BIOCHEMISTRY AND MOLECULAR BIOLOGY (BMB)

BMB 145. Introduction to BMB Research. 2 Credit Hours.
Students will collaborate on a research project and learn valuable laboratory skills. The goal for this course is to make students "research-ready" through an active, inquiry-based, platform for developing core competencies in biology, genetics, BMB (biochemistry & molecular biology), bioinformatics, scientific discourse and ethics.
Components: LAB.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 245. Foundations in BMB Research. 2 Credit Hours.
Students shadow a research assistant in the lab of a BMB faculty member and learn about the research projects and techniques used by the group. Students will assist in preparing reagents, conducting experiments, analyzing data and generating brief reports. Attendance in lab group meetings is expected. Students maintain a weekly online journal and will write a paper describing the research in the lab and proposing a research problem and approach to solve in BMB545.
Components: LAB.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 401. Biochemistry for the Biomedical Sciences. 4 Credit Hours.
The biochemical composition, structure, and cellular metabolism of proteins, carbohydrates, lipids, and nucleic acids are rigorously described, emphasizing problem solving strategies required of biomedical field applications.
Prerequisite: CHM 222 And with a grade of C- or higher.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 402. Principles of Experimental BMB. 2 Credit Hours.
An active, inquiry-based, platform for developing core competencies in biochemistry & molecular biology, making students "research ready".
Corequisite or Prerequisite: BMB 401.
Components: LAB.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 411. Readings in BMB. 1 Credit Hour.
Students read and discuss one BMB primary research article each week and answer a set of questions meant to provoke critical evaluation of the work. The course introduces students to critical reading of the primary literature in BMB and is open to students at any level. Peer-mentoring and informal student-led instruction is central to the course.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 417. Metabolic Regulation. 3 Credit Hours.
Students will learn to formulate mechanisms of enzyme catalysis and inhibition. Next, students will learn how to plot and analyze enzyme kinetic and binding data. Data analysis will be extended to more complicated, but realistic scenarios, to more rigorously examine metabolic flux control points.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 501. Senior Seminars. 1 Credit Hour.
Students attend seminars of their own choice, presented by either visiting/residing faculty or graduate/postdoctoral students on recent research topics in BMB or any other discipline in the basic biomedical sciences. Students write short reports on these seminars and critically evaluate the presentations. This course can be taken more than once.
Prerequisite: BMB 401.
Components: SEM.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 506. Biomedical Case Studies. 1 Credit Hour.
Students explore topics in BMB in the context of solving problems presented in a clinical/biomedical framework. Students work in small groups and independently to acquire, critically evaluate, synthesize and present information.
Corequisite or Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 507. Protein Structure, Function and Biology. 3 Credit Hours.
The physical characteristics and behavior of proteins are described, including structure, folding, dynamics, modifications, and interactions. In addition, experimental approaches to protein structure and function are addressed. Readings include both textbook assignments and current research articles, and a term paper is written and submitted for writing credit.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 509. Molecular Biology of the Gene. 3 Credit Hours.
Biochemical processes involved in the flow of genetic information in both prokaryotes and eukaryotes are described, including DNA replication, repair, genetic recombination, RNA transcription and processing, protein synthesis, control of gene expression, cell differentiation, and recombinant DNA technology. Extensive classroom discussion is mandatory. Reading includes BMB primary research papers, course notes and a textbook.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 511. Topics in BMB. 3 Credit Hours.
Students independently explore the literature in BMB with guidance by a BMB Faculty mentor. BMB primary research literature in an area of mutual interest to the student and the Faculty mentor (usually a content expert in that area) is discussed. Students prepare a paper or other appropriate product (e.g. computer software, a structural model, a dynamic simulation) for evaluation. Writing credit is available for papers.
Prerequisite: BMB 401.
Components: IND.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 514. Genetics and Genomics: Principles, Mechanisms, and Use. 3 Credit Hours.
The quantitative and analytical problem solving, as well as spatial reasoning in genetics. The course will propose genetic hypotheses, identify genetic predictions, create genetic systems for challenging these predictions, and analyze genetic data to solve practical problems.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 518. Nanomedicine. 3 Credit Hours.
Students will learn how various nanomaterials are synthesized, characterized, and utilized in various medical applications, including imaging, drug delivery, gene therapy, and tissue engineering. Student abilities to read and comprehend advanced research topics and applications in nanotechnology and applications to medicine will be considerably enhanced.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 519. Epigenetics and Nutrition. 3 Credit Hours.
How epigenetic mechanisms control gene expression and (ii) how epigenetic modifications are propagated. Then, students explore how such epigenetic control and inheritance can be modulated through diet and nutrition. Class participation and attendance are required, since in class discussion will be largely based on emerging and late-breaking topics from recent literature.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 521. Molecular Pathology and Clinical Diagnostics. 3 Credit Hours.
Basic science principles underlying development, testing, and utilization of biosensors, including various examples of glucose monitoring, immunoassays, and gene expression analyses. Particular attention will be focused towards clinical use and validation. Late-breaking technological aspects of microfluidics will be central to all applications.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 545. Research Problems in BMB. 3-12 Credit Hours.
Participation in the research laboratory of a faculty mentor to work on an independent research project. Students develop abilities to formulate good questions and sound hypotheses, design practical experiments, collect and analyze useful data, and make justifiable conclusions. Students maintain a weekly online journal, write a paper, and present their research in the lab. Two semesters of BMB 545 are required to write a thesis (pre-requisite for graduating with honors in BMB).
Components: LAB.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 555. Cellular Structure, Function, and Biology. 3 Credit Hours.
Students learn composition and function of cellular organelles, and closely examine their biogenic and degradative pathways. Next, students learn cell signaling pathways and mechanisms controlling mitosis, meiosis, and cytokinesis that account for inherited traits. Studies of the molecular basis of cell-cell and cell-matrix interactions provide students with better understanding of tissue stability and function. Modem perspectives regarding stem and cancer cell biology are explored, along with new cell-based therapeutic strategies.
Prerequisite: BMB 401.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 601. Research Journal Club. 1 Credit Hour.
All MS students must participate in the BMB Journal Club course. In this course, pre-doctoral trainees are required to critically review published paper(s) of their choice in the BMB topic area in Fall semester and present their research findings in Spring semester. The MS students will participate in this course and will write summary of the presentation.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 602. BMB Graduate Research Seminars. 1 Credit Hour.
The Biochemistry and Molecular Biology (BMB) department has an active seminar program that meets every Friday at noon. In this program seminars are presented by the BMB faculty (primary and secondary), invited speakers within the University of Miami, and from other Universities, government agencies, and industry. Topics presented cover many aspects in the field of biochemistry and biomedical sciences. All BMB Graduate Students enrolled in this course will be required to attend seminars and engage in informal interactions with speakers, allowing for discussions and exchanging of ideas on seminar day.
Components: SEM.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 605. Principles of Biochemistry and Molecular Biology. 3 Credit Hours.
This course is divided into three parts. Part 1, examine the biochemical composition and structure of the four basic types of biological macromolecules: (i) carbohydrates, (ii) nucleic acids, (iii) proteins, and (iv) lipids. In addition, students will learn the composition and function of dietary nutrients and vitamins. Part 2, study how genetic information flows from its storage as DNA sequence to its expression as functional RNA and protein molecules. A particular emphasis will be towards understanding control of gene expression by various epigenetic and signaling mechanisms. Part 3, learn how metabolic pathways are used to convert food molecules into energy and chemical intermediates used for biosynthesis of our own cellular materials.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 610. Advanced Topics in Biochemistry and Molecular Biology. 3 Credit Hours.
This is a special-topics course for graduate students and advanced undergraduate students. This course will focus on nanotechnology and its applications in medicine. This course offers an introductory concept of an interdisciplinary field of nanotechnology for students with physical, chemical, biological, medical, and engineering background. This course will be focused on nanomaterials, engineering of nanomaterials, cellular and intracellular interactions of nanoparticles, nanotechnology-based drug delivery systems, nano-based diagnosis, nanotoxicology, and clinical translational aspects of nanomedicines. Unique properties, which are offered by the materials at the nanoscale, will be discussed. Nanotechnology in sensing and diagnostics will be discussed. The topics to be discussed are of considerable interest across a broad range of areas in medicine, chemistry, biology, physics, pharmacy, medicine, mathematics, and engineering.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 612. Medical Genetics. 3 Credit Hours.
This course will provide the learner with greater knowledge and current understanding the human genome, the mechanisms by which variations and environmental factors contribute to human phenotypes. Examples of potential topics include chromosome aberrations, phenotype-genotype correlations, cytogenetics, multifactorial traits, population genetics, risk assessment, multi-generation Epigenetics, reprogramming and gene therapy. Importantly, students will learn the new developments in Epigenetics. Epigenetics is considered by many to be the "new genetics". The effects of epigenetics are vast
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 614. Molecular Genetics. 3 Credit Hours.
There are 4 major sub-disciplines of genetics. This course will focus on the first three and leave assessment of quantitative traits as needed for students work. The sub-disciplines include, 1. transmission genetics: basic principles of genetics and how traits are passed from one generation to the next. 2. Molecular genetics: the chemical nature of genes and genomes; how genetic information is encoded, replicated, and expressed. It includes the cellular processes of replication, transcription, and translation - by which genetic information is transferred from one molecule to another – and gene regulation - the processes that control the expression of genetic information. 3. population genetics: the genetic composition of groups of individual members of the same species and how that composition changes over time and geographic space, and 4. quantitative genetics: deals with phenotypes that vary continuously (in characters such as height or mass) – as opposed to discretely identifiable phenotypes and gene-products (such as eye color, or the presence of a particular biochemical).
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 615. Structural Biology and Applications to Drug Discovery (Masters). 2 Credit Hours.
This course provides an introduction to structural biology and illustrates how understanding the relationship between structure and function of biological macromolecules drives drug discovery. The course will be in three parts, with the first covering experimental and computational tools of structural biology – X-ray crystallography, cryo-electron microscopy and molecular modeling. The second part of the course will look at examples where structural biology has influenced drug design. The final part of this course will look at structures of nucleic acid (DNA and RNA) binding proteins and how they inform drug discovery.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 616. Basis of Mitochondrial Medicine. 2 Credit Hours.
Overall, the course aims to integrate basic knowledge in mitochondrial structure and function with our current understanding of the role mitochondria play in human health and disease. The first part of the course provides a core introduction to the major aspects of mitochondrial biology, including mitochondrial metabolism, genetics and biogenesis. The second part of the course focus on the role of mitochondrial and metabolic dysfunction in specific human disorders.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 618. Scientific Communications & Journal Review. 1 Credit Hour.
This course will train students in how to communicate science to different audiences. The lectures will focus on training students on how to make effective power point and poster presentations. Lectures will also guide on how to write manuscripts and grant applications. Training in data science as well as patents and inventions will be provided. Students will get understanding on academic career. Each student will prepare presentation on their research and will be guided by the instructor on how to improve it.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

BMB 619. Epigenetic Control of Gene Expression. 4 Credit Hours.
This course will provide thorough understanding of Epigenetics and the interaction of nutrients and the epigenome. Epigenetics is considered by many to be the new genetics because of the overwhelming evidence of the contribution of non-genetic factors such as nutrition, environment, and chemical exposure on gene expression. The effects of epigenetics are vast, including tissue/organ regeneration, X-chromosome inactivation, and stem cell differentiation and genomic imprinting and aging. Aberrations of epigenetics influence many diseases for which clinical intervention is already in place, and many novel epigenetic therapies for cancer, immune disorders, neurological and metabolic disorders, and imprinting diseases are on the horizon.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 620. Molecular Pathology and Clinical Diagnostics. 3 Credit Hours.
After completing this course, students will overall be able to better read and comprehend advanced topics in clinical diagnostic, molecular pathology, and biochemical methods and techniques used in designing diagnostics tests.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 621. Clinical Diagnostics and Biosensors. 3 Credit Hours.
This course will focus on training students in diagnostic methods and the fundamentals and design of biosensors that are used in clinical diagnostics. Several biosensors are currently in use in diagnostic applications. They range from glucose sensors to PCR-based pathogen detection. The topics covered in this course will give students background on how these biosensors are designed, what are the biological recognition elements used, how to design portable platforms, what characteristics are needed for clinical use, how to use it, etc. An example of the target such as glucose, COVID-19, blood chemistry, will be used to explain constructions and fundamentals of biosensors. A background on recombinant DNA methods and protein chemistry, reporter probes, biological recognition elements, miniaturized analytical devices, point of care diagnostics. immunoassays, nucleic acid sensing, etc. will be covered in the course. The course will also cover culturing methods and detection of heavy metal in clinical samples. The topics covered in this course train students in multi-disciplinary fields including biochemistry, medicine, diagnostics, chemistry, and biology.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 630. Research in Biochemistry and Molecular Biology I. 1-9 Credit Hours.
This will form the most significant portion of the MS student's degree program. Students will perform research with a mentor that they choose depending upon their research interest. A committee consisting of 3 faculty from the graduate program will be formed to evaluate student for the final oral comprehensive examination. The final oral exam will be scheduled in the last semester of the study. This oral comprehensive exam will involve the review of all experimental data and the entire presentation. During the examination, the mentor is responsible for allotting appropriate time for questions by all participants. Students are expected to understand the significance of their findings, display adequate knowledge of the relevant literature and know the theory and limitations of methods employed. Students must demonstrate the ability to independently design, execute and interpret original experiments. This group will make a decision to pass or fail a student's oral comprehensive exam.
Components: RSC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 633. Capstone project in Biochemistry and Molecular Biology. 1-3 Credit Hours.
This course will help students learn how to prepare presentations as well as write reports and publications. Students will also learn about the latest advances in the biochemistry field and upcoming topics of interest to the field to help them prepare for their careers. Students will write a report-based on the industrial internship. They will also prepare a presentation about the work performed. The students' mentor/course instructor will provide guidance as needed in writing the report and presentation.
Components: THI.
Grading: SUS.
Typically Offered: Offered by Announcement Only.

BMB 634. Research in Biochemistry and Molecular Biology II. 1-9 Credit Hours.
BMB 634 is a continuation of the 15-credit course requirement for completion of the Master of Science in Biochemistry and Molecular Biology. The overall goal of the BMB research is to provide students with an opportunity for hands-on exposure to scientific research and mentorship. (Required-fall, spring and summer)
Prerequisite: BMB 630.
Components: RSC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 635. Research In Biochemistry and Molecular Biology III. 1-9 Credit Hours.
BMB 635 is a continuation of the 15-credit course requirement for completion of the Master of Science in Biochemistry and Molecular Biology. The overall goal of the BMB research is to provide students with an opportunity for hands-on exposure to scientific research and mentorship. (Required-fall, spring and summer)
Prerequisite: BMB 630 And BMB 634.
Components: RSC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 641. Essentials of Biotechniques I & II. 3 Credit Hours.
Students will be introduced to variety of techniques used in biotechnology research. The course will be a combination of lectures and hands-on technique experience. The course will teach students both traditional and new techniques used in BMB.
Components: LAB.
Grading: GRD.
Typically Offered: Fall.

BMB 642. Essentials of Biotechniques II. 3 Credit Hours.
Students will be introduced to variety of techniques used in biotechnology research. The course will be a combination of lectures and hands-on technique experience. The course will teach students both traditional and new techniques used in BMB.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 644. Independent Studies in BMB Scientific Research. 1-6 Credit Hours.
The overall goal of the BMB research is to provide students with an opportunity for independent learning with exposure to scientific research. Students in this course may conduct individual projects focused on research, literature review, or extension/enhancement of other coursework. All work is conducted under supervision and evaluation of a departmental faculty member. Departmental approval is required prior to enrollment.
Components: IND.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 680. Responsible Conduct of Research. 1 Credit Hour.
In this course, ethical case studies are discussed, and an introduction to laboratory management is provided. Short lectures and discussion are conducted to provide students with the ability to tackle dilemmas and pitfalls associated with the responsible conduct of research. Information is provided on regulatory requirements of conducting research, including safety issues and the use of humans, animals, and radioactive/bio hazardous material. The obligations of scientists with respect to public policy and advocacy are also discussed. In addition, students will participate in an online RCR training course (RST-401/501/601 sections) offered by the Collaborative Institutional Training Initiative (CITI) Program at UM. A CITI Program RCR course typically requires around 4 hours to complete. These students receive an “S” (satisfactory) grade for a CITI RCR course after the completion of the online module. This online training course will serve as yearly continuation of RCR training after completion of the Research Ethics course. Additionally, every semester faculty in the department present a seminar related to topics in research ethics. Students also attend an online training in RCR. Several professional skills workshop such as grant writing workshop, career workshops, and seminars by professional scientists related to career are organized by the BMB department as well as the Office of Graduate studies. Students will attend these series of events.
Components: LEC.
Grading: SUS.
Typically Offered: Offered by Announcement Only.

BMB 701. Research Journal Club.. 1 Credit Hour.
All registered BMB students must participate in the Journal Club/Seminar. Stud ents are required to critically review published paper(s) of their choice and d escribe in detail the findings described therein. Senior students will present their own research.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 702. Biochemical Science Seminar. 1 Credit Hour.
The Biochemistry and Molecular Biology (BMB) department has an active seminar program that meets on every Friday at noon. In this program seminars are presented by the BMB faculty (primary and secondary), invited speakers within the University of Miami and from other universities, government agencies, and industry. All BMB Graduate Students enrolled in this course will be required to attend this seminar and and will have informal interactions with speaker, and exchange ideas at lunch on the seminar day.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 705. Principles of Biochemistry and Molecular Biology. 4 Credit Hours.
This course is divided into three parts. In Part 1, you will examine the biochemical composition and structure of the four basic types of biological macromolecules: (i) carbohydrates, (ii) nucleic acids, (iii) proteins, and (iv) lipids. In addition, you will learn the composition and function of dietary nutrients and vitamins. Most important, you will be introduced to nature's catalytic substances termed enzymes, paying special attention to their mechanisms of action and regulation. In Parts 2 and 3, you will learn how metabolic pathways are used to convert food molecules into energy and chemical intermediates used for biosynthesis of our own cellular materials. In Part 4, you will study how genetic information flows from its storage as DNA sequence to its expression as functional RNA and protein molecules. Here, you will give particular emphasis towards understanding control of gene expression by various epigenetic and signaling mechanisms. You are expected to finish this course with rigorous understanding of the biochemical composition, structure, and cellular metabolism of proteins, carbohydrates, lipids, and nucleic acids. This will enable you to read and understand advancing topics and applications in a vast array of biomedical specialties.
Components: DIL.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 707. Proteins-Structure, Function and Biology. 3 Credit Hours.
Proteins are the central functional macromolecules of life. This course surveys the structures, functions and biology of proteins with a strong structural perspective. The course has four modules. Module 1 covers the building blocks of proteins and how they come together to form intricate structures. Module 2 discusses practical methods to produce and characterize proteins, as well as contemporary experimental techniques to understand their 3D structure. Module 3 looks at the functions of proteins through the lens of enzymes. Finally, module 4 looks at proteins in biology – how they are made, folded, processed and modified in cells, and their diverse roles as switches, motors, membrane proteins, and large complexes. The course uses lectures and student presentations of 8-10 research papers to cover these topics. Students also write a short review on an assigned protein as a term paper.
Components: DIL.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 709. Advanced Biochemistry and Molecular Biology. 3 Credit Hours.
This course is a continuation course for BMB 616. It covers essentially the same topics as BMB 616 but at a more advanced level. It brings the student to the forefront of research in Molecular Biology. The course material is discussed exclusively in the form of original research papers. Based on this experience, students are required to propose experimental approaches to biological problems and defend them.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 710. Advanced Topics in Biochemistry and Molecular Biology. 1-5 Credit Hours.
This course is offered by various faculty members in the department on a rotating basis depending upon their expertise. For example, an advanced topic course in Nanomedicine offered by Dr. Deo and Dr. Dhar covers these topics through lectures.
Components: DIL.
Grading: GRD.
Typically Offered: Spring.

BMB 711. Best Practices in BMB Instruction. 1-3 Credit Hours.
Graduate students in the basic sciences will explore different approaches to science course development, implementation and assessment. This includes identifying gaps in the curriculum, creating classroom structure that reflects the content and execution of classroom activities, identifying and gathering appropriate material from the primary research literature, instructing undergraduates in how to become highly interactive self-directed learners, providing formative feedback to improve student achievement throughout a course, proper design and implementation of assessment tools, student communication, classroom management and ethics.
Components: DIS.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 712. Human Genetics. 3 Credit Hours.
This course will provide the learner with greater knowledge and current understanding the human genome, the mechanisms by which variations and environmental factors contribute to human phenotypes. Examples of potential topics include chromosome aberrations, phenotype-genotype correlations, cytogenetics, multifactorial traits, population genetics, risk assessment, multi-generation Epigenetics, reprogramming and gene therapy. Importantly, students will learn the new developments in Epigenetics. Epigenetics is considered by many to be the "new genetics". The effects of epigenetics are vast, including tissue/organ regeneration, X-chromosome inactivation, and stem cell differentiation and genomic imprinting and aging. This course will discuss the overwhelming evidence of the contribution of non-genetic factors, such as nutrition, environment, and chemical exposure, on gene expression.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 714. Molecular Genetics. 4 Credit Hours.
This course deals with mechanisms and fundamental concepts of genetic inheritance. The first part of the course is devoted to the genetics of bacteria and bacteriophages. Topics include genetic implementation, recombination, suppression, transposition, conjugation, transformation, transaction, and regulation of prokaryotic gene expression. The second part of the course covers selected topics in eukaryotic genetics (including molecular genetics of yeast, mitochondria, Drosophila, mice and humans). Problem solving is emphasized in homework and exams. The objective of the course is to provide students with an appreciation of the value of molecular genetics as a tool they can use to solve a wide variety of problems in bio-medical research.
Components: DIL.
Grading: GRD.
Typically Offered: Fall.

BMB 715. Structural Biology and Applications to Drug Discovery. 2 Credit Hours.
This course focuses on the relationships between structure and function in biological macromolecules, and how this knowledge has led to the discoveries of new drugs.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 716. Bioinformatics of Gene Regulation and Protein Function. 3 Credit Hours.
Among the skills required to become a successful interdisciplinary life scientist is the ability to navigate biological databases to better understand gene and protein function. Genome sequences contain the signals that guide differential gene expression and encode structural RNAs, regulatory RNAs and proteins. This course will introduce the tools, databases and evolutionary considerations that help us understand the regulation of gene expression and predict protein function. The biochemical and regulatory functions encoded in genomic DNA sequences will be explored using bioinformatics techniques including gene finding, BLAST searches, PubMed searches, high-throughput dataset mining, multiple alignments, phylogenic analysis, identification of conserved functional domains and motifs, assessment of protein-protein and protein-ligand interactions, gene context and co-occurrence analysis. secondary and tertiary structural analysis, metabolic and cellular modeling, and phenotypic analysis. The databases, tools and tutorials available at websites developed by the National Center for Biotechnology Information, EMBL-EBI, the Protein Data Bank, and others will be used as supporting course materials. Each week will have a set of online videos and instructions to complete before the weekly live lecture. The live lecture consist of a one hour slide presentation and one half-hour of Q&A discussions. Competency in bioinformatics will be assessed by a midterm and a final exam.
Components: DIL.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 717. Nutrients, Enzymes, and Metabolic Flux. 3 Credit Hours.
Students learn how macronutrients (carbohydrates, protein, and lipids) and (ii) micronutrients (vitamins and minerals) are obtained in the diet, digested, absorbed, and assimilated. Then, students learn to formulate mechanisms of enzyme catalysis and inhibition. Such analytical skills are then used to more rigorously examine enzymes that control specific points of metabolic flux. Students finish this course with thorough mechanistic understanding of (i) macronutrient composition, intake, and energy production and (ii) requirements of micronutrients and hormones in controlling metabolic balance.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 718. Scientific Communication. 3 Credit Hours.
This course will train students in how to communicate science to different audiences. The lectures will focus on training students on how to make effective power point and poster presentations. Lectures will also guide on how to write manuscripts and grant applications. Training in data science as well as patents and inventions will be provided. Students will get understanding on academic career. Each student will prepare presentation on their research and will be guided by the instructor on how to improve it.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

BMB 719. Fundamentals of Epigenetics. 3 Credit Hours.
The influence of nutrition on gene expression through modification of DNA and proteins in chromatin is described (i.e., epigenetics). Also, genetic variations, as well as the influence of bacterial flora of the digestive tract, are considered with respect to abilities to metabolize various dietary components. Students learn how to gather information about course topics and present their findings
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 721. Clinical Diagnostics and Biosensors. 2 Credit Hours.
This course will focus on training students in diagnostic methods and the fundamentals and design of biosensors that are used in clinical diagnostics. Several biosensors are currently in use in diagnostic applications. They range from glucose sensors to PCR-based pathogen detection. The topics covered in this course will give students background on how these biosensors are designed, what are the biological recognition elements used, how to design portable platforms, what characteristics are needed for clinical use, how to use it, etc. An example of the target such as glucose, COVID-19, blood chemistry, will be used to explain constructions and fundamentals of biosensors. A background on recombinant DNA methods and protein chemistry, reporter probes, biological recognition elements, miniaturized analytical devices, point of care diagnostics. immunoassays, nucleic acid sensing, etc. will be covered in the course. The course will also cover culturing methods and detection of heavy metal in clinical samples. The topics covered in this course train students in multi-disciplinary fields including biochemistry, medicine, diagnostics, chemistry, and biology.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 723. Systems and Network Biology. 2 Credit Hours.
The course is designed to cover the principles of systems biology at the molecular level. It will emphasize on the particular understanding of the properties of biological systems as profiles and heavily interconnected networks. We will explore how “omics” data, e.g. RNA-sequencing, can be used to extract biological insight beyond merely the differentially expressed genes and pathways. We will study how expression and other omic profiles are snapshots of dynamic biological states, how we can infer (gene) regulatory networks, fluxes and how biological systems are organized in networks with specific topological properties. We will further explore how single-cell methodologies reveal the dynamics of cell state transitions as well as how machine learning (artificial intelligence; AI) is utilized to extract novel and higher-order biological inter-dependencies. Overall, the course’s aim is to describe biological systems, not from a reductionist analysis of the components (e.g. genes, proteins, metabolites), but from studying the dynamic interrelationships among the biological components. Specific topics to be covered: DNA/RNA-sequencing, MS-based proteomics and metabolomics, Machine learning, Classification algorithms, Network biology, Gene and protein regulatory/signaling networks, Biological organization, Stochasticity in biology, Modeling biological systems, Mathematical Biology, Format: Two 60-minutes sessions per week. Each session will be in the form of a lecture from the instructor or invited speaker on a specific topic within the overall theme of the course. Every fourth week, students will be assigned a research paper that’s relevant to the context presented in the previous three weeks and will be asked to present. Students will be graded based on their presentation, understanding and critical thinking on the concepts relevant to the course. Expectations: Students will learn the properties of network topology, systems biology as well as dynamic and mathematical biology. They will further learn how multivariate statistical methods, including dimensionality reduction and clustering algorithms as well as more advanced machine learning tools are applied in biological data. Successful completion of the course will allow students to critically assess these concepts in the published literature and also apply them in their research projects. Suggested textbooks A first course in systems biology, 3rd edition Eberhard Voit, Melissa Kemp Garland Science, 2025 Handbook of systems biology: concepts and insights Marian Walhout, Marc Vidal, Job Dekker Academic Press, 2013
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

BMB 726. Basis of Mitochondrial Medicine. 2 Credit Hours.
This course aims to integrate basic knowledge in mitochondrial structure and function with our current understanding of the role mitochondria play in human health and disease. The first part of the course provides a core introduction to the major aspects of mitochondrial biology, including mitochondrial metabolism, genetics, and biogenesis. The second part of the course focus on the role of mitochondrial and metabolic dysfunction in specific human disorders.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

BMB 730. Data Science Practitioner. 3 Credit Hours.
This course is an implementation of the IBM Skills Academy program. It will introduce the students with the fundamentals of Data Science and make them familiar with data processing and artificial intelligence (AI) paradigm concepts. Students will learn how to process data and run AI tasks using python. Students will work with different types of data, including applications in medicine and biology. For content information, please refer to the course topics section at the end of the syllabus.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

BMB 731. Special Work. 1-3 Credit Hours.
Special work, lecture, or laboratory or a combination of these, as determined by advisor in accord with student's individual interest.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Summer.

BMB 810. Master's Thesis. 1-6 Credit Hours.
The student working on his/her master’s thesis enrolls for this credit. In most departments not to exceed six credits, as determined by his/her advisor.
Components: THI.
Grading: SUS.
Typically Offered: Offered by Announcement Only.

BMB 830. Doctoral Dissertation. 1-12 Credit Hours.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 24. Not more than 12 hours of BMB 730 may be taken in a regular semester, nor more than six in a summer session. Where a student has passed his/her (a) qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.
Components: THI.
Grading: SUS.
Typically Offered: Fall & Summer.

BMB 840. Doctoral Dissertation- Post Candidacy. 1-12 Credit Hours.
Required for all PhD candidates. The student will enroll for credits as determined by the Office of Graduate and Postdoctoral Studies.
Components: DIL.
Grading: SUS.
Typically Offered: Fall & Summer.

BMB 850. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THE.
Grading: SUS.
Typically Offered: Fall & Summer.