QUANTITATIVE/FORMAL REASONING (QFR)

The Quantitative/Formal Reasoning (QFR) requirement is intended to help students become adept at reasoning mathematically and abstractly. The ability to apply a formal method to reach conclusions, use numbers comfortably, and employ the research tools necessary to analyze data lessens barriers to carrying out professional and economic roles. The hallmarks of a QFR course are the representation of facts in a language of mathematical symbols and the use of formal rules to obtain a determinate answer. Primary evaluation in these courses is based on multistep mathematical, statistical, or logical inference (as opposed to descriptive answers).

Prior to senior year, all students must satisfactorily complete ONE QFR course. Students requiring extra assistance (as assessed during First Days) are normally placed into Mathematics 100/101/102, which is to be taken before fulfilling the QFR requirement.

ASTR 111 (F) Introduction to Astrophysics (QFR)

The science of astronomy spans vast scales of space and time, from individual atoms to entire galaxies and from the universe's beginning to the future fate of our Sun. In this course, we will survey some of the main ideas in modern astrophysics, with an emphasis on the physics of stars and galaxies. ASTR 111 is the first course in the Astrophysics and Astronomy major sequences. It is also appropriate for students planning to major in one of the other sciences or mathematics and for others who would like a quantitative introduction that emphasizes the relationship of contemporary physics to astronomy. Topics include gravity and orbits, radiation laws and stellar spectra, physical characteristics of the Sun and other stars, star formation and evolution, black holes, galaxies, the expanding universe, and the Big Bang. Students will also use telescopes remotely to observe stars, nebulae, planets, and galaxies and to make daytime observations of the Sun.

Class Format: This is a hybrid course. Lectures will be provided both in-person and for remote viewing. Students will work in small groups on discussions and calculations. Each group can choose to meet remotely or in class. Students can switch groups, and groups can switch format, as needed. Prof. Jaskot will meet with remote groups during their discussion to answer questions. The class has 6 afternoon labs, with both in-person and remote options. Remote observing sessions will occur throughout the semester.

Prerequisites: a year of high school Physics, concurrent college Physics, or permission of instructor, and MATH 140 or equivalent

Enrollment Limit: 28

Enrollment Preferences: potential Astronomy majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course requires regular problem sets and quantitative assignments. The course will emphasize how physical equations explain the observed properties of the universe.

Fall 2020

LEC Section: H1 TR 11:30 am - 12:45 pm Anne Jaskot

LAB Section: H2 T 1:00 pm - 3:00 pm Kevin Flaherty

LAB Section: H3 W 1:00 pm - 3:00 pm Kevin Flaherty

ASTR 402 (S) Between the Stars: The Interstellar Medium (QFR)

The matter between the stars--the interstellar medium--tells the story of the past and future evolution of galaxies and the stars within them. Stars are accompanied by diffuse matter all through their lifetimes, from their birthplaces in dense molecular clouds, to the stellar winds they eject as they evolve, to their final fates as they shed their outer layers, whether as planetary nebulae or dazzling supernovae. As these processes go on, they enrich the interstellar medium with the products of the stars' nuclear fusion. Interpreting the emission from this interstellar gas is one of astronomers' most powerful tools to measure the physical conditions, motions, and composition of our own galaxy and others. In this course we will study the interstellar medium in its various forms, from cold, dense, star-forming molecular clouds to X-ray-emitting bubbles formed by supernovae. We will learn about the physical mechanisms that produce the radiation we observe, including radiative ionization and recombination, collisional excitation of "forbidden" lines, collisional ionization, and synchrotron radiation. Applying our understanding of these processes, we will analyze the physical conditions and chemical compositions of a variety of nebulae. Finally, we will discuss the evolution of interstellar material in galaxies across cosmic time. This course is observing-intensive. Throughout the semester students will work in small groups to design, carry out, analyze, and critique their own observations of the interstellar medium using the equipment on our observing deck.

Class Format: plus observing projects

Prerequisites: ASTR 111 and PHYS 201 or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: juniors and seniors

Expected Class Size: 6

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: In this course, students will derive quantitative physical formulas, use these equations to calculate and compare physical properties, and generate and analyze graphical representations of data. They will also make and analyze measurements of astronomical data through observing projects.

Spring 2021

LEC Section: 01 TBA Anne Jaskot

ASTR 498 (S) Independent Study: Astronomy or Astrophysics (QFR)

Astronomy/Astrophysics independent study, directed by one of the Astronomy faculty: Pasachoff/Jaskot/Flaherty

Prerequisites: suitable Astronomy/Astrophysics/Physics/Math-Stats-Geosciences/Chemistry courses

Enrollment Limit: 10

Enrollment Preferences: research topic

Expected Class Size: 5

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Substantial quantitative and formal reasoning are involved

Spring 2021

IND Section: 01 TBA Jay M. Pasachoff

BIMO 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Primary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

Spring 2021

LEC Section: 01 TBA Katie M. Hart

BIMO 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Primary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

BIOL 202 (F) Genetics (QFR)

Genetics, classically defined as the study of heredity, has evolved into a discipline whose limits are continually expanded by innovative molecular technologies. This course covers the experimental basis for our current understanding of the inheritance, structures, and functions of genes. It introduces approaches used by contemporary geneticists and molecular biologists to explore questions in areas of biology ranging from evolution to medicine. The laboratory part of the course provides an experimental introduction to modern genetic analysis. Laboratory experiments include linkage analysis, bacterial transformation with plasmids and DNA restriction mapping. This COVID year we will have in-person lectures and labs. Furthermore all students will have access to recorded lectures, notes, slides and handouts. For remote students, lab reports will also be required (writing and data analysis). Remote students will be able to collect data for some of the labs or otherwise will have access to class data for analyses.

Class Format: six hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102

Enrollment Limit: 60

Enrollment Preferences: Students planning on Biology major

Expected Class Size: 60

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course has a large quantitative component, mainly probabilities and basic statistics. Lab reports and data analyses are a large component of the grade.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: 04 M 1:00 pm - 3:00 pm Derek Dean

LAB Section: 05 T 1:00 pm - 3:00 pm Derek Dean

LAB Section: 06 W 1:00 pm - 3:00 pm Derek Dean

LAB Section: 07 R 1:00 pm - 3:00 pm Derek Dean

LAB Section: 08 M 3:30 pm - 5:30 pm Derek Dean

LAB Section: 09 T 3:30 pm - 5:30 pm Derek Dean

LAB Section: 10 W 3:30 pm - 5:30 pm Derek Dean

LAB Section: 11 R 3:30 pm - 5:30 pm Derek Dean

LEC Section: H1 MWF 10:40 am - 11:30 am Luana S. Maroja

LEC Section: H2 MWF 12:00 pm - 12:50 pm Luana S. Maroja

LAB Section: R3 MW 6:45 pm - 8:00 pm Derek Dean

BIOL 203 (F) Ecology (QFR)

Cross-listings: ENVI 203 BIOL 203

Primary Cross-listing

This course combines lectures with field and indoor laboratory exercises to explore factors that determine the distribution and abundance of plants and animals in natural systems. The course begins with an overall view of global patterns and then builds from the population to the ecosystem level. An emphasis is given to basic ecological principles and relates them to current environmental issues. Selected topics include population dynamics (competition, predation, mutualism); community interactions (succession, food chains and diversity) and ecosystem function (biogeochemical cycles, energy flow). In Fall 2020, the course will use a hybrid model, with recorded lecture material available to all students. In person and remote class meetings will focus on problem sets and interactive case studies. Labs will be available in either in person or remote modalities. Remote participants will have the opportunity to collect their own data for some lab exercises, while in other cases will receive background information and media describing the data collection process. All students will be required to complete all data analyses and written lab reports.

Class Format: Six hours per week. All labs will be available in both remote and in-person modalities. All students (whether in person or remote) may choose their preferred modality for each lab module. Due to COVID-19 distancing requirements, some labs will require walking to field sites. The instructor will work with individual students to identify accommodations that support in person lab participation as needed.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102, or ENVI 101 or 102, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: students planning to pursue Biology and/or ENVI

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 203 (D3) BIOL 203 (D3)

Quantative/Formal Reasoning Notes: Much of the material in this course centers on the interpretation and application of mathematical models used to describe ecological systems. The laboratory section of this course also contains a large data analysis component. Students are introduced to t-tests, Mann-Whitney U tests, chi-square analysis, and regression.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Living Systems Courses

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Allison L. Gill

LAB Section: H2 T 1:00 pm - 3:00 pm Allison L. Gill

LAB Section: H3 T 3:30 pm - 5:30 pm Allison L. Gill

BIOL 210 (F) Mathematical Biology (QFR)

Cross-listings: BIOL 210 MATH 310

Secondary Cross-listing

This course will provide an introduction to the many ways in which mathematics can be used to understand, analyze, and predict biological dynamics. We will learn how to construct mathematical models that capture essential properties of biological processes while maintaining analytic tractability. Analytic techniques, such as stability and bifurcation analysis, will be introduced in the context of both continuous and discrete time models. Additionally, students will couple these analytic tools with numerical simulation to gain a more global picture of the biological dynamics. Possible biological applications include, but are not limited to, single and multi-species population dynamics, neural and biological oscillators, tumor cell growth, and infectious disease dynamics.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 250 and MATH 309, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: if over-enrolled, will have students submit reasons for taking class; preference to those with interest in both subjects

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 210 (D3) MATH 310 (D3)

Quantative/Formal Reasoning Notes: The course will introduce methods for developing and analyzing mathematical models.

Attributes: PHLH Methods in Public Health

Fall 2020

LEC Section: H1 TR 11:30 am - 12:45 pm Julie C. Blackwood

BIOL 222 (S) Essentials of Biochemistry (QFR)

This course will explore the biochemistry of cellular processes and contextualize these processes in healthy and diseased states. Lecture topics in this one semester course will include the structure and function of proteins (enzymes and non-enzymatic proteins), lipids, and carbohydrates. Lectures will also survey the major metabolic pathways (carbohydrates, lipids, and amino acids) with particular attention to enzyme regulation and the integration of metabolism in different tissues and under different metabolic conditions. In the discussion/laboratory component of the course a combination of primary literature, hypothesis-driven exercises, problem solving, and bench work will be used to illustrate how particular techniques and experimental approaches are used in biochemical fields.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the biology major in addition to either BIOL 321 or BIOL 322; cannot be counted towards the BIMO concentration

Prerequisites: BIOL 101 and CHEM 156; not open to students who have taken BIOL 321 or BIOL 322

Enrollment Limit: 24

Enrollment Preferences: seniors who need to fulfill the biochemistry requirement for premedical school

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the biology major in addition to either BIOL 321 or BIOL 322; cannot be counted towards the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Spring 2021

LEC Section: 01 TBA Daniel V. Lynch

BIOL 305 (S) Evolution (QFR)

This course offers a critical analysis of contemporary concepts in biological evolution. We focus on the relation of evolutionary mechanisms (e.g., selection, drift, and migration) to long term evolutionary patterns (e.g., evolutionary innovations, origin of major groups, and the emergence of diversity). Topics include micro-evolutionary models, natural selection and adaptation, sexual selection, speciation, the inference of evolutionary history among others.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 202

Enrollment Limit: 24

Enrollment Preferences: Seniors and biology majors

Expected Class Size: 24

Grading: yes pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Attributes: BIGP Courses BIMO Interdepartmental Electives COGS Related Courses

Spring 2021

LEC Section: 01 TBA Luana S. Maroja

BIOL 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Primary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

BIOL 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

Spring 2021

LEC Section: 01 TBA Katie M. Hart

BIOL 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

BIOL 329 (F) Conservation Biology (QFR)

Cross-listings: ENVI 339 BIOL 329

Primary Cross-listing

This course examines the application of population genetics, population ecology, community ecology, and systematics to the conservation of biological diversity. The overarching theme of the course is on the role of stochastic processes for small populations. Lecture/discussion topics will include extinction, the genetics of small populations, metapopulations, and importantly, conservation strategies. Labs will include a mixture of computer and lab projects.

Class Format: lecture and discussion, 3 hours per week; lab, 1.25 hours per week. students will be assigned to a lab section (block AA - either W or F from 1:30-2:45) during the first week of class.

Requirements/Evaluation: Satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 203/ENVI 203, or BIOL 305, or permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Biology majors, seniors, and juniors

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 339 (D3) BIOL 329 (D3)

Quantative/Formal Reasoning Notes: This course uses quantitative and statistical analyses in both the laboratory and lecture portion of the course. In lectures mathematical models will be covered to understand conservation dynamics. In lab, students will collect and analyze data and present results in graphical and statistical forms.

Attributes: ENVI Natural World Electives

Fall 2020

LEC Section: H1 TR 8:00 am - 9:15 am Manuel A. Morales

LAB Section: H2 WF 1:30 pm - 2:45 pm Manuel A. Morales

CHEM 114 (S) The Science Behind Materials: Shaping the Past and Future of Society (QFR)

We are surrounded by materials. They have fulfilled human needs since ancient times. From Phoenician glass to flexible OLED displays, materials have impacted society and changed the way humans lead their lives. What makes materials the way they are? Why are some brittle while others are ductile? How can we design materials with specific properties that will solve tomorrow's problems? To answer these questions, we have to think about materials at the atomic scale, looking at how their smallest building blocks organize into specific structures. In this course, we will discuss how a material's structure relates to its properties. Then, we will dive into how different types of materials have been used in the past, how they were produced, the needs they satisfied, and how they shaped human civilization. This course will also cover both traditional and novel methods used to fabricate and analyze materials. We will talk about some of the cutting-edge research that materials scientists are working on today, concluding with an outlook to potential applications of emerging technologies.

Prerequisites: none; designed for the non-science major who does not intend to pursue a career in the natural sciences.

Enrollment Limit: 20

Enrollment Preferences: juniors and seniors; not appropriate for CHEM, BIOL, PHYS majors, or for those who have taken CHEM 151, 153, or 155

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Spring 2021

LEC Section: 01 TBA Amnon G Ortoll-Bloch

CHEM 117 (S) Roses are Red, Violets are Blue: The Origins, Perception, and Impact of Color (QFR)

Have you ever been tickled pink? Felt blue? Seen red?, Been green with envy? The course will consider color, starting with the physical and chemical origins of color (the electromagnetic spectrum, the absorption and emission of electromagnetic radiation, refraction, diffraction, incandescence, fluorescence, phosphorescence, iridescence). We will develop an understanding of chemical bonding and how that influences color. We will cover how we measure and describe color from a scientific perspective as well as how we can generate materials and devices with different color properties (liquid crystal displays, light emitting diodes for instance). From there we will discuss pigments used in works of art and textiles over time, the characteristics that make certain pigments suitable for particular applications. If we have time, we will touch on the historical and cultural impacts and meanings of different pigments and hues, the biological perception of color, and some color theory.

Class Format: There may be some brief laboratory exercises, which will require some extra time blocks, to be scheduled later.

Prerequisites: non-science students; students who have taken any introductory chemistry or physics courses are ineligible

Enrollment Limit: 20

Enrollment Preferences: first-years and sophomores

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will require students to become comfortable with some quantitative descriptions of light and its interaction with matter.

Spring 2021

LEC Section: 01 TBA Lee Y. Park

CHEM 151 (F) Introductory Chemistry (QFR)

This course provides an introduction to chemistry for those students with little or no high school chemistry. Students will be introduced to concepts fundamental to studying matter at the molecular level. Principal topics include introductions to the nature of atoms and molecules, stoichiometry, solubility rules and equilibria, gas laws, chemical equilibrium, acid-base reactions, periodic relationships, chemical bonding, molecular structure, intermolecular forces, oxidation-reduction reactions, and related applications. Laboratory work comprises a system of qualitative analysis and quantitative techniques. The course provides preparation for further study of organic chemistry, biochemistry, physical and inorganic chemistry and is intended for students who are anticipating professional study in chemistry, in related sciences, or in one of the health professions, as well as for those students who are interested in exploring the fundamental ideas of chemistry as part of their general education.

Class Format: pre-recorded lectures, two hours per week; recitations, two 75-minute meetings per week (in-person or remote); laboratory, one 2-hour lab per week (in-person or remote)

Requirements/Evaluation: CHEM 151 may be taken concurrently with MATH 102--see under Mathematics; CHEM 151 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: first-year students; students who have studied chemistry for one or more years are directed to CHEM 153 or 155

Expected Class Size: 32

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 151 may be taken concurrently with MATH 102--see under Mathematics; CHEM 151 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LEC Section: 01 MW 10:00 am - 11:15 am Katie M. Hart

LEC Section: 02 MW 11:45 am - 1:00 pm Katie M. Hart

LAB Section: H4 M 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: H5 M 3:30 pm - 5:30 pm Laura R. Strauch

LAB Section: H6 T 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: H7 T 3:30 pm - 5:30 pm Laura R. Strauch

LEC Section: R3 MW 11:45 am - 1:00 pm Sarah L. Goh

CHEM 153 (F) Concepts of Chemistry (QFR)

This course broadens and deepens the foundation in chemistry of students who have had typically one year of chemistry at the high school level. Most students begin study of chemistry at Williams with this course. Familiarity with stoichiometry, basic concepts of equilibria, and the model of an atom is expected. Principal topics for this course include kinetic theory of gases, modern atomic theory, molecular structure and bonding, states of matter, chemical equilibrium (acid-base and solubility), and an introduction to atomic and molecular spectroscopies. Laboratory periods will largely focus on data analysis, literature, scientific writing, ethics, and other skills critical to students' development as scientists. There may also be the opportunity for some hands-on laboratory experience for students who are on-campus. The course is of interest to students who anticipate professional study in chemistry, related sciences, or one of the health professions, as well as to those who want to explore the fundamental ideas of chemistry as part of their general education.

Class Format: Lecture/discussion, three hours per week and laboratory, two hours per week

Requirements/Evaluation: CHEM 153 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: incoming first year students also must meet with a faculty member during First Days

Expected Class Size: 60

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 153 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LEC Section: 01 MW 10:00 am - 11:15 am Bob Rawle

LAB Section: H10 W 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H11 R 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H12 R 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H13

LEC Section: H3 TR 6:45 pm - 8:00 pm Lee Y. Park

LEC Section: H4 TR 8:30 pm - 9:45 pm Lee Y. Park

LAB Section: H5 M 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H6 M 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H7 T 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H8 T 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H9 W 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LEC Section: R2 MW 11:45 am - 1:00 pm Bob Rawle

CHEM 155 (F) Principles of Modern Chemistry (QFR)

This course is designed for students with strong preparation in secondary school chemistry, including a laboratory experience, such as provided by an Advanced Placement chemistry course (or equivalent) with a corresponding score of 5 of the AP Chemistry Exam (or a 7 on the IB Exam, or equivalent). Topics include chemical thermodynamics, kinetics, structure and bonding, coordination chemistry, electrochemistry and spectroscopy and their application to fields such as materials science, industrial, environmental, biological, and medicinal chemistry. Laboratory/discussion periods will focus on data analysis, literature, scientific writing, ethics, and other skills critical to students' development as scientists. This course is of interest for students who are anticipating professional study in chemistry, related sciences, or one of the health professions, as well as for students who want to explore the fundamental ideas of chemistry as part of their general education.

Class Format: lecture, three hours per week and laboratory, two hours per week

Requirements/Evaluation: CHEM 155 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: incoming first year students also must meet with a faculty member during First Days

Expected Class Size: 30

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 155 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LEC Section: 01 MWF 8:00 am - 8:50 am Enrique Peacock-López

LAB Section: 03 W 1:00 pm - 3:00 pm Enrique Peacock-López

LAB Section: 05 R 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: 06 R 3:30 pm - 5:30 pm Laura R. Strauch

LAB Section: 07 W 3:30 pm - 5:30 pm Enrique Peacock-López

LEC Section: R2 MWF 10:40 am - 11:30 am Enrique Peacock-López

LAB Section: R4 W 3:30 pm - 5:30 pm Anthony J. Carrasquillo

CHEM 156 (S) Organic Chemistry: Introductory Level (QFR)

This course provides the necessary background in organic chemistry for students who are planning advanced study or a career in chemistry, the biological sciences, or the health professions. It initiates the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. The fundamentals of molecular modeling as applied to organic molecules are presented. Specific topics include basic organic structure and bonding, isomerism, stereochemistry, molecular energetics, the theory and interpretation of infrared and nuclear magnetic spectroscopy, substitution and elimination reactions, and the addition reactions of alkenes and alkynes. The coordinated laboratory work includes purification and separation techniques, structure-reactivity studies, organic synthesis, IR and NMR spectroscopy, and the identification of unknown compounds.

Class Format: lecture three hours per week and laboratory four hours per week

Prerequisites: CHEM 151 or 153 or 155 or placement exam or permission of instructor

Enrollment Limit: 16/lab

Expected Class Size: 120

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Attributes: BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Kerry-Ann Green, Ben W. Thuronyi

CHEM 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

CHEM 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

Spring 2021

LEC Section: 01 TBA Katie M. Hart

CHEM 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

CSCI 134 (F)(S) Introduction to Computer Science (QFR)

This course introduces students to the science of computation by exploring the representation and manipulation of data and algorithms. We organize and transform information in order to solve problems using algorithms written in a modern object-oriented language. Topics include organization of data using objects and classes, and the description of processes using conditional control, iteration, methods and classes. We also begin the study of abstraction, self-reference, reuse, and performance analysis. While the choice of programming language and application area will vary in different offerings, the skills students develop will transfer equally well to more advanced study in many areas. In particular, this course is designed to provide the programming skills needed for further study in computer science and is expected to satisfy introductory programming requirements in other departments.

Class Format: Each lab section will meet only once per week, on either Monday or Tuesday.

Requirements/Evaluation: students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

Prerequisites: none, except for the standard prerequisites for a (QFR) course; previous programming experience is not required

Enrollment Limit: 30(10/lab)

Enrollment Preferences: if the course is over-enrolled, enrollment will be determined by lottery

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets, labs, and/or projects in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIGP Courses COGS Interdepartmental Electives

Fall 2020

LEC Section: 02 MWF 12:00 pm - 12:50 pm Daniel P. Aalberts

LEC Section: R1 MWF 9:20 am - 10:10 am Duane A. Bailey

LAB Section: R3 MR 1:30 pm - 2:45 pm Duane A. Bailey

LAB Section: R4 MR 1:30 pm - 2:45 pm Molly Q Feldman

LAB Section: R5 MR 3:15 pm - 4:30 pm Duane A. Bailey

LAB Section: R6 MR 3:15 pm - 4:30 pm Molly Q Feldman

LAB Section: R7 TR 9:45 am - 11:00 am Daniel P. Aalberts

LAB Section: R8 TF 3:15 pm - 4:30 pm Daniel P. Aalberts

Spring 2021

LEC Section: 01 TBA Molly Q Feldman, Duane A. Bailey

CSCI 136 (F)(S) Data Structures and Advanced Programming (QFR)

This course builds on the programming skills acquired in Computer Science 134. It couples work on program design, analysis, and verification with an introduction to the study of data structures. Data structures capture common ways in which to store and manipulate data, and they are important in the construction of sophisticated computer programs. Students are introduced to some of the most important and frequently used data structures: lists, stacks, queues, trees, hash tables, graphs, and files. Students will be expected to write several programs, ranging from very short programs to more elaborate systems. Emphasis will be placed on the development of clear, modular programs that are easy to read, debug, verify, analyze, and modify.

Class Format: Lecture content will be through asynchronously viewed video modules. Three scheduled (MWF) course sections will be used for synchronous conference meetings. Two sections will be in-person and one will be remote. There will be 5 scheduled weekly lab sections that will be remote. Students should sign up for the lecture section, one conference, and one lab.

Prerequisites: CSCI 134 or equivalent; fulfilling the Discrete Mathematics Proficiency requirement is recommended, but not required

Enrollment Limit: 60(12/lab)

Enrollment Preferences: if the course is over-enrolled, enrollment will be determined by lottery

Expected Class Size: 60

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets, labs, and/or projects in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIGP Courses

Fall 2020

CON Section: 03 MWF 10:40 am - 11:30 am Bill K. Jannen

LEC Section: R1 TBA Bill K. Jannen, William J. Lenhart

CON Section: R2 MWF 9:20 am - 10:10 am William J. Lenhart

CON Section: R4 MWF 12:00 pm - 12:50 pm William J. Lenhart

LAB Section: R5 R 1:00 pm - 2:30 pm William J. Lenhart

LAB Section: R6 R 1:00 pm - 2:30 pm Bill K. Jannen

LAB Section: R7 R 3:30 pm - 5:00 pm William J. Lenhart

LAB Section: R8 R 3:30 pm - 5:00 pm Bill K. Jannen

LAB Section: R9 R 8:30 pm - 10:00 pm Bill K. Jannen, William J. Lenhart

Spring 2021

LEC Section: 01 TBA Samuel McCauley, William J. Lenhart

CSCI 237 (F)(S) Computer Organization (QFR)

This course studies the basic instruction set architecture and organization of a modern computer. It provides a programmer's view of how computer systems execute programs, store information, and communicate. Over the semester the student learns the fundamentals of translating higher level languages into assembly language, and the interpretation of machine languages by hardware. At the same time, a model of computer hardware organization is developed from the gate level upward.

Class Format: There is no scheduled time for lectures. They will be available for asynchronous viewing. Each lab section will meet once per week, on either Tuesday or Wednesday. Students should sign up for lecture and one lab.

Prerequisites: CSCI 136

Enrollment Limit: 40(7/lab)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 40

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will consist of programming assignments and problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

LAB Section: 02 TF 1:30 pm - 2:45 pm Kelly A. Shaw

LAB Section: 03 TF 3:15 pm - 4:30 pm Kelly A. Shaw

LAB Section: 04 WF 1:30 pm - 2:45 pm Kelly A. Shaw

LAB Section: 05 MW 10:00 am - 11:15 am Kelly A. Shaw

LAB Section: 06 MWF 11:45 am - 1:00 pm Kelly A. Shaw

LEC Section: R1 TBA Kelly A. Shaw

LAB Section: R7 MWF 8:15 am - 9:30 am Kelly A. Shaw

Spring 2021

LEC Section: 01 TBA Kelly A. Shaw

CSCI 256 (F)(S) Algorithm Design and Analysis (QFR)

This course investigates methods for designing efficient and reliable algorithms. By carefully analyzing the structure of a problem within a mathematical framework, it is often possible to dramatically decrease the computational resources needed to find a solution. In addition, analysis provides a method for verifying the correctness of an algorithm and accurately estimating its running time and space requirements. We will study several algorithm design strategies that build on data structures and programming techniques introduced in Computer Science 136. These include induction, divide-and-conquer, dynamic programming, and greedy algorithms. Additional topics of study include algorithms on graphs and strategies for handling potentially intractable problems.

Class Format: Lectures will be simultaneously recorded in classroom and broadcast over Zoom. Office hours will be done over Zoom. Some additional course materials (examples, solutions, definitions and core concepts, etc.) may be provided as prerecorded videos.

Prerequisites: CSCI 136 and fulfillment of the Discrete Mathematics Proficiency requirement

Enrollment Limit: 20

Enrollment Preferences: Preference will be given to students who need the class in order to complete the major. Ties will be broken by seniority (seniors first, then juniors, etc.).

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will have weekly problem sets in which students will formally prove statements about the behavior and performance of algorithms. In short, the entirety of the course is about applying abstract and mathematical reasoning to the way computers work.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Samuel McCauley

Spring 2021

LEC Section: 01 TBA Shikha Singh

CSCI 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

CSCI 333 (S) Storage Systems (QFR)

This course will examine topics in the design, implementation, and evaluation of storage systems. Topics include the memory hierarchy; ways that data is organized (both logically and physically); storage hardware and its influence on storage software designs; data structures; performance models; and system measurement/evaluation. Readings will be taken from recent technical literature, and an emphasis will be placed on identifying and evaluating design trade-offs.

Prerequisites: CSCI 136; CSCI 237 or permission of instructor

Enrollment Limit: 40

Enrollment Preferences: current Computer Science majors, students with research experience or interest

Expected Class Size: 40

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will have students develop quantitative/formal reasoning skills through problem sets and programming assignments.

Spring 2021

LEC Section: 01 TBA Bill K. Jannen

CSCI 334 (F)(S) Principles of Programming Languages (QFR)

This course examines the concepts and structures governing the design and implementation of programming languages. It presents an introduction to the concepts behind compilers and run-time representations of programming languages; features of programming languages supporting abstraction and polymorphism; and the procedural, functional, object-oriented, and concurrent programming paradigms. Programs will be required in languages illustrating each of these paradigms.

Class Format: There is no scheduled time for lectures. They will be available online for asynchronous viewing. Each conference section will meet once per week, on either Monday or Tuesday. Students should sign up for lecture and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 20(5/conf)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets and labs in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

LEC Section: R1 TBA Stephen N. Freund

CON Section: R2 MW 10:00 am - 11:15 am Stephen N. Freund

CON Section: R3 MR 1:30 pm - 2:45 pm Stephen N. Freund

CON Section: R4 MR 3:15 pm - 4:30 pm Stephen N. Freund

CON Section: R5 TR 9:45 am - 11:00 am Stephen N. Freund

Spring 2021

LEC Section: 01 TBA Stephen N. Freund

CSCI 357 (F) Algorithmic Game Theory (QFR)

This course focuses on topics in game theory and mechanism design from a computational perspective. We will explore questions such as: how to design algorithms that incentivize truthful behavior, that is, where the participants have no incentive to cheat? Should we let drivers selfishly minimize their commute time or let a central algorithm direct traffic? Does Arrow's impossibility result mean that all voting protocols are doomed? The overarching goal of these questions is to understand and analyze selfish behavior and whether it can or should influence system design. Students will learn how to model and reason about incentives in computational systems both theoretically and empirically. Topics include types of equilibria, efficiency of equilibria, auction design, network games, two-sided markets, incentives in computational applications such as file sharing and cryptocurrencies, and computational social choice.

Class Format: Synchronous in-class lectures will be broadcast live to remote students via zoom and recorded for asynchronous viewing. Lecture content may additionally be supplemented with prerecorded videos, and scheduled class time used as exercise or review sessions.

Prerequisites: CSCI 256 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will consist problem sets and programming assignments in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

LEC Section: H1 TR 11:30 am - 12:45 pm Shikha Singh

CSCI 361 (F)(S) Theory of Computation (QFR)

Cross-listings: MATH 361 CSCI 361

Primary Cross-listing

This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory--the examination of what problems can be solved and what problems cannot be solved--and the study of complexity theory--the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: Lecture content will be through asynchronously viewed video modules. Two scheduled course sections will be used for synchronous conference meetings. One section (MR) will be in-person and the other section (TR) will be remote. Students should sign up for lecture and one conference.

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit: 20(10/sec)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 361 (D3) CSCI 361 (D3)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: COGS Interdepartmental Electives

Fall 2020

CON Section: 02 MR 1:30 pm - 2:45 pm Aaron M. Williams

LEC Section: R1 TBA Aaron M. Williams

CON Section: R3 TR 9:45 am - 11:00 am Aaron M. Williams

Spring 2021

LEC Section: 01 TBA Aaron M. Williams

CSCI 374 (F)(S) Machine Learning (QFR)

This tutorial examines the design, implementation, and analysis of machine learning algorithms. Machine Learning is a field that derives from Artificial Intelligence, Statistics, and others, and aims to develop algorithms that will improve a system's performance. Improvement might involve acquiring new factual knowledge from data, learning to perform a new task, or learning to perform an old task more efficiently or effectively. This tutorial will cover examples of supervised learning algorithms (including Bayesian approaches, support vector machines, and neural networks -- both deep and traditional), unsupervised learning algorithms (including k-means and expectation maximization), and possibly reinforcement learning algorithms (such as Q learning and temporal difference learning). It will also introduce methods for the evaluation of learning algorithms, as well as topics in computational learning theory and ethics.

Class Format: Though this course will be offered remotely by the instructor, pairs of students on campus may choose to meet in person for their tutorial sessions. If so, a classroom will be scheduled for them by the instructor.

Prerequisites: CSCI 136 and CSCI 256 or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: Computer Science majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course heavily relies on discrete mathematics, calculus, and elementary statistics. Students will be proving theorems, among many other mathematically oriented assignments. Additionally, they will be programming, which involves analytical and logical thinking.

Attributes: COGS Interdepartmental Electives

Fall 2020

TUT Section: HT1 TBA Andrea Danyluk

Spring 2021

TUT Section: T1 TBA Andrea Danyluk

CSCI 377 (F)(S) Human Work in Computational Systems (QFR)

Cross-listings: CSCI 377 STS 375

Primary Cross-listing

As far as we know, the technological singularity has not yet arrived. Therefore, humans remain a part of our current computation pipeline. However, the role humans play varies greatly: self-driving cars aim to have human involvement only in development and emergencies, whereas educational tools are built for constant human involvement. In this course, we broadly explore human work within computational systems through topics such as crowdsourcing, educational technology, citizen science, human computation, open-source software, micro-labor markets, and online gaming. Students should expect broad exposure to a wide variety of human computing topics and group projects on building and evaluating computational systems that use human work.

Class Format: Lectures will be held on Wednesday and Friday each week. Conference sections will each meet only once per week, on either Wednesday or Thursday. Students should sign up for the lecture section and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 18

Enrollment Preferences: Preference for current CS majors

Expected Class Size: 18

Grading: yes pass/fail option, no fifth course option

Materials/Lab Fee: $75 for purchase of software and work on crowdsourcing platforms.

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CSCI 377 (D3) STS 375 (D2)

Quantative/Formal Reasoning Notes: This course includes regular homework and projects in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

CON Section: 04 TR 9:45 am - 11:00 am Molly Q Feldman

CON Section: 05 TR 11:30 am - 12:45 pm Molly Q Feldman

LEC Section: H1 MWF 11:45 am - 1:00 pm Molly Q Feldman

CON Section: R2 W 1:30 pm - 2:20 pm Molly Q Feldman

CON Section: R3 W 2:50 pm - 3:40 pm Molly Q Feldman

Spring 2021

LEC Section: 01 TBA Molly Q Feldman

ECON 110 (F)(S) Principles of Microeconomics (QFR)

This course is an introduction to the study of the forces of supply and demand that determine prices and the allocation of resources in markets for goods and services, markets for labor, and markets for natural resources. The focus is on how and why markets work, why they may fail to work, and the policy implications of both their successes and failures. The course focuses on developing the basic tools of microeconomic analysis and then applying those tools to topics of popular or policy interest such as minimum wage legislation, pollution control, competition policy, international trade policy, discrimination, tax policy, and the role of government in a market economy.

Class Format: Sections taught by Professors Bradburd and Chao will be strictly remote, with both asynchronous and synchronous components. All other sections will be taught in a hybrid format and will include in-person elements.

Requirements/Evaluation: The department recommends students follow this course with ECON 120 or with a lower-level elective that has ECON 110 as its prerequisite; students may alternatively proceed directly to ECON 251 after taking this introductory course.

Prerequisites: none

Enrollment Limit: 30

Enrollment Preferences: This course is required of Economics and Political Economy majors and highly recommended for those non-majors interested in Environmental Studies and Women's, Gender and Sexuality Studies.

Expected Class Size: 30

Grading: yes pass/fail option, no fifth course option

Unit Notes: The department recommends students follow this course with ECON 120 or with a lower-level elective that has ECON 110 as its prerequisite; students may alternatively proceed directly to ECON 251 after taking this introductory course.

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Attributes: POEC Required Courses

Fall 2020

LEC Section: 05 TR 9:45 am - 11:00 am Susan Godlonton

LEC Section: 06 TR 11:30 am - 12:45 pm Susan Godlonton

LEC Section: R1 TF 1:30 pm - 2:45 pm Ralph M. Bradburd

LEC Section: R2 TF 3:15 pm - 4:30 pm Ralph M. Bradburd

LEC Section: R3 TR 6:45 pm - 8:00 pm Matthew Chao

LEC Section: R4 TR 8:30 pm - 9:45 pm Matthew Chao

LEC Section: R7 MR 1:30 pm - 2:45 pm Lucie Schmidt

LEC Section: R8 MR 3:15 pm - 4:30 pm Lucie Schmidt

Spring 2021

LEC Section: 01 TBA Ralph M. Bradburd, Owen Thompson

ECON 120 (F)(S) Principles of Macroeconomics (QFR)

This course provides an introduction to the study of the aggregate national economy. It develops the basic theories of macroeconomics and applies them to topics of current interest. Issues to be explored include: the causes of inflation, unemployment, recessions, and depressions; the role of government fiscal and monetary policy in stabilizing the economy; the determinants of long-run economic growth; the long- and short-run effects of taxes, budget deficits, and other government policies on the national economy; the role of financial frictions in amplifying recessions; and the workings of exchange rates and international finance.

Class Format: Fall semester sections will be entirely remote, with both asynchronous and synchronous components. Spring section formats are TBD.

Prerequisites: ECON 110

Enrollment Limit: 30

Enrollment Preferences: First-year students and sophomores.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Attributes: POEC Required Courses

Fall 2020

LEC Section: R1 MWF 8:00 am - 8:50 am Kenneth N. Kuttner

LEC Section: R2 MWF 12:00 pm - 12:50 pm Kenneth N. Kuttner

Spring 2021

LEC Section: 01 TBA Jon M. Bakija, Gregory P. Casey, Sara LaLumia

ECON 213 (F) Introduction to Environmental and Natural Resource Economics (QFR)

Cross-listings: ECON 213 ENVI 213

Primary Cross-listing

We'll use economics to learn why we harm the environment and overuse natural resources, and what we can do about it. We'll talk about whether and how we can put a dollar value on nature and ecosystem services. We'll study cost benefit analysis, pollution in general, climate change, environmental justice, natural resources (like fisheries, forests, and fossil fuels), and energy. We will take an economic approach to global sustainability, and study the relationship between the environment and economic growth and trade. Consideration of justice and equity will be woven through the whole semester.

Class Format: We will likely use small, focused discussion groups in combination with lectures

Requirements/Evaluation: this course will count toward both the Environmental Studies major and concentration

Prerequisites: ECON 110 or equivalent

Enrollment Limit: 25

Enrollment Preferences: first-year and sophomore students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this course will count toward both the Environmental Studies major and concentration

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 213 (D2) ENVI 213 (D2)

Quantative/Formal Reasoning Notes: We will use formal theory expressed in math and graphs, perform calculations, and consume statistical data.

Attributes: ENVI Environmental Policy EVST Social Science/Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: H1 MW 6:45 pm - 8:00 pm Sarah A. Jacobson

ECON 251 (F)(S) Price and Allocation Theory (QFR)

A study of the determination of relative prices and their importance in shaping the allocation of resources and the distribution of income. Subjects include: behavior of households in a variety of settings, such as buying goods and services, saving, and labor supply; behavior of firms in various kinds of markets; results of competitive and noncompetitive markets in goods, labor, land, and capital; market failure; government policies as sources of and responses to market failure; welfare criteria; limitations of mainstream analysis.

Class Format: Sections taught by Professors Jakiela and Sheppard in the fall will be strictly remote, with both asynchronous and synchronous components. Spring section formats are TBD.

Prerequisites: ECON 110 and MATH 130 or its equivalent

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves developing and analyzing mathematical models of real-world phenomena, grounded in tools like calculus and game theory. Students are assumed to be comfortable with topics from introductory calculus, including differentiation and integration.

Fall 2020

LEC Section: R1 TF 1:30 pm - 2:45 pm Pamela Jakiela

LEC Section: R2 TF 3:15 pm - 4:30 pm Pamela Jakiela

LEC Section: R3 MR 1:30 pm - 2:45 pm Stephen C. Sheppard

LEC Section: R4 MR 3:15 pm - 4:30 pm Stephen C. Sheppard

Spring 2021

LEC Section: 01 TBA Sarah A. Jacobson, Ashok S. Rai

ECON 252 (F)(S) Macroeconomics (QFR)

A study of aggregate economic activity: output, employment, inflation, and interest rates. The class will develop a theoretical framework for analyzing economic growth and business cycles. The theory will be used to evaluate policies designed to promote growth and stability, and to understand economic developments in the U.S. and abroad. Instructors may use elementary calculus in assigned readings, exams and lectures.

Class Format: Sections taught by Professor Pedroni in the fall will be strictly remote, with both asynchronous and synchronous components. Professor Montiel's fall section will be taught in person. Spring section formats are TBD.

Prerequisites: ECON 110 and 120 and MATH 130 or its equivalent

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Fall 2020

LEC Section: 01 MWF 8:15 am - 9:30 am Peter J. Montiel

LEC Section: R2 TF 1:30 pm - 2:45 pm Peter L. Pedroni

LEC Section: R3 TF 3:15 pm - 4:30 pm Peter L. Pedroni

Spring 2021

LEC Section: 01 TBA Kenneth N. Kuttner, Peter L. Pedroni, Greg Phelan

ECON 255 (F)(S) Econometrics (QFR)

An introduction to the theory and practice of applied quantitative economic analysis. This course familiarizes students with the strengths and weaknesses of the basic empirical methods used by economists to evaluate economic theory against economic data. Emphasizes both the statistical foundations of regression techniques and the practical application of those techniques in empirical research, with a focus on understanding when a causal interpretation is warranted. Computer exercises will provide experience in using the empirical methods, but no previous computer experience is expected. Highly recommended for students considering graduate training in economics or public policy.

Class Format: Professor Ozier's fall section will be strictly remote, with both asynchronous and synchronous components. Professor Zimmerman's fall section will be taught in a hybrid format and will include in-person elements. Spring section formats are TBD.

Requirements/Evaluation: Students may substitute the combination of STAT 201 and 346 for ECON 255

Prerequisites: MATH 130, plus STAT 161, 201 or 202 (or equivalent), plus one course in ECON; STAT 101 will also serve as a prerequisite, but only if taken prior to the fall of 2018

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics and Political Economy majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: Students may substitute the combination of STAT 201 and 346 for ECON 255

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course teaches research tools necessary to analyze data.

Attributes: EVST Methods Courses PHLH Statistics Courses POEC Required Courses

Fall 2020

LEC Section: 02 MWF 8:15 am - 9:30 am David J. Zimmerman

LEC Section: R1 TR 11:30 am - 12:45 pm Owen Ozier

LEC Section: R3 MR 3:15 pm - 4:30 pm Matthew Gibson

Spring 2021

LEC Section: 01 TBA Matthew Gibson, Owen Ozier, Tara E. Watson

ECON 360 (S) Monetary Economics (QFR)

This course covers a range of theoretical and applied issues bearing on monetary policy as conducted in the U.S. and abroad. Topics to be discussed include: What causes inflation? What are the channels through which monetary policy affects the economy? Why should central banks commit to policy rules? How do exchange rates respond to monetary policy? How did the gold standard work? And will cryptocurrencies replace the dollar? In addition, we will develop and learn how to simulate the "New Keynesian" macroeconomic model, which has become the standard framework for monetary policy analysis for central banks around the world.

Prerequisites: ECON 252 and 255. Multivariate calculus (MATH 150 or 151) is recommended but not required

Enrollment Limit: 20

Enrollment Preferences: junior and senior Economics majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course entails the use of mathematical economic models, the presentation of quantitative information, and the interpretation of statistical analysis.

Attributes: GBST Economic Development Studies Electives POEC International Political Economy Courses

Spring 2021

LEC Section: 01 TBA Kenneth N. Kuttner

ECON 376 (F) The Economics of Global Inequality (QFR)

This course focuses on the proximate and ultimate causes of global economic inequality across nations. Motivated by several stylized facts from cross-country data, we will pose a series of questions: Why are some countries so rich while others remain so poor? What explains heterogeneity in the experience of economic growth across nations, with some growing at a moderate pace over long periods of time, others experiencing rapid growth over shorter intervals, and yet others stagnating persistently? Do all economies face comparable challenges to achieving sustained economic growth?

Will poorer countries ever catch up to richer ones? To answer these and other related questions, we will explore the underlying mechanisms of economic growth. What role is played by savings and investment (i.e., the accumulation of physical capital)? What is the influence of population growth? How important are investments in human capital (i.e., education and population health)? What about technological differences across nations? How much significance should we ascribe to cross-country differences in geographical characteristics? How much should we ascribe to differences in the quality of institutions? For each question, we will explore both theoretical and empirical approaches, ranging from formal models to qualitative historical evidence to cross-country growth regressions. We will debate the usefulness of these different approaches for development policy and will discuss the reasons why so many questions about global economic inequality remain difficult to answer.

Class Format: This course will be taught in hybrid format in Fall 2020. All classroom lectures will be recorded and made available for remote learners unable to attend lectures virtually. Problem set assignments and exams may be submitted electronically as needed, and all exams will be "take home." Additional office hours will be offered to accommodate the needs of remote learners.

Prerequisites: ECON 252 and either ECON 255 or STAT 346. ECON 251 recommended but not required.

Enrollment Limit: 20

Enrollment Preferences: Junior and senior economics majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course material will draw heavily on mathematical and statistical models of economic growth and cross-country comparative development. Students will routinely work on sophisticated mathematical models of economic growth, involving the application of solution concepts from dynamic optimization and differential equations. Students will also be required to perform some econometric analyses in their assignments.

Attributes: GBST Economic Development Studies Electives

Fall 2020

LEC Section: H1 TF 1:30 pm - 2:45 pm Quamrul H. Ashraf

ECON 384 (F) Corporate Finance (QFR)

This course analyzes the major financial decisions facing firms. While the course takes the perspective of a manager making decisions about both what investments to undertake and how to finance these projects, it will emphasize the underlying economic models that are relevant for these decisions.Topics include capital budgeting, links between real and financial investments, capital structure choices, dividend policy, and firm valuation. Additional topics may include issues in corporate risk management, corporate governance and corporate restructuring, such as mergers and acquisitions. In the fall of 2020, special consideration will be given to how both financial and real economic shocks interact with firms' financial decisions.

Class Format: Lecture / discussion; in the fall of 2020, some weeks we will meet for one 75-minute section (in person when possible) and break into smaller groups for one hour section groups (most likely remote). The timing of the sections will be arranged at the beginning of the semester.

Prerequisites: ECON 251, 252, and some familiarity with statistics (e.g., ECON 255)

Enrollment Limit: 20

Enrollment Preferences: Senior Economics majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course uses quantitative models to evaluate decisions.

Fall 2020

LEC Section: 01 MW 6:45 pm - 8:00 pm William M. Gentry

LEC Section: R2 MWF 11:45 am - 1:00 pm William M. Gentry

ECON 387 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Primary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1 MR 1:30 pm - 2:45 pm Matthew Gibson

ECON 477 (F) Economics of Environmental Behavior (QFR)

Cross-listings: ECON 477 ENVI 376

Primary Cross-listing

A community maintains a fishery; a firm decides whether to get a green certification; you choose to fly home or stay here for spring break: behaviors of people and firms determine our impact on the environment. We'll use economics to model environmental behavior and to consider how policies can help or hurt the environment. Topics we'll study include: voluntary conservation, social norms and nudges, firm responses to mandatory and voluntary rules, and boycotts and divestment.

Class Format: Class sessions will largely consist of presentations and discussions of academic research papers, as well as lab sessions to work on empirical exercises; we may break the class into groups for some discussions

Prerequisites: ECON 251 and (ECON 255 or STAT 346)

Enrollment Limit: 15

Enrollment Preferences: senior Economics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 477 (D2) ENVI 376 (D2)

Quantative/Formal Reasoning Notes: The research students will consume and produce in the class will be based on math-based theory and/or econometric-based empirical analysis.

Attributes: ENVI Humanities, Arts + Social Science Electives MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

SEM Section: H1   MW 8:30 pm - 9:45 pm   Sarah A. Jacobson

ECON 522 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Secondary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1   MR 1:30 pm - 2:45 pm   Matthew Gibson

ENVI 203 (F) Ecology (QFR)

Cross-listings: ENVI 203 BIOL 203

Secondary Cross-listing

This course combines lectures with field and indoor laboratory exercises to explore factors that determine the distribution and abundance of plants and animals in natural systems. The course begins with an overall view of global patterns and then builds from the population to the ecosystem level. An emphasis is given to basic ecological principles and relates them to current environmental issues. Selected topics include population dynamics (competition, predation, mutualism); community interactions (succession, food chains and diversity) and ecosystem function (biogeochemical cycles, energy flow). In Fall 2020, the course will use a hybrid model, with recorded lecture material available to all students. In person and remote class meetings will focus on problem sets and interactive case studies. Labs will be available in either in person or remote modalities. Remote participants will have the opportunity to collect their own data for some lab exercises, while in other cases will receive background information and media describing the data collection process. All students will be required to complete all data analyses and written lab reports.

Class Format: Six hours per week. All labs will be available in both remote and in-person modalities. All students (whether in person or remote) may choose their preferred modality for each lab module. Due to COVID-19 distancing requirements, some labs will require walking to field sites. The instructor will work with individual students to identify accommodations that support in person lab participation as needed.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102, or ENVI 101 or 102, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: students planning to pursue Biology and/or ENVI

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 203 (D3) BIOL 203 (D3)

Quantative/Formal Reasoning Notes: Much of the material in this course centers on the interpretation and application of mathematical models used to describe ecological systems. The laboratory section of this course also contains a large data analysis component. Students are introduced to t-tests, Mann-Whitney U tests, chi-square analysis, and regression.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Living Systems Courses

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Allison L. Gill

LAB Section: H2 T 1:00 pm - 3:00 pm Allison L. Gill

LAB Section: H3 T 3:30 pm - 5:30 pm Allison L. Gill

ENVI 209 (F) Modern Climate (QFR)

Cross-listings: GEOS 309 ENVI 209

Secondary Cross-listing

What will happen to the Earth's climate in the next century? What is contributing to sea level rise? Is Arctic sea ice doomed? In this course we will study the components of the climate system (atmosphere, ocean, cryosphere, biosphere and land surface) and the processes through which they interact. Greenhouse gas emission scenarios will form the basis for investigating how these systems might respond to human activity. This course will explore how heat and mass are moved around the atmosphere and ocean to demonstrate how the geographic patterns of climate change arise. We will also focus on climate feedback effects--like the albedo feedback associated with sea ice and glacier loss--and how these processes can accelerate climate change. In labs we will learn MATLAB to use process and full-scale climate models to investigate the behavior of these systems in response to increasing greenhouse gasses in the atmosphere. This course is in the Oceans and Climate group for the Geosciences major.

Class Format: Lectures will be held synchronously online. Labs will be remote and in small groups. Lab groups will each meet online for two 1-hour sessions each week, scheduled according to the needs of the class. In-person office hours available.

Prerequisites: Any of GEOS 100, GEOS 103, ENVI 102, GEOS 215, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: GEOS and ENVI majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

GEOS 309 (D3) ENVI 209 (D3)

Quantative/Formal Reasoning Notes: Labs consist of a series of numerical climate modeling projects, which require significant quantitative and logical reasoning.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Methods Courses GEOS Group A Electives - Climate + Oceans

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Alice C. Bradley

ENVI 213 (F) Introduction to Environmental and Natural Resource Economics (QFR)

Cross-listings: ECON 213 ENVI 213

Secondary Cross-listing

We'll use economics to learn why we harm the environment and overuse natural resources, and what we can do about it. We'll talk about whether and how we can put a dollar value on nature and ecosystem services. We'll study cost benefit analysis, pollution in general, climate change, environmental justice, natural resources (like fisheries, forests, and fossil fuels), and energy. We will take an economic approach to global sustainability, and study the relationship between the environment and economic growth and trade. Consideration of justice and equity will be woven through the whole semester.

Class Format: We will likely use small, focused discussion groups in combination with lectures

Requirements/Evaluation: this course will count toward both the Environmental Studies major and concentration

Prerequisites: ECON 110 or equivalent

Enrollment Limit: 25

Enrollment Preferences: first-year and sophomore students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this course will count toward both the Environmental Studies major and concentration

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 213 (D2) ENVI 213 (D2)

Quantative/Formal Reasoning Notes: We will use formal theory expressed in math and graphs, perform calculations, and consume statistical data.

Attributes: ENVI Environmental Policy EVST Social Science/Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: H1 MW 6:45 pm - 8:00 pm Sarah A. Jacobson

ENVI 339 (F) Conservation Biology (QFR)

Cross-listings: ENVI 339 BIOL 329

Secondary Cross-listing

This course examines the application of population genetics, population ecology, community ecology, and systematics to the conservation of biological diversity. The overarching theme of the course is on the role of stochastic processes for small populations. Lecture/discussion topics will include extinction, the genetics of small populations, metapopulations, and importantly, conservation strategies. Labs will include a mixture of computer and lab projects.

Class Format: lecture and discussion, 3 hours per week; lab, 1.25 hours per week. students will be assigned to a lab section (block AA - either W or F from 1:30-2:45) during the first week of class.

Requirements/Evaluation: Satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 203/ENVI 203, or BIOL 305, or permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Biology majors, seniors, and juniors

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 339 (D3) BIOL 329 (D3)

Quantative/Formal Reasoning Notes: This course uses quantitative and statistical analyses in both the laboratory and lecture portion of the course. In lectures mathematical models will be covered to understand conservation dynamics. In lab, students will collect and analyze data and present results in graphical and statistical forms.

Attributes: ENVI Natural World Electives

Fall 2020

LEC Section: H1 TR 8:00 am - 9:15 am Manuel A. Morales

LAB Section: H2 WF 1:30 pm - 2:45 pm Manuel A. Morales

ENVI 376 (F) Economics of Environmental Behavior (QFR)

Cross-listings: ECON 477 ENVI 376

Secondary Cross-listing

A community maintains a fishery; a firm decides whether to get a green certification; you choose to fly home or stay here for spring break: behaviors of people and firms determine our impact on the environment. We'll use economics to model environmental behavior and to consider how policies can help or hurt the environment. Topics we'll study include: voluntary conservation, social norms and nudges, firm responses to mandatory and voluntary rules, and boycotts and divestment.

Class Format: Class sessions will largely consist of presentations and discussions of academic research papers, as well as lab sessions to work on empirical exercises; we may break the class into groups for some discussions

Prerequisites: ECON 251 and (ECON 255 or STAT 346)

Enrollment Limit: 15

Enrollment Preferences: senior Economics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 477 (D2) ENVI 376 (D2)

Quantative/Formal Reasoning Notes: The research students will consume and produce in the class will be based on math-based theory and/or econometric-based empirical analysis.

Attributes: ENVI Humanities, Arts + Social Science Electives MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

SEM Section: H1 MW 8:30 pm - 9:45 pm Sarah A. Jacobson

ENVI 387 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Secondary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1 MR 1:30 pm - 2:45 pm Matthew Gibson

GEOS 309 (F) Modern Climate (QFR)

Cross-listings: GEOS 309 ENVI 209

Primary Cross-listing

What will happen to the Earth's climate in the next century? What is contributing to sea level rise? Is Arctic sea ice doomed? In this course we will study the components of the climate system (atmosphere, ocean, cryosphere, biosphere and land surface) and the processes through which they interact. Greenhouse gas emission scenarios will form the basis for investigating how these systems might respond to human activity. This course will explore how heat and mass are moved around the atmosphere and ocean to demonstrate how the geographic patterns of climate change arise. We will also focus on climate feedback effects--like the albedo feedback associated with sea ice and glacier loss--and how these processes can accelerate climate change. In labs we will learn MATLAB to use process and full-scale climate models to investigate the behavior of these systems in response to increasing greenhouse gasses in the atmosphere. This course is in the Oceans and Climate group for the Geosciences major.

Class Format: Lectures will be held synchronously online. Labs will be remote and in small groups. Lab groups will each meet online for two 1-hour sessions each week, scheduled according to the needs of the class. In-person office hours available.

Prerequisites: Any of GEOS 100, GEOS 103, ENVI 102, GEOS 215, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: GEOS and ENVI majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

GEOS 309 (D3) ENVI 209 (D3)

Quantative/Formal Reasoning Notes: Labs consist of a series of numerical climate modeling projects, which require significant quantitative and logical reasoning.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Methods Courses GEOS Group A Electives - Climate + Oceans

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Alice C. Bradley

MATH 119 (F) The Mathematics of Pandemics: From the Spread of Infections to Cost-Benefit Analyses of Responses (QFR)

The goal of the class is to help students learn to ask the right questions, and to gather and analyze the data needed to answer them, to understand the covid pandemic and the worldwide responses. Through local experts and numerous guest speakers playing key roles in these problems, we will discuss numerous aspects, from mathematical models for virus propagation to analyzing the economic, educational, social and emotional consequences of lockdowns and social distancing; from moral and legal dilemnas created by the pandemic and responses to the international political scene and relations between countries. Offered as Math 119 or Math 312 (those taking as Math 312 will have some of the readings replaced with more technical modeling papers and subsequent homework). Pre-requisites: None for Math 119; for Math 312 linear algebra is recommended.

Prerequisites: none

Enrollment Limit: 30

Enrollment Preferences: all students will have an equal chance; if possible none will be turned away.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: We will discuss mathematical models and use statistics to analyze data.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Steven J. Miller

MATH 130 (F)(S) Calculus I (QFR)

Calculus permits the computation of velocities and other instantaneous rates of change by a limiting process called differentiation. The same process also solves "max-min" problems: how to maximize profit or minimize pollution. A second limiting process, called integration, permits the computation of areas and accumulations of income or medicines. The Fundamental Theorem of Calculus provides a useful and surprising link between the two processes. Subtopics include trigonometry, exponential growth, and logarithms.

Requirements/Evaluation: students who have previously taken a calculus course may not enroll in MATH 130 without the permission of instructor

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test); this is an introductory course for students who have not seen calculus before

Enrollment Limit: 30

Enrollment Preferences: first-year students

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students who have previously taken a calculus course may not enroll in MATH 130 without the permission of instructor

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This a calculus course.

Fall 2020

LEC Section: H1 TF 1:30 pm - 2:45 pm Lori A. Pedersen

LEC Section: H2 TF 3:15 pm - 4:30 pm Lori A. Pedersen

Spring 2021

LEC Section: 01 TBA Lori A. Pedersen

MATH 140 (F)(S) Calculus II (QFR)

Mastery of calculus requires understanding how integration computes areas and business profit and acquiring a stock of techniques. Further methods solve equations involving derivatives ("differential equations") for population growth or pollution levels. Exponential and logarithmic functions and trigonometric and inverse functions play an important role. This course is the right starting point for students who have seen derivatives, but not necessarily integrals, before.

Requirements/Evaluation: students who have higher advanced placement must enroll in MATH 150 or above

Prerequisites: MATH 130 or equivalent; students who have received the equivalent of advanced placement of AB 4, BC 3 or higher may not enroll in MATH 140 without the permission of instructor

Enrollment Limit: 30

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students who have higher advanced placement must enroll in MATH 150 or above

Distributions: (D3) (QFR)

Fall 2020

LEC Section: R1   TF 1:30 pm - 2:45 pm   Josh Carlson

LEC Section: R2   TF 3:15 pm - 4:30 pm   Josh Carlson

Spring 2021

LEC Section: 01   TBA   Josh Carlson

MATH 150 (F)(S) Multivariable Calculus (QFR)

Applications of calculus in mathematics, science, economics, psychology, the social sciences, involve several variables. This course extends calculus to several variables: vectors, partial derivatives, multiple integrals. There is also a unit on infinite series, sometimes with applications to differential equations. Note: This course will be taught via flipped-course method, an instructional strategy reversing the traditional learning environment by delivering instructional content outside of the classroom. This includes prerecorded lectures along with questions that students must watch and answer prior to attending class. Class time include synchronous meetings clarifying concepts and working in small groups through challenging problems with the support of the professor and peers. Building positive collaborative working relationships and public speaking skills will be added benefits of this course.

Requirements/Evaluation: students with the equivalent of advanced placement of AB 4 or above should enroll in MATH 150, students with a BC 3 or higher should enroll in Math 151 when it is being offered, and Math 150 otherwise.

Prerequisites: MATH 140 or equivalent, such as satisfactory performance on an Advanced Placement Examination

Enrollment Limit: 30

Enrollment Preferences: Professor's discretion

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with the equivalent of advanced placement of AB 4 or above should enroll in MATH 150, students with a BC 3 or higher should enroll in Math 151 when it is being offered, and Math 150 otherwise.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: mathematics

Fall 2020

SEM Section: R1   TR 8:00 am - 9:15 am   Pamela E. Harris

SEM Section: R2   TR 9:45 am - 11:00 am   Pamela E. Harris

SEM Section: R3   TR 11:30 am - 12:45 pm   Pamela E. Harris

Spring 2021

SEM Section: 01   TBA   Steven J. Miller

MATH 151 (F) Multivariable Calculus (QFR)

Applications of calculus in mathematics, science, economics, psychology, the social sciences, involve several variables. This course extends calculus to several variables: vectors, partial derivatives and multiple integrals. The goal of the course is Stokes Theorem, a deep and profound generalization of the Fundamental Theorem of Calculus. The difference between this course and MATH 150 is that MATH 150 covers infinite series instead of Stokes Theorem. Students with the equivalent of BC 3 or higher should enroll in MATH 151, as well as students who have taken the equivalent of an integral calculus and who have already been exposed to infinite series. For further clarification as to whether MATH 150 or MATH 151 is appropriate, please consult a member of the math/stat department.

Class Format: Hybrid; short lectures will be asynchronous, with longer synchronous in-person problem sessions (these will be available remotely, and uploaded later for asynchronous viewing)

Requirements/Evaluation: MATH 151 satisfies any MATH 150 prerequisite; credit will not be given for both MATH 150 and MATH 151

Prerequisites: AP BC 3 or higher or integral calculus with infinite series

Enrollment Limit: 30

Enrollment Preferences: First-years, sophomores, and juniors

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: MATH 151 satisfies any MATH 150 prerequisite; credit will not be given for both MATH 150 and MATH 151

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course builds quantitative skills

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Ralph E. Morrison

LEC Section: H2 MWF 10:40 am - 11:30 am Ralph E. Morrison

LEC Section: H3 MWF 12:00 pm - 12:50 pm Ralph E. Morrison

MATH 200 (F)(S) Discrete Mathematics (QFR)

This course will help you understand the world through a mathematical lens and will develop your powers of argumentation and critical thinking. We will explore and utilize diverse areas of discrete mathematics including logic, set theory, functions and relations, combinatorics, probability, networks, and more. We also will discuss methods and styles of mathematical proofs in order to prepare you for more advanced math courses. Finally, while mathematical knowledge is often perceived as being "pure," we will highlight some ways in which it is socially constructed and hence subject to human limitations and biases.

Class Format: To afford students flexibility during the COVID pandemic, this course is taught online. Students will watch lecture material asynchronously and will participate in a a once-per-week synchronous small-group tutorial meeting with the instructor via video chat.

Prerequisites: Calculus at the level of an AP course or Williams College Math 130 or 140. Students who have taken a 300-level or 400-level math course should obtain permission of the instructor before enrolling.

Enrollment Limit: 30

Enrollment Preferences: As determined by instructor.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course involve developing the formal mathematical language of logic and set theory. It also involves using quantitative tools to solve problems relating to combinatorics, probability, and other fields of discrete mathematics.

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Chad M. Topaz

LEC Section: R2 TR 11:30 am - 12:45 pm Chad M. Topaz

Spring 2021

LEC Section: 01 TBA Allison Pacelli

MATH 210 (S) Mathematical Methods for Scientists (QFR)

Cross-listings: PHYS 210 MATH 210

Secondary Cross-listing

This course covers a variety of mathematical methods used in the sciences, focusing particularly on the solution of ordinary and partial differential equations. In addition to calling attention to certain special equations that arise frequently in the study of waves and diffusion, we develop general techniques such as looking for series solutions and, in the case of nonlinear equations, using phase portraits and linearizing around fixed points. We study some simple numerical techniques for solving differential equations. A series of optional sessions in Mathematica will be offered for students who are not already familiar with this computational tool.

Class Format: three hours per week

Prerequisites: MATH 150 or 151 and familiarity with Newtonian mechanics at the level of PHYS 131

Enrollment Limit: 50

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 210 (D3) MATH 210 (D3)

Spring 2021

LEC Section: 01 TBA Frederick W. Strauch

MATH 250 (F)(S) Linear Algebra (QFR)

Many social, political, economic, biological, and physical phenomena can be described, at least approximately, by linear relations. In the study of systems of linear equations one may ask: When does a solution exist? When is it unique? How does one find it? How can one interpret it geometrically? This course develops the theoretical structure underlying answers to these and other questions and includes the study of matrices, vector spaces, linear independence and bases, linear transformations, determinants and inner products. Course work is balanced between theoretical and computational, with attention to improving mathematical style and sophistication.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely.

Prerequisites: MATH 150/151 or MATH 200

Enrollment Limit: 30

Enrollment Preferences: Students who have officially declared a major that requires Math 250.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: In this course, students will engage in both quantitative and formal reasoning.

Attributes: COGS Related Courses

Fall 2020

LEC Section: H1 TF 1:30 pm - 2:45 pm Susan R. Loepp

LEC Section: H2 TF 3:15 pm - 4:30 pm Susan R. Loepp

Spring 2021

LEC Section: 01 TBA John D. Wiltshire-Gordon

MATH 307 (S) Computational Linear Algebra (QFR)

Linear algebra is of central importance in the quantitative sciences, including application areas such as image and signal processing, data mining, computational finance, structural biology, and much more. When the problems must be solved computationally, approximation, round-off errors, convergence, and efficiency matter, and traditional linear algebra techniques may fail to succeed. We will adopt linear algebra techniques on a large scale, implement them computationally, and apply them to core problems in scientific computing. Topics may include: systems of linear and nonlinear equations; approximation and statistical function estimation; optimization; interpolation; and Monte Carlo techniques. This course could also be considered a course in numerical analysis or computational science.

Prerequisites: MATH 250, some elementary computer programming experience is strongly recommended

Enrollment Limit: 30

Enrollment Preferences: Professor's discretion

Expected Class Size: 25

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01   TBA   Chad M. Topaz

MATH 309 (F) Differential Equations (QFR)

Ordinary differential equations (ODE) frequently arise as models of phenomena in the natural and social sciences. This course presents core ideas of ODE from an applied standpoint. Topics covered early in the course may include numerical solutions, separation of variables, integrating factors, constant coefficient linear equations, and power series solutions. Later, we will focus on nonlinear ODEs, for which it is usually impossible to find analytical solutions. Tools from dynamical systems will be introduced to allow us to obtain some information about the behavior of the ODE without explicitly knowing the solution.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 150/151 and MATH 250

Enrollment Limit: 20

Enrollment Preferences: discretion of the instructor

Expected Class Size: 20

Grading: yes pass/fail option,   yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: 300-level mathematics course

Fall 2020

LEC Section: R1   TR 9:45 am - 11:00 am   Julie C. Blackwood

MATH 310 (F) Mathematical Biology (QFR)

Cross-listings: BIOL 210 MATH 310

Primary Cross-listing

This course will provide an introduction to the many ways in which mathematics can be used to understand, analyze, and predict biological dynamics. We will learn how to construct mathematical models that capture essential properties of biological processes while maintaining analytic tractability. Analytic techniques, such as stability and bifurcation analysis, will be introduced in the context of both continuous and discrete time models. Additionally, students will couple these analytic tools with numerical simulation to gain a more global picture of the biological dynamics. Possible biological applications include, but are not limited to, single and multi-species population dynamics, neural and biological oscillators, tumor cell growth, and infectious disease dynamics.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 250 and MATH 309, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: if over-enrolled, will have students submit reasons for taking class; preference to those with interest in both subjects

Expected Class Size: 20

Grading: no pass/fail option,   no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 210 (D3) MATH 310 (D3)

Quantative/Formal Reasoning Notes: The course will introduce methods for developing and analyzing mathematical models.

Attributes: PHLH Methods in Public Health

Fall 2020

LEC Section: R1   TR 11:30 am - 12:45 pm   Julie C. Blackwood

MATH 312 (F) The Mathematics of Pandemics: From the Spread of Infections to Cost-Benefit Analyses of Responses (QFR)

The goal of the class is to help students learn to ask the right questions, and to gather and analyze the data needed to answer them, to understand the covid pandemic and the worldwide responses. Through local experts and numerous guest speakers playing key roles in these problems, we will discuss numerous aspects, from mathematical models for virus propagation to analyzing the economic, educational, social and emotional consequences of lockdowns and social distancing; from moral and legal dilemnas created by the pandemic and responses to the international political scene and relations between countries. Offered as Math 119 or Math 312 (those taking as Math 312 will have some of the readings replaced with more technical modeling papers and subsequent homework). Pre-requisites: None for Math 119; for Math 312 linear algebra is recommended.

Prerequisites: Linear algebra recommended.

Enrollment Limit: none

Enrollment Preferences: all students will have an equal chance; if possible none will be turned away.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: We will discuss mathematical models and use statistics to analyze data.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Steven J. Miller

MATH 313 (S) Introduction to Number Theory (QFR)

The study of numbers dates back thousands of years, and is fundamental in mathematics. In this course, we will investigate both classical and modern questions about numbers. In particular, we will explore the integers, and examine issues involving primes, divisibility, and congruences. We will also look at the ideas of number and prime in more general settings, and consider fascinating questions that are simple to understand, but can be quite difficult to answer. This course will be using an active learning method, an instructional strategy reversing the traditional learning environment by supplying instructional content outside of the classroom. This will include reading the textbook and completing other assigned activities prior to attending class. Class time will be spent clarifying concepts and working in small groups through challenging problems with the support of the professor and peers. Building positive collaborative working relationships and public speaking skills will be added benefits of this class.

Class Format: This course will employ an active learning method rather than the traditional lecture. Please see the course description for details.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 40

Enrollment Preferences: All are welcome regardless of major or year. In case of over-enrollment, preference will be given to those needing the course for graduation.

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course requires working with various number systems, performing explicit computations, and proving mathematical results using logical reasoning practices.

Spring 2021

LEC Section: 01 TBA Eva Goedhart

MATH 315 (S) Methods for Solving Diophantine Equations (QFR)

A Diophantine equation is an equation with integer (or rational) coefficients that is to be solved in integers (or rational numbers). A focus of study for hundreds of years, Diophantine analysis remains a vibrant area of research. It has yielded a multitude of beautiful results and has wide ranging applications in other areas of mathematics, in cryptography, and in the natural sciences. In this project-based tutorial, we will focus on studying and implementing various methods for solving previously unsolved infinite families of Diophantine equations. Depending on their interests, students may choose one or several methods to apply to open problems in the field.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 10

Enrollment Preferences: Sophomores, Juniors, and Seniors based on a short questionnaire of interests.

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course requires working with various number systems, performing explicit computations, and proving mathematical results using logical reasoning practices.

Spring 2021

TUT Section: T1 TBA Eva Goedhart

MATH 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

MATH 334 (S) Graph Theory (QFR)

A graph is a collection of vertices, joined together by edges. In this course, we will study the sorts of structures that can be encoded in graphs, along with the properties of those graphs. We'll learn about such classes of graphs as multi-partite, planar, and perfect graphs, and will see applications to such optimization problems as minimum colorings of graphs, maximum matchings in graphs, and network flows.

Prerequisites: MATH 200 or MATH 250

Enrollment Limit: 35

Enrollment Preferences: Math majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Josh Carlson

MATH 341 (F)(S) Probability (QFR)

Cross-listings: STAT 341 MATH 341

Primary Cross-listing

While probability began with a study of games, it has grown to become a discipline with numerous applications throughout mathematics and the sciences. Drawing on gaming examples for motivation, this course will present axiomatic and mathematical aspects of probability. Included will be discussions of random variables, expectation, independence, laws of large numbers, and the Central Limit Theorem. Many interesting and important applications will also be presented, potentially including some from coding theory, number theory and nuclear physics.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Priority will be given to Stats majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

STAT 341 (D3) MATH 341 (D3)

Quantative/Formal Reasoning Notes: This is a 300-level Math/Stat course

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Stewart D. Johnson

Spring 2021

LEC Section: 01 TBA Mihai Stoiciu

MATH 350 (F)(S) Real Analysis (QFR)

Why is the product of two negative numbers positive? Why do we depict the real numbers as a line? Why is this line continuous, and what does that actually mean? More fundamentally, what is the definition of a real number? Real analysis addresses such questions, delving into the structure of real numbers and functions on them. Along the way we'll discuss sequences and limits, series, completeness, compactness, derivatives and integrals, and metric spaces. Results covered will include the Cantor-Schroeder-Bernstein theorem, the monotone convergence theorem, the Bolzano-Weierstrass theorem, the Cauchy criterion, Dirichlet's and Riemann's rearrangement theorem, the Heine-Borel theorem, the intermediate value theorem, and many others. This course is excellent preparation for graduate studies in mathematics, statistics, and economics.

Class Format: Discussion-based course held remotely.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Seniors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Fall 2020

LEC Section: R1 MR 3:15 pm - 4:30 pm Leo Goldmakher

Spring 2021

LEC Section: 01 TBA Stewart D. Johnson

MATH 351 (S) Applied Real Analysis (QFR)

Real analysis or the theory of calculus-derivatives, integrals, continuity, convergence--starts with a deeper understanding of real numbers and limits. Applications in the calculus of variations or "infinite-dimensional calculus" include geodesics, harmonic functions, minimal surfaces, Hamilton's action and Lagrange's equations, optimal economic strategies, nonEuclidean geometry, and general relativity. .

Prerequisites: MATH 150 and MATH 250, or permission of instructor

Enrollment Limit: 50

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Core mathematics major course with daily problem sets.

Spring 2021

LEC Section: 01 TBA Stewart D. Johnson

MATH 355 (F)(S) Abstract Algebra (QFR)

Algebra gives us tools to solve equations. The integers, the rationals, and the real numbers have special properties which make algebra work according to the circumstances. In this course, we generalize algebraic processes and the sets upon which they operate in order to better understand, theoretically, when equations can and cannot be solved. We define and study abstract algebraic structures such as groups, rings, and fields, as well as the concepts of factor group, quotient ring, homomorphism, isomorphism, and various types of field extensions. This course introduces students to abstract rigorous mathematics.

Class Format: Remote lectures. TA sessions will be held in person. If taken pass/fail, this course does not count towards the Mathematics major.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 24

Enrollment Preferences: Questionnaires.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: 300-level math course

Fall 2020

LEC Section: R1 MW 11:45 am - 1:00 pm Allison Pacelli

Spring 2021

LEC Section: 01 TBA Susan R. Loepp

MATH 361 (F)(S) Theory of Computation (QFR)

Cross-listings: MATH 361 CSCI 361

Secondary Cross-listing

This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory--the examination of what problems can be solved and what problems cannot be solved--and the study of complexity theory--the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: Lecture content will be through asynchronously viewed video modules. Two scheduled course sections will be used for synchronous conference meetings. One section (MR) will be in-person and the other section (TR) will be remote. Students should sign up for lecture and one conference.

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit: 20(10/sec)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 361 (D3) CSCI 361 (D3)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: COGS Interdepartmental Electives

Fall 2020

CON Section: 02 MR 1:30 pm - 2:45 pm Aaron M. Williams

LEC Section: R1 TBA Aaron M. Williams

CON Section: R3 TR 9:45 am - 11:00 am Aaron M. Williams

Spring 2021

LEC Section: 01 TBA Aaron M. Williams

MATH 374 (S) Topology (QFR)

In Real Analysis you learned about metric spaces -- any set of objects endowed with a way of measuring distance -- and the topology of sets in such spaces (open, closed, bounded, etc). In this course we flip this on its head: we explore how to develop analysis (limits, continuity, etc) in spaces where the topology is known but the metric is not. This will lead us to a bizarre and fascinating version of geometry in which we cannot distinguish between shapes that can be continuously deformed into one another. Not only does this theory turn out to be beautiful in the abstract, it has become a vital part of data analysis and is also connected to many areas of math and physics. This course is excellent preparation for graduate programs in mathematics.

Prerequisites: MATH 350 or 351; not open to students who have taken MATH 323. Familiarity with basic group theory recommended, but not required.

Enrollment Limit: 30

Enrollment Preferences: Juniors and seniors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Spring 2021

LEC Section: 01 TBA Leo Goldmakher

MATH 391 (F) Introduction to computer algebra (QFR)

Students will learn new mathematics in the context of computer-based exposition, experimentation, and interaction. They will gain proficiency with Sage, GAP, Macaulay2, or Mathematica, and possibly one of the more-specialized systems SnapPea, kenzo, magma, MATLAB, Perseus, coq, etc. Individuals and teams will build interactive demonstrations of mathematical theorems, which will then be appreciated by the instructor and the rest of the class. No prior programming experience is expected.

Class Format: Class will be held online, but there will be recorded components, asynchronous interactive components, and outside-of-class small-group online meetings.

Prerequisites: Math 355 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: math majors

Expected Class Size: 15

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Mathematical programming requires complete synthesis of abstract concepts to produce computer code, which is necessarily formal.

Fall 2020

LEC Section: R1 TR 6:45 pm - 8:00 pm John D. Wiltshire-Gordon

MATH 392 (S) Undergraduate Research Topics in Graph Theory (QFR)

Graph theory is a vibrant area of research with many applications to the social sciences, psychology, and economics. In this tutorial we focus on two topics of mathematical research in graph theory: evasion-pursuit games on graphs and domination theory. Students in this project-based tutorial will select among the presented topics, and will begin original research on an open problem in the field. Student assessment is based on problem sets, drafts of research project manuscript, and a final oral class presentation.

Prerequisites: MATH 355 or permission of the instructor

Enrollment Limit: 10

Enrollment Preferences: programming experience, students with interests in the intersection of combinatorics and graph theory

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

TUT Section: T1 TBA Pamela E. Harris

MATH 402 (F) Measure Theory and Hilbert Spaces (QFR)

How large is the unit square? One might measure the number of individual points in the square (uncountably infinite), the area of the square (1), or the dimension of the square (2). But what about for more complicated sets, e.g., the set of all rational points in the unit square? What's the area of this set? What's the dimension? In this course we'll come up with precise ways to measure size -- length, area, volume, dimension -- that apply to a broad array of sets. Along the way we'll encounter Lebesgue measure and Lebesgue integration, Hausdorff measure and fractals, space-filling curves and the Banach-Tarski paradox. We will also investigate Hilbert spaces, mathematical objects that combine the tidiness of linear algebra with the power of analysis and are fundamental to the study of differential equations, functional analysis, harmonic analysis, and ergodic theory, and also apply to fields like quantum mechanics and machine learning. This material provides good preparation for graduate studies in mathematics, statistics and economics.

Class Format: Discussion-based course held remotely.

Prerequisites: MATH 350 or MATH 351 or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Seniors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Fall 2020

LEC Section: R1 TF 3:15 pm - 4:30 pm Leo Goldmakher

MATH 408 (F) L-Functions and Sphere Packing (QFR)

Optimal packing problems arise in many important problems, and have been a source of excellent mathematics for centuries. The Kepler Problem (what is the most efficient way to pack balls in three-space) is a good example. The original formulation has been used in such diverse areas as stacking cannonballs on battleships to grocers preparing fruit displays, and its generalizations allow the creation of powerful error detection and correction codes. While the solution of the Kepler Problem is now known, the higher dimensional version is very much open. There has been remarkable progress in the last few years, with number theory playing a key role in these results. We will develop sufficient background material to understand many of these problems and the current state of the field. Pre-requisites are real analysis.

Prerequisites: Math 350 or 351

Enrollment Limit: 40

Enrollment Preferences: Senior math majors, students planning on graduate study in a STEM field

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400 level math class

Fall 2020

LEC Section: H1 MWF 12:00 pm - 12:50 pm Steven J. Miller

MATH 420 (S) Analytic Number Theory (QFR)

How many primes are smaller than x? How many divisors does an integer n have? How many different numbers appear in the N x N multiplication table? Over the course of the past 150 years, tremendous progress has been made towards resolving these and similar questions in number theory, relying on tools and methods from analysis. The goal of this tutorial is to explain and motivate the ubiquitous appearance of analysis in modern number theory--a surprising fact, given that analysis is concerned with continuous functions, while number theory is concerned with discrete objects (integers, primes, divisors, etc). Topics to be covered include: asymptotic analysis, partial and Euler-Maclaurin summation, counting divisors and Dirichlet's hyperbola method, the randomness of prime factorization and the Erdos-Kac theorem, the partition function and the saddle point method, the prime number theorem and the Riemann zeta function, primes in arithmetic progressions and Dirichlet L-functions, the Goldbach conjecture and the circle method, gaps between primes, and other topics as time and interest allow.

Prerequisites: MATH 350 or MATH 351 and familiarity with basic modular arithmetic are hard prerequisites. Familiarity with complex analysis and abstract algebra recommended, but not required.

Enrollment Limit: 10

Enrollment Preferences: Those with complex analysis background will be given priority.

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Spring 2021

TUT Section: T1 TBA Leo Goldmakher

MATH 433 (S) Mathematical Modeling (QFR)

Mathematical modeling means (1) translating a real-life problem into a mathematical object, and (2) studying that object using mathematical techniques, and (3) interpreting the results in order to learn something about the real-life problem. Mathematical modeling is used in biology, economics, chemistry, geology, sociology, political science, art, and countless other fields. This is an advanced, seminar-style, course appropriate for students who have a strong enthusiasm for applied mathematics.

Class Format: discussion, research

Prerequisites: MATH 250, MATH 309 or similar, and some experience with computer programming (equivalent to CSCI 134 or MATH 307)

Enrollment Limit: 24

Enrollment Preferences: Professor's discretion

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Chad M. Topaz

MATH 434 (F) Applied Dynamics and Optimal Control (QFR)

We seek to understand how dynamical systems evolve, how that evolution depends on the various parameters of the system, and how we might manipulate those parameters to optimize an outcome. We will explore the language of dynamics by deepening our understanding of differential and difference equations, study parameter dependence and bifurcations, and explore optimal control through Pontryagin's maximum principle and Hamilton-Jacobi-Bellman equations. These tools have broad application in ecology, economics, finance, and engineering, and we will draw on basic models from these fields to motivate our study.

Prerequisites: MATH 209 or PHYS 210, and MATH 350 or 351, or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Preference will be given to senior math majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400 level math course.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Stewart D. Johnson

MATH 456 (F) Representation Theory (QFR)

Representation theory has applications in fields such as physics (via models for elementary particles), engineering (considering symmetries of structures), and even in voting theory (voting for committees in agreeable societies). This course will introduce the concepts and techniques of the representation theory of finite groups, and will focus on the representation theory of the symmetric group. We will undertake this study through a variety of perspectives, including general representation theory, combinatorial algorithms, and symmetric functions.

Prerequisites: MATH 355

Enrollment Limit: 40

Enrollment Preferences: junior and senior Math majors

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400-level Math course.

Fall 2020

LEC Section: R1   TF 1:30 pm - 2:45 pm   John D. Wiltshire-Gordon

MATH 474 (S) Tropical Geometry (QFR)

This course offers an introduction to tropical geometry, a young subject that has already established deep connections between itself and pure and applied mathematics. We will study a rich variety of objects arising from polynomials over the min-plus semiring, where addition is defined as taking a minimum, and multiplication is defined as usual addition. We will learn how these polyhedral objects connect to other areas of mathematics like algebraic geometry, and how they can be applied to solve problems in scheduling theory, phylogenetics, and other diverse fields.

Prerequisites: MATH 355 or permission of instructor

Enrollment Limit: 25

Enrollment Preferences: senior Math majors

Expected Class Size: 15

Grading: no pass/fail option,   no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course builds quantitative skills

Spring 2021

LEC Section: 01   TBA   Ralph E. Morrison

PHYS 131 (F) Introduction to Mechanics (QFR)

We focus first on the Newtonian mechanics of point particles: the relationship between velocity, acceleration, and position; the puzzle of circular motion; forces, Newton's laws, and gravitation; energy and momentum; and the physics of vibrations. Then we turn to the basic properties of waves, such as interference and refraction, as exemplified by sound and light waves. We also study the optics of lenses, mirrors and the human eye. This course is not intended for students who have successfully completed an AP physics course in high school.

Class Format: hybrid

Requirements/Evaluation: PHYS 131 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Prerequisites: MATH 130; students who scored 4 or 5 on an AP physics exam, or 6 or 7 on the IB Physics HL exam may not take this course and are encouraged to take PHYS 141 instead

Enrollment Limit: 30

Enrollment Preferences: seniority

Expected Class Size: 60

Grading: yes pass/fail option,   yes fifth course option

Unit Notes: PHYS 131 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This class will have weekly problem sets requiring substantial quantitative reasoning

Fall 2020

LEC Section: H1   MWF 8:00 am - 8:50 am   Graham K. Giovanetti

LAB Section: H2   M 1:00 pm - 3:00 pm   Graham K. Giovanetti

LAB Section: H3   W 1:00 pm - 3:00 pm   Graham K. Giovanetti

PHYS 132 (S) Electromagnetism and the Physics of Matter (QFR)

This course is intended as the second half of a one-year survey of physics with some emphasis on applications to medicine. In the first part of the semester we will focus on electromagnetic phenomena. We will introduce the concept of electric and magnetic fields and study in detail the way in which electrical circuits and circuit elements work. The deep connection between electric and magnetic phenomena is highlighted with a discussion of Faraday's Law of Induction. Following our introduction to electromagnetism we will discuss some of the most central topics in twentieth-century physics, including Einstein's theory of special relativity and some aspects of quantum theory. We will end with a treatment of nuclear physics, radioactivity, and uses of radiation.

Class Format: lecture three hours per week, laboratory three hours approximately every other week, and conference section 1 hour approximately every other week

Prerequisites: PHYS 131 or 141 or permission of instructor, and MATH 130 (formerly 103)

Enrollment Limit: 22 per lab

Expected Class Size: 60

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Henrik Ronellenfitsch

PHYS 141 (F) Mechanics and Waves (QFR)

This is the typical first course for a prospective physics major. It covers most of the same topics as PHYS 131, but with a higher level of mathematical sophistication. It is intended for students with solid backgrounds in the sciences, either from high school or college, who are comfortable with basic calculus.

Class Format: This will be a hybrid course with both recorded and in-person lecture/demonstration material, both "at home" and in-person hands-on/laboratory exercises, problem-solving group sessions and office hours (available both in person and remote), as well as several short tests/quizzes and a final exam.

Requirements/Evaluation: PHYS 141 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Prerequisites: high school physics and MATH 130 or equivalent placement, or permission of the instructor

Enrollment Limit: 30

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: PHYS 141 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course consists of lectures, problem-solving conferences, lab exercises, problem sets and exams, all of which have a substantial quantitative component.

Fall 2020

LEC Section: H1 TR 9:45 am - 11:00 am Protik K. Majumder

LAB Section: H2 M 1:00 pm - 3:00 pm Kevin M. Jones

LAB Section: H3 T 1:00 pm - 3:00 pm Kevin M. Jones

LAB Section: H4 W 1:00 pm - 3:00 pm Kevin M. Jones

LAB Section: H5 M 3:30 pm - 5:30 pm Kevin M. Jones

PHYS 142 (S) Foundations of Modern Physics (QFR)

Newtonian Mechanics, spectacular as it is in describing planetary motion and a wide range of other phenomena, only hints at the richness of behaviors seen in the universe. Special relativity, which extends physics into the realm of high speeds and high energies, requires we rethink our basic notions of space and time. Quantum mechanics successfully describes atoms, molecules, and solids while at the same time calling into question our expectation of what can be predicted by a physical theory. Statistical physics reveals new behaviors that emerge when many particles are present in a system. This course will survey ideas from each of these three arenas, and can serve either as a terminal course for those seeking to complete a year of physics or as the basis for future advanced study of these topics.

Class Format: lecture, two hours weekly; problem-solving conference session, one hour weekly; laboratory, 2-3 hours most weeks, alternating between 'hands-on' and computational sessions (limit 22 per lab, 18 per conference section)

Prerequisites: PHYS 141 and MATH 130, or equivalent; PHYS 131 may substitute for PHYS 141 with the permission of instructor; students may not take both PHYS 142 and PHYS 151

Enrollment Limit: 18 per CON

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Heavily problem-solving focused, involving algebraic manipulations, single-variable calculus, generating and reading graphs, etc.

Spring 2021

LEC Section: 01 TBA Charlie Doret

PHYS 151 (F) Seminar in Modern Physics (QFR)

Newtonian Mechanics, spectacular as it is in describing planetary motion and a wide range of other phenomena, only hints at the richness of behaviors seen in the universe. Special relativity has extended physics into the realm of high speeds and high energies and requires us to rethink our basic notions of space and time. Quantum mechanics successfully describes atoms, molecules, and solids while at the same time calling into question our notions of what can be predicted by a physical theory. Statistical physics reveals new behaviors that emerge when many particles are present in a system. This course covers the same basic material as PHYS 142 but in a small seminar format for students with strong prior preparation in physics.

Class Format: This will be a hybrid course format, with some online and some in-person components. All in-person components will have a remote option. Lecture 3 hours per week (synchronous interactive video or in-person), Laboratory/Conference section 2.5 hours per week (synchronous interactive video or in-person). Compared to previous years, some of the laboratory activities in the course will be replaced by assignments that can be completed remotely.

Requirements/Evaluation: this is a small seminar designed for first-year students who have placed out of PHYS 141

Prerequisites: placement by the department (see "advanced placement" section in the description about the department). Students may take either PHYS 142 or PHYS 151 but not both

Enrollment Limit: 18

Enrollment Preferences: first-years

Expected Class Size: 18

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this is a small seminar designed for first-year students who have placed out of PHYS 141

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: besides the final paper, all assignments in the course have a substantial quantitative component

Fall 2020

LEC Section: H1 MWF 12:00 pm - 12:50 pm Catherine Kealhofer

LAB Section: H2 MR 1:30 pm - 2:45 pm Catherine Kealhofer

LAB Section: H3 MR 3:15 pm - 4:30 pm Catherine Kealhofer

PHYS 201 (F) Electricity and Magnetism (QFR)

The classical theory of electricity and magnetism is very rich yet it can be written in a remarkably succinct form using Maxwell's equations. This course is an introduction to electricity and magnetism and their mathematical description, connecting electric and magnetic phenomena via the special theory of relativity. Topics include electrostatics, magnetic fields, electromagnetic induction, DC and AC circuits, and the electromagnetic properties of matter. The laboratory component of the course is an introduction to electronics where students will develop skills in building and debugging electrical circuits.

Class Format: Hybrid: online with some in-person components. All in-person components will have a remote option. Lecture: three hours per week. Laboratory/conference section: two hours per week.

Prerequisites: PHYS 142 OR 151; MATH 150 or 151; with a preference for MATH 151

Enrollment Limit: 10 per lab

Enrollment Preferences: prospective physics majors, then by seniority

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am David R. Tucker-Smith

LAB Section: H2 T 1:00 pm - 3:00 pm David R. Tucker-Smith

LAB Section: H3 W 1:00 pm - 3:00 pm David R. Tucker-Smith

LAB Section: H4 T 3:30 pm - 5:30 pm David R. Tucker-Smith

PHYS 202 (S) Vibrations, Waves and Optics (QFR)

Waves and oscillations characterize many different physical systems, including vibrating strings, springs, water waves, sound waves, electromagnetic waves, and gravitational waves. Quantum mechanics even describes particles with wave functions. Despite these diverse settings waves exhibit several common characteristics, so that the understanding of a few simple systems can provide insight into a wide array of phenomena. In this course we begin with the study of oscillations of simple systems with only a few degrees of freedom. We then move on to study transverse and longitudinal waves in continuous media in order to gain a general description of wave behavior. The rest of the course focuses on electromagnetic waves and in particular on optical examples of wave phenomena. In addition to well known optical effects such as interference and diffraction, we will study a number of modern applications of optics such as short pulse lasers and optical communications. Throughout the course mathematical methods useful for higher-level physics will be introduced.

Class Format: lecture three hours per week and laboratory three hours per week

Prerequisites: PHYS 201; co-requisite: PHYS/MATH 210 or MATH 209 or permission of instructor

Enrollment Limit: none

Enrollment Preferences: none

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Graham K. Giovanetti

PHYS 210 (S) Mathematical Methods for Scientists (QFR)

Cross-listings: PHYS 210 MATH 210

Primary Cross-listing

This course covers a variety of mathematical methods used in the sciences, focusing particularly on the solution of ordinary and partial differential equations. In addition to calling attention to certain special equations that arise frequently in the study of waves and diffusion, we develop general techniques such as looking for series solutions and, in the case of nonlinear equations, using phase portraits and linearizing around fixed points. We study some simple numerical techniques for solving differential equations. A series of optional sessions in Mathematica will be offered for students who are not already familiar with this computational tool.

Class Format: three hours per week

Prerequisites: MATH 150 or 151 and familiarity with Newtonian mechanics at the level of PHYS 131

Enrollment Limit: 50

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 210 (D3) MATH 210 (D3)

Spring 2021

LEC Section: 01 TBA Frederick W. Strauch

PHYS 301 (F) Quantum Physics (QFR)

This course serves as a one-semester introduction to the formalism, and phenomenology of quantum mechanics. After a brief discussion of historical origins of the quantum theory, we introduce the Schrodinger wave equation, the concept of matter waves, and wave-packets. With this introduction as background, we will continue our discussion with a variety of one-dimensional problems such as the particle-in-a-box and the harmonic oscillator. We then extend this work to systems in two and three dimensions, including a detailed discussion of the structure of the hydrogen atom. Along the way we will develop connections between mathematical formalism and physical predictions of the theory. Finally, we conclude the course with a discussion of angular momentum and spins, with applications to atomic physics, entanglement, and quantum information.

Class Format: Phys 301 will be taught in a hybrid format, with in-person and remote elements. Remote options will be available for in-person components. Lecture will meet for 3 hours weekly, with synchronous elements wherever feasible (either in-person or via videoconference). Laboratories will meet for 2 hours weekly, with some additional individual preparation required, with laboratory groups being mixed between in-person and remote students.

Prerequisites: PHYS 202 and PHYS/MATH 210 or MATH 309

Enrollment Limit: 20

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Phys 301 relies heavily upon mathematics and quantitative reasoning in all elements, including problem sets, examinations, and laboratories.

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Charlie Doret

LAB Section: H2 T 1:00 pm - 3:00 pm Charlie Doret

LAB Section: H3 W 1:00 pm - 3:00 pm Charlie Doret

PHYS 302 (S) Stat Mechanics & Thermodynamics (QFR)

Macroscopic objects are made up of huge numbers of fundamental particles interacting in simple ways--obeying the Schrõdinger equation, Newton's and Coulomb's Laws--and these objects can be described by macroscopic properties like temperature, pressure, magnetization, heat capacity, conductivity, etc. In this course we will develop the tools of statistical physics, which will allow us to predict the cooperative phenomena that emerge in large ensembles of interacting particles. We will apply those tools to a wide variety of physical questions, including the behavior of gases, polymers, heat engines, biological and astrophysical systems, magnets, and electrons in solids.

Class Format: lecture/discussion three hours per week and laboratory three hours per week

Prerequisites: required: PHYS 201, PHYS/MATH 210 or MATH 209; recommended: PHYS 202, PHYS 301

Enrollment Limit: 10 per lab

Expected Class Size: 10 per lab

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Attributes: BIGP Courses

Spring 2021

LEC Section: 01 TBA Daniel P. Aalberts

PHYS 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

PHYS 321 (S) Introduction to Particle Physics (QFR)

The Standard Model of particle physics incorporates special relativity, quantum mechanics, and almost all that we know about elementary particles and their interactions. This course introduces some of the main ideas and phenomena associated with the Standard Model. After a review of relativistic kinematics, we will learn about symmetries in particle physics, Feynman diagrams, and selected applications of quantum electrodynamics, the weak interactions, and quantum chromodynamics. We will conclude with a discussion of spontaneous symmetry breaking and the Higgs mechanism.

Class Format: three hours a week

Prerequisites: PHYS 301, which may be taken concurrently, plus permission of instructor

Enrollment Limit: 15

Enrollment Preferences: 1. Students that have taken Phys 301. 2. By seniority.

Expected Class Size: 10

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA David R. Tucker-Smith

PHYS 402 (S) Applications of Quantum Mechanics (QFR)

This course will explore a number of important topics in the application of quantum mechanics to physical systems, including perturbation theory, the variational principle and the semiclassical interaction of atoms and radiation. The course will finish up with three weeks on quantum optics including an experimental project on non-classical interference phenomena. Applications and examples will be taken mostly from atomic physics with some discussion of solid state systems.

Prerequisites: PHYS 301

Enrollment Limit: 10 per sec

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

TUT Section: T1 TBA Catherine Kealhofer

PHYS 411 (F) Classical Mechanics (QFR)

This course will explore advanced topics in classical mechanics including the calculus of variations, the Lagrangian and Hamiltonian formulations of mechanics, phase space, non-linear dynamics and chaos, central-force motion, non-inertial reference frames (including implications for physics on a rotating Earth), and rigid-body rotations. Numerical and perturbative techniques will be developed and used extensively. We will also examine the ways in which classical mechanics informs other fields of physics. In addition to weekly tutorial meetings the class with will meet once a week as a whole to discuss new material.

Class Format: hybrid

Prerequisites: PHYS 202 and PHYS/MATH 210 or MATH 209

Enrollment Limit: 10/section

Enrollment Preferences: majors

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: weekly problem sets requiring substantial quantitative reasoning using analytical and numerical methods.

Fall 2020

TUT Section: HT1 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

TUT Section: HT2 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

TUT Section: HT3 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

POEC 253 (F) Empirical Methods in Political Economy (QFR)

This course introduces students to common empirical tools used in policy analysis and implementation. The broad aim is to train students to be discriminating consumers of public policy-relevant research. The emphasis in the course is on intuitive understanding of the central concepts. Through hands-on work with data and critical assessment of existing empirical social scientific research, students will develop the ability to choose and employ the appropriate tool for a particular research problem, and to understand the limitations of the techniques. Topics to be covered include basic principles of probability; random variables and distributions; statistical estimation, inference and hypothesis testing; and modeling using multiple regression, with a particular focus on understanding whether and how relationships between variables can be determined to be causal--an essential requirement for effective policy formation. Throughout the course, the focus will be on public policy applications relevant to the fields of political science, sociology, and public health, as well as to economics.

Class Format: The class will be remote. I will present the material using a mix of synchronous and asynchronous methods. We will use the synchronous time for discussion and Q and A as well.

Requirements/Evaluation: does not satisfy the econometrics requirement for the Economics major; POEC 253 cannot be substituted for ECON 255, or count as an elective towards the Economics major

Prerequisites: MATH 130 or its equivalent; one course in ECON; not open to students who have taken ECON 255

Enrollment Limit: 20

Enrollment Preferences: Political Economy majors, Environmental Policy majors and sophomores

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the econometrics requirement for the Economics major; POEC 253 cannot be substituted for ECON 255, or count as an elective towards the Economics major

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course teaches econometrics, i.e. statistics as economists use it, with applications in economics and political science.

Attributes: EVST Methods Courses PHLH Statistics Courses POEC Required Courses

Fall 2020

LEC Section: R1 TR 11:30 am - 12:45 pm Anand V. Swamy

PSYC 201 (F)(S) Experimentation and Statistics (QFR)

An introduction to the basic principles of research in psychology. We focus on how to design and execute experiments, analyze and interpret results, and write research reports. Students conduct a series of research studies in different areas of psychology that illustrate basic designs and methods of analysis.

Class Format: Prof. Savitsky's section will be taught remotely. Synchronous lectures and lab meetings will be recorded for those who can't attend but synchronous participation is preferred, especially in lab. In Prof. Cone's section, many lectures will be held via synchronous, remote gatherings. Periodically, students who can meet in person will gather for discussions, problem solving sessions, and lab work with others joining remotely. You must register for lab and lecture with the same instructor.

Prerequisites: PSYC 101; not open to first-year students except with permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Psychology majors

Expected Class Size: 12

Grading: no pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: This course has weekly problem sets focused on experimental design and quantitative data analysis. Students will design and conduct several experiments, analyze the data, and report their findings.

Attributes: COGS Related Courses PHLH Statistics Courses

Fall 2020

LEC Section: H1 MW 10:00 am - 11:15 am Jeremy D. Cone

LAB Section: H2 T 1:00 pm - 3:00 pm Jeremy D. Cone

LEC Section: R3 MW 10:00 am - 11:15 am Kenneth K. Savitsky

LAB Section: R4 W 1:00 pm - 3:00 pm Kenneth K. Savitsky

Spring 2021

LEC Section: 01 TBA Catherine B. Stroud, Noah J. Sandstrom, Jeremy C Simon

STAT 101 (F)(S) Elementary Statistics and Data Analysis (QFR)

It is impossible to be an informed citizen in the world today without an understanding of data and information. Whether opinion polls, unemployment rates, salary differences between men and women, the efficacy of vaccines or consumer webdata, we need to be able to separate the signal from the noise. We will learn the statistical methods used to analyze and interpret data from a wide variety of sources. The goal of the course is to help reach conclusions and make informed decisions based on data.

Class Format: Hybrid format with both synchronous and asynchronous elements.

Requirements/Evaluation: students with MATH130 but no statistics should enroll in STAT161; students with MATH150 but no statistics should enroll in STAT201. Students with AP Stat 4/5 or STAT 101/161/201 should enroll in STAT 202 (if no calc background) or 302 (MATH140 prereq).

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)

Enrollment Limit: 25

Enrollment Preferences: sophomores, juniors, and seniors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with MATH130 but no statistics should enroll in STAT161; students with MATH150 but no statistics should enroll in STAT201. Students with AP Stat 4/5 or STAT 101/161/201 should enroll in STAT 202 (if no calc background) or 302 (MATH140 prereq).

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is a quantitative course.

Attributes: BIGP Courses COGS Related Courses PHLH Statistics Courses

Fall 2020

LEC Section: H1 MWF 8:00 am - 8:50 am Shaoyang Ning

LEC Section: H2 MWF 9:20 am - 10:10 am Shaoyang Ning

Spring 2021

LEC Section: 01 TBA Shaoyang Ning, Daniel B. Turek

STAT 161 (F)(S) Introductory Statistics for Social Science (QFR)

This course will cover the basics of modern statistical analysis with a view toward applications in the social sciences and sciences. Topics include exploratory data analysis, elements of probability theory, basic statistical inference, and introduction to statistical modeling. The course focuses on the application of statistics tools to solve problems, to make decisions, and the use of statistical thinking to understand the world.

Requirements/Evaluation: students with calculus background should consider STAT 201, 202 or 302 instead. Students without any calculus background should consider STAT 101. Please refer to the placement chart on the department website for more information.

Prerequisites: MATH 130 (or equivalent); not open to students who have completed STAT 101 or equivalent

Enrollment Limit: 25

Enrollment Preferences: Economics majors, sophomores

Expected Class Size: 25

Grading: no pass/fail option, no fifth course option

Unit Notes: students with calculus background should consider STAT 201, 202 or 302 instead. Students without any calculus background should consider STAT 101. Please refer to the placement chart on the department website for more information.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Course analyzes data

Attributes: PHLH Statistics Courses

Fall 2020

LEC Section: R1 MWF 8:15 am - 9:30 am Bernhard Klingenberg

LEC Section: R2 TR 9:45 am - 11:00 am Daniel B. Turek

Spring 2021

LEC Section: 01 TBA Bernhard Klingenberg, Daniel B. Turek

STAT 201 (F)(S) Statistics and Data Analysis (QFR)

Statistics can be viewed as the art and science of turning data into information. Real world decision-making, whether in business or science is often based on data and the perceived information it contains. Sherlock Holmes, when prematurely asked the merits of a case by Dr. Watson, snapped back, "Data, data, data! I can't make bricks without clay." In this course, we will study the basic methods by which statisticians attempt to extract information from data. These will include many of the standard tools of statistical inference such as hypothesis testing, confidence intervals, and linear regression as well as exploratory and graphical data analysis techniques. This is an accelerated introductory statistics course that involves computational programming and incorporates modern statistical techniques.

Class Format: Hybrid format: lecture material will be prerecorded, and you will be asked to attend (in person or virtually) one class session a week, during which we will briefly review lecture materials, allow time for questions, and work through a lab in RStudio to practice using the techniques discussed during that week's lectures.

Requirements/Evaluation: Students with AP Stat 4/5 or STAT 101/161 should enroll in STAT 202 (if no calc background) or 302 (MATH 140 prereq). Students with no calc or stats background should enroll in STAT 101. Students with MATH 140 but no statistics should enroll in STAT 161.

Prerequisites: MATH 150 or equivalent; not open to students who have completed STAT 101 or STAT 161 or equivalent

Enrollment Limit: 25

Enrollment Preferences: Prospective Statistics majors, students for whom the course is a major prerequisite, and seniors

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Students with AP Stat 4/5 or STAT 101/161 should enroll in STAT 202 (if no calc background) or 302 (MATH 140 prereq). Students with no calc or stats background should enroll in STAT 101. Students with MATH 140 but no statistics should enroll in STAT 161.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Students will learn to interpret, choose, carry out, and communicate analyses of data.

Attributes: BIGP Courses COGS Related Courses EVST Methods Courses PHLH Statistics Courses

Fall 2020

LEC Section: R1 MR 3:15 pm - 4:30 pm Anna M. Plantinga

LEC Section: R2 WF 1:30 pm - 2:45 pm Elizabeth M. Upton

Spring 2021

LEC Section: 01 TBA Anna M. Plantinga, Richard D. De Veaux

STAT 202 (F)(S) Introduction to Statistical Modeling (QFR)

Data come from a variety of sources: sometimes from planned experiments or designed surveys, sometimes by less organized means. In this course we'll explore the kinds of models and predictions that we can make from both kinds of data, as well as design aspects of collecting data. We'll focus on model building, especially multiple regression, and talk about its potential to answer questions about the world -- and about its limitations. We'll emphasize applications over theory and analyze real data sets throughout the course.

Class Format: Introductory lectures will be available asynchronously as text and video; synchronous sessions will discuss questions from lecture, dive further into the material, and work on examples. You'll use chat and discussion boards to build community, study with classmates, and ask questions outside of class time. The professor and TAs will also offer optional synchronous office hours/review sessions.

Requirements/Evaluation: students with a 4 on the AP Stats exam should contact the department for proper placement

Prerequisites: AP Statistics 4 or 5, or STAT 101, or STAT 161, or STAT 201, or permission of instructor

Enrollment Limit: 25

Enrollment Preferences: Prospective Statistics majors and more senior students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with a 4 on the AP Stats exam should contact the department for proper placement

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course uses mathematical tools and computing programs to create models, make predictions, assess uncertainty, and describe data. We'll also emphasize choosing appropriate mathematical tools and interpreting their results in a real-world context.

Attributes: EVST Methods Courses PHLH Statistics Courses

Fall 2020

LEC Section: R1 MWF 12:00 pm - 12:50 pm Laurie L. Tupper

Spring 2021

LEC Section: 01 TBA Laurie L. Tupper

STAT 302 (F)(S) Applied Statistical Modeling (QFR)

Data may come from various sources and studies with different purpose of analysis. Statistical modeling provides a unified framework to embrace different data types, and focuses on the goals of understanding relationships, assessing differences and making predictions. We will explore different types of statistical models (linear regression, ANOVA, logistic regression etc), and focus on their conditions, the interactive modeling process, as well as the statistical inference tools for drawing conclusions from them. Throughout the course, real datasets will be modeled for interesting questions about the world, and the limitations will be addressed as well.

Class Format: This will be a hybrid course for students who are both remote and in-person, with a mix of synchronous and asynchronous elements.

Prerequisites: One of the following: i) STAT 201; ii) MATH 140 and STAT 101/161/AP Statistics 4/5; iii) Permission of instructor

Enrollment Limit: 19

Enrollment Preferences: students interested in statistics which have solid background in math and stat

Expected Class Size: 15

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is an advanced statistics class with prerequisites that are QFR courses

Fall 2020

LEC Section: H1 MWF 11:45 am - 1:00 pm Xizhen Cai

Spring 2021

LEC Section: 01 TBA Xizhen Cai

STAT 310 (F) Data Visualization (QFR)

This course is about preparing, visualizing, reporting and presenting different types of data. We will start with creating common plots (e.g., barcharts, histograms, density plots, boxplots, time series and lattice plots), but also discuss visualizing results of statistical models, such as linear or logistic regression models. We will use the ggplot library in R but then switch to the plotly library for interactive graphs with mouse-over and click events. Using R's shiny and DT libraries, we will learn how to create and publish web-apps and dashboards that explore datasets and support online filtering. We will end the class with creating web apps that contain multiple graphs or maps which react to user inputs (such as selecting which variables to plot) or provide real time monitoring of streaming data. Throughout, we will use version control software (Github) to organize and keep track of our code. This course will be taught in a semi-flipped style. While the instructor will introduce certain topics, students will often be responsible for reading material ahead of time and then work individually or in pairs to reproduce material or implement it on their own data.

Prerequisites: Stat 201/202/302; Good knowledge of R

Enrollment Limit: 15

Enrollment Preferences: Preference may be given to stats majors who need the course in order to graduate, but then random selection.

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course teaches how to organize and present data graphically, but also how to critique existing data visualizations.

Fall 2020

LEC Section: R1 MW 10:00 am - 11:15 am Bernhard Klingenberg

STAT 315 (S) Applied Machine Learning (QFR)

How does Netflix recommend films based on your viewing history? How does Facebook group its users and send out targeted ads? How did Google select from thousands of search terms to predict flu? Machine learning (ML) is a rapidly growing field that is concerned with algorithms and models to find patterns in data and solve these practical problems at the intersection between statistics, data science and computer science. This course provides a broad introduction to ideas and methods in machine learning, with emphasis on statistical intuitions and practical data analysis. Topics including regularized regression, SVM, supervised/unsupervised learning, text analysis, neural networks will be covered. Students will use R extensively throughout the course while getting introduced to some ML tools in Python.

Prerequisites: MATH 140, and STAT 201/202, or equivalent; or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Statistics majors, seniors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical, computational, and data analysis skills as well as appropriate practical application of analysis methods

Spring 2021

LEC Section: 01 TBA Shaoyang Ning

STAT 335 (S) Biostatistics and Epidemiology (QFR)

Epidemiology, a public health discipline, is the study of disease and disability in human populations. Biostatistics focuses on the development and application of statistical methods to address questions that arise in medicine, public health, or biology. This course will begin with epidemiological study designs and core concepts in epidemiology, followed by key statistical methods in public health research. Topics will include multiple regression, analysis of categorical data (two sample methods, sets of 2x2 tables, RxC tables, and logistic regression), survival analysis (Cox proportional hazards model), and a brief introduction to regression with correlated data.

Prerequisites: STAT 201 or 202 and MATH 140, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Junior and senior statistics majors; public health concentrators

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a statistics course with a focus on quantitative methods relevant to public health studies.

Attributes: PHLH Statistics Courses

Spring 2021

LEC Section: 01 TBA Anna M. Plantinga

STAT 341 (F)(S) Probability (QFR)

Cross-listings: STAT 341 MATH 341

Secondary Cross-listing

While probability began with a study of games, it has grown to become a discipline with numerous applications throughout mathematics and the sciences. Drawing on gaming examples for motivation, this course will present axiomatic and mathematical aspects of probability. Included will be discussions of random variables, expectation, independence, laws of large numbers, and the Central Limit Theorem. Many interesting and important applications will also be presented, potentially including some from coding theory, number theory and nuclear physics.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Priority will be given to Stats majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

STAT 341 (D3) MATH 341 (D3)

Quantative/Formal Reasoning Notes: This is a 300-level Math/Stat course

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Stewart D. Johnson

Spring 2021

LEC Section: 01 TBA Mihai Stoiciu

STAT 344 (F) Statistical Design of Experiments (QFR)

How do you get informative research results? By doing the right experiment in the first place. We'll explore the techniques used to plan experiments that are both efficient and statistically sound, the analysis of the resulting data, and the conclusions we can draw from that analysis. We'll look at classical tools like one- and two-way ANOVA and fractional factorial designs, but we'll also look at optimal design, and see how these two frameworks differ in their philosophy and in what they can do. Throughout the course, we'll make extensive use of R to work with real-world data.

Class Format: Introductory lectures will be available asynchronously as text and video; synchronous sessions will discuss questions from lecture, dive further into the material, and work on examples. You'll use chat and discussion boards to build community, study with classmates, and ask questions outside of class time. There will also be optional synchronous office hours/review sessions.

Prerequisites: STAT 201, 202, or equivalent, or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: Statistics majors, seniors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course uses mathematical tools and computing programs to design experiments, analyze their results, and assess their effectiveness. We'll also emphasize choosing appropriate mathematical tools and interpreting their results in a real-world context.

Attributes: COGS Related Courses

Fall 2020

LEC Section: R1 MR 3:15 pm - 4:30 pm Laurie L. Tupper

STAT 346 (F)(S) Regression Theory and Applications (QFR)

This course focuses on the building of empirical models through data in order to predict, explain, and interpret scientific phenomena. Regression modeling is the most widely used method for analyzing and predicting a response data and for understand the relationship with explanatory variables. This course provides both theoretical and practical training in statistical modeling with particular emphasis on simple linear, logistic and multiple regression, using R to develop and diagnose models. The course covers the theory of multiple regression and diagnostics from a linear algebra perspective with emphasis on the practical application of the methods to real data sets. The data sets will be taken from a wide variety of disciplines.

Prerequisites: MATH 250 and at least one of STAT 201, 202 or 302. Or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: Statistics Majors

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course prepares students in the use of quantitative methods for the modeling, prediction and understanding of scientific phenomena.

Attributes: EVST Methods Courses

Fall 2020

LEC Section: H1 MWF 11:45 am - 1:00 pm Richard D. De Veaux

Spring 2021

LEC Section: 01 TBA Richard D. De Veaux

STAT 355 (F) Multivariate Statistical Analysis (QFR)

To better understand complex processes, we study how variables are related to one another, and how they work in combination. Therefore, we want to make inferences about more than one variable at time? Elementary statistical methods might not apply. In this course, we study the tools and the intuition that are necessary to analyze and describe such data sets. Topics covered will include data visualization techniques for high dimensional data sets, parametric and non-parametric techniques to estimate joint distributions, techniques for combining variables, as well as classification and clustering algorithms.

Class Format: This will be a hybrid course for students who are both remote and in-person, with a mix of synchronous and asynchronous elements

Prerequisites: MATH 250, and STAT 346 or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: students interested in statistics which have solid background in math and stat

Expected Class Size: 10

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is an advanced statistics class with prerequisites that are QFR courses

Fall 2020

LEC Section: H1 WF 1:30 pm - 2:45 pm Xizhen Cai

STAT 356 (S) Time Series Analysis (QFR)

Time series--data collected over time--crop up in applications from economics to engineering to transit. But because the observations are generally not independent, we need special methods to investigate them. This course will include exploratory methods and modeling for time series, including smoothing, ARIMA and state space models, and a foray into the frequency domain. We will emphasize applications to a variety of real data.

Prerequisites: STAT 346 (may be taken concurrently) or permission of instructor

Enrollment Limit: 30

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Laurie L. Tupper

STAT 360 (S) Statistical Inference (QFR)

How do we estimate unknown parameters and express the uncertainty we have in our estimate? Is there an estimator that works best? Many topics from introductory statistics such as random variables, the central limit theorem, point and interval estimation and hypotheses testing will be revisited and put on a more rigorous mathematical footing. The focus is on maximum likelihood estimators and their properties. Bayesian and computer intensive resampling techniques (e.g., the bootstrap) will also be considered.

Prerequisites: MATH 250, STAT 201 or 202, STAT 341

Enrollment Limit: 30

Enrollment Preferences: Statistics majors

Expected Class Size: 30

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Bernhard Klingenberg

STAT 372 (F) Longitudinal Data Analysis: Modeling Change over Time (QFR)

This course explores modern statistical methods for drawing scientific inferences from longitudinal data, i.e., data collected repeatedly on experimental units over time. The independence assumption made for most classical statistical methods does not hold with this data structure because we have multiple measurements on each individual. Topics will include linear and generalized linear models for correlated data, including marginal and random effect models, as well as computational issues and methods for fitting these models. We will consider many applications in the social and biological sciences.

Class Format: Hybrid format. Approximately 2/3 of class time will be lecture (in person for students who are on campus, recorded for remote students). All synchronous students (whether in person or online) will attend a remote lab/discussion section each week. Asynchronous options will be provided for students unable to participate synchronously.

Prerequisites: STAT 201 and STAT 346

Enrollment Limit: 15

Enrollment Preferences: junior and senior Statistics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will cover a variety of statistical analysis methods for longitudinal data.

Attributes: PHLH Statistics Courses

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Anna M. Plantinga

STAT 442 (S) Statistical Learning and Data Mining (QFR)

In both science and industry today, the ability to collect and store data can outpace our ability to analyze it. Traditional techniques in statistics are often unable to cope with the size and complexity of today's data bases and data warehouses. New methodologies in Statistics have recently been developed, designed to address these inadequacies, emphasizing visualization, exploration and empirical model building at the expense of traditional hypothesis testing. In this course we will examine these new techniques and apply them to a variety of real data sets.

Prerequisites: STAT 346 or permission of instructor

Enrollment Limit: 14

Enrollment Preferences: seniors and Statistics Majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Xizhen Cai

STAT 465 (F) Bayesian Statistics (QFR)

Interest and application of Bayesian methods have exploded in recent decades, being facilitated by recent advances in computational power. Indeed, the Bayesian approach is now recognized across scientific disciples as a modern and powerful tool. We begin with an introduction to Bayes' Theorem, the theoretical underpinning of Bayesian statistics which dates back to the 1700's, and the concepts of prior and posterior distributions, conjugacy, and closed-form Bayesian inference. Building on this, we introduce modern computational approaches to performing Bayesian inference, including Markov chain Monte Carlo (MCMC), Metropolis-Hastings sampling, and the theory underlying these simple and powerful methods, before moving on to multivariate sampling methods and methodology. Students will become comfortable with modern software tools for MCMC using a variety of applied hierarchical modeling examples, and will use R for all statistical computing. The course will culminate in an independent Bayesian research project.

Prerequisites: STAT 346, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Juniors and Seniors, and Statistics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course mandates significant mathematical and statistical prowess.

Fall 2020

LEC Section: R1 TR 8:00 am - 9:15 am Daniel B. Turek

STS 375 (F)(S) Human Work in Computational Systems (QFR)

Cross-listings: CSCI 377 STS 375

Secondary Cross-listing

As far as we know, the technological singularity has not yet arrived. Therefore, humans remain a part of our current computation pipeline. However, the role humans play varies greatly: self-driving cars aim to have human involvement only in development and emergencies, whereas educational tools are built for constant human involvement. In this course, we broadly explore human work within computational systems through topics such as crowdsourcing, educational technology, citizen science, human computation, open-source software, micro-labor markets, and online gaming. Students should expect broad exposure to a wide variety of human computing topics and group projects on building and evaluating computational systems that use human work.

Class Format: Lectures will be held on Wednesday and Friday each week. Conference sections will each meet only once per week, on either Wednesday or Thursday. Students should sign up for the lecture section and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 18

Enrollment Preferences: Preference for current CS majors

Expected Class Size: 18

Grading: yes pass/fail option, no fifth course option

Materials/Lab Fee: $75 for purchase of software and work on crowdsourcing platforms.

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CSCI 377 (D3) STS 375 (D2)

Quantative/Formal Reasoning Notes: This course includes regular homework and projects in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

CON Section: 04 TR 9:45 am - 11:00 am Molly Q Feldman

CON Section: 05 TR 11:30 am - 12:45 pm Molly Q Feldman

LEC Section: H1 MWF 11:45 am - 1:00 pm Molly Q Feldman

CON Section: R2 W 1:30 pm - 2:20 pm Molly Q Feldman

CON Section: R3 W 2:50 pm - 3:40 pm Molly Q Feldman

Spring 2021

LEC Section: 01 TBA Molly Q Feldman

THEA 310 (F) Playwriting: Facing the Blank Page (WS) (QFR)

I believe that after food and shelter, humans need stories to survive. this class will focus on each writers, dreams, fears and desires and how to turn them into plays. Students will explore the fundamentals of playwriting. This will include writing exercises, weekly pages, hearing your scenes out loud and at the end of the semester the first draft of a new play.

Class Format: Hybrid

Prerequisites: none

Enrollment Limit: 19

Enrollment Preferences: Theater majors first, then Concentrators

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D1) (WS) (QFR)

Writing Skills Notes: You are expected to attend class, to keep up with required writing, readings drafts pages to class and participate in all discussions.

Quantative/Formal Reasoning Notes: You are also expected to think critically and articulate your thoughts.

Fall 2020

SEM Section: H1 RF 3:15 pm - 4:30 pm Lucy Thurber, Ren Dara Santiago

Quantitative and Formal Reasoning

ASTR 111 (F) Introduction to Astrophysics (QFR)

The science of astronomy spans vast scales of space and time, from individual atoms to entire galaxies and from the universe's beginning to the future fate of our Sun. In this course, we will survey some of the main ideas in modern astrophysics, with an emphasis on the physics of stars and galaxies. ASTR 111 is the first course in the Astrophysics and Astronomy major sequences. It is also appropriate for students planning to major in one of the other sciences or mathematics and for others who would like a quantitative introduction that emphasizes the relationship of contemporary physics to astronomy. Topics include gravity and orbits, radiation laws and stellar spectra, physical characteristics of the Sun and other stars, star formation and evolution, black holes, galaxies, the expanding universe, and the Big Bang. Students will also use telescopes remotely to observe stars, nebulae, planets, and galaxies and to make daytime observations of the Sun.

Class Format: This is a hybrid course. Lectures will be provided both in-person and for remote viewing. Students will work in small groups on discussions and calculations. Each group can choose to meet remotely or in class. Students can switch groups, and groups can switch format, as needed. Prof. Jaskot will meet with remote groups during their discussion to answer questions. The class has 6 afternoon labs, with both in-person and remote options. Remote observing sessions will occur throughout the semester.

Prerequisites: a year of high school Physics, concurrent college Physics, or permission of instructor, and MATH 140 or equivalent

Enrollment Limit: 28

Enrollment Preferences: potential Astronomy majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course requires regular problem sets and quantitative assignments. The course will emphasize how physical equations explain the observed properties of the universe.

Fall 2020

LAB Section: H2 T 1:00 pm - 3:00 pm Kevin Flaherty

LAB Section: H3 W 1:00 pm - 3:00 pm Kevin Flaherty

LEC Section: H1 TR 11:30 am - 12:45 pm Anne Jaskot

ASTR 402 (S) Between the Stars: The Interstellar Medium (QFR)

The matter between the stars--the interstellar medium--tells the story of the past and future evolution of galaxies and the stars within them. Stars are accompanied by diffuse matter all through their lifetimes, from their birthplaces in dense molecular clouds, to the stellar winds they eject as they evolve, to their final fates as they shed their outer layers, whether as planetary nebulae or dazzling supernovae. As these processes go on, they enrich the interstellar medium with the products of the stars' nuclear fusion. Interpreting the emission from this interstellar gas is one of astronomers' most powerful tools to measure the physical conditions, motions, and composition of our own galaxy and others. In this course we will study the interstellar medium in its various forms, from cold, dense, star-forming molecular clouds to X-ray-emitting bubbles formed by supernovae. We will learn about the physical mechanisms that produce the radiation we observe, including radiative ionization and recombination, collisional excitation of "forbidden" lines, collisional ionization, and synchrotron radiation. Applying our understanding of these processes, we will analyze the physical conditions and chemical compositions of a variety of nebulae. Finally, we will discuss the evolution of interstellar material in galaxies across cosmic time. This course is observing-intensive. Throughout the semester students will work in small groups to design, carry out, analyze, and critique their own observations of the interstellar medium using the equipment on our observing deck.

Class Format: plus observing projects

Prerequisites: ASTR 111 and PHYS 201 or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: juniors and seniors

Expected Class Size: 6

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: In this course, students will derive quantitative physical formulas, use these equations to calculate and compare physical properties, and generate and analyze graphical representations of data. They will also make and analyze measurements of astronomical data through observing projects.

Spring 2021

LEC Section: 01 TBA Anne Jaskot

ASTR 498 (S) Independent Study: Astronomy or Astrophysics (QFR)

Astronomy/Astrophysics independent study, directed by one of the Astronomy faculty: Pasachoff/Jaskot/Flaherty

Prerequisites: suitable Astronomy/Astrophysics/Physics/Math-Stats-Geosciences/Chemistry courses

Enrollment Limit: 10

Enrollment Preferences: research topic

Expected Class Size: 5

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Substantial quantitative and formal reasoning are involved

Spring 2021

IND Section: 01 TBA Jay M. Pasachoff

BIMO 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Primary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

Spring 2021

LEC Section: 01 TBA Katie M. Hart

BIMO 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Primary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

BIOL 202 (F) Genetics (QFR)

Genetics, classically defined as the study of heredity, has evolved into a discipline whose limits are continually expanded by innovative molecular technologies. This course covers the experimental basis for our current understanding of the inheritance, structures, and functions of genes. It introduces approaches used by contemporary geneticists and molecular biologists to explore questions in areas of biology ranging from evolution to medicine. The laboratory part of the course provides an experimental introduction to modern genetic analysis. Laboratory experiments include linkage analysis, bacterial transformation with plasmids and DNA restriction mapping. This COVID year we will have in-person lectures and labs. Furthermore all students will have access to recorded lectures, notes, slides and handouts. For remote students, lab reports will also be required (writing and data analysis). Remote students will be able to collect data for some of the labs or otherwise will have access to class data for analyses.

Class Format: six hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102

Enrollment Limit: 60

Enrollment Preferences: Students planning on Biology major

Expected Class Size: 60

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course has a large quantitative component, mainly probabilities and basic statistics. Lab reports and data analyses are a large component of the grade.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: 11 R 3:30 pm - 5:30 pm Derek Dean

LAB Section: R3 MW 6:45 pm - 8:00 pm Derek Dean

LEC Section: H1 MWF 10:40 am - 11:30 am Luana S. Maroja

LAB Section: 10 W 3:30 pm - 5:30 pm Derek Dean

LAB Section: 09 T 3:30 pm - 5:30 pm Derek Dean

LAB Section: 08 M 3:30 pm - 5:30 pm Derek Dean

LAB Section: 07 R 1:00 pm - 3:00 pm Derek Dean

LAB Section: 06 W 1:00 pm - 3:00 pm Derek Dean

LAB Section: 05 T 1:00 pm - 3:00 pm Derek Dean

LEC Section: H2 MWF 12:00 pm - 12:50 pm Luana S. Maroja

LAB Section: 04 M 1:00 pm - 3:00 pm Derek Dean

BIOL 203 (F) Ecology (QFR)

Cross-listings: ENVI 203 BIOL 203

Primary Cross-listing

This course combines lectures with field and indoor laboratory exercises to explore factors that determine the distribution and abundance of plants and animals in natural systems. The course begins with an overall view of global patterns and then builds from the population to the ecosystem level. An emphasis is given to basic ecological principles and relates them to current environmental issues. Selected topics include population dynamics (competition, predation, mutualism); community interactions (succession, food chains and diversity) and ecosystem function (biogeochemical cycles, energy flow). In Fall 2020, the course will use a hybrid model, with recorded lecture material available to all students. In person and remote class meetings will focus on problem sets and interactive case studies. Labs will be available in either in person or remote modalities. Remote participants will have the opportunity to collect their own data for some lab exercises, while in other cases will receive background information and media describing the data collection process. All students will be required to complete all data analyses and written lab reports.

Class Format: Six hours per week. All labs will be available in both remote and in-person modalities. All students (whether in person or remote) may choose their preferred modality for each lab module. Due to COVID-19 distancing requirements, some labs will require walking to field sites. The instructor will work with individual students to identify accommodations that support in person lab participation as needed.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102, or ENVI 101 or 102, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: students planning to pursue Biology and/or ENVI

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 203 (D3) BIOL 203 (D3)

Quantative/Formal Reasoning Notes: Much of the material in this course centers on the interpretation and application of mathematical models used to describe ecological systems. The laboratory section of this course also contains a large data analysis component. Students are introduced to t-tests, Mann-Whitney U tests, chi-square analysis, and regression.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Living Systems Courses

Fall 2020

LAB Section: H3 T 3:30 pm - 5:30 pm Allison L. Gill

LEC Section: H1 MWF 9:20 am - 10:10 am Allison L. Gill

LAB Section: H2 T 1:00 pm - 3:00 pm Allison L. Gill

BIOL 210 (F) Mathematical Biology (QFR)

Cross-listings: BIOL 210 MATH 310

Secondary Cross-listing

This course will provide an introduction to the many ways in which mathematics can be used to understand, analyze, and predict biological dynamics. We will learn how to construct mathematical models that capture essential properties of biological processes while maintaining analytic tractability. Analytic techniques, such as stability and bifurcation analysis, will be introduced in the context of both continuous and discrete time models. Additionally, students will couple these analytic tools with numerical simulation to gain a more global picture of the biological dynamics. Possible biological applications include, but are not limited to, single and multi-species population dynamics, neural and biological oscillators, tumor cell growth, and infectious disease dynamics.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 250 and MATH 309, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: if over-enrolled, will have students submit reasons for taking class; preference to those with interest in both subjects

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 210 (D3) MATH 310 (D3)

Quantative/Formal Reasoning Notes: The course will introduce methods for developing and analyzing mathematical models.

Attributes: PHLH Methods in Public Health

Fall 2020

LEC Section: H1 TR 11:30 am - 12:45 pm Julie C. Blackwood

BIOL 222 (S) Essentials of Biochemistry (QFR)

This course will explore the biochemistry of cellular processes and contextualize these processes in healthy and diseased states. Lecture topics in this one semester course will include the structure and function of proteins (enzymes and non-enzymatic proteins), lipids, and carbohydrates. Lectures will also survey the major metabolic pathways (carbohydrates, lipids, and amino acids) with particular attention to enzyme regulation and the integration of metabolism in different tissues and under different metabolic conditions. In the discussion/laboratory component of the course a combination of primary literature, hypothesis-driven exercises, problem solving, and bench work will be used to illustrate how particular techniques and experimental approaches are used in biochemical fields.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the biology major in addition to either BIOL 321 or BIOL 322; cannot be counted towards the BIMO concentration

Prerequisites: BIOL 101 and CHEM 156; not open to students who have taken BIOL 321 or BIOL 322

Enrollment Limit: 24

Enrollment Preferences: seniors who need to fulfill the biochemistry requirement for premedical school

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the biology major in addition to either BIOL 321 or BIOL 322; cannot be counted towards the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Spring 2021

LEC Section: 01 TBA Daniel V. Lynch

BIOL 305 (S) Evolution (QFR)

This course offers a critical analysis of contemporary concepts in biological evolution. We focus on the relation of evolutionary mechanisms (e.g., selection, drift, and migration) to long term evolutionary patterns (e.g., evolutionary innovations, origin of major groups, and the emergence of diversity). Topics include micro-evolutionary models, natural selection and adaptation, sexual selection, speciation, the inference of evolutionary history among others.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 202

Enrollment Limit: 24

Enrollment Preferences: Seniors and biology majors

Expected Class Size: 24

Grading: yes pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Attributes: BIGP Courses BIMO Interdepartmental Electives COGS Related Courses

Spring 2021

LEC Section: 01 TBA Luana S. Maroja

BIOL 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Primary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

BIOL 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

Spring 2021

LEC Section: 01 TBA Katie M. Hart

BIOL 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

BIOL 329 (F) Conservation Biology (QFR)

Cross-listings: ENVI 339 BIOL 329

Primary Cross-listing

This course examines the application of population genetics, population ecology, community ecology, and systematics to the conservation of biological diversity. The overarching theme of the course is on the role of stochastic processes for small populations. Lecture/discussion topics will include extinction, the genetics of small populations, metapopulations, and importantly, conservation strategies. Labs will include a mixture of computer and lab projects.

Class Format: lecture and discussion, 3 hours per week; lab, 1.25 hours per week. students will be assigned to a lab section (block AA - either W or F from 1:30-2:45) during the first week of class.

Requirements/Evaluation: Satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 203/ENVI 203, or BIOL 305, or permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Biology majors, seniors, and juniors

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 339 (D3) BIOL 329 (D3)

Quantative/Formal Reasoning Notes: This course uses quantitative and statistical analyses in both the laboratory and lecture portion of the course. In lectures mathematical models will be covered to understand conservation dynamics. In lab, students will collect and analyze data and present results in graphical and statistical forms.

Attributes: ENVI Natural World Electives

Fall 2020

LAB Section: H2 WF 1:30 pm - 2:45 pm Manuel A. Morales

LEC Section: H1 TR 8:00 am - 9:15 am Manuel A. Morales

CHEM 114 (S) The Science Behind Materials: Shaping the Past and Future of Society (QFR)

We are surrounded by materials. They have fulfilled human needs since ancient times. From Phoenician glass to flexible OLED displays, materials have impacted society and changed the way humans lead their lives. What makes materials the way they are? Why are some brittle while others are ductile? How can we design materials with specific properties that will solve tomorrow's problems? To answer these questions, we have to think about materials at the atomic scale, looking at how their smallest building blocks organize into specific structures. In this course, we will discuss how a material's structure relates to its properties. Then, we will dive into how different types of materials have been used in the past, how they were produced, the needs they satisfied, and how they shaped human civilization. This course will also cover both traditional and novel methods used to fabricate and analyze materials. We will talk about some of the cutting-edge research that materials scientists are working on today, concluding with an outlook to potential applications of emerging technologies.

Prerequisites: none; designed for the non-science major who does not intend to pursue a career in the natural sciences.

Enrollment Limit: 20

Enrollment Preferences: juniors and seniors; not appropriate for CHEM, BIOL, PHYS majors, or for those who have taken CHEM 151, 153, or 155

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Spring 2021

LEC Section: 01 TBA Amnon G Ortoll-Bloch

CHEM 117 (S) Roses are Red, Violets are Blue: The Origins, Perception, and Impact of Color (QFR)

Have you ever been tickled pink? Felt blue? Seen red?, Been green with envy? The course will consider color, starting with the physical and chemical origins of color (the electromagnetic spectrum, the absorption and emission of electromagnetic radiation, refraction, diffraction, incandescence, fluorescence, phosphorescence, iridescence). We will develop an understanding of chemical bonding and how that influences color. We will cover how we measure and describe color from a scientific perspective as well as how we can generate materials and devices with different color properties (liquid crystal displays, light emitting diodes for instance). From there we will discuss pigments used in works of art and textiles over time, the characteristics that make certain pigments suitable for particular applications. If we have time, we will touch on the historical and cultural impacts and meanings of different pigments and hues, the biological perception of color, and some color theory.

Class Format: There may be some brief laboratory exercises, which will require some extra time blocks, to be scheduled later.

Prerequisites: non-science students; students who have taken any introductory chemistry or physics courses are ineligible

Enrollment Limit: 20

Enrollment Preferences: first-years and sophomores

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will require students to become comfortable with some quantitative descriptions of light and its interaction with matter.

Spring 2021

LEC Section: 01 TBA Lee Y. Park

CHEM 151 (F) Introductory Chemistry (QFR)

This course provides an introduction to chemistry for those students with little or no high school chemistry. Students will be introduced to concepts fundamental to studying matter at the molecular level. Principal topics include introductions to the nature of atoms and molecules, stoichiometry, solubility rules and equilibria, gas laws, chemical equilibrium, acid-base reactions, periodic relationships, chemical bonding, molecular structure, intermolecular forces, oxidation-reduction reactions, and related applications. Laboratory work comprises a system of qualitative analysis and quantitative techniques. The course provides preparation for further study of organic chemistry, biochemistry, physical and inorganic chemistry and is intended for students who are anticipating professional study in chemistry, in related sciences, or in one of the health professions, as well as for those students who are interested in exploring the fundamental ideas of chemistry as part of their general education.

Class Format: pre-recorded lectures, two hours per week; recitations, two 75-minute meetings per week (in-person or remote); laboratory, one 2-hour lab per week (in-person or remote)

Requirements/Evaluation: CHEM 151 may be taken concurrently with MATH 102--see under Mathematics; CHEM 151 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: first-year students; students who have studied chemistry for one or more years are directed to CHEM 153 or 155

Expected Class Size: 32

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 151 may be taken concurrently with MATH 102--see under Mathematics; CHEM 151 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LAB Section: H5 M 3:30 pm - 5:30 pm Laura R. Strauch

LEC Section: 02 MW 11:45 am - 1:00 pm Katie M. Hart

LAB Section: H4 M 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: H6 T 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: H7 T 3:30 pm - 5:30 pm Laura R. Strauch

LEC Section: R3 MW 11:45 am - 1:00 pm Sarah L. Goh

LEC Section: 01 MW 10:00 am - 11:15 am Katie M. Hart

CHEM 153 (F) Concepts of Chemistry (QFR)

This course broadens and deepens the foundation in chemistry of students who have had typically one year of chemistry at the high school level. Most students begin study of chemistry at Williams with this course. Familiarity with stoichiometry, basic concepts of equilibria, and the model of an atom is expected. Principal topics for this course include kinetic theory of gases, modern atomic theory, molecular structure and bonding, states of matter, chemical equilibrium (acid-base and solubility), and an introduction to atomic and molecular spectroscopies. Laboratory periods will largely focus on data analysis, literature, scientific writing, ethics, and other skills critical to students' development as scientists. There may also be the opportunity for some hands-on laboratory experience for students who are on-campus. The course is of interest to students who anticipate professional study in chemistry, related sciences, or one of the health professions, as well as to those who want to explore the fundamental ideas of chemistry as part of their general education.

Class Format: Lecture/discussion, three hours per week and laboratory, two hours per week

Requirements/Evaluation: CHEM 153 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: incoming first year students also must meet with a faculty member during First Days

Expected Class Size: 60

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 153 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LAB Section: H10 W 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H12 R 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LEC Section: 01 MW 10:00 am - 11:15 am Bob Rawle

LEC Section: H4 TR 8:30 pm - 9:45 pm Lee Y. Park

LEC Section: H3 TR 6:45 pm - 8:00 pm Lee Y. Park

LAB Section: H13

LAB Section: H11 R 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H6 M 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LAB Section: H7 T 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H9 W 1:00 pm - 3:00 pm Jennifer K. Rosenthal

LAB Section: H8 T 3:30 pm - 5:30 pm Jennifer K. Rosenthal

LEC Section: R2 MW 11:45 am - 1:00 pm Bob Rawle

LAB Section: H5 M 1:00 pm - 3:00 pm Jennifer K. Rosenthal

CHEM 155 (F) Principles of Modern Chemistry (QFR)

This course is designed for students with strong preparation in secondary school chemistry, including a laboratory experience, such as provided by an Advanced Placement chemistry course (or equivalent) with a corresponding score of 5 of the AP Chemistry Exam (or a 7 on the IB Exam, or equivalent). Topics include chemical thermodynamics, kinetics, structure and bonding, coordination chemistry, electrochemistry and spectroscopy and their application to fields such as materials science, industrial, environmental, biological, and medicinal chemistry. Laboratory/discussion periods will focus on data analysis, literature, scientific writing, ethics, and other skills critical to students' development as scientists. This course is of interest for students who are anticipating professional study in chemistry, related sciences, or one of the health professions, as well as for students who want to explore the fundamental ideas of chemistry as part of their general education.

Class Format: lecture, three hours per week and laboratory, two hours per week

Requirements/Evaluation: CHEM 155 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to meet with a faculty member during First Days.

Enrollment Limit: 8/lab

Enrollment Preferences: incoming first year students also must meet with a faculty member during First Days

Expected Class Size: 30

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 155 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2020

LAB Section: 05 R 1:00 pm - 3:00 pm Laura R. Strauch

LAB Section: 06 R 3:30 pm - 5:30 pm Laura R. Strauch

LAB Section: 07 W 3:30 pm - 5:30 pm Enrique Peacock-López

LAB Section: 03 W 1:00 pm - 3:00 pm Enrique Peacock-López

LEC Section: 01 MWF 8:00 am - 8:50 am Enrique Peacock-López

LAB Section: R4 W 3:30 pm - 5:30 pm Anthony J. Carrasquillo

LEC Section: R2 MWF 10:40 am - 11:30 am Enrique Peacock-López

CHEM 156 (S) Organic Chemistry: Introductory Level (QFR)

This course provides the necessary background in organic chemistry for students who are planning advanced study or a career in chemistry, the biological sciences, or the health professions. It initiates the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. The fundamentals of molecular modeling as applied to organic molecules are presented. Specific topics include basic organic structure and bonding, isomerism, stereochemistry, molecular energetics, the theory and interpretation of infrared and nuclear magnetic spectroscopy, substitution and elimination reactions, and the addition reactions of alkenes and alkynes. The coordinated laboratory work includes purification and separation techniques, structure-reactivity studies, organic synthesis, IR and NMR spectroscopy, and the identification of unknown compounds.

Class Format: lecture three hours per week and laboratory four hours per week

Prerequisites: CHEM 151 or 153 or 155 or placement exam or permission of instructor

Enrollment Limit: 16/lab

Expected Class Size: 120

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Attributes: BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Kerry-Ann Green, Ben W. Thuronyi

CHEM 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

CHEM 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: Lecture, three hours per week and laboratory, two hours per week. Hybrid course. Most lecture material will be presented asynchronously, and scheduled class time for both in-person and remote students will focus on discussion of the material and problem-solving. Enrollment in the appropriate laboratory section is required for both in-person and remote students.

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 8/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2020

LEC Section: H1 MWF 11:45 am - 1:00 pm Amy Gehring

LAB Section: 06 R 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 3:00 pm Jenna L. MacIntire

LAB Section: 03 W 3:30 pm - 5:30 pm Jenna L. MacIntire

LAB Section: 02 T 1:00 pm - 3:00 pm Amy Gehring

LAB Section: R5 R 1:00 pm - 3:00 pm Amy Gehring

Spring 2021

LEC Section: 01 TBA Katie M. Hart

CHEM 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture three hours per week and laboratory three hours per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 54

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 54

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2021

LEC Section: 01 TBA Cynthia K. Holland

CSCI 134 (F)(S) Introduction to Computer Science (QFR)

This course introduces students to the science of computation by exploring the representation and manipulation of data and algorithms. We organize and transform information in order to solve problems using algorithms written in a modern object-oriented language. Topics include organization of data using objects and classes, and the description of processes using conditional control, iteration, methods and classes. We also begin the study of abstraction, self-reference, reuse, and performance analysis. While the choice of programming language and application area will vary in different offerings, the skills students develop will transfer equally well to more advanced study in many areas. In particular, this course is designed to provide the programming skills needed for further study in computer science and is expected to satisfy introductory programming requirements in other departments.

Class Format: Each lab section will meet only once per week, on either Monday or Tuesday.

Requirements/Evaluation: students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

Prerequisites: none, except for the standard prerequisites for a (QFR) course; previous programming experience is not required

Enrollment Limit: 30(10/lab)

Enrollment Preferences: if the course is over-enrolled, enrollment will be determined by lottery

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets, labs, and/or projects in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIGP Courses COGS Interdepartmental Electives

Fall 2020

LAB Section: R3 MR 1:30 pm - 2:45 pm Duane A. Bailey

LEC Section: R1 MWF 9:20 am - 10:10 am Duane A. Bailey

LAB Section: R7 TR 9:45 am - 11:00 am Daniel P. Aalberts

LAB Section: R6 MR 3:15 pm - 4:30 pm Molly Q Feldman

LEC Section: 02 MWF 12:00 pm - 12:50 pm Daniel P. Aalberts

LAB Section: R5 MR 3:15 pm - 4:30 pm Duane A. Bailey

LAB Section: R4 MR 1:30 pm - 2:45 pm Molly Q Feldman

LAB Section: R8 TF 3:15 pm - 4:30 pm Daniel P. Aalberts

Spring 2021

LEC Section: 01 TBA Molly Q Feldman, Duane A. Bailey

CSCI 136 (F)(S) Data Structures and Advanced Programming (QFR)

This course builds on the programming skills acquired in Computer Science 134. It couples work on program design, analysis, and verification with an introduction to the study of data structures. Data structures capture common ways in which to store and manipulate data, and they are important in the construction of sophisticated computer programs. Students are introduced to some of the most important and frequently used data structures: lists, stacks, queues, trees, hash tables, graphs, and files. Students will be expected to write several programs, ranging from very short programs to more elaborate systems. Emphasis will be placed on the development of clear, modular programs that are easy to read, debug, verify, analyze, and modify.

Class Format: Lecture content will be through asynchronously viewed video modules. Three scheduled (MWF) course sections will be used for synchronous conference meetings. Two sections will be in-person and one will be remote. There will be 5 scheduled weekly lab sections that will be remote. Students should sign up for the lecture section, one conference, and one lab.

Prerequisites: CSCI 134 or equivalent; fulfilling the Discrete Mathematics Proficiency requirement is recommended, but not required

Enrollment Limit: 60(12/lab)

Enrollment Preferences: if the course is over-enrolled, enrollment will be determined by lottery

Expected Class Size: 60

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets, labs, and/or projects in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIGP Courses

Fall 2020

LAB Section: R8 R 3:30 pm - 5:00 pm Bill K. Jannen

LAB Section: R5 R 1:00 pm - 2:30 pm William J. Lenhart

LAB Section: R6 R 1:00 pm - 2:30 pm Bill K. Jannen

LAB Section: R9 R 8:30 pm - 10:00 pm Bill K. Jannen, William J. Lenhart

LAB Section: R7 R 3:30 pm - 5:00 pm William J. Lenhart

CON Section: 03 MWF 10:40 am - 11:30 am Bill K. Jannen

LEC Section: R1 TBA Bill K. Jannen, William J. Lenhart

CON Section: R2 MWF 9:20 am - 10:10 am William J. Lenhart

CON Section: R4 MWF 12:00 pm - 12:50 pm William J. Lenhart

Spring 2021

LEC Section: 01 TBA Samuel McCauley, William J. Lenhart

CSCI 237 (F)(S) Computer Organization (QFR)

This course studies the basic instruction set architecture and organization of a modern computer. It provides a programmer's view of how computer systems execute programs, store information, and communicate. Over the semester the student learns the fundamentals of translating higher level languages into assembly language, and the interpretation of machine languages by hardware. At the same time, a model of computer hardware organization is developed from the gate level upward.

Class Format: There is no scheduled time for lectures. They will be available for asynchronous viewing. Each lab section will meet once per week, on either Tuesday or Wednesday. Students should sign up for lecture and one lab.

Prerequisites: CSCI 136

Enrollment Limit: 40(7/lab)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 40

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will consist of programming assignments and problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

LAB Section: R7 MWF 8:15 am - 9:30 am Kelly A. Shaw

LAB Section: 06 MWF 11:45 am - 1:00 pm Kelly A. Shaw

LAB Section: 02 TF 1:30 pm - 2:45 pm Kelly A. Shaw

LAB Section: 04 WF 1:30 pm - 2:45 pm Kelly A. Shaw

LAB Section: 05 MW 10:00 am - 11:15 am Kelly A. Shaw

LAB Section: 03 TF 3:15 pm - 4:30 pm Kelly A. Shaw

LEC Section: R1 TBA Kelly A. Shaw

Spring 2021

LEC Section: 01 TBA Kelly A. Shaw

CSCI 256 (F)(S) Algorithm Design and Analysis (QFR)

This course investigates methods for designing efficient and reliable algorithms. By carefully analyzing the structure of a problem within a mathematical framework, it is often possible to dramatically decrease the computational resources needed to find a solution. In addition, analysis provides a method for verifying the correctness of an algorithm and accurately estimating its running time and space requirements. We will study several algorithm design strategies that build on data structures and programming techniques introduced in Computer Science 136. These include induction, divide-and-conquer, dynamic programming, and greedy algorithms. Additional topics of study include algorithms on graphs and strategies for handling potentially intractable problems.

Class Format: Lectures will be simultaneously recorded in classroom and broadcast over Zoom. Office hours will be done over Zoom. Some additional course materials (examples, solutions, definitions and core concepts, etc.) may be provided as prerecorded videos.

Prerequisites: CSCI 136 and fulfillment of the Discrete Mathematics Proficiency requirement

Enrollment Limit: 20

Enrollment Preferences: Preference will be given to students who need the class in order to complete the major. Ties will be broken by seniority (seniors first, then juniors, etc.).

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will have weekly problem sets in which students will formally prove statements about the behavior and performance of algorithms. In short, the entirety of the course is about applying abstract and mathematical reasoning to the way computers work.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Samuel McCauley

Spring 2021

LEC Section: 01 TBA Shikha Singh

CSCI 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

CSCI 333 (S) Storage Systems (QFR)

This course will examine topics in the design, implementation, and evaluation of storage systems. Topics include the memory hierarchy; ways that data is organized (both logically and physically); storage hardware and its influence on storage software designs; data structures; performance models; and system measurement/evaluation. Readings will be taken from recent technical literature, and an emphasis will be placed on identifying and evaluating design trade-offs.

Prerequisites: CSCI 136; CSCI 237 or permission of instructor

Enrollment Limit: 40

Enrollment Preferences: current Computer Science majors, students with research experience or interest

Expected Class Size: 40

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will have students develop quantitative/formal reasoning skills through problem sets and programming assignments.

Spring 2021

LEC Section: 01 TBA Bill K. Jannen

CSCI 334 (F)(S) Principles of Programming Languages (QFR)

This course examines the concepts and structures governing the design and implementation of programming languages. It presents an introduction to the concepts behind compilers and run-time representations of programming languages; features of programming languages supporting abstraction and polymorphism; and the procedural, functional, object-oriented, and concurrent programming paradigms. Programs will be required in languages illustrating each of these paradigms.

Class Format: There is no scheduled time for lectures. They will be available online for asynchronous viewing. Each conference section will meet once per week, on either Monday or Tuesday. Students should sign up for lecture and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 20(5/conf)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets and labs in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

CON Section: R2 MW 10:00 am - 11:15 am Stephen N. Freund

LEC Section: R1 TBA Stephen N. Freund

CON Section: R5 TR 9:45 am - 11:00 am Stephen N. Freund

CON Section: R3 MR 1:30 pm - 2:45 pm Stephen N. Freund

CON Section: R4 MR 3:15 pm - 4:30 pm Stephen N. Freund

Spring 2021

LEC Section: 01 TBA Stephen N. Freund

CSCI 357 (F) Algorithmic Game Theory (QFR)

This course focuses on topics in game theory and mechanism design from a computational perspective. We will explore questions such as: how to design algorithms that incentivize truthful behavior, that is, where the participants have no incentive to cheat? Should we let drivers selfishly minimize their commute time or let a central algorithm direct traffic? Does Arrow's impossibility result mean that all voting protocols are doomed? The overarching goal of these questions is to understand and analyze selfish behavior and whether it can or should influence system design. Students will learn how to model and reason about incentives in computational systems both theoretically and empirically. Topics include types of equilibria, efficiency of equilibria, auction design, network games, two-sided markets, incentives in computational applications such as file sharing and cryptocurrencies, and computational social choice.

Class Format: Synchronous in-class lectures will be broadcast live to remote students via zoom and recorded for asynchronous viewing. Lecture content may additionally be supplemented with prerecorded videos, and scheduled class time used as exercise or review sessions.

Prerequisites: CSCI 256 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will consist problem sets and programming assignments in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

LEC Section: H1 TR 11:30 am - 12:45 pm Shikha Singh

CSCI 361 (F)(S) Theory of Computation (QFR)

Cross-listings: MATH 361 CSCI 361

Primary Cross-listing

This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory--the examination of what problems can be solved and what problems cannot be solved--and the study of complexity theory--the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: Lecture content will be through asynchronously viewed video modules. Two scheduled course sections will be used for synchronous conference meetings. One section (MR) will be in-person and the other section (TR) will be remote. Students should sign up for lecture and one conference.

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit: 20(10/sec)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 361 (D3) CSCI 361 (D3)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: COGS Interdepartmental Electives

Fall 2020

LEC Section: R1 TBA Aaron M. Williams

CON Section: R3 TR 9:45 am - 11:00 am Aaron M. Williams

CON Section: 02 MR 1:30 pm - 2:45 pm Aaron M. Williams

Spring 2021

LEC Section: 01 TBA Aaron M. Williams

CSCI 374 (F)(S) Machine Learning (QFR)

This tutorial examines the design, implementation, and analysis of machine learning algorithms. Machine Learning is a field that derives from Artificial Intelligence, Statistics, and others, and aims to develop algorithms that will improve a system's performance. Improvement might involve acquiring new factual knowledge from data, learning to perform a new task, or learning to perform an old task more efficiently or effectively. This tutorial will cover examples of supervised learning algorithms (including Bayesian approaches, support vector machines, and neural networks -- both deep and traditional), unsupervised learning algorithms (including k-means and expectation maximization), and possibly reinforcement learning algorithms (such as Q learning and temporal difference learning). It will also introduce methods for the evaluation of learning algorithms, as well as topics in computational learning theory and ethics.

Class Format: Though this course will be offered remotely by the instructor, pairs of students on campus may choose to meet in person for their tutorial sessions. If so, a classroom will be scheduled for them by the instructor.

Prerequisites: CSCI 136 and CSCI 256 or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: Computer Science majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course heavily relies on discrete mathematics, calculus, and elementary statistics. Students will be proving theorems, among many other mathematically oriented assignments. Additionally, they will be programming, which involves analytical and logical thinking.

Attributes: COGS Interdepartmental Electives

Fall 2020

TUT Section: HT1 TBA Andrea Danyluk

Spring 2021

TUT Section: T1 TBA Andrea Danyluk

CSCI 377 (F)(S) Human Work in Computational Systems (QFR)

Cross-listings: CSCI 377 STS 375

Primary Cross-listing

As far as we know, the technological singularity has not yet arrived. Therefore, humans remain a part of our current computation pipeline. However, the role humans play varies greatly: self-driving cars aim to have human involvement only in development and emergencies, whereas educational tools are built for constant human involvement. In this course, we broadly explore human work within computational systems through topics such as crowdsourcing, educational technology, citizen science, human computation, open-source software, micro-labor markets, and online gaming. Students should expect broad exposure to a wide variety of human computing topics and group projects on building and evaluating computational systems that use human work.

Class Format: Lectures will be held on Wednesday and Friday each week. Conference sections will each meet only once per week, on either Wednesday or Thursday. Students should sign up for the lecture section and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 18

Enrollment Preferences: Preference for current CS majors

Expected Class Size: 18

Grading: yes pass/fail option, no fifth course option

Materials/Lab Fee: $75 for purchase of software and work on crowdsourcing platforms.

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CSCI 377 (D3) STS 375 (D2)

Quantative/Formal Reasoning Notes: This course includes regular homework and projects in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

CON Section: 04 TR 9:45 am - 11:00 am Molly Q Feldman

CON Section: 05 TR 11:30 am - 12:45 pm Molly Q Feldman

CON Section: R3 W 2:50 pm - 3:40 pm Molly Q Feldman

CON Section: R2 W 1:30 pm - 2:20 pm Molly Q Feldman

LEC Section: H1 MWF 11:45 am - 1:00 pm Molly Q Feldman

Spring 2021

LEC Section: 01 TBA Molly Q Feldman

ECON 110 (F)(S) Principles of Microeconomics (QFR)

This course is an introduction to the study of the forces of supply and demand that determine prices and the allocation of resources in markets for goods and services, markets for labor, and markets for natural resources. The focus is on how and why markets work, why they may fail to work, and the policy implications of both their successes and failures. The course focuses on developing the basic tools of microeconomic analysis and then applying those tools to topics of popular or policy interest such as minimum wage legislation, pollution control, competition policy, international trade policy, discrimination, tax policy, and the role of government in a market economy.

Class Format: Sections taught by Professors Bradburd and Chao will be strictly remote, with both asynchronous and synchronous components. All other sections will be taught in a hybrid format and will include in-person elements.

Requirements/Evaluation: The department recommends students follow this course with ECON 120 or with a lower-level elective that has ECON 110 as its prerequisite; students may alternatively proceed directly to ECON 251 after taking this introductory course.

Prerequisites: none

Enrollment Limit: 30

Enrollment Preferences: This course is required of Economics and Political Economy majors and highly recommended for those non-majors interested in Environmental Studies and Women's, Gender and Sexuality Studies.

Expected Class Size: 30

Grading: yes pass/fail option, no fifth course option

Unit Notes: The department recommends students follow this course with ECON 120 or with a lower-level elective that has ECON 110 as its prerequisite; students may alternatively proceed directly to ECON 251 after taking this introductory course.

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Attributes: POEC Required Courses

Fall 2020

LEC Section: R7 MR 1:30 pm - 2:45 pm Lucie Schmidt

LEC Section: R3 TR 6:45 pm - 8:00 pm Matthew Chao

LEC Section: 06 TR 11:30 am - 12:45 pm Susan Godlonton

LEC Section: 05 TR 9:45 am - 11:00 am Susan Godlonton

LEC Section: R8 MR 3:15 pm - 4:30 pm Lucie Schmidt

LEC Section: R1 TF 1:30 pm - 2:45 pm Ralph M. Bradburd

LEC Section: R2 TF 3:15 pm - 4:30 pm Ralph M. Bradburd

LEC Section: R4 TR 8:30 pm - 9:45 pm Matthew Chao

Spring 2021

LEC Section: 01 TBA Ralph M. Bradburd, Owen Thompson

ECON 120 (F)(S) Principles of Macroeconomics (QFR)

This course provides an introduction to the study of the aggregate national economy. It develops the basic theories of macroeconomics and applies them to topics of current interest. Issues to be explored include: the causes of inflation, unemployment, recessions, and depressions; the role of government fiscal and monetary policy in stabilizing the economy; the determinants of long-run economic growth; the long- and short-run effects of taxes, budget deficits, and other government policies on the national economy; the role of financial frictions in amplifying recessions; and the workings of exchange rates and international finance.

Class Format: Fall semester sections will be entirely remote, with both asynchronous and synchronous components. Spring section formats are TBD.

Prerequisites: ECON 110

Enrollment Limit: 30

Enrollment Preferences: First-year students and sophomores.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Attributes: POEC Required Courses

Fall 2020

LEC Section: R2 MWF 12:00 pm - 12:50 pm Kenneth N. Kuttner

LEC Section: R1 MWF 8:00 am - 8:50 am Kenneth N. Kuttner

Spring 2021

LEC Section: 01 TBA Jon M. Bakija, Gregory P. Casey, Sara LaLumia

ECON 213 (F) Introduction to Environmental and Natural Resource Economics (QFR)

Cross-listings: ECON 213 ENVI 213

Primary Cross-listing

We'll use economics to learn why we harm the environment and overuse natural resources, and what we can do about it. We'll talk about whether and how we can put a dollar value on nature and ecosystem services. We'll study cost benefit analysis, pollution in general, climate change, environmental justice, natural resources (like fisheries, forests, and fossil fuels), and energy. We will take an economic approach to global sustainability, and study the relationship between the environment and economic growth and trade. Consideration of justice and equity will be woven through the whole semester.

Class Format: We will likely use small, focused discussion groups in combination with lectures

Requirements/Evaluation: this course will count toward both the Environmental Studies major and concentration

Prerequisites: ECON 110 or equivalent

Enrollment Limit: 25

Enrollment Preferences: first-year and sophomore students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this course will count toward both the Environmental Studies major and concentration

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 213 (D2) ENVI 213 (D2)

Quantative/Formal Reasoning Notes: We will use formal theory expressed in math and graphs, perform calculations, and consume statistical data.

Attributes: ENVI Environmental Policy EVST Social Science/Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: H1 MW 6:45 pm - 8:00 pm Sarah A. Jacobson

ECON 251 (F)(S) Price and Allocation Theory (QFR)

A study of the determination of relative prices and their importance in shaping the allocation of resources and the distribution of income. Subjects include: behavior of households in a variety of settings, such as buying goods and services, saving, and labor supply; behavior of firms in various kinds of markets; results of competitive and noncompetitive markets in goods, labor, land, and capital; market failure; government policies as sources of and responses to market failure; welfare criteria; limitations of mainstream analysis.

Class Format: Sections taught by Professors Jakiela and Sheppard in the fall will be strictly remote, with both asynchronous and synchronous components. Spring section formats are TBD.

Prerequisites: ECON 110 and MATH 130 or its equivalent

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves developing and analyzing mathematical models of real-world phenomena, grounded in tools like calculus and game theory. Students are assumed to be comfortable with topics from introductory calculus, including differentiation and integration.

Fall 2020

LEC Section: R3 MR 1:30 pm - 2:45 pm Stephen C. Sheppard

LEC Section: R4 MR 3:15 pm - 4:30 pm Stephen C. Sheppard

LEC Section: R1 TF 1:30 pm - 2:45 pm Pamela Jakiela

LEC Section: R2 TF 3:15 pm - 4:30 pm Pamela Jakiela

Spring 2021

LEC Section: 01 TBA Sarah A. Jacobson, Ashok S. Rai

ECON 252 (F)(S) Macroeconomics (QFR)

A study of aggregate economic activity: output, employment, inflation, and interest rates. The class will develop a theoretical framework for analyzing economic growth and business cycles. The theory will be used to evaluate policies designed to promote growth and stability, and to understand economic developments in the U.S. and abroad. Instructors may use elementary calculus in assigned readings, exams and lectures.

Class Format: Sections taught by Professor Pedroni in the fall will be strictly remote, with both asynchronous and synchronous components. Professor Montiel's fall section will be taught in person. Spring section formats are TBD.

Prerequisites: ECON 110 and 120 and MATH 130 or its equivalent

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course involves mathematical modeling of real-world phenomena, analyzing quantitative results, and describing those results in words.

Fall 2020

LEC Section: R2 TF 1:30 pm - 2:45 pm Peter L. Pedroni

LEC Section: 01 MWF 8:15 am - 9:30 am Peter J. Montiel

LEC Section: R3 TF 3:15 pm - 4:30 pm Peter L. Pedroni

Spring 2021

LEC Section: 01 TBA Kenneth N. Kuttner, Peter L. Pedroni, Greg Phelan

ECON 255 (F)(S) Econometrics (QFR)

An introduction to the theory and practice of applied quantitative economic analysis. This course familiarizes students with the strengths and weaknesses of the basic empirical methods used by economists to evaluate economic theory against economic data. Emphasizes both the statistical foundations of regression techniques and the practical application of those techniques in empirical research, with a focus on understanding when a causal interpretation is warranted. Computer exercises will provide experience in using the empirical methods, but no previous computer experience is expected. Highly recommended for students considering graduate training in economics or public policy.

Class Format: Professor Ozier's fall section will be strictly remote, with both asynchronous and synchronous components. Professor Zimmerman's fall section will be taught in a hybrid format and will include in-person elements. Spring section formats are TBD.

Requirements/Evaluation: Students may substitute the combination of STAT 201 and 346 for ECON 255

Prerequisites: MATH 130, plus STAT 161, 201 or 202 (or equivalent), plus one course in ECON; STAT 101 will also serve as a prerequisite, but only if taken prior to the fall of 2018

Enrollment Limit: 20

Enrollment Preferences: Current or prospective Economics and Political Economy majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: Students may substitute the combination of STAT 201 and 346 for ECON 255

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: Course teaches research tools necessary to analyze data.

Attributes: EVST Methods Courses PHLH Statistics Courses POEC Required Courses

Fall 2020

LEC Section: 02 MWF 8:15 am - 9:30 am David J. Zimmerman

LEC Section: R1 TR 11:30 am - 12:45 pm Owen Ozier

LEC Section: R3 MR 3:15 pm - 4:30 pm Matthew Gibson

Spring 2021

LEC Section: 01 TBA Matthew Gibson, Owen Ozier, Tara E. Watson

ECON 360 (S) Monetary Economics (QFR)

This course covers a range of theoretical and applied issues bearing on monetary policy as conducted in the U.S. and abroad. Topics to be discussed include: What causes inflation? What are the channels through which monetary policy affects the economy? Why should central banks commit to policy rules? How do exchange rates respond to monetary policy? How did the gold standard work? And will cryptocurrencies replace the dollar? In addition, we will develop and learn how to simulate the "New Keynesian" macroeconomic model, which has become the standard framework for monetary policy analysis for central banks around the world.

Prerequisites: ECON 252 and 255. Multivariate calculus (MATH 150 or 151) is recommended but not required

Enrollment Limit: 20

Enrollment Preferences: junior and senior Economics majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course entails the use of mathematical economic models, the presentation of quantitative information, and the interpretation of statistical analysis.

Attributes: GBST Economic Development Studies Electives POEC International Political Economy Courses

Spring 2021

LEC Section: 01 TBA Kenneth N. Kuttner

ECON 376 (F) The Economics of Global Inequality (QFR)

This course focuses on the proximate and ultimate causes of global economic inequality across nations. Motivated by several stylized facts from cross-country data, we will pose a series of questions: Why are some countries so rich while others remain so poor? What explains heterogeneity in the experience of economic growth across nations, with some growing at a moderate pace over long periods of time, others experiencing rapid growth over shorter intervals, and yet others stagnating persistently? Do all economies face comparable challenges to achieving sustained economic growth? Will poorer countries ever catch up to richer ones? To answer these and other related questions, we will explore the underlying mechanisms of economic growth. What role is played by savings and investment (i.e., the accumulation of physical capital)? What is the influence of population growth? How important are investments in human capital (i.e., education and population health)? What about technological differences across nations? How much significance should we ascribe to cross-country differences in geographical characteristics? How much should we ascribe to differences in the quality of institutions? For each question, we will explore both theoretical and empirical approaches, ranging from formal models to qualitative historical evidence to cross-country growth regressions. We will debate the usefulness of these different approaches for development policy and will discuss the reasons why so many questions about global economic inequality remain difficult to answer.

Class Format: This course will be taught in hybrid format in Fall 2020. All classroom lectures will be recorded and made available for remote learners unable to attend lectures virtually. Problem set assignments and exams may be submitted electronically as needed, and all exams will be "take home." Additional office hours will be offered to accommodate the needs of remote learners.

Prerequisites: ECON 252 and either ECON 255 or STAT 346. ECON 251 recommended but not required.

Enrollment Limit: 20

Enrollment Preferences: Junior and senior economics majors.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course material will draw heavily on mathematical and statistical models of economic growth and cross-country comparative development. Students will routinely work on sophisticated mathematical models of economic growth, involving the application of solution concepts from dynamic optimization and differential equations. Students will also be required to perform some econometric analyses in their assignments.

Attributes: GBST Economic Development Studies Electives

Fall 2020

LEC Section: H1   TF 1:30 pm - 2:45 pm   Quamrul H. Ashraf

ECON 384 (F) Corporate Finance (QFR)

This course analyzes the major financial decisions facing firms. While the course takes the perspective of a manager making decisions about both what investments to undertake and how to finance these projects, it will emphasize the underlying economic models that are relevant for these decisions.Topics include capital budgeting, links between real and financial investments, capital structure choices, dividend policy, and firm valuation. Additional topics may include issues in corporate risk management, corporate governance and corporate restructuring, such as mergers and acquisitions. In the fall of 2020, special consideration will be given to how both financial and real economic shocks interact with firms' financial decisions.

Class Format: Lecture / discussion; in the fall of 2020, some weeks we will meet for one 75-minute section (in person when possible) and break into smaller groups for one hour section groups (most likely remote). The timing of the sections will be arranged at the beginning of the semester.

Prerequisites: ECON 251, 252, and some familiarity with statistics (e.g., ECON 255)

Enrollment Limit: 20

Enrollment Preferences: Senior Economics majors

Expected Class Size: 20

Grading: yes pass/fail option,   yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course uses quantitative models to evaluate decisions.

Fall 2020

LEC Section: 01   MW 6:45 pm - 8:00 pm   William M. Gentry

LEC Section: R2   MWF 11:45 am - 1:00 pm   William M. Gentry

ECON 387 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Primary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option,   no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1   MR 1:30 pm - 2:45 pm   Matthew Gibson

ECON 477 (F) Economics of Environmental Behavior (QFR)

Cross-listings: ECON 477 ENVI 376

Primary Cross-listing

A community maintains a fishery; a firm decides whether to get a green certification; you choose to fly home or stay here for spring break: behaviors of people and firms determine our impact on the environment. We'll use economics to model environmental behavior and to consider how policies can help or hurt the environment. Topics we'll study include: voluntary conservation, social norms and nudges, firm responses to mandatory and voluntary rules, and boycotts and divestment.

Class Format: Class sessions will largely consist of presentations and discussions of academic research papers, as well as lab sessions to work on empirical exercises; we may break the class into groups for some discussions

Prerequisites: ECON 251 and (ECON 255 or STAT 346)

Enrollment Limit: 15

Enrollment Preferences: senior Economics majors

Expected Class Size: 15

Grading: yes pass/fail option,   yes fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 477 (D2) ENVI 376 (D2)

Quantative/Formal Reasoning Notes: The research students will consume and produce in the class will be based on math-based theory and/or econometric-based empirical analysis.

Attributes: ENVI Humanities, Arts + Social Science Electives MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

SEM Section: H1   MW 8:30 pm - 9:45 pm   Sarah A. Jacobson

ECON 522 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Secondary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option,   no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1 MR 1:30 pm - 2:45 pm Matthew Gibson

ENVI 203 (F) Ecology (QFR)

Cross-listings: ENVI 203 BIOL 203

Secondary Cross-listing

This course combines lectures with field and indoor laboratory exercises to explore factors that determine the distribution and abundance of plants and animals in natural systems. The course begins with an overall view of global patterns and then builds from the population to the ecosystem level. An emphasis is given to basic ecological principles and relates them to current environmental issues. Selected topics include population dynamics (competition, predation, mutualism); community interactions (succession, food chains and diversity) and ecosystem function (biogeochemical cycles, energy flow). In Fall 2020, the course will use a hybrid model, with recorded lecture material available to all students. In person and remote class meetings will focus on problem sets and interactive case studies. Labs will be available in either in person or remote modalities. Remote participants will have the opportunity to collect their own data for some lab exercises, while in other cases will receive background information and media describing the data collection process. All students will be required to complete all data analyses and written lab reports.

Class Format: Six hours per week. All labs will be available in both remote and in-person modalities. All students (whether in person or remote) may choose their preferred modality for each lab module. Due to COVID-19 distancing requirements, some labs will require walking to field sites. The instructor will work with individual students to identify accommodations that support in person lab participation as needed.

Requirements/Evaluation: satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 101 and 102, or ENVI 101 or 102, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: students planning to pursue Biology and/or ENVI

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 203 (D3) BIOL 203 (D3)

Quantative/Formal Reasoning Notes: Much of the material in this course centers on the interpretation and application of mathematical models used to describe ecological systems. The laboratory section of this course also contains a large data analysis component. Students are introduced to t-tests, Mann-Whitney U tests, chi-square analysis, and regression.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Living Systems Courses

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Allison L. Gill

LAB Section: H2 T 1:00 pm - 3:00 pm Allison L. Gill

LAB Section: H3 T 3:30 pm - 5:30 pm Allison L. Gill

ENVI 209 (F) Modern Climate (QFR)

Cross-listings: GEOS 309 ENVI 209

Secondary Cross-listing

What will happen to the Earth's climate in the next century? What is contributing to sea level rise? Is Arctic sea ice doomed? In this course we will study the components of the climate system (atmosphere, ocean, cryosphere, biosphere and land surface) and the processes through which they interact. Greenhouse gas emission scenarios will form the basis for investigating how these systems might respond to human activity. This course will explore how heat and mass are moved around the atmosphere and ocean to demonstrate how the geographic patterns of climate change arise. We will also focus on climate feedback effects--like the albedo feedback associated with sea ice and glacier loss--and how these processes can accelerate climate change. In labs we will learn MATLAB to use process and full-scale climate models to investigate the behavior of these systems in response to increasing greenhouse gasses in the atmosphere. This course is in the Oceans and Climate group for the Geosciences major.

Class Format: Lectures will be held synchronously online. Labs will be remote and in small groups. Lab groups will each meet online for two 1-hour sessions each week, scheduled according to the needs of the class. In-person office hours available.

Prerequisites: Any of GEOS 100, GEOS 103, ENVI 102, GEOS 215, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: GEOS and ENVI majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

GEOS 309 (D3) ENVI 209 (D3)

Quantative/Formal Reasoning Notes: Labs consist of a series of numerical climate modeling projects, which require significant quantitative and logical reasoning.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Methods Courses GEOS Group A Electives - Climate + Oceans

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Alice C. Bradley

ENVI 213 (F) Introduction to Environmental and Natural Resource Economics (QFR)

Cross-listings: ECON 213 ENVI 213

Secondary Cross-listing

We'll use economics to learn why we harm the environment and overuse natural resources, and what we can do about it. We'll talk about whether and how we can put a dollar value on nature and ecosystem services. We'll study cost benefit analysis, pollution in general, climate change, environmental justice, natural resources (like fisheries, forests, and fossil fuels), and energy. We will take an economic approach to global sustainability, and study the relationship between the environment and economic growth and trade. Consideration of justice and equity will be woven through the whole semester.

Class Format: We will likely use small, focused discussion groups in combination with lectures

Requirements/Evaluation: this course will count toward both the Environmental Studies major and concentration

Prerequisites: ECON 110 or equivalent

Enrollment Limit: 25

Enrollment Preferences: first-year and sophomore students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this course will count toward both the Environmental Studies major and concentration

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 213 (D2) ENVI 213 (D2)

Quantative/Formal Reasoning Notes: We will use formal theory expressed in math and graphs, perform calculations, and consume statistical data.

Attributes: ENVI Environmental Policy EVST Social Science/Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: H1 MW 6:45 pm - 8:00 pm Sarah A. Jacobson

ENVI 339 (F) Conservation Biology (QFR)

Cross-listings: ENVI 339 BIOL 329

Secondary Cross-listing

This course examines the application of population genetics, population ecology, community ecology, and systematics to the conservation of biological diversity. The overarching theme of the course is on the role of stochastic processes for small populations. Lecture/discussion topics will include extinction, the genetics of small populations, metapopulations, and importantly, conservation strategies. Labs will include a mixture of computer and lab projects.

Class Format: lecture and discussion, 3 hours per week; lab, 1.25 hours per week. students will be assigned to a lab section (block AA - either W or F from 1:30-2:45) during the first week of class.

Requirements/Evaluation: Satisfies the distribution requirement for the Biology major

Prerequisites: BIOL 203/ENVI 203, or BIOL 305, or permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Biology majors, seniors, and juniors

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 339 (D3) BIOL 329 (D3)

Quantative/Formal Reasoning Notes: This course uses quantitative and statistical analyses in both the laboratory and lecture portion of the course. In lectures mathematical models will be covered to understand conservation dynamics. In lab, students will collect and analyze data and present results in graphical and statistical forms.

Attributes: ENVI Natural World Electives

Fall 2020

LEC Section: H1 TR 8:00 am - 9:15 am Manuel A. Morales

LAB Section: H2 WF 1:30 pm - 2:45 pm Manuel A. Morales

ENVI 376 (F) Economics of Environmental Behavior (QFR)

Cross-listings: ECON 477 ENVI 376

Secondary Cross-listing

A community maintains a fishery; a firm decides whether to get a green certification; you choose to fly home or stay here for spring break: behaviors of people and firms determine our impact on the environment. We'll use economics to model environmental behavior and to consider how policies can help or hurt the environment. Topics we'll study include: voluntary conservation, social norms and nudges, firm responses to mandatory and voluntary rules, and boycotts and divestment.

Class Format: Class sessions will largely consist of presentations and discussions of academic research papers, as well as lab sessions to work on empirical exercises; we may break the class into groups for some discussions

Prerequisites: ECON 251 and (ECON 255 or STAT 346)

Enrollment Limit: 15

Enrollment Preferences: senior Economics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 477 (D2) ENVI 376 (D2)

Quantative/Formal Reasoning Notes: The research students will consume and produce in the class will be based on math-based theory and/or econometric-based empirical analysis.

Attributes: ENVI Humanities, Arts + Social Science Electives MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

SEM Section: H1 MW 8:30 pm - 9:45 pm Sarah A. Jacobson

ENVI 387 (F) Economics of Climate Change (QFR)

Cross-listings: ECON 522 ENVI 387 ECON 387

Secondary Cross-listing

This course introduces the economic view of climate change, including both theory and empirical evidence. Given the substantial changes implied by the current stock of greenhouse gases (GHGs) in the atmosphere, we will begin by looking at impacts on agriculture, health, income, and migration. We will consider the distribution of climate damages across poor and wealthy people, both within and across countries. Next we will study adaptation, including capital investments and behavioral changes. We will examine the sources of climate change, especially electricity generation and transportation, and think about optimal policies. What is the socially optimal amount of climate change? Why have countries had such a hard time agreeing on GHG emissions reductions, and how might we overcome such difficulties? We will consider the growing body of evidence from attempts to regulate GHGs, including China's cap-and-trade programs, the EU ETS, and US state policies. Throughout the course we will discuss the limits of the economic approach, pointing out normative questions on which economic theory provides little guidance.

Class Format: Lectures, office hours and TA sessions will take place on Zoom.

Prerequisites: ECON 251, familiarity with statistics

Enrollment Limit: 20

Enrollment Preferences: Junior/Senior Economics majors and CDE fellows

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

ECON 522 (D2) ENVI 387 (D2) ECON 387 (D2)

Quantative/Formal Reasoning Notes: The course involves simple calculus-based theory and applied statistics.

Attributes: ENVI Environmental Policy MAST Interdepartmental Electives POEC Comparative POEC/Public Policy Courses

Fall 2020

LEC Section: R1 MR 1:30 pm - 2:45 pm Matthew Gibson

GEOS 309 (F) Modern Climate (QFR)

Cross-listings: GEOS 309 ENVI 209

Primary Cross-listing

What will happen to the Earth's climate in the next century? What is contributing to sea level rise? Is Arctic sea ice doomed? In this course we will study the components of the climate system (atmosphere, ocean, cryosphere, biosphere and land surface) and the processes through which they interact. Greenhouse gas emission scenarios will form the basis for investigating how these systems might respond to human activity. This course will explore how heat and mass are moved around the atmosphere and ocean to demonstrate how the geographic patterns of climate change arise. We will also focus on climate feedback effects--like the albedo feedback associated with sea ice and glacier loss--and how these processes can accelerate climate change. In labs we will learn MATLAB to use process and full-scale climate models to investigate the behavior of these systems in response to increasing greenhouse gasses in the atmosphere. This course is in the Oceans and Climate group for the Geosciences major.

Class Format: Lectures will be held synchronously online. Labs will be remote and in small groups. Lab groups will each meet online for two 1-hour sessions each week, scheduled according to the needs of the class. In-person office hours available.

Prerequisites: Any of GEOS 100, GEOS 103, ENVI 102, GEOS 215, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: GEOS and ENVI majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

GEOS 309 (D3) ENVI 209 (D3)

Quantative/Formal Reasoning Notes: Labs consist of a series of numerical climate modeling projects, which require significant quantitative and logical reasoning.

Attributes: ENVI Natural World Electives EVST Environmental Science EVST Methods Courses GEOS Group A Electives - Climate + Oceans

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Alice C. Bradley

MATH 119 (F) The Mathematics of Pandemics: From the Spread of Infections to Cost-Benefit Analyses of Responses (QFR)

The goal of the class is to help students learn to ask the right questions, and to gather and analyze the data needed to answer them, to understand the covid pandemic and the worldwide responses. Through local experts and numerous guest speakers playing key roles in these problems, we will discuss numerous aspects, from mathematical models for virus propagation to analyzing the economic, educational, social and emotional consequences of lockdowns and social distancing; from moral and legal dilemnas created by the pandemic and responses to the international political scene and relations between countries. Offered as Math 119 or Math 312 (those taking as Math 312 will have some of the readings replaced with more technical modeling papers and subsequent homework). Pre-requisites: None for Math 119; for Math 312 linear algebra is recommended.

Prerequisites: none

Enrollment Limit: 30

Enrollment Preferences: all students will have an equal chance; if possible none will be turned away.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: We will discuss mathematical models and use statistics to analyze data.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Steven J. Miller

MATH 130 (F)(S) Calculus I (QFR)

Calculus permits the computation of velocities and other instantaneous rates of change by a limiting process called differentiation. The same process also solves "max-min" problems: how to maximize profit or minimize pollution. A second limiting process, called integration, permits the computation of areas and accumulations of income or medicines. The Fundamental Theorem of Calculus provides a useful and surprising link between the two processes. Subtopics include trigonometry, exponential growth, and logarithms.

Requirements/Evaluation: students who have previously taken a calculus course may not enroll in MATH 130 without the permission of instructor

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test); this is an introductory course for students who have not seen calculus before

Enrollment Limit: 30

Enrollment Preferences: first-year students

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students who have previously taken a calculus course may not enroll in MATH 130 without the permission of instructor

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This a calculus course.

Fall 2020

LEC Section: H2 TF 3:15 pm - 4:30 pm Lori A. Pedersen

LEC Section: H1 TF 1:30 pm - 2:45 pm Lori A. Pedersen

Spring 2021

LEC Section: 01 TBA Lori A. Pedersen

MATH 140 (F)(S) Calculus II (QFR)

Mastery of calculus requires understanding how integration computes areas and business profit and acquiring a stock of techniques. Further methods solve equations involving derivatives ("differential equations") for population growth or pollution levels. Exponential and logarithmic functions and trigonometric and inverse functions play an important role. This course is the right starting point for students who have seen derivatives, but not necessarily integrals, before.

Requirements/Evaluation: students who have higher advanced placement must enroll in MATH 150 or above

Prerequisites: MATH 130 or equivalent; students who have received the equivalent of advanced placement of AB 4, BC 3 or higher may not enroll in MATH 140 without the permission of instructor

Enrollment Limit: 30

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students who have higher advanced placement must enroll in MATH 150 or above

Distributions: (D3) (QFR)

Fall 2020

LEC Section: R2 TF 3:15 pm - 4:30 pm Josh Carlson

LEC Section: R1 TF 1:30 pm - 2:45 pm Josh Carlson

Spring 2021

LEC Section: 01 TBA Josh Carlson

MATH 150 (F)(S) Multivariable Calculus (QFR)

Applications of calculus in mathematics, science, economics, psychology, the social sciences, involve several variables. This course extends calculus to several variables: vectors, partial derivatives, multiple integrals. There is also a unit on infinite series, sometimes with applications to differential equations. Note: This course will be taught via flipped-course method, an instructional strategy reversing the traditional learning environment by delivering instructional content outside of the classroom. This includes prerecorded lectures along with questions that students must watch and answer prior to attending class. Class time include synchronous meetings clarifying concepts and working in small groups through challenging problems with the support of the professor and peers. Building positive collaborative working relationships and public speaking skills will be added benefits of this course.

Requirements/Evaluation: students with the equivalent of advanced placement of AB 4 or above should enroll in MATH 150, students with a BC 3 or higher should enroll in Math 151 when it is being offered, and Math 150 otherwise.

Prerequisites: MATH 140 or equivalent, such as satisfactory performance on an Advanced Placement Examination

Enrollment Limit: 30

Enrollment Preferences: Professor's discretion

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with the equivalent of advanced placement of AB 4 or above should enroll in MATH 150, students with a BC 3 or higher should enroll in Math 151 when it is being offered, and Math 150 otherwise.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: mathematics

Fall 2020

SEM Section: R2 TR 9:45 am - 11:00 am Pamela E. Harris

SEM Section: R3 TR 11:30 am - 12:45 pm Pamela E. Harris

SEM Section: R1 TR 8:00 am - 9:15 am Pamela E. Harris

Spring 2021

SEM Section: 01 TBA Steven J. Miller

MATH 151 (F) Multivariable Calculus (QFR)

Applications of calculus in mathematics, science, economics, psychology, the social sciences, involve several variables. This course extends calculus to several variables: vectors, partial derivatives and multiple integrals. The goal of the course is Stokes Theorem, a deep and profound generalization of the Fundamental Theorem of Calculus. The difference between this course and MATH 150 is that MATH 150 covers infinite series instead of Stokes Theorem. Students with the equivalent of BC 3 or higher should enroll in MATH 151, as well as students who have taken the equivalent of an integral calculus and who have already been exposed to infinite series. For further clarification as to whether MATH 150 or MATH 151 is appropriate, please consult a member of the math/stat department.

Class Format: Hybrid; short lectures will be asynchronous, with longer synchronous in-person problem sessions (these will be available remotely, and uploaded later for asynchronous viewing)

Requirements/Evaluation: MATH 151 satisfies any MATH 150 prerequisite; credit will not be given for both MATH 150 and MATH 151

Prerequisites: AP BC 3 or higher or integral calculus with infinite series

Enrollment Limit: 30

Enrollment Preferences: First-years, sophomores, and juniors

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: MATH 151 satisfies any MATH 150 prerequisite; credit will not be given for both MATH 150 and MATH 151

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course builds quantitative skills

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Ralph E. Morrison

LEC Section: H3 MWF 12:00 pm - 12:50 pm Ralph E. Morrison

LEC Section: H2 MWF 10:40 am - 11:30 am Ralph E. Morrison

MATH 200 (F)(S) Discrete Mathematics (QFR)

This course will help you understand the world through a mathematical lens and will develop your powers of argumentation and critical thinking. We will explore and utilize diverse areas of discrete mathematics including logic, set theory, functions and relations, combinatorics, probability, networks, and more. We also will discuss methods and styles of mathematical proofs in order to prepare you for more advanced math courses. Finally, while mathematical knowledge is often perceived as being "pure," we will highlight some ways in which it is socially constructed and hence subject to human limitations and biases.

Class Format: To afford students flexibility during the COVID pandemic, this course is taught online. Students will watch lecture material asynchronously and will participate in a a once-per-week synchronous small-group tutorial meeting with the instructor via video chat.

Prerequisites: Calculus at the level of an AP course or Williams College Math 130 or 140. Students who have taken a 300-level or 400-level math course should obtain permission of the instructor before enrolling.

Enrollment Limit: 30

Enrollment Preferences: As determined by instructor.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course involve developing the formal mathematical language of logic and set theory. It also involves using quantitative tools to solve problems relating to combinatorics, probability, and other fields of discrete mathematics.

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Chad M. Topaz

LEC Section: R2 TR 11:30 am - 12:45 pm Chad M. Topaz

Spring 2021

LEC Section: 01 TBA Allison Pacelli

MATH 210 (S) Mathematical Methods for Scientists (QFR)

Cross-listings: PHYS 210 MATH 210

Secondary Cross-listing

This course covers a variety of mathematical methods used in the sciences, focusing particularly on the solution of ordinary and partial differential equations. In addition to calling attention to certain special equations that arise frequently in the study of waves and diffusion, we develop general techniques such as looking for series solutions and, in the case of nonlinear equations, using phase portraits and linearizing around fixed points. We study some simple numerical techniques for solving differential equations. A series of optional sessions in Mathematica will be offered for students who are not already familiar with this computational tool.

Class Format: three hours per week

Prerequisites: MATH 150 or 151 and familiarity with Newtonian mechanics at the level of PHYS 131

Enrollment Limit: 50

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 210 (D3) MATH 210 (D3)

Spring 2021

LEC Section: 01 TBA Frederick W. Strauch

MATH 250 (F)(S) Linear Algebra (QFR)

Many social, political, economic, biological, and physical phenomena can be described, at least approximately, by linear relations. In the study of systems of linear equations one may ask: When does a solution exist? When is it unique? How does one find it? How can one interpret it geometrically? This course develops the theoretical structure underlying answers to these and other questions and includes the study of matrices, vector spaces, linear independence and bases, linear transformations, determinants and inner products. Course work is balanced between theoretical and computational, with attention to improving mathematical style and sophistication.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely.

Prerequisites: MATH 150/151 or MATH 200

Enrollment Limit: 30

Enrollment Preferences: Students who have officially declared a major that requires Math 250.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: In this course, students will engage in both quantitative and formal reasoning.

Attributes: COGS Related Courses

Fall 2020

LEC Section: H1 TF 1:30 pm - 2:45 pm Susan R. Loepp

LEC Section: H2 TF 3:15 pm - 4:30 pm Susan R. Loepp

Spring 2021

LEC Section: 01 TBA John D. Wiltshire-Gordon

MATH 307 (S) Computational Linear Algebra (QFR)

Linear algebra is of central importance in the quantitative sciences, including application areas such as image and signal processing, data mining, computational finance, structural biology, and much more. When the problems must be solved computationally, approximation, round-off errors, convergence, and efficiency matter, and traditional linear algebra techniques may fail to succeed. We will adopt linear algebra techniques on a large scale, implement them computationally, and apply them to core problems in scientific computing. Topics may include: systems of linear and nonlinear equations; approximation and statistical function estimation; optimization; interpolation; and Monte Carlo techniques. This course could also be considered a course in numerical analysis or computational science.

Prerequisites: MATH 250, some elementary computer programming experience is strongly recommended

Enrollment Limit: 30

Enrollment Preferences: Professor's discretion

Expected Class Size: 25

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Chad M. Topaz

MATH 309 (F) Differential Equations (QFR)

Ordinary differential equations (ODE) frequently arise as models of phenomena in the natural and social sciences. This course presents core ideas of ODE from an applied standpoint. Topics covered early in the course may include numerical solutions, separation of variables, integrating factors, constant coefficient linear equations, and power series solutions. Later, we will focus on nonlinear ODEs, for which it is usually impossible to find analytical solutions. Tools from dynamical systems will be introduced to allow us to obtain some information about the behavior of the ODE without explicitly knowing the solution.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 150/151 and MATH 250

Enrollment Limit: 20

Enrollment Preferences: discretion of the instructor

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: 300-level mathematics course

Fall 2020

LEC Section: R1 TR 9:45 am - 11:00 am Julie C. Blackwood

MATH 310 (F) Mathematical Biology (QFR)

Cross-listings: BIOL 210 MATH 310

Primary Cross-listing

This course will provide an introduction to the many ways in which mathematics can be used to understand, analyze, and predict biological dynamics. We will learn how to construct mathematical models that capture essential properties of biological processes while maintaining analytic tractability. Analytic techniques, such as stability and bifurcation analysis, will be introduced in the context of both continuous and discrete time models. Additionally, students will couple these analytic tools with numerical simulation to gain a more global picture of the biological dynamics. Possible biological applications include, but are not limited to, single and multi-species population dynamics, neural and biological oscillators, tumor cell growth, and infectious disease dynamics.

Class Format: Unless circumstances change, students will have the option of taking the course in person or remotely

Prerequisites: MATH 250 and MATH 309, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: if over-enrolled, will have students submit reasons for taking class; preference to those with interest in both subjects

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 210 (D3) MATH 310 (D3)

Quantative/Formal Reasoning Notes: The course will introduce methods for developing and analyzing mathematical models.

Attributes: PHLH Methods in Public Health

Fall 2020

LEC Section: R1 TR 11:30 am - 12:45 pm Julie C. Blackwood

MATH 312 (F) The Mathematics of Pandemics: From the Spread of Infections to Cost-Benefit Analyses of Responses (QFR)

The goal of the class is to help students learn to ask the right questions, and to gather and analyze the data needed to answer them, to understand the covid pandemic and the worldwide responses. Through local experts and numerous guest speakers playing key roles in these problems, we will discuss numerous aspects, from mathematical models for virus propagation to analyzing the economic, educational, social and emotional consequences of lockdowns and social distancing; from moral and legal dilemnas created by the pandemic and responses to the international political scene and relations between countries. Offered as Math 119 or Math 312 (those taking as Math 312 will have some of the readings replaced with more technical modeling papers and subsequent homework). Pre-requisites: None for Math 119; for Math 312 linear algebra is recommended.

Prerequisites: Linear algebra recommended.

Enrollment Limit: none

Enrollment Preferences: all students will have an equal chance; if possible none will be turned away.

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: We will discuss mathematical models and use statistics to analyze data.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Steven J. Miller

MATH 313 (S) Introduction to Number Theory (QFR)

The study of numbers dates back thousands of years, and is fundamental in mathematics. In this course, we will investigate both classical and modern questions about numbers. In particular, we will explore the integers, and examine issues involving primes, divisibility, and congruences. We will also look at the ideas of number and prime in more general settings, and consider fascinating questions that are simple to understand, but can be quite difficult to answer. This course will be using an active learning method, an instructional strategy reversing the traditional learning environment by supplying instructional content outside of the classroom. This will include reading the textbook and completing other assigned activities prior to attending class. Class time will be spent clarifying concepts and working in small groups through challenging problems with the support of the professor and peers. Building positive collaborative working relationships and public speaking skills will be added benefits of this class.

Class Format: This course will employ an active learning method rather than the traditional lecture. Please see the course description for details.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 40

Enrollment Preferences: All are welcome regardless of major or year. In case of over-enrollment, preference will be given to those needing the course for graduation.

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course requires working with various number systems, performing explicit computations, and proving mathematical results using logical reasoning practices.

Spring 2021

LEC Section: 01 TBA Eva Goedhart

MATH 315 (S) Methods for Solving Diophantine Equations (QFR)

A Diophantine equation is an equation with integer (or rational) coefficients that is to be solved in integers (or rational numbers). A focus of study for hundreds of years, Diophantine analysis remains a vibrant area of research. It has yielded a multitude of beautiful results and has wide ranging applications in other areas of mathematics, in cryptography, and in the natural sciences. In this project-based tutorial, we will focus on studying and implementing various methods for solving previously unsolved infinite families of Diophantine equations. Depending on their interests, students may choose one or several methods to apply to open problems in the field.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 10

Enrollment Preferences: Sophomores, Juniors, and Seniors based on a short questionnaire of interests.

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course requires working with various number systems, performing explicit computations, and proving mathematical results using logical reasoning practices.

Spring 2021

TUT Section: T1 TBA Eva Goedhart

MATH 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells.

Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

MATH 334 (S) Graph Theory (QFR)

A graph is a collection of vertices, joined together by edges. In this course, we will study the sorts of structures that can be encoded in graphs, along with the properties of those graphs. We'll learn about such classes of graphs as multi-partite, planar, and perfect graphs, and will see applications to such optimization problems as minimum colorings of graphs, maximum matchings in graphs, and network flows.

Prerequisites: MATH 200 or MATH 250

Enrollment Limit: 35

Enrollment Preferences: Math majors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Josh Carlson

MATH 341 (F)(S) Probability (QFR)

Cross-listings: STAT 341 MATH 341

Primary Cross-listing

While probability began with a study of games, it has grown to become a discipline with numerous applications throughout mathematics and the sciences. Drawing on gaming examples for motivation, this course will present axiomatic and mathematical aspects of probability. Included will be discussions of random variables, expectation, independence, laws of large numbers, and the Central Limit Theorem. Many interesting and important applications will also be presented, potentially including some from coding theory, number theory and nuclear physics.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Priority will be given to Stats majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

STAT 341 (D3) MATH 341 (D3)

Quantative/Formal Reasoning Notes: This is a 300-level Math/Stat course

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Stewart D. Johnson

Spring 2021

LEC Section: 01 TBA Mihai Stoiciu

MATH 350 (F)(S) Real Analysis (QFR)

Why is the product of two negative numbers positive? Why do we depict the real numbers as a line? Why is this line continuous, and what does that actually mean? More fundamentally, what is the definition of a real number? Real analysis addresses such questions, delving into the structure of real numbers and functions on them. Along the way we'll discuss sequences and limits, series, completeness, compactness, derivatives and integrals, and metric spaces. Results covered will include the Cantor-Schroeder-Bernstein theorem, the monotone convergence theorem, the Bolzano-Weierstrass theorem, the Cauchy criterion, Dirichlet's and Riemann's rearrangement theorem, the Heine-Borel theorem, the intermediate value theorem, and many others. This course is excellent preparation for graduate studies in mathematics, statistics, and economics.

Class Format: Discussion-based course held remotely.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Seniors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Fall 2020

LEC Section: R1 MR 3:15 pm - 4:30 pm Leo Goldmakher

Spring 2021

LEC Section: 01 TBA Stewart D. Johnson

MATH 351 (S) Applied Real Analysis (QFR)

Real analysis or the theory of calculus-derivatives, integrals, continuity, convergence--starts with a deeper understanding of real numbers and limits. Applications in the calculus of variations or "infinite-dimensional calculus" include geodesics, harmonic functions, minimal surfaces, Hamilton's action and Lagrange's equations, optimal economic strategies, nonEuclidean geometry, and general relativity. .

Prerequisites: MATH 150 and MATH 250, or permission of instructor

Enrollment Limit: 50

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Core mathematics major course with daily problem sets.

Spring 2021

LEC Section: 01 TBA Stewart D. Johnson

MATH 355 (F)(S) Abstract Algebra (QFR)

Algebra gives us tools to solve equations. The integers, the rationals, and the real numbers have special properties which make algebra work according to the circumstances. In this course, we generalize algebraic processes and the sets upon which they operate in order to better understand, theoretically, when equations can and cannot be solved. We define and study abstract algebraic structures such as groups, rings, and fields, as well as the concepts of factor group, quotient ring, homomorphism, isomorphism, and various types of field extensions. This course introduces students to abstract rigorous mathematics.

Class Format: Remote lectures. TA sessions will be held in person. If taken pass/fail, this course does not count towards the Mathematics major.

Prerequisites: MATH 250 or permission of instructor

Enrollment Limit: 24

Enrollment Preferences: Questionnaires.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: 300-level math course

Fall 2020

LEC Section: R1 MW 11:45 am - 1:00 pm Allison Pacelli

Spring 2021

LEC Section: 01 TBA Susan R. Loepp

MATH 361 (F)(S) Theory of Computation (QFR)

Cross-listings: MATH 361 CSCI 361

Secondary Cross-listing

This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory--the examination of what problems can be solved and what problems cannot be solved--and the study of complexity theory--the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: Lecture content will be through asynchronously viewed video modules. Two scheduled course sections will be used for synchronous conference meetings. One section (MR) will be in-person and the other section (TR) will be remote. Students should sign up for lecture and one conference.

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit: 20(10/sec)

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 20

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 361 (D3) CSCI 361 (D3)

Quantative/Formal Reasoning Notes: This course include regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: COGS Interdepartmental Electives

Fall 2020

CON Section: R3 TR 9:45 am - 11:00 am Aaron M. Williams

CON Section: 02 MR 1:30 pm - 2:45 pm Aaron M. Williams

LEC Section: R1 TBA Aaron M. Williams

Spring 2021

LEC Section: 01 TBA Aaron M. Williams

MATH 374 (S) Topology (QFR)

In Real Analysis you learned about metric spaces -- any set of objects endowed with a way of measuring distance -- and the topology of sets in such spaces (open, closed, bounded, etc). In this course we flip this on its head: we explore how to develop analysis (limits, continuity, etc) in spaces where the topology is known but the metric is not. This will lead us to a bizarre and fascinating version of geometry in which we cannot distinguish between shapes that can be continuously deformed into one another. Not only does this theory turn out to be beautiful in the abstract, it has become a vital part of data analysis and is also connected to many areas of math and physics. This course is excellent preparation for graduate programs in mathematics.

Prerequisites: MATH 350 or 351; not open to students who have taken MATH 323. Familiarity with basic group theory recommended, but not required.

Enrollment Limit: 30

Enrollment Preferences: Juniors and seniors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Spring 2021

LEC Section: 01 TBA Leo Goldmakher

MATH 391 (F) Introduction to computer algebra (QFR)

Students will learn new mathematics in the context of computer-based exposition, experimentation, and interaction. They will gain proficiency with Sage, GAP, Macaulay2, or Mathematica, and possibly one of the more-specialized systems SnapPea, kenzo, magma, MATLAB, Perseus, coq, etc. Individuals and teams will build interactive demonstrations of mathematical theorems, which will then be appreciated by the instructor and the rest of the class. No prior programming experience is expected.

Class Format: Class will be held online, but there will be recorded components, asynchronous interactive components, and outside-of-class small-group online meetings.

Prerequisites: Math 355 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: math majors

Expected Class Size: 15

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Mathematical programming requires complete synthesis of abstract concepts to produce computer code, which is necessarily formal.

Fall 2020

LEC Section: R1 TR 6:45 pm - 8:00 pm John D. Wiltshire-Gordon

MATH 392 (S) Undergraduate Research Topics in Graph Theory (QFR)

Graph theory is a vibrant area of research with many applications to the social sciences, psychology, and economics. In this tutorial we focus on two topics of mathematical research in graph theory: evasion-pursuit games on graphs and domination theory. Students in this project-based tutorial will select among the presented topics, and will begin original research on an open problem in the field. Student assessment is based on problem sets, drafts of research project manuscript, and a final oral class presentation.

Prerequisites: MATH 355 or permission of the instructor

Enrollment Limit: 10

Enrollment Preferences: programming experience, students with interests in the intersection of combinatorics and graph theory

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

TUT Section: T1 TBA Pamela E. Harris

MATH 402 (F) Measure Theory and Hilbert Spaces (QFR)

How large is the unit square? One might measure the number of individual points in the square (uncountably infinite), the area of the square (1), or the dimension of the square (2). But what about for more complicated sets, e.g., the set of all rational points in the unit square? What's the area of this set? What's the dimension? In this course we'll come up with precise ways to measure size -- length, area, volume, dimension -- that apply to a broad array of sets. Along the way we'll encounter Lebesgue measure and Lebesgue integration, Hausdorff measure and fractals, space-filling curves and the Banach-Tarski paradox. We will also investigate Hilbert spaces, mathematical objects that combine the tidiness of linear algebra with the power of analysis and are fundamental to the study of differential equations, functional analysis, harmonic analysis, and ergodic theory, and also apply to fields like quantum mechanics and machine learning. This material provides good preparation for graduate studies in mathematics, statistics and economics.

Class Format: Discussion-based course held remotely.

Prerequisites: MATH 350 or MATH 351 or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Seniors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Fall 2020

LEC Section: R1 TF 3:15 pm - 4:30 pm Leo Goldmakher

MATH 408 (F) L-Functions and Sphere Packing (QFR)

Optimal packing problems arise in many important problems, and have been a source of excellent mathematics for centuries. The Kepler Problem (what is the most efficient way to pack balls in three-space) is a good example. The original formulation has been used in such diverse areas as stacking cannonballs on battleships to grocers preparing fruit displays, and its generalizations allow the creation of powerful error detection and correction codes. While the solution of the Kepler Problem is now known, the higher dimensional version is very much open. There has been remarkable progress in the last few years, with number theory playing a key role in these results. We will develop sufficient background material to understand many of these problems and the current state of the field. Pre-requisites are real analysis.

Prerequisites: Math 350 or 351

Enrollment Limit: 40

Enrollment Preferences: Senior math majors, students planning on graduate study in a STEM field

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400 level math class

Fall 2020

LEC Section: H1 MWF 12:00 pm - 12:50 pm Steven J. Miller

MATH 420 (S) Analytic Number Theory (QFR)

How many primes are smaller than x? How many divisors does an integer n have? How many different numbers appear in the N x N multiplication table? Over the course of the past 150 years, tremendous progress has been made towards resolving these and similar questions in number theory, relying on tools and methods from analysis. The goal of this tutorial is to explain and motivate the ubiquitous appearance of analysis in modern number theory--a surprising fact, given that analysis is concerned with continuous functions, while number theory is concerned with discrete objects (integers, primes, divisors, etc). Topics to be covered include: asymptotic analysis, partial and Euler-Maclaurin summation, counting divisors and Dirichlet's hyperbola method, the randomness of prime factorization and the Erdos-Kac theorem, the partition function and the saddle point method, the prime number theorem and the Riemann zeta function, primes in arithmetic progressions and Dirichlet L-functions, the Goldbach conjecture and the circle method, gaps between primes, and other topics as time and interest allow.

Prerequisites: MATH 350 or MATH 351 and familiarity with basic modular arithmetic are hard prerequisites. Familiarity with complex analysis and abstract algebra recommended, but not required.

Enrollment Limit: 10

Enrollment Preferences: Those with complex analysis background will be given priority.

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Math

Spring 2021

TUT Section: T1 TBA Leo Goldmakher

MATH 433 (S) Mathematical Modeling (QFR)

Mathematical modeling means (1) translating a real-life problem into a mathematical object, and (2) studying that object using mathematical techniques, and (3) interpreting the results in order to learn something about the real-life problem. Mathematical modeling is used in biology, economics, chemistry, geology, sociology, political science, art, and countless other fields. This is an advanced, seminar-style, course appropriate for students who have a strong enthusiasm for applied mathematics.

Class Format: discussion, research

Prerequisites: MATH 250, MATH 309 or similar, and some experience with computer programming (equivalent to CSCI 134 or MATH 307)

Enrollment Limit: 24

Enrollment Preferences: Professor's discretion

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Chad M. Topaz

MATH 434 (F) Applied Dynamics and Optimal Control (QFR)

We seek to understand how dynamical systems evolve, how that evolution depends on the various parameters of the system, and how we might manipulate those parameters to optimize an outcome. We will explore the language of dynamics by deepening our understanding of differential and difference equations, study parameter dependence and bifurcations, and explore optimal control through Pontryagin's maximum principle and Hamilton-Jacobi-Bellman equations. These tools have broad application in ecology, economics, finance, and engineering, and we will draw on basic models from these fields to motivate our study.

Prerequisites: MATH 209 or PHYS 210, and MATH 350 or 351, or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Preference will be given to senior math majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400 level math course.

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Stewart D. Johnson

MATH 456 (F) Representation Theory (QFR)

Representation theory has applications in fields such as physics (via models for elementary particles), engineering (considering symmetries of structures), and even in voting theory (voting for committees in agreeable societies). This course will introduce the concepts and techniques of the representation theory of finite groups, and will focus on the representation theory of the symmetric group. We will undertake this study through a variety of perspectives, including general representation theory, combinatorial algorithms, and symmetric functions.

Prerequisites: MATH 355

Enrollment Limit: 40

Enrollment Preferences: junior and senior Math majors

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a 400-level Math course.

Fall 2020

LEC Section: R1 TF 1:30 pm - 2:45 pm John D. Wiltshire-Gordon

MATH 474 (S) Tropical Geometry (QFR)

This course offers an introduction to tropical geometry, a young subject that has already established deep connections between itself and pure and applied mathematics. We will study a rich variety of objects arising from polynomials over the min-plus semiring, where addition is defined as taking a minimum, and multiplication is defined as usual addition. We will learn how these polyhedral objects connect to other areas of mathematics like algebraic geometry, and how they can be applied to solve problems in scheduling theory, phylogenetics, and other diverse fields.

Prerequisites: MATH 355 or permission of instructor

Enrollment Limit: 25

Enrollment Preferences: senior Math majors

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course builds quantitative skills

Spring 2021

LEC Section: 01 TBA Ralph E. Morrison

PHYS 131 (F) Introduction to Mechanics (QFR)

We focus first on the Newtonian mechanics of point particles: the relationship between velocity, acceleration, and position; the puzzle of circular motion; forces, Newton's laws, and gravitation; energy and momentum; and the physics of vibrations. Then we turn to the basic properties of waves, such as interference and refraction, as exemplified by sound and light waves. We also study the optics of lenses, mirrors and the human eye. This course is not intended for students who have successfully completed an AP physics course in high school.

Class Format: hybrid

Requirements/Evaluation: PHYS 131 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Prerequisites: MATH 130; students who scored 4 or 5 on an AP physics exam, or 6 or 7 on the IB Physics HL exam may not take this course and are encouraged to take PHYS 141 instead

Enrollment Limit: 30

Enrollment Preferences: seniority

Expected Class Size: 60

Grading: yes pass/fail option, yes fifth course option

Unit Notes: PHYS 131 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This class will have weekly problem sets requiring substantial quantitative reasoning

Fall 2020

LAB Section: H3 W 1:00 pm - 3:00 pm Graham K. Giovanetti

LEC Section: H1 MWF 8:00 am - 8:50 am Graham K. Giovanetti

LAB Section: H2 M 1:00 pm - 3:00 pm Graham K. Giovanetti

PHYS 132 (S) Electromagnetism and the Physics of Matter (QFR)

This course is intended as the second half of a one-year survey of physics with some emphasis on applications to medicine. In the first part of the semester we will focus on electromagnetic phenomena. We will introduce the concept of electric and magnetic fields and study in detail the way in which electrical circuits and circuit elements work. The deep connection between electric and magnetic phenomena is highlighted with a discussion of Faraday's Law of Induction. Following our introduction to electromagnetism we will discuss some of the most central topics in twentieth-century physics, including Einstein's theory of special relativity and some aspects of quantum theory. We will end with a treatment of nuclear physics, radioactivity, and uses of radiation.

Class Format: lecture three hours per week, laboratory three hours approximately every other week, and conference section 1 hour approximately every other week

Prerequisites: PHYS 131 or 141 or permission of instructor, and MATH 130 (formerly 103)

Enrollment Limit: 22 per lab

Expected Class Size: 60

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Henrik Ronellenfitsch

PHYS 141 (F) Mechanics and Waves (QFR)

This is the typical first course for a prospective physics major. It covers most of the same topics as PHYS 131, but with a higher level of mathematical sophistication. It is intended for students with solid backgrounds in the sciences, either from high school or college, who are comfortable with basic calculus.

Class Format: This will be a hybrid course with both recorded and in-person lecture/demonstration material, both "at home" and in-person hands-on/laboratory exercises, problem-solving group sessions and office hours (available both in person and remote), as well as several short tests/quizzes and a final exam.

Requirements/Evaluation: PHYS 141 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Prerequisites: high school physics and MATH 130 or equivalent placement, or permission of the instructor

Enrollment Limit: 30

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: PHYS 141 can lead to either PHYS 132 (for students wanting a one-year survey of physics) or PHYS 142 (for students considering a Physics or Astrophysics major)

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course consists of lectures, problem-solving conferences, lab exercises, problem sets and exams, all of which have a substantial quantitative component.

Fall 2020

LAB Section: H4 W 1:00 pm - 3:00 pm Kevin M. Jones

LEC Section: H1 TR 9:45 am - 11:00 am Protik K. Majumder

LAB Section: H3 T 1:00 pm - 3:00 pm Kevin M. Jones

LAB Section: H5 M 3:30 pm - 5:30 pm Kevin M. Jones

LAB Section: H2 M 1:00 pm - 3:00 pm Kevin M. Jones

PHYS 142 (S) Foundations of Modern Physics (QFR)

Newtonian Mechanics, spectacular as it is in describing planetary motion and a wide range of other phenomena, only hints at the richness of behaviors seen in the universe. Special relativity, which extends physics into the realm of high speeds and high energies, requires we rethink our basic notions of space and time. Quantum mechanics successfully describes atoms, molecules, and solids while at the same time calling into question our expectation of what can be predicted by a physical theory. Statistical physics reveals new behaviors that emerge when many particles are present in a system. This course will survey ideas from each of these three arenas, and can serve either as a terminal course for those seeking to complete a year of physics or as the basis for future advanced study of these topics.

Class Format: lecture, two hours weekly; problem-solving conference session, one hour weekly; laboratory, 2-3 hours most weeks, alternating between 'hands-on' and computational sessions (limit 22 per lab, 18 per conference section)

Prerequisites: PHYS 141 and MATH 130, or equivalent; PHYS 131 may substitute for PHYS 141 with the permission of instructor; students may not take both PHYS 142 and PHYS 151

Enrollment Limit: 18 per CON

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Heavily problem-solving focused, involving algebraic manipulations, single-variable calculus, generating and reading graphs, etc.

Spring 2021

LEC Section: 01 TBA Charlie Doret

PHYS 151 (F) Seminar in Modern Physics (QFR)

Newtonian Mechanics, spectacular as it is in describing planetary motion and a wide range of other phenomena, only hints at the richness of behaviors seen in the universe. Special relativity has extended physics into the realm of high speeds and high energies and requires us to rethink our basic notions of space and time. Quantum mechanics successfully describes atoms, molecules, and solids while at the same time calling into question our notions of what can be predicted by a physical theory. Statistical physics reveals new behaviors that emerge when many particles are present in a system. This course covers the same basic material as PHYS 142 but in a small seminar format for students with strong prior preparation in physics.

Class Format: This will be a hybrid course format, with some online and some in-person components. All in-person components will have a remote option. Lecture 3 hours per week (synchronous interactive video or in-person), Laboratory/Conference section 2.5 hours per week (synchronous interactive video or in-person). Compared to previous years, some of the laboratory activities in the course will be replaced by assignments that can be completed remotely.

Requirements/Evaluation: this is a small seminar designed for first-year students who have placed out of PHYS 141

Prerequisites: placement by the department (see "advanced placement" section in the description about the department). Students may take either PHYS 142 or PHYS 151 but not both

Enrollment Limit: 18

Enrollment Preferences: first-years

Expected Class Size: 18

Grading: yes pass/fail option, yes fifth course option

Unit Notes: this is a small seminar designed for first-year students who have placed out of PHYS 141

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: besides the final paper, all assignments in the course have a substantial quantitative component

Fall 2020

LAB Section: H2 MR 1:30 pm - 2:45 pm Catherine Kealhofer

LEC Section: H1 MWF 12:00 pm - 12:50 pm Catherine Kealhofer

LAB Section: H3 MR 3:15 pm - 4:30 pm Catherine Kealhofer

PHYS 201 (F) Electricity and Magnetism (QFR)

The classical theory of electricity and magnetism is very rich yet it can be written in a remarkably succinct form using Maxwell's equations. This course is an introduction to electricity and magnetism and their mathematical description, connecting electric and magnetic phenomena via the special theory of relativity. Topics include electrostatics, magnetic fields, electromagnetic induction, DC and AC circuits, and the electromagnetic properties of matter. The laboratory component of the course is an introduction to electronics where students will develop skills in building and debugging electrical circuits.

Class Format: Hybrid: online with some in-person components. All in-person components will have a remote option. Lecture: three hours per week. Laboratory/conference section: two hours per week.

Prerequisites: PHYS 142 OR 151; MATH 150 or 151; with a preference for MATH 151

Enrollment Limit: 10 per lab

Enrollment Preferences: prospective physics majors, then by seniority

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Fall 2020

LAB Section: H4 T 3:30 pm - 5:30 pm David R. Tucker-Smith

LAB Section: H3 W 1:00 pm - 3:00 pm David R. Tucker-Smith

LAB Section: H2 T 1:00 pm - 3:00 pm David R. Tucker-Smith

LEC Section: H1 MWF 10:40 am - 11:30 am David R. Tucker-Smith

PHYS 202 (S) Vibrations, Waves and Optics (QFR)

Waves and oscillations characterize many different physical systems, including vibrating strings, springs, water waves, sound waves, electromagnetic waves, and gravitational waves. Quantum mechanics even describes particles with wave functions. Despite these diverse settings waves exhibit several common characteristics, so that the understanding of a few simple systems can provide insight into a wide array of phenomena. In this course we begin with the study of oscillations of simple systems with only a few degrees of freedom. We then move on to study transverse and longitudinal waves in continuous media in order to gain a general description of wave behavior. The rest of the course focuses on electromagnetic waves and in particular on optical examples of wave phenomena. In addition to well known optical effects such as interference and diffraction, we will study a number of modern applications of optics such as short pulse lasers and optical communications. Throughout the course mathematical methods useful for higher-level physics will be introduced.

Class Format: lecture three hours per week and laboratory three hours per week

Prerequisites: PHYS 201; co-requisite: PHYS/MATH 210 or MATH 209 or permission of instructor

Enrollment Limit: none

Enrollment Preferences: none

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Graham K. Giovanetti

PHYS 210 (S) Mathematical Methods for Scientists (QFR)

Cross-listings: PHYS 210 MATH 210

Primary Cross-listing

This course covers a variety of mathematical methods used in the sciences, focusing particularly on the solution of ordinary and partial differential equations. In addition to calling attention to certain special equations that arise frequently in the study of waves and diffusion, we develop general techniques such as looking for series solutions and, in the case of nonlinear equations, using phase portraits and linearizing around fixed points. We study some simple numerical techniques for solving differential equations. A series of optional sessions in Mathematica will be offered for students who are not already familiar with this computational tool.

Class Format: three hours per week

Prerequisites: MATH 150 or 151 and familiarity with Newtonian mechanics at the level of PHYS 131

Enrollment Limit: 50

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 210 (D3) MATH 210 (D3)

Spring 2021

LEC Section: 01 TBA Frederick W. Strauch

PHYS 301 (F) Quantum Physics (QFR)

This course serves as a one-semester introduction to the formalism, and phenomenology of quantum mechanics. After a brief discussion of historical origins of the quantum theory, we introduce the Schrodinger wave equation, the concept of matter waves, and wave-packets. With this introduction as background, we will continue our discussion with a variety of one-dimensional problems such as the particle-in-a-box and the harmonic oscillator. We then extend this work to systems in two and three dimensions, including a detailed discussion of the structure of the hydrogen atom. Along the way we will develop connections between mathematical formalism and physical predictions of the theory. Finally, we conclude the course with a discussion of angular momentum and spins, with applications to atomic physics, entanglement, and quantum information.

Class Format: Phys 301 will be taught in a hybrid format, with in-person and remote elements. Remote options will be available for in-person components. Lecture will meet for 3 hours weekly, with synchronous elements wherever feasible (either in-person or via videoconference). Laboratories will meet for 2 hours weekly, with some additional individual preparation required, with laboratory groups being mixed between in-person and remote students.

Prerequisites: PHYS 202 and PHYS/MATH 210 or MATH 309

Enrollment Limit: 20

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Phys 301 relies heavily upon mathematics and quantitative reasoning in all elements, including problem sets, examinations, and laboratories.

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Charlie Doret

LAB Section: H2 T 1:00 pm - 3:00 pm Charlie Doret

LAB Section: H3 W 1:00 pm - 3:00 pm Charlie Doret

PHYS 302 (S) Stat Mechanics & Thermodynamics (QFR)

Macroscopic objects are made up of huge numbers of fundamental particles interacting in simple ways--obeying the Schrődinger equation, Newton's and Coulomb's Laws--and these objects can be described by macroscopic properties like temperature, pressure, magnetization, heat capacity, conductivity, etc. In this course we will develop the tools of statistical physics, which will allow us to predict the cooperative phenomena that emerge in large ensembles of interacting particles. We will apply those tools to a wide variety of physical questions, including the behavior of gases, polymers, heat engines, biological and astrophysical systems, magnets, and electrons in solids.

Class Format: lecture/discussion three hours per week and laboratory three hours per week

Prerequisites: required: PHYS 201, PHYS/MATH 210 or MATH 209; recommended: PHYS 202, PHYS 301

Enrollment Limit: 10 per lab

Expected Class Size: 10 per lab

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Attributes: BIGP Courses

Spring 2021

LEC Section: 01 TBA Daniel P. Aalberts

PHYS 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week

Requirements/Evaluation: does not satisfy the distribution requirement for the Biology major

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Spring 2021

SEM Section: 01 TBA Lois M. Banta

PHYS 321 (S) Introduction to Particle Physics (QFR)

The Standard Model of particle physics incorporates special relativity, quantum mechanics, and almost all that we know about elementary particles and their interactions. This course introduces some of the main ideas and phenomena associated with the Standard Model. After a review of relativistic kinematics, we will learn about symmetries in particle physics, Feynman diagrams, and selected applications of quantum electrodynamics, the weak interactions, and quantum chromodynamics. We will conclude with a discussion of spontaneous symmetry breaking and the Higgs mechanism.

Class Format: three hours a week

Prerequisites: PHYS 301, which may be taken concurrently, plus permission of instructor

Enrollment Limit: 15

Enrollment Preferences: 1. Students that have taken Phys 301. 2. By seniority.

Expected Class Size: 10

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA David R. Tucker-Smith

PHYS 402 (S) Applications of Quantum Mechanics (QFR)

This course will explore a number of important topics in the application of quantum mechanics to physical systems, including perturbation theory, the variational principle and the semiclassical interaction of atoms and radiation. The course will finish up with three weeks on quantum optics including an experimental project on non-classical interference phenomena. Applications and examples will be taken mostly from atomic physics with some discussion of solid state systems.

Prerequisites: PHYS 301

Enrollment Limit: 10 per sec

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

TUT Section: T1 TBA Catherine Kealhofer

PHYS 411 (F) Classical Mechanics (QFR)

This course will explore advanced topics in classical mechanics including the calculus of variations, the Lagrangian and Hamiltonian formulations of mechanics, phase space, non-linear dynamics and chaos, central-force motion, non-inertial reference frames (including implications for physics on a rotating Earth), and rigid-body rotations. Numerical and perturbative techniques will be developed and used extensively. We will also examine the ways in which classical mechanics informs other fields of physics. In addition to weekly tutorial meetings the class with will meet once a week as a whole to discuss new material.

Class Format: hybrid

Prerequisites: PHYS 202 and PHYS/MATH 210 or MATH 209

Enrollment Limit: 10/section

Enrollment Preferences: majors

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: weekly problem sets requiring substantial quantitative reasoning using analytical and numerical methods.

Fall 2020

TUT Section: HT2 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

TUT Section: HT1 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

TUT Section: HT3 F 1:30 pm - 2:45 pm Henrik Ronellenfitsch, Kevin M. Jones

POEC 253 (F) Empirical Methods in Political Economy (QFR)

This course introduces students to common empirical tools used in policy analysis and implementation. The broad aim is to train students to be discriminating consumers of public policy-relevant research. The emphasis in the course is on intuitive understanding of the central concepts. Through hands-on work with data and critical assessment of existing empirical social scientific research, students will develop the ability to choose and employ the appropriate tool for a particular research problem, and to understand the limitations of the techniques. Topics to be covered include basic principles of probability; random variables and distributions; statistical estimation, inference and hypothesis testing; and modeling using multiple regression, with a particular focus on understanding whether and how relationships between variables can be determined to be causal--an essential requirement for effective policy formation. Throughout the course, the focus will be on public policy applications relevant to the fields of political science, sociology, and public health, as well as to economics.

Class Format: The class will be remote. I will present the material using a mix of synchronous and asynchronous methods. We will use the synchronous time for discussion and Q and A as well.

Requirements/Evaluation: does not satisfy the econometrics requirement for the Economics major; POEC 253 cannot be substituted for ECON 255, or count as an elective towards the Economics major

Prerequisites: MATH 130 or its equivalent; one course in ECON; not open to students who have taken ECON 255

Enrollment Limit: 20

Enrollment Preferences: Political Economy majors, Environmental Policy majors and sophomores

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the econometrics requirement for the Economics major; POEC 253 cannot be substituted for ECON 255, or count as an elective towards the Economics major

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: The course teaches econometrics, i.e. statistics as economists use it, with applications in economics and political science.

Attributes: EVST Methods Courses PHLH Statistics Courses POEC Required Courses

Fall 2020

LEC Section: R1 TR 11:30 am - 12:45 pm Anand V. Swamy

PSYC 201 (F)(S) Experimentation and Statistics (QFR)

An introduction to the basic principles of research in psychology. We focus on how to design and execute experiments, analyze and interpret results, and write research reports. Students conduct a series of research studies in different areas of psychology that illustrate basic designs and methods of analysis.

Class Format: Prof. Savitsky's section will be taught remotely. Synchronous lectures and lab meetings will be recorded for those who can't attend but synchronous participation is preferred, especially in lab. In Prof. Cone's section, many lectures will be held via synchronous, remote gatherings. Periodically, students who can meet in person will gather for discussions, problem solving sessions, and lab work with others joining remotely. You must register for lab and lecture with the same instructor.

Prerequisites: PSYC 101; not open to first-year students except with permission of instructor

Enrollment Limit: 12

Enrollment Preferences: Psychology majors

Expected Class Size: 12

Grading: no pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

Quantative/Formal Reasoning Notes: This course has weekly problem sets focused on experimental design and quantitative data analysis. Students will design and conduct several experiments, analyze the data, and report their findings.

Attributes: COGS Related Courses PHLH Statistics Courses

Fall 2020

LEC Section: H1 MW 10:00 am - 11:15 am Jeremy D. Cone

LAB Section: H2 T 1:00 pm - 3:00 pm Jeremy D. Cone

LEC Section: R3 MW 10:00 am - 11:15 am Kenneth K. Savitsky

LAB Section: R4 W 1:00 pm - 3:00 pm Kenneth K. Savitsky

Spring 2021

LEC Section: 01 TBA Catherine B. Stroud, Noah J. Sandstrom, Jeremy C Simon

STAT 101 (F)(S) Elementary Statistics and Data Analysis (QFR)

It is impossible to be an informed citizen in the world today without an understanding of data and information. Whether opinion polls, unemployment rates, salary differences between men and women, the efficacy of vaccines or consumer webdata, we need to be able to separate the signal from the noise. We will learn the statistical methods used to analyze and interpret data from a wide variety of sources. The goal of the course is to help reach conclusions and make informed decisions based on data.

Class Format: Hybrid format with both synchronous and asynchronous elements.

Requirements/Evaluation: students with MATH130 but no statistics should enroll in STAT161; students with MATH150 but no statistics should enroll in STAT201. Students with AP Stat 4/5 or STAT 101/161/201 should enroll in STAT 202 (if no calc background) or 302 (MATH140 prereq).

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)

Enrollment Limit: 25

Enrollment Preferences: sophomores, juniors, and seniors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with MATH130 but no statistics should enroll in STAT161; students with MATH150 but no statistics should enroll in STAT201. Students with AP Stat 4/5 or STAT 101/161/201 should enroll in STAT 202 (if no calc background) or 302 (MATH140 prereq).

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is a quantitative course.

Attributes: BIGP Courses COGS Related Courses PHLH Statistics Courses

Fall 2020

LEC Section: H1 MWF 8:00 am - 8:50 am Shaoyang Ning

LEC Section: H2 MWF 9:20 am - 10:10 am Shaoyang Ning

Spring 2021

LEC Section: 01 TBA Shaoyang Ning, Daniel B. Turek

STAT 161 (F)(S) Introductory Statistics for Social Science (QFR)

This course will cover the basics of modern statistical analysis with a view toward applications in the social sciences and sciences. Topics include exploratory data analysis, elements of probability theory, basic statistical inference, and introduction to statistical modeling. The course focuses on the application of statistics tools to solve problems, to make decisions, and the use of statistical thinking to understand the world.

Requirements/Evaluation: students with calculus background should consider STAT 201, 202 or 302 instead. Students without any calculus background should consider STAT 101. Please refer to the placement chart on the department website for more information.

Prerequisites: MATH 130 (or equivalent); not open to students who have completed STAT 101 or equivalent

Enrollment Limit: 25

Enrollment Preferences: Economics majors, sophomores

Expected Class Size: 25

Grading: no pass/fail option, no fifth course option

Unit Notes: students with calculus background should consider STAT 201, 202 or 302 instead. Students without any calculus background should consider STAT 101. Please refer to the placement chart on the department website for more information.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Course analyzes data

Attributes: PHLH Statistics Courses

Fall 2020

LEC Section: R1 MWF 8:15 am - 9:30 am Bernhard Klingenberg

LEC Section: R2 TR 9:45 am - 11:00 am Daniel B. Turek

Spring 2021

LEC Section: 01 TBA Bernhard Klingenberg, Daniel B. Turek

STAT 201 (F)(S) Statistics and Data Analysis (QFR)

Statistics can be viewed as the art and science of turning data into information. Real world decision-making, whether in business or science is often based on data and the perceived information it contains. Sherlock Holmes, when prematurely asked the merits of a case by Dr. Watson, snapped back, "Data, data, data! I can't make bricks without clay." In this course, we will study the basic methods by which statisticians attempt to extract information from data. These will include many of the standard tools of statistical inference such as hypothesis testing, confidence intervals, and linear regression as well as exploratory and graphical data analysis techniques. This is an accelerated introductory statistics course that involves computational programming and incorporates modern statistical techniques.

Class Format: Hybrid format: lecture material will be prerecorded, and you will be asked to attend (in person or virtually) one class session a week, during which we will briefly review lecture materials, allow time for questions, and work through a lab in RStudio to practice using the techniques discussed during that week's lectures.

Requirements/Evaluation: Students with AP Stat 4/5 or STAT 101/161 should enroll in STAT 202 (if no calc background) or 302 (MATH 140 prereq). Students with no calc or stats background should enroll in STAT 101. Students with MATH 140 but no statistics should enroll in STAT 161.

Prerequisites: MATH 150 or equivalent; not open to students who have completed STAT 101 or STAT 161 or equivalent

Enrollment Limit: 25

Enrollment Preferences: Prospective Statistics majors, students for whom the course is a major prerequisite, and seniors

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Students with AP Stat 4/5 or STAT 101/161 should enroll in STAT 202 (if no calc background) or 302 (MATH 140 prereq). Students with no calc or stats background should enroll in STAT 101. Students with MATH 140 but no statistics should enroll in STAT 161.

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: Students will learn to interpret, choose, carry out, and communicate analyses of data.

Attributes: BIGP Courses COGS Related Courses EVST Methods Courses PHLH Statistics Courses

Fall 2020

LEC Section: R2 WF 1:30 pm - 2:45 pm Elizabeth M. Upton

LEC Section: R1 MR 3:15 pm - 4:30 pm Anna M. Plantinga

Spring 2021

LEC Section: 01 TBA Anna M. Plantinga, Richard D. De Veaux

STAT 202 (F)(S) Introduction to Statistical Modeling (QFR)

Data come from a variety of sources: sometimes from planned experiments or designed surveys, sometimes by less organized means. In this course we'll explore the kinds of models and predictions that we can make from both kinds of data, as well as design aspects of collecting data. We'll focus on model building, especially multiple regression, and talk about its potential to answer questions about the world -- and about its limitations. We'll emphasize applications over theory and analyze real data sets throughout the course.

Class Format: Introductory lectures will be available asynchronously as text and video; synchronous sessions will discuss questions from lecture, dive further into the material, and work on examples. You'll use chat and discussion boards to build community, study with classmates, and ask questions outside of class time. The professor and TAs will also offer optional synchronous office hours/review sessions.

Requirements/Evaluation: students with a 4 on the AP Stats exam should contact the department for proper placement

Prerequisites: AP Statistics 4 or 5, or STAT 101, or STAT 161, or STAT 201, or permission of instructor

Enrollment Limit: 25

Enrollment Preferences: Prospective Statistics majors and more senior students

Expected Class Size: 25

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with a 4 on the AP Stats exam should contact the department for proper placement

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course uses mathematical tools and computing programs to create models, make predictions, assess uncertainty, and describe data. We'll also emphasize choosing appropriate mathematical tools and interpreting their results in a real-world context.

Attributes: EVST Methods Courses PHLH Statistics Courses

Fall 2020

LEC Section: R1 MWF 12:00 pm - 12:50 pm Laurie L. Tupper

Spring 2021

LEC Section: 01 TBA Laurie L. Tupper

STAT 302 (F)(S) Applied Statistical Modeling (QFR)

Data may come from various sources and studies with different purpose of analysis. Statistical modeling provides a unified framework to embrace different data types, and focuses on the goals of understanding relationships, assessing differences and making predictions. We will explore different types of statistical models (linear regression, ANOVA, logistic regression etc), and focus on their conditions, the interactive modeling process, as well as the statistical inference tools for drawing conclusions from them. Throughout the course, real datasets will be modeled for interesting questions about the world, and the limitations will be addressed as well.

Class Format: This will be a hybrid course for students who are both remote and in-person, with a mix of synchronous and asynchronous elements.

Prerequisites: One of the following: i) STAT 201; ii) MATH 140 and STAT 101/161/AP Statistics 4/5; iii) Permission of instructor

Enrollment Limit: 19

Enrollment Preferences: students interested in statistics which have solid background in math and stat

Expected Class Size: 15

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is an advanced statistics class with prerequisites that are QFR courses

Fall 2020

LEC Section: H1 MWF 11:45 am - 1:00 pm Xizhen Cai

Spring 2021

LEC Section: 01 TBA Xizhen Cai

STAT 310 (F) Data Visualization (QFR)

This course is about preparing, visualizing, reporting and presenting different types of data. We will start with creating common plots (e.g., barcharts, histograms, density plots, boxplots, time series and lattice plots), but also discuss visualizing results of statistical models, such as linear or logistic regression models. We will use the ggplot library in R but then switch to the plotly library for interactive graphs with mouse-over and click events. Using R's shiny and DT libraries, we will learn how to create and publish web-apps and dashboards that explore datasets and support online filtering. We will end the class with creating web apps that contain multiple graphs or maps which react to user inputs (such as selecting which variables to plot) or provide real time monitoring of streaming data. Throughout, we will use version control software (Github) to organize and keep track of our code. This course will be taught in a semi-flipped style. While the instructor will introduce certain topics, students will often be responsible for reading material ahead of time and then work individually or in pairs to reproduce material or implement it on their own data.

Prerequisites: Stat 201/202/302; Good knowledge of R

Enrollment Limit: 15

Enrollment Preferences: Preference may be given to stats majors who need the course in order to graduate, but then random selection.

Expected Class Size: 15

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course teaches how to organize and present data graphically, but also how to critique existing data visualizations.

Fall 2020

LEC Section: R1 MW 10:00 am - 11:15 am Bernhard Klingenberg

STAT 315 (S) Applied Machine Learning (QFR)

How does Netflix recommend films based on your viewing history? How does Facebook group its users and send out targeted ads? How did Google select from thousands of search terms to predict flu? Machine learning (ML) is a rapidly growing field that is concerned with algorithms and models to find patterns in data and solve these practical problems at the intersection between statistics, data science and computer science. This course provides a broad introduction to ideas and methods in machine learning, with emphasis on statistical intuitions and practical data analysis. Topics including regularized regression, SVM, supervised/unsupervised learning, text analysis, neural networks will be covered. Students will use R extensively throughout the course while getting introduced to some ML tools in Python.

Prerequisites: MATH 140, and STAT 201/202, or equivalent; or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Statistics majors, seniors

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical, computational, and data analysis skills as well as appropriate practical application of analysis methods

Spring 2021

LEC Section: 01 TBA Shaoyang Ning

STAT 335 (S) Biostatistics and Epidemiology (QFR)

Epidemiology, a public health discipline, is the study of disease and disability in human populations. Biostatistics focuses on the development and application of statistical methods to address questions that arise in medicine, public health, or biology. This course will begin with epidemiological study designs and core concepts in epidemiology, followed by key statistical methods in public health research. Topics will include multiple regression, analysis of categorical data (two sample methods, sets of 2x2 tables, RxC tables, and logistic regression), survival analysis (Cox proportional hazards model), and a brief introduction to regression with correlated data.

Prerequisites: STAT 201 or 202 and MATH 140, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Junior and senior statistics majors; public health concentrators

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This is a statistics course with a focus on quantitative methods relevant to public health studies.

Attributes: PHLH Statistics Courses

Spring 2021

LEC Section: 01 TBA Anna M. Plantinga

STAT 341 (F)(S) Probability (QFR)

Cross-listings: STAT 341 MATH 341

Secondary Cross-listing

While probability began with a study of games, it has grown to become a discipline with numerous applications throughout mathematics and the sciences. Drawing on gaming examples for motivation, this course will present axiomatic and mathematical aspects of probability. Included will be discussions of random variables, expectation, independence, laws of large numbers, and the Central Limit Theorem. Many interesting and important applications will also be presented, potentially including some from coding theory, number theory and nuclear physics.

Prerequisites: MATH 250 or permission of the instructor

Enrollment Limit: 20

Enrollment Preferences: Priority will be given to Stats majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

STAT 341 (D3) MATH 341 (D3)

Quantative/Formal Reasoning Notes: This is a 300-level Math/Stat course

Fall 2020

LEC Section: H1 MWF 9:20 am - 10:10 am Stewart D. Johnson

Spring 2021

LEC Section: 01 TBA Mihai Stoiciu

STAT 344 (F) Statistical Design of Experiments (QFR)

How do you get informative research results? By doing the right experiment in the first place. We'll explore the techniques used to plan experiments that are both efficient and statistically sound, the analysis of the resulting data, and the conclusions we can draw from that analysis. We'll look at classical tools like one- and two-way ANOVA and fractional factorial designs, but we'll also look at optimal design, and see how these two frameworks differ in their philosophy and in what they can do. Throughout the course, we'll make extensive use of R to work with real-world data.

Class Format: Introductory lectures will be available asynchronously as text and video; synchronous sessions will discuss questions from lecture, dive further into the material, and work on examples. You'll use chat and discussion boards to build community, study with classmates, and ask questions outside of class time. There will also be optional synchronous office hours/review sessions.

Prerequisites: STAT 201, 202, or equivalent, or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: Statistics majors, seniors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course uses mathematical tools and computing programs to design experiments, analyze their results, and assess their effectiveness. We'll also emphasize choosing appropriate mathematical tools and interpreting their results in a real-world context.

Attributes: COGS Related Courses

Fall 2020

LEC Section: R1 MR 3:15 pm - 4:30 pm Laurie L. Tupper

STAT 346 (F)(S) Regression Theory and Applications (QFR)

This course focuses on the building of empirical models through data in order to predict, explain, and interpret scientific phenomena. Regression modeling is the most widely used method for analyzing and predicting a response data and for understand the relationship with explanatory variables. This course provides both theoretical and practical training in statistical modeling with particular emphasis on simple linear, logistic and multiple regression, using R to develop and diagnose models. The course covers the theory of multiple regression and diagnostics from a linear algebra perspective with emphasis on the practical application of the methods to real data sets. The data sets will be taken from a wide variety of disciplines.

Prerequisites: MATH 250 and at least one of STAT 201, 202 or 302. Or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: Statistics Majors

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course prepares students in the use of quantitative methods for the modeling, prediction and understanding of scientific phenomena.

Attributes: EVST Methods Courses

Fall 2020

LEC Section: H1 MWF 11:45 am - 1:00 pm Richard D. De Veaux

Spring 2021

LEC Section: 01 TBA Richard D. De Veaux

STAT 355 (F) Multivariate Statistical Analysis (QFR)

To better understand complex processes, we study how variables are related to one another, and how they work in combination. Therefore, we want to make inferences about more than one variable at time? Elementary statistical methods might not apply. In this course, we study the tools and the intuition that are necessary to analyze and describe such data sets. Topics covered will include data visualization techniques for high dimensional data sets, parametric and non-parametric techniques to estimate joint distributions, techniques for combining variables, as well as classification and clustering algorithms.

Class Format: This will be a hybrid course for students who are both remote and in-person, with a mix of synchronous and asynchronous elements

Prerequisites: MATH 250, and STAT 346 or permission of instructor

Enrollment Limit: 15

Enrollment Preferences: students interested in statistics which have solid background in math and stat

Expected Class Size: 10

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: It is an advanced statistics class with prerequisites that are QFR courses

Fall 2020

LEC Section: H1 WF 1:30 pm - 2:45 pm Xizhen Cai

STAT 356 (S) Time Series Analysis (QFR)

Time series--data collected over time--crop up in applications from economics to engineering to transit. But because the observations are generally not independent, we need special methods to investigate them. This course will include exploratory methods and modeling for time series, including smoothing, ARIMA and state space models, and a foray into the frequency domain. We will emphasize applications to a variety of real data.

Prerequisites: STAT 346 (may be taken concurrently) or permission of instructor

Enrollment Limit: 30

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Laurie L. Tupper

STAT 360 (S) Statistical Inference (QFR)

How do we estimate unknown parameters and express the uncertainty we have in our estimate? Is there an estimator that works best? Many topics from introductory statistics such as random variables, the central limit theorem, point and interval estimation and hypotheses testing will be revisited and put on a more rigorous mathematical footing. The focus is on maximum likelihood estimators and their properties. Bayesian and computer intensive resampling techniques (e.g., the bootstrap) will also be considered.

Prerequisites: MATH 250, STAT 201 or 202, STAT 341

Enrollment Limit: 30

Enrollment Preferences: Statistics majors

Expected Class Size: 30

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Bernhard Klingenberg

STAT 372 (F) Longitudinal Data Analysis: Modeling Change over Time (QFR)

This course explores modern statistical methods for drawing scientific inferences from longitudinal data, i.e., data collected repeatedly on experimental units over time. The independence assumption made for most classical statistical methods does not hold with this data structure because we have multiple measurements on each individual. Topics will include linear and generalized linear models for correlated data, including marginal and random effect models, as well as computational issues and methods for fitting these models. We will consider many applications in the social and biological sciences.

Class Format: Hybrid format. Approximately 2/3 of class time will be lecture (in person for students who are on campus, recorded for remote students). All synchronous students (whether in person or online) will attend a remote lab/discussion section each week. Asynchronous options will be provided for students unable to participate synchronously.

Prerequisites: STAT 201 and STAT 346

Enrollment Limit: 15

Enrollment Preferences: junior and senior Statistics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: The course will cover a variety of statistical analysis methods for longitudinal data.

Attributes: PHLH Statistics Courses

Fall 2020

LEC Section: H1 MWF 10:40 am - 11:30 am Anna M. Plantinga

STAT 442 (S) Statistical Learning and Data Mining (QFR)

In both science and industry today, the ability to collect and store data can outpace our ability to analyze it. Traditional techniques in statistics are often unable to cope with the size and complexity of today's data bases and data warehouses. New methodologies in Statistics have recently been developed, designed to address these inadequacies, emphasizing visualization, exploration and empirical model building at the expense of traditional hypothesis testing. In this course we will examine these new techniques and apply them to a variety of real data sets.

Prerequisites: STAT 346 or permission of instructor

Enrollment Limit: 14

Enrollment Preferences: seniors and Statistics Majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Spring 2021

LEC Section: 01 TBA Xizhen Cai

STAT 465 (F) Bayesian Statistics (QFR)

Interest and application of Bayesian methods have exploded in recent decades, being facilitated by recent advances in computational power. Indeed, the Bayesian approach is now recognized across scientific disciples as a modern and powerful tool. We begin with an introduction to Bayes' Theorem, the theoretical underpinning of Bayesian statistics which dates back to the 1700's, and the concepts of prior and posterior distributions, conjugacy, and closed-form Bayesian inference. Building on this, we introduce modern computational approaches to performing Bayesian inference, including Markov chain Monte Carlo (MCMC), Metropolis-Hastings sampling, and the theory underlying these simple and powerful methods, before moving on to multivariate sampling methods and methodology. Students will become comfortable with modern software tools for MCMC using a variety of applied hierarchical modeling examples, and will use R for all statistical computing. The course will culminate in an independent Bayesian research project.

Prerequisites: STAT 346, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: Juniors and Seniors, and Statistics majors

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course mandates significant mathematical and statistical prowess.

Fall 2020

LEC Section: R1 TR 8:00 am - 9:15 am Daniel B. Turek

STS 375 (F)(S) Human Work in Computational Systems (QFR)

Cross-listings: CSCI 377 STS 375

Secondary Cross-listing

As far as we know, the technological singularity has not yet arrived. Therefore, humans remain a part of our current computation pipeline. However, the role humans play varies greatly: self-driving cars aim to have human involvement only in development and emergencies, whereas educational tools are built for constant human involvement. In this course, we broadly explore human work within computational systems through topics such as crowdsourcing, educational technology, citizen science, human computation, open-source software, micro-labor markets, and online gaming. Students should expect broad exposure to a wide variety of human computing topics and group projects on building and evaluating computational systems that use human work.

Class Format: Lectures will be held on Wednesday and Friday each week. Conference sections will each meet only once per week, on either Wednesday or Thursday. Students should sign up for the lecture section and one conference.

Prerequisites: CSCI 136

Enrollment Limit: 18

Enrollment Preferences: Preference for current CS majors

Expected Class Size: 18

Grading: yes pass/fail option, no fifth course option

Materials/Lab Fee: $75 for purchase of software and work on crowdsourcing platforms.

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CSCI 377 (D3) STS 375 (D2)

Quantative/Formal Reasoning Notes: This course includes regular homework and projects in which quantitative/formal reasoning skills are practiced and evaluated.

Fall 2020

CON Section: 04 TR 9:45 am - 11:00 am Molly Q Feldman

LEC Section: H1 MWF 11:45 am - 1:00 pm Molly Q Feldman

CON Section: R2 W 1:30 pm - 2:20 pm Molly Q Feldman

CON Section: R3 W 2:50 pm - 3:40 pm Molly Q Feldman

CON Section: 05 TR 11:30 am - 12:45 pm Molly Q Feldman

Spring 2021

LEC Section: 01 TBA Molly Q Feldman

THEA 310 (F) Playwriting: Facing the Blank Page (WS) (QFR)

I believe that after food and shelter, humans need stories to survive. this class will focus on each writers, dreams, fears and desires and how to turn them into plays. Students will explore the fundamentals of playwriting. This will include writing exercises, weekly pages, hearing your scenes out loud and at the end of the semester the first draft of a new play.

Class Format: Hybrid

Prerequisites: none

Enrollment Limit: 19

Enrollment Preferences: Theater majors first, then Concentrators

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D1) (WS) (QFR)

Writing Skills Notes: You are expected to attend class, to keep up with required writing, readings drafts pages to class and participate in all discussions.

Quantative/Formal Reasoning Notes: You are also expected to think critically and articulate your thoughts.

Fall 2020

SEM Section: H1 RF 3:15 pm - 4:30 pm Lucy Thurber, Ren Dara Santiago