSE DESCRIPTION:
This is an introduction to fundamental topics in biochemistry and physical biochemistry. Topics include: protein structure, folding, and function, nucleic acid structure and protein-DNA interactions, enzymology, energetics & allostery, posttranslational modification of protein function, transcription, translation, and DNA replication. The material is presented in formal lectures in conjunction with a protein/nucleic acid structure-based tutorial.

COURSE OBJECTIVES:
The goal of this course is to educate students on the fundamentals of biochemistry including protein and nucleic acid structure, enzymology, and DNA replication, transcription, and translation. In addition, students will learn how to interpret and manipulate protein and nucleic acid structures.

PREREQUISITES:
One semester of undergraduate biochemistry and a course in organic chemistry are required. Undergraduate physical chemistry is also helpful preparation. Students who are uncertain about the adequacy of their undergraduate training for this course should discuss the issue with their advisory committee and then consult the course leader. Students should be familiar with the general principles of biochemistry including basic knowledge of amino acid and nucleic acid structure. They should also be familiar with general principles such as DNA replication, transcription and translation. All students who want to register for Graduate Biochemistry must complete the assessment exam during Orientation Week.

REQUIRED MATERIALS:
Biochemistry, 4th Edition, D. Voet and J. G. Voet. ISBN 978-0470570951

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
There are three closed-book exams (2 hours each) administered throughout the Block worth 30% each. In addition, 10% of the grade will be based on tutorials for nucleic acid/protein structure.

CREDIT HOURS: 5.0

BIOS 7026 – Introduction to Systems Biology

COURSE LEADER:
Aviv Bergman, PhD

COURSE DESCRIPTION:
By means By means of biological case studies we will cover a broad range of relevant techniques from mathematical, statistical, and computational sciences. In this course we will introduce computational and simulation platforms that the students will build upon as the course progresses. By the end of the course we expect all students to have attained a substantial programming proficiency. The main aim of this course is to provide the students with the means to move beyond quantitative techniques for descriptive purposes alone, towards making biologically relevant predictive models.
The course offer the student with the knowledge of the computational platform Matlab and R, and their usage in modeling biological processes.

COURSE OBJECTIVES:
The course is a set of lectures each delivered by a different faculty member of the department. It covers topics ranging for statistical analysis using the computational platform R, through set of lectures of bioinformatics (broadly defined) and exposure to Python. Other topics include Computational Neuroscience, Ecology of Microbiome, Multi-level modeling and Theoretical Evolution.
All the topics presented are aimed at inspiring individuals to engage, self-learn topics of interest and engage with the material presented.

PREREQUISITES:
Quantitative background encouraged
Preferred prerequisite (not required) Calculus, Linear Algebra, Differential Equations and Stochastic Processes. Also, background in computer programing such as C/C++ or any other programming language as well as biostatistics is desirable.

REQUIRED MATERIALS:
Laptop computer is required for classroom work

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
Grading is based on class participation and writing summary articles for 4 of the topics presented.

CREDIT HOURS: 3.0

BIOS 7006 – Molecular Genetics

COURSE LEADER:
Nicholas E. Baker, PhD

COURSE DESCRIPTION:
The course is designed to convey genetic concepts and their application in a diverse set of model systems. It will allow students to understand and critically evaluate the literature. The course is divided in to three sections. In the first section, students will briefly review basic genetic concepts. This part is followed by a discussion of yeast and bacteria as genetic models and their use in high throughput and classical biochemical approaches. In the second section, students will learn about the major vertebrate systems, including human genetics, mouse genetics, and zebra fish genetics. The third section is dedicated to invertebrate genetics (including worms and flies) as well as to a discussion of special aspects of cancer genetics. Overall, this course should convey graduate level genetics in all its modern facets and constitute the foundation for more advanced studies.

COURSE OBJECTIVES:
A comprehensive syllabus includes a brief introduction and an overview of all major model organisms currently in use for research. The goal of this course is to provide an overview over modern genetic methods and approaches using both classic and modern examples and to convey the possibilities and contributions of the field of Genetics to the understanding of biological processes.

PREREQUISITES:
Undergraduate genetics is required

REQUIRED MATERIALS:
Computer

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
Passing grade is usually 60%. There are exams after each section of the course. The first and second exam count for 30% each and the third exam for 40%.

CREDIT HOURS: 5.0

BIOS 5015 – MSTP Pharmacology-Physiology-Pathology

COURSE LEADER:
Myles Akabas, MD, PhD

COURSE DESCRIPTION:
This course will material included in the medical school MCFM-2A module at a more scientifically rigorous level. The MCFM-2A module includes content in pharmacology, physiology, and pathology. The pharmacology section of the course will focus on pharmacokinetics, pharmacodynamics, exemplar drug classes, and drug development. The physiology section will focus on the molecular and cellular basis of muscle contraction comparing the contractile processes and regulation of contractile strength in skeletal, smooth, and cardiac muscle. The pathology section will cover three topics, 1) cell injury and death, 2) cell repair and adaptation, and 3) aging.

COURSE OBJECTIVES:
The course has three major objectives.
1) Students should understand the processes of drug absorption, distribution, metabolism, and excretion and the general approaches to drug development.
2) Students should understand the mechanisms of contraction and the, control and regulation of muscle contraction in smooth, skeletal, and cardiac muscle.
3) Students should understand the cellular responses to injury, repair, cell death, and the effects of aging on cellular processes.

PREREQUISITES:
One year of undergraduate physics, biology, chemistry, organic chemistry/biochemistry, and mathematics. Completion of the MSTP Physiology: Membranes & Transport course.

REQUIRED MATERIALS:
Chapters from relevant textbooks and journal articles will be provided via the Canvas course website.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes; required for 1st year MSTP students

STUDENT ASSESSMENTS:
There will be three assessments, one for each section of the course. They will be completed as open book quizzes, followed by in class small group discussions of the problems, and then discussion of the answers by the entire class. Each assessment will be worth 30% of the grade, and students will get 10% based on class participation. Passing will be based on demonstration of understanding the material covered in the course.

CREDIT HOURS: 1.0

BIOS 7406 – Principles of Neuroscience I

COURSE LEADER:
Bryen A. Jordan, PhD **|** Alberto E. Pereda, MD, PhD

COURSE DESCRIPTION:
Principles of Neuroscience I is a highly-interactive 13-week course required for students in the Department of Neuroscience. The course offers a multidisciplinary approach to the study of the nervous system from first principles with a focus on the molecular and cellular basis of brain function. Topics include fundamental principles underlying neuronal excitability, mechanisms of electrical and synaptic neurotransmission, the cells of the brain and their role in neurotransmission, and the architecture of the central nervous system. The class format consists of a combination of formal and informal lectures and student presentations with a major emphasis on interactive class discussion. The course requires active student participation during the class and offers review sessions if needed. This course makes significant use of the Canvas online discussion forum, where assignments are often given to expand on topics covered in class. In addition to normal course scheduled lectures, the course includes lab visits and students are also required to prepare and present at a symposium on a specific topic and to attend the weekly Neuroscience Seminar Series.

COURSE OBJECTIVES:

1- Understand the chemical and electrical principles that lead to neuronal excitability

2- Understand the principles that underlie neurotransmission, and understand how non-neuronal cells support this process

3- Understand the molecular and cellular mechanisms the give rise to neurotransmission, and how input leads to short and long-term changes in neuronal function

PREREQUISITES:
None

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
Attendance and class participation, 25%; presentations 25%; final exam 50%. The Final Exam must be passed to pass the course. However, this is not sufficient. Active participation in class and well-prepared presentations will also be assessed and considered for passing. Students who are not sufficiently participating will be informed by the course leaders to provide them with the opportunity to increase their class participation.

CREDIT HOURS: 6.0

BIOS 7010A – Quantitative Skills for the Biomedical Researcher I

COURSE LEADER:
Ryung S. Kim, PhD **|** Jee Young Moon, PhD

COURSE DESCRIPTION:
Topics covered will include introduction to probability, discrete and continuous probability models, sampling distributions, the central limit theorem, confidence intervals, and hypothesis testing. While computing is not one of the main learning outcomes, the students will be briefly introduced to the statistical programming language R.

COURSE OBJECTIVES:
This 3-week course aims to acquaint students with the fundamental concepts of biostatistics, applications of basic methods, and their interpretation.

PREREQUISITES:
All students are expected to have basic computer skills and college mathematics. Although not required, we highly recommend those without R experience to attend Beginning R workshop (2 sessions, each 1.5 hours) the week before QSBR 1.

REQUIRED MATERIALS:
No Textbook required; Computer with R freeware installed.

Statistical Software: You will use the statistical software R. The core learning outcomes of the course are conceptual and are *not* related to the software. You are not going to need the software for the exam.
Recommended Textbooks: These books are not necessary for the course but they may be helpful resources for your research.

- Marcello Pagano and Kimberlee Gauvreau, *Principles of Biostatistics* (2^{nd} Edition) ISBN-13: 978-0534229023, ISBN-10: 0534229026.
- Bernard Rosner, *Fundamentals of Biostatistics* (8th Edition) ISBN-13: 978-1305268920; ISBN-10: 130526892X

SUITABLE FOR 1ST YEAR STUDENTS:
Not recommended; permission from course leader required if seeking to take this course in the first year.

STUDENT ASSESSMENTS:
Course grade will be based on homework (20%), and an exam (80%).

CREDIT HOURS: 1.0

BIOS 7010B – Quantitative Skills for the Biomedical Researcher II

COURSE LEADER:
Qian (Kenny) Ye, PhD

COURSE DESCRIPTION:
In QSBR I, the focus is on the basic concepts of statistical inference, especial the idea of quantifying the uncertainty of estimation and reasoning of hypothesis testing. In QSBR II, we will apply the basic concepts of statistical inference to explore relations between two or more variables, and the focus of the teaching will shift from basic concepts towards the art of data analysis. Below are a few things that might help you do well in learning statistics.
The best way to learn statistics is to apply your own common sense and reasoning, and applying statistical methods to real problems encountered in your research.
Although math plays an important role in statistics, for the vast majority of biomedical researchers, it is more important to understand what a particular statistical method tries to do than to know the details of the mathematical formula and computational algorithms. In other words, you want to have the big pictures before getting into the details. Mathematics mostly serves the purpose of justifying our common sense and enabling us to handle complicated problems.
For data analysis, it is often much more important to make sense of the data using a variety of visualization tools before describing them with numbers and statistical models.
We will also use software R in this module. It is used mainly for

1. visualizing the data
2. numerical simulation to help understand statistical methods
3. perform some modern statistical computational methods.

Topics to be covered:

- Fisher Exact Test and Hypothesis Testing
- Chi-square Tests + R session
- Correlation and Linear Regression
- Regression Diagnostics
- One-Way ANOVA + R session
- Two-Way ANOVA and Statistical Interactions
- Permutation tests (Bring your laptops to the classroom)
- Logistic Regression + Extra R session
- (Possibly) Repeated Measure and Random Effect Model

COURSE OBJECTIVES:
Build your confidence in understanding and using at least some statistical methods that are not taught in this course when you need them in your future research.

PREREQUISITES:
Quantitative Skills for the Biomedical Researcher I or equivalent.

RECOMMENDED MATERIALS:

- Peter Dalgaard: *Introductory Statistics with R*. ISBN-13 978-0387790534
- Robert Elston: *Basic Biostatistics for Geneticists and Epidemiologists.* ISBN-13: 978-0470024904; ISBN-10: 0470024909

SUITABLE FOR 1ST YEAR STUDENTS:

Not recommended; permission from course leader required if seeking to take this course in the first year.

STUDENT ASSESSMENTS:

50% Homework and 50% on Final Exam

CREDIT HOURS: 1.0

BIOS 7010C – Quantitative Skills for the Biomedical Researcher III

COURSE LEADER:
Kith Pradhan, PhD

COURSE DESCRIPTION:
This course will cover the statistical principles that are pertinent to the study of big–omic data sets being collected in biology. Students will learn about current statistical approaches, issues related to experimental design and reproducible research, and important case studies that illuminate some of the challenges of analyzing big data. This course is the third module of the Quantitative Skills for the Biomedical Researcher series, and builds upon the material covered in the first two modules. As part of the assessment, students will gain practical experience by conducting a mini big data research project while working in small teams.

COURSE OBJECTIVES:
Students will be taught practical skills to conduct big data analysis and understand the challenges/limitations of this field.

PREREQUISITES:
It is expected that students will have completed Quantitative Skills for the Biomedical Researcher I and II, or have acquired this material through other means (please consult the course leader if in doubt). Programming skills in R is mandatory. All students are expected to have a working knowledge of basic computers and college mathematics.

RECOMMENDED MATERIALS:
Principles of Biostatistics (Second edition) by Marcello Pagano and Kimberlee Gauvreau, ISBN-13: 978-0534229023, ISBN-10: 0534229026; Laptop with R freeware installed.

SUITABLE FOR 1ST YEAR STUDENTS:
Not recommended; permission from course leader required if seeking to take this course in the first year.

STUDENT ASSESSMENTS:
Final project (100%).

CREDIT HOURS: 1.0

BIOS 7020A – Responsible Conduct of Research – Advanced

COURSE LEADER:
Victoria H. Freedman, PhD

COURSE DESCRIPTION:
The National Institutes of Health (NIH) requires that all pre-doctoral and post-doctoral trainees receive training in the responsible conduct of research at a frequency of no less than every four years. This advanced course in the responsible conduct of research is for the more experienced (5th year) graduate students and postdocs. (All pre-doctoral and post-doctoral trainees are required to take the first instance of the RCR course in year one of training.)
This advanced course will cover the following topics:

- Overview of RCR and Policies
- Data Management Practices and Problems
- Mentor and Trainee Responsibilities and Relationship Issues
- Authorship and Publication – Balancing Expectations and Realities; Strategies for Success

This is a four-week course. The first session will be a general overview and review of institutional, professional and national policies. The other three sessions will include a 40-45 minute-lecture followed by small breakout group sessions (1 hour) to review scenarios and problem-based case studies.
This course fulfills an NIH retraining in RCR requirement and is *required for PhD students and post-doctoral fellows in the 5th year of training.*

PREREQUISITES:
1st year Responsible Conduct of Research

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

SUITABLE FOR 1ST YEAR STUDENTS:
No

STUDENT ASSESSMENTS:
To satisfy this advanced course, attendance at every session (lecture and breakout) is required. Missing a session (due to illness or professional travel) will require the submission of a make-up assignment in order to satisfactory complete the course.

CREDIT HOURS: 0.5

CLRM 5820 – Epidemiologic Research Methods

COURSE LEADER:

H. Dean Hosgood, PhD

COURSE DESCRIPTION:

This course focuses on the analytical issues of epidemiological studies: biases, confounding, interaction, and statistical methods used in case-control and longitudinal studies. In-class exercises will reinforce these concepts. Students are expected to know the basic design issues of retrospective and prospective studies as well as clinical trials from the Clinical Research Intensive course.

PREREQUISITES:

Clinical Research Intensive (summer course).
Students are expected to know the basic design issues of retrospective and prospective studies as well as clinical trials from the Clinical Research Intensive course.

REQUIRED MATERIALS:

Moyses Szklo & F. Javier Nieto: Epidemiology: Beyond the Basics. 3rd Edition, Jones & Bartlett Publishers, Sudbury, Massachusetts, 2012. ISBN-13: 9781449604691; ISBN-10: 1449604692. Available online through the Einstein Library. To access the e-book you must be at Einstein or have remote access to the Library.

SUITABLE FOR 1ST YEAR STUDENTS:

No

STUDENT ASSESSMENTS:

In-class exercises/class participation 50%, Mid-term test 25%, Final Exam 25%

(CLOSED REGISTRATION) LIMITED TO 15 STUDENTS NEED APPROVAL FROM PROGRAM DIRECTOR-DR. AILEEN MCGINN (PICK UP COURSE REGISTRATION FORM IN THE GRADUATE OFFICE)

CREDIT HOURS: 3.0

CLRM 5860 – Multivariable Regression

COURSE LEADER:
Aileen P. McGinn, PhD

COURSE DESCRIPTION:
Multivariable Regression builds on the knowledge of univariate and bivariate analyses that were learned in the Clinical Research Intensive course and introduces concepts related to multivariable model building for multiple linear regression, logistic regression and survival analysis. Both the lecture and the lab will focus on multiple regression model building, interpretation and diagnostic tests, assessing for interaction, and statistical adjustment for confounding.

COURSE OBJECTIVES:

- To learn the basics and applications of multivariable regression in assessing associations between exposure/explanatory variables and various forms of outcome variables.
- To use Stata software to conduct multivariable regression and be able to interpret results from the application of these modeling techniques.

REQUIRED MATERIALS:

- Regression Methods in Biostatistics. *Vittinghoff et al*: ISBN-13: 9781461413523; ISBN-10: 1461413524
  NOTE: this textbook is available online via the Einstein Library as a pdf
- *Primer of Applied Regression and Analysis of Variance*. *Glantz & Slinker*. ISBN-13: 9780071360869; ISBN-10: 0071360867. NOTE: available for loan via the CRTP Library—please see Nancy Marte in Block 506
- Applied Logistic Regression by David W. Hosmer, Stanley Lemeshow & Rodney X. Sturdivant (3rd edition). ISBN-13: 9781118548356; ISBN-10: 1118548353. NOTE: this textbook is available online via the Einstein Library as a pdf
- Survival Analysis: A Self-learning Text by David Kleinbaum and Mitchel Klein (3rd edition). ISBN-13: 9781493950188; ISBN-10: 1493950185. NOTE: this textbook is available online via the Einstein Library as a pdf

PREREQUISITES:
Clinical Research Intensive; Students are expected to know the material covered in Clinical Research Intensive, including univariate and bivariate statistical analyses and basic epidemiological study designs.

SUITABLE FOR 1ST YEAR STUDENTS:
No. Closed registration: limited to students on the PCI track

STUDENT ASSESSMENTS: Class Participation 10%, Homework 30%, In-class quizzes 15%, Take home exams 45%

CREDIT HOURS: 5.5