Microbiology (MB)

MB 101/BCH 101 Introduction to Microbiology and Biochemistry Laboratory Practices (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. A "hands on" introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.

Typically offered in Summer only

MB 103 Introductory Topics in Microbiology (1 credit hours)
Introduction to scope and objectives of university education. Emphasis on microbiology. Career opportunities, computers, university resources.

Typically offered in Fall only

MB 180 Introduction to Microbial Bioprocessing (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. Fundamental cell biology concepts pertaining to biomanufacturing. Students gain an understanding of the basic principles of microbiology, culture preparation, physiology, and genetics of microbial cell cultures. Team-based decisions, collaborations and consideration of multiple perspectives are emphasized. Practical experience in laboratory and culture techniques used in biomanufacturing. Transportation will be provided for field trips. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS), as well as other pre-college, transitional and early-college programs. Suitable for students with less than 30 credit hours.

Typically offered in Summer only

MB 200 The Fourth Horseman: Plagues that Changed the World (3 credit hours)
An integrated and in-depth study of select microbial pathogens and their influence on history, public health, and human affairs. Five major pathogens will be examined to identify causative agents of disease, modes of transmission, prevention, and treatment. These pathogens will be framed in the power of plagues to shape human history and their impact on public health.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MB 210/BIT 210 Phage Hunters (3 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will isolate and characterize naturally-occurring bacteriophage (viruses that infect bacteria, but not humans) from the environment. They will present their data to each other, and the genome of one phage will be sequenced. Students have the option to continue in a second semester to annotate that genome, culminating in a submission to genbank and a poster presentation. Students in the course are part of the National Genome Research Initiative funded by The Howard Hughes Medical Institute. Student should have had a high school biology course before taking this course.

GEP Natural Sciences
Typically offered in Fall only

MB 211/BIT 211 Phage Genomics (2 credit hours)
This course offers first-year students an opportunity for mentored research. Student will apply the scientific method to make novel discoveries. Students will build on the work they began in BIT/MB 210; The novel phage isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to analyze and annotate the genome sequence. This semester will culminate in a submission to genbank and a poster presentation. Students in the course are part of the national genome research initiative funded by the Howard Hughes Medical Institute.

Prerequisite: BIT(MB) 210
GEP Natural Sciences
Typically offered in Spring only

MB 251 General Microbiology (3 credit hours)
Introduction to basic principles of microbiology for all students. Before taking this course, students should understand the requirements of life including cell structure and function, central carbon metabolism, and flow of genetic information.

Prerequisite: (BIO 181 or BIO 183) and one Chemistry course
Typically offered in Fall, Spring, and Summer

MB 252 General Microbiology Laboratory (1 credit hours)
A laboratory experience including development of skills such as aseptic technique, cultivation and identification of bacteria, staining, microscopy, and enumeration of microorganisms. A student successfully completing this course will demonstrate increased skills in scientific problem solving, data analysis, and communication. Cannot receive credit for both MB 252 and MB 254.

Corequisite: MB 251
Typically offered in Fall and Spring

MB 254 Inquiry-Guided Microbiology Lab (1 credit hours)
A laboratory experience for microbiology majors and honors students. Students will present findings of a semester-long research project in both written and oral formats. Students will develop skills such as aseptic technique, cultivation and identification of bacteria, staining, microscopy, and enumeration of microorganisms. A student successfully completing this course will demonstrate increased skills in scientific problem solving, data analysis, and communication. Credit is not allowed for both MB 252 and MB 254.

Corequisite: MB 251
Typically offered in Fall and Spring

MB 311 Medical Microbiology (3 credit hours)
This course will discuss medically important pathogens and their interaction with a human host. Students will examine the biology of microbial pathogens, including bacteria, viruses, fungi, and protozoa, along with the mechanisms of microbial pathogenesis and mammalian host immune responses to infections. The clinical characteristics and epidemiology of infectious diseases including transmission mechanisms, diagnosis, prevention, and treatment will be analyzed. Students should come into this course already familiar with biological properties of different types of microorganisms.

Prerequisite: MB 251
Typically offered in Fall and Spring

MB 312 Medical Microbiology Laboratory (1 credit hours)
Laboratory experience to complement MB 311. Students will gain hands-on experience with methods of culturing, identifying, and safe handling of pathogenic microorganisms. We will use clinical lab identification and research strategies to diagnose infection, track disease outbreaks, and answer research questions of clinical importance. Students should have previous experience with aseptic technique, micropipetting, and basic microbiological culturing methods.

Prerequisite: MB 252 or MB 254; Corequisite: MB 311
Typically offered in Spring only

MB 360 Scientific Inquiry in Microbiology: At the Bench (3 credit hours)
Scientific questions, controls and variables, designing, preparing for and carrying out experiments, keeping a notebook, interpreting results, and presenting their findings: i.e. the pragmatic things a student must know in order to work efficiently in a research lab regardless of the discipline. Prior or current enrollment in MB 352 or MB 354 recommended.

Prerequisite:CH 101 and BIO 183 (both with a C- or better)
Typically offered in Fall only

MB 405/FS 505/MB 505/FS 405 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

MB 406/FS 506/MB 506/FS 406 Food Microbiology Lab (2 credit hours)
Laboratory experience to complement FS/MB 405 or FS/MB 505. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes, and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Typically offered in Fall only

MB 414 Microbial Metabolic Regulation (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through an analysis of metabolic regulatory functions.

Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

MB 420/MB 520 Fundamentals of Microbial Cell Biotransformations (2 credit hours)
This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.

Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

MB 435/MB 535 Bacterial Pathogenesis (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert hos defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed. Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.

Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

MB 441 Immunology (3 credit hours)
Introduction to principles of molecular immunology. Overview of immune system development and function, and discussions of ongoing scientific research regarding immune regulation.

P: C- or better in (MB 351 or BCH 351 or BCH 451 or BIO 414 or PB 414 or BIO 421)
Typically offered in Fall and Spring

MB 451 Microbial Diversity (3 credit hours)
Molecular, biochemical, and evolutionary diversity of the microbial world, including Bacteria, Archaea, and Eukaryotes. Evolutionary perspective on microbial relationships, molecular methods of study and classical and modern biotechnological methods utilizing this genetic diversity to explore the microbial world and use the resulting insight to meet the needs of our own species.

Prerequisite: MB 411 and (GN 311 or BCH 351 or BCH 451)
Typically offered in Fall and Spring

MB 452 Microbial Diversity Lab (2 credit hours)
This lab course is project-oriented. Students perform a series of classical enrichments and isolations, starting from environmental samples collected by the students themselves. Some of these isolations serve as the starting materials for a series of modern molecular biology experiments, in which students purify DNA, amplify ribosomal DNA by PCR, and have a portion of this gene sequenced. This sequence information is the starting point for the term project, a detailed molecular phylogenetic analysis of the isolated organisms. Students will be required to provide their own transportation during non-scheduled class time for local field sample collection.

Prerequisite: MB 412; Corequisite: MB 451
Typically offered in Fall only

MB 455 Microbial Biotechnology (3 credit hours)
Introduction to industrial microbiology with focus on biotechnology including developments employing recombinant nucleic acid and monoclonal antibody techniques. Bioremediation, industrial enzymes, transgenic plants, biopesticides, medical diagnostics, recombinant vaccines production of important secondary metabolites, and other topics. Field trips to local biotechnology companies.

Prerequisite: MB 351 and GN 311
Typically offered in Spring only

MB 461 Molecular Virology (3 credit hours)
Introduction to principles of molecular virology. Overview of classification and nomenclature, virus structure, interaction of viruses with cells, organisms (immunology, pathology), and populations (epidemiology). Detailed case studies from major groups of viruses; picornaviruses, togaviruses, orthomyxoviruses, retroviruses, polyomaviruses, and herpesviruses.

Prerequisite: MB 351, MB 411
Typically offered in Spring only

MB 470 Emerging and Re-emerging Infectious Diseases (3 credit hours)
Human behavior plays a big part in the emergence and reemergence of infectious diseases. Humanity encroaches consistently into previously uninhabited parts of the planet increasing the risk of exposure to novel pathogens that have the potential to jump into the human host or livestock. In addition to exposure to new diseases the complexities of politics and global relations often create opportunities for the re-emergence of infections that were once thought to be under control. This course aims to provide students interested in the health sciences with a foundation to understand the principles governing emergence of diseases.

Prerequisite: MB 251
Typically offered in Spring only

MB 479/MB 579 Microbial Symbiosis & Microbiomes (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.

Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 480 Current Issues in Microbiology (1 credit hours)
Library research on current topics in all areas of microbiology. Presentation of research results orally and in the form of a major term paper.

Prerequisite: SMB majors or minors, Senior standing, and MB 351
Typically offered in Fall and Spring

MB 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

MB 501/PP 501/PB 501 Biology of Plant Pathogens (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.

Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

MB 505/FS 405/MB 405/FS 505 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

MB 506/FS 406/MB 406/FS 506 Food Microbiology Lab (2 credit hours)
Laboratory experience to complement FS/MB 405 or FS/MB 505. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes, and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Typically offered in Fall only

MB 520/MB 420 Fundamentals of Microbial Cell Biotransformations (2 credit hours)
This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.

Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

MB 532/SSC 532 Soil Microbiology (3 credit hours)
Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality.

Prerequisite: MB 351, CH 220
Typically offered in Spring only

MB 535/MB 435 Bacterial Pathogenesis (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert hos defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed. Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.

Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

MB 555 Microbial Biotechnology (3 credit hours)
Overview of industrial microbiology focusing on current biotechnology methods (bacteria, yeast, fungi) employing rDNA, optimization of heterologous gene expression, microbial metabolic pathway engineering, metabolomics, protein engineering and recombinant antibodies. Genetic and pathway engineering strategies for developing new microbes to screen for new therapeutic compounds or overproduce: primary metabolites, antibiotics, biotherapeutic proteins, industrially useful enzymes, medical diagnostics, recombinant vaccines, biopolymers. Utilization of biofilms, methods to immobilize biocatalysts, and microbial kinetics are also covered. Field trip to local biotechnology company. Students cannot receive credit for both 455 and 555.

Prerequisite: Undergraduate microbiology, genetics, and biochemistry course: MB351, BCH 351, and GN 311
Typically offered in Spring only

MB 575/PP 575/PB 575 Introduction to Mycology (4 credit hours)
A survey of the fungal kingdom in context of phyla and classes. Systematics, ecology, biology and utilization. Illustrative material, cultural techniques in laboratories. Collection and paper required.

Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only
This course is offered alternate odd years

MB 579/MB 479 Microbial Symbiosis & Microbiomes (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.

Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 585 Biotechnology Industry Practicum I (3 credit hours)
Project-based course directly working with biotechnology and pharmaceutical companies. Students work in teams on a company-specific project. Projects range from developing business or marketing plans for new products; writing Small Business Innovation Research (SBIR) grants or white papers; creating procedures, protocols, and/or process improvements for a company-specific process; and studying intellectual property issues. Written and oral communication skills as well as teamwork, flexibility, and ambiguity management are emphasized. Restricted to MBT students.

Restriction: enrollment in the Master of Microbial Biotechnology Program required
Typically offered in Fall only

MB 586 Biotechnology Industry Practicum II (3 credit hours)
This is a project-based course directly working with small (fewer than 500 employees) biotechnology and pharmaceutical companies. It builds on knowledge and skills introduced in MB 585, but with increased independence and autonomy. The class will further explore issues in biotechnology including funding, intellectual property, regulatory affairs, and commercialization. Students work in teams on a company-specific project with input from their industry mentor. In addition, students will participate in the campus-wide CATALYZE Conference pitch competition. Written, oral, and visual communication skills as well as teamwork, flexibility, and ambiguity management are emphasized. Restricted to MMB students.

Prerequisite: MB 585 and restricted to students enrolled in the Master of Microbial Biotechnology Program
Typically offered in Spring only

MB 587 Biotechnology Industry Practicum III (3 credit hours)
This course builds on MB 585 and 586, placing the students in this course in leadership and mentoring roles in their team projects. Students work with faculty innovators and industry mentors on real-world questions such as market analyses, patent searching, strategic partnerships, and supply chain networks. At the start of the semester, student teams work on a 5-week project with an NC State innovator, followed by a 10-week project with participating companies, meeting with their industry mentor on a regular schedule. In addition, students will begin the ideation process for their capstone projects using a Design Thinking Framework. Students will participate in an ideation workshop, brainstorm unmet needs relevant to the biotechnology industry, explore possible solutions, and delve into the desirability, feasibility, and sustainability of their ideas as a jumping point for the MMB capstone course. Restricted to MMB students.

Prerequisite: MB 586 and enrollment in the MMB program
Typically offered in Fall only

MB 588/BIT 588 Microbiome Analysis (3 credit hours)
Microbiomes are increasingly recognized for their important roles in ecosystem services ranging from human health to soil biogeochemical cycling. Studying these complex communities relies on DNA sequencing, which often generates large, sparse datasets. Students will be introduced to conceptual and practical aspects of how to analyze microbiome data, and will apply both bioinformatics and statistical approaches. Topics include identifying microbial sequence variants, exploratory analysis of microbial community diversity and structure, applying hypothesis testing to complex microbiome data, and reproducible research.

Prerequisite: Graduate Standing
Typically offered in Spring only

MB 589 Master of Microbial Biotechnology Capstone (3 credit hours)
MB 589 is a graduate-level course required for the MMB Program in the final semester. In this course, students integrate skills and knowledge acquired through the MB 585 industry practicum experience to identify an unmet need and to evaluate the feasibility of a novel product or service generated through their own ideation process. They develop a comprehensive, customer-validated business model and create an investor pitch for both the solution and the company that will provide the solution.

Requisite: MMB Program with successful completion of three semesters of MB 585 and in good academic standing
Typically offered in Spring only

MB 590 Topical Problems (1-3 credit hours)
Informal group discussion of prepared topics assigned by instructor.

Prerequisite: Graduate standing

MB 601 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall only

MB 610 Special Topics Microbiology (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.

Typically offered in Fall, Spring, and Summer

MB 620 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.

Typically offered in Fall, Spring, and Summer

MB 624 Topical Problems (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 670 Laboratory Research Methods (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant to each laboratory. Microbiology graduate students only.

Typically offered in Fall only

MB 680 Microbiology Research Presentations (1 credit hours)
Essential elements of structure, delivery, and data visualization in scientific research presentations. Hands-on training in scientific communication across microbiology research fields and evaluation of student seminars based on ongoing or proposed microbiology research projects. Coverage of cutting-edge microbiology research topics as determined by instructor. Microbiology graduate students only.

Prerequisite: Graduate Standing
Typically offered in Fall only

MB 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 686 Teaching Experience (1 credit hours)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.

Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Summer only

MB 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Summer only

MB 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MB 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 714 Microbial Metabolic Regulation (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through analysis of metabolic regulatory functions.

Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

MB 715/PP 715 Applied Evolutionary Population Genetics (3 credit hours)
This course will introduce students to nonparametric and model-based methods for making inferences on population processes (i.e., mutation, migration, drift, recombination, and selection). The goal is to provide a conceptual overview of these methods in lectures and hands-on training on how to analyze and interpret sample data sets in guided computer lab sessions. The course will leverage the tools and resources implemented in the DeCIFR toolkit (https://decifr.cifr.ncsu.edu/). DeCIFR is a comprehensive suite of biodiversity informatics pipelines and visualization tools to discover, evaluate, and describe taxa at multiple spatial and phylogenetic scales. Students will apply these tools to estimate population parameters in different organisms with a focus on eukaryotic microbes, viruses, and bacteria.

Typically offered in Fall only

MB 718 Introductory Virology (3 credit hours)
Introduction to principles of virology including: classification and nomenclature, epidemiology, structure, genome replication, gene expression strategies and cellular infection cycle. Major groups of viruses including those with DNA genomes and positive-sense or negative-sense RNA genomes.

Prerequisite: BCH 451 or GN 411 or MB 351
Typically offered in Fall only
This course is offered alternate odd years

MB 725/FS 725 Fermentation Microbiology (3 credit hours)
Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.

Prerequisite: BCH 451, MB 351
Typically offered in Spring only
This course is offered alternate years

MB 751/IMM 751 Immunology (3 credit hours)
Introduction to mechanisms of immunity in man and animals. Emphasis on interactions between cells of the immune system in production of immune responses and the molecules in control of these interactions.

Prerequisite: BCH 451, GN 411, MB 351
Typically offered in Spring only

MB 758/GN 758 Microbial Genetics & Genomics (3 credit hours)
Structure and function in microbial genetics, with emphasis on microbial genome organization, stable maintenance and evolution. DNA mutation and repair pathways, transcriptional and translational regulation, DNA replication and recombination and characterization of recombinant DNA molecules. Applications of genetic and genomic analysis methods to microbial processes, including strain construction, genome manipulation, and enhancement of gene expression.

Prerequisite: BCH 451 or GN 311
Typically offered in Spring only

MB 774/PB 774 Phycology (3 credit hours)
Introduction to taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention to local freshwater flow and physiology of selected species in relation to algal blooms, water quality and nutrient loading in aquatic habitats.

Typically offered in Spring only
This course is offered alternate odd years

MB 783/CBS 783/IMM 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only
This course is offered alternate odd years

MB 790 Topical Problems (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

MB 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

MB 810 Special Topics Microbiology (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.

Typically offered in Fall, Spring, and Summer

MB 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.

Typically offered in Summer only

MB 824 Topical Problems (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 870 Doctoral Lab Rotations (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant to each laboratory. Microbiology graduate students only.

Typically offered in Fall only

MB 880 Doctoral Microbiology Research Presentations (1 credit hours)
Essential elements of structure, delivery, and data visualization in scientific research presentations. Hands-on training in scientific communication across microbiology research fields and evaluation of student seminars based on ongoing or proposed microbiology research projects. Coverage of cutting-edge microbiology research topics as determined by instructor. Microbiology graduate students only.

R: Graduate Standing
Typically offered in Fall only

MB 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 886 Teaching Experience (1 credit hours)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.

Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MB 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer