BIOINFORMATICS, GENOMICS, AND PROTEOMICS (Div III)


On leave Fall/Spring: Professors: J. Edwards, B. Klingenberg.
On leave Fall only: Associate Professor L. Maroja.
On leave Spring only: Professors: L. Banta, A. Gehring, M. Morales, S. Swoap.

Bioinformatics, genomics, and proteomics are rapidly advancing fields that integrate the tools and knowledge from biology, chemistry, computer science, mathematics, physics, and statistics in research at the intersection of the biological and informational sciences. Inspired by the enormous amount of biological data that are being generated from the sequencing of genomes, these new fields will help us pose and answer biological questions that have long been considered too complex to address. Research in genomics, proteomics, and bioinformatics will also significantly impact society affecting medicine, culture, economics, and politics.

The Bioinformatics, Genomics, and Proteomics curriculum involves faculty from the Biology, Chemistry, Computer Science, Mathematics/Statistics, and Physics departments and was designed to provide students with an understanding of these revolutionary new areas of investigation. The introductory level courses, Computation and Biology and Statistics for Biologists are accessible to all students interested in gaining familiarity with the power of genomic analysis. Students interested in graduate work in bioinformatics, genomics, and proteomics should take the core courses and five of the recommended courses. Interested students are also encouraged to participate in independent research with members of the advisory faculty as they explore the development of these new fields.

BGNP Core Courses

**Biol 319 (F) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)**

Crosslistings: BIOL319 / CHEM319 / MATH319 / PHYS319 / CSCI319

Primary Crosslisting

What can computational biology teach us about cancer? In this capstone 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, phylogenetics, and recombinant DNA techniques 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 MAPK signal transduction pathway 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 will 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: lab participation, several short homework assignments, one lab report, a programming project, and a grant proposal

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and CSCI 315 or 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

Department Notes: does not satisfy the distribution requirement in the Biology major

Distributions: (D3) (QFR)
BGNP Recommended Courses

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.

Class Format: lecture/laboratory, six hours per week
Requirements/Evaluation: evaluation will be based on bi-weekly problem sets, weekly laboratory exercises and laboratory reports, and examinations
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: BIOL 101 and 102
Enrollment Limit: none
Expected Class Size: 84
Department Notes: does not satisfy the distribution requirement in the Biology major
Distributions: (D3) (QFR)
Attributes: BGNP Recommended Courses; BIMO Required Courses;

Fall 2018
LAB Section: 03  T 1:00 pm - 4:00 pm  Derek Dean
LAB Section: 05  R 1:00 pm - 4:00 pm  Derek Dean
LAB Section: 04  W 1:00 pm - 4:00 pm  Derek Dean
LAB Section: 02  M 1:00 pm - 4:00 pm  Derek Dean
LEC Section: 01  MWF 11:00 am - 11:50 am  David W. Loehlin

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.

Class Format: lecture/discussion/laboratory, six hours per week
Requirements/Evaluation: evaluation will be based on independent research project, problem sets, participation in discussions and exams
Prerequisites: BIOL 202
Enrollment Limit: 24
Enrollment Preferences: Seniors and biology majors
Expected Class Size: 24
Department Notes: satisfies the distribution requirement in the Biology major
Distributions: (D3) (QFR)
Attributes: BGNP Recommended Courses; BIMO Interdepartmental Electives; COGS Related Courses;
BIOL 430 (F) Genome Sciences: At the Cutting Edge (WI)

Research in genomics has integrated and revolutionized the field of biology, including areas of medicine, plant biology, microbiology, and evolutionary biology. Moreover, recent developments in "metagenomics" (genomic studies of entire communities of microorganisms in natural environments, such as the mammalian gut and the deep sea) and "metatranscriptomics" (studies of genome wide changes in expression and mRNA levels in natural communities of organisms) have generated unprecedented knowledge about the genomic potential of a community and the in situ biological activity of different ecological niches. In this course we will explore how research in these and related areas, including proteomics, have advanced our fundamental understanding of (1) organisms in the three domains of life, and their interactions and evolutionary relationships; (2) biological systems and environments, such as the human body, extreme environments, and the oceans; (3) strategies for solving global challenges in medicine, agriculture, energy resources, and environmental sciences. During the course, students will meet each week for one hour with a tutorial partner and the instructor. Every other week, students will present a written and oral critical analysis of the assigned research articles. On alternate weeks, students will question/critique the work of their colleague.

Class Format: tutorial

Requirements/Evaluation: evaluation will be based on five (4-5 page) papers, tutorial presentations, and the student's effectiveness as a critic

Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option

Prerequisites: BIOL 202

Enrollment Limit: 10

Enrollment Preferences: open to juniors and seniors; senior Biology majors who have not taken a 400-level course

Expected Class Size: 10

Department Notes: BIMO, BIGP; does not satisfy the distribution requirement in the Biology major

Distributions: (D3) (WI)

Attributes: BGNP Recommended Courses; BIMO Interdepartmental Electives;

Not offered current academic year

CSCI 134 (F) Introduction to Computer Science: Objects, Events, and Graphics (QFR)

Computing is central to many aspects of our lives and the world. This course introduces fundamental ideas in computer science and builds the skills necessary to create computer programs in the Java programming language, with an emphasis on graphics and user interfaces. Students learn to design programs in a wide range of application areas, from games to spam filters and image editing to scientific simulations. Programming topics include object-oriented programming, control structures, arrays, recursion, and event-driven programming, as well as how to construct correct, understandable, and efficient programs. This course is appropriate for all students who want to create software and have little or no prior computing experience.

Class Format: lecture/laboratory

Requirements/Evaluation: evaluation will be based on weekly assignments, final programming projects, and examinations

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

Enrollment Limit: 90

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

Expected Class Size: 90

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

Distributions: (D3) (QFR)

Attributes: BGNP Recommended Courses; COGS Interdepartmental Electives;

Not offered current academic year
A digital revolution has transformed the way we communicate and process information. Digital cameras have replaced film, MP3s have replaced LPs, communications through email, chat systems, and the Web have become part of daily life. This course explores the principles that underlie such digital information processing and communication systems. All digital information processing and communication systems are driven by precise rules or algorithms expressed as computer programs. We will develop an appreciation for the nature and limitations of such algorithms by exploring abstract algorithms for complex processes and by learning the basics of computer programming in Java. Programming topics covered will include object-oriented programming, control structures, arrays, recursion, and event-driven programming. Programming projects will include network applications like chat clients, tools to process and compress digital images, and simple network servers.

Class Format: lecture/laboratory

Requirements/Evaluation: evaluation will be based on weekly assignments, final programming projects, and examinations

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

Enrollment Limit: 90

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

Expected Class Size: 90

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

Distributions: (D3) (QFR)

Attributes: BGNP Recommended Courses; COGS Interdepartmental Electives;

Not offered current academic year
CSCI 136 (F) 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/laboratory
Requirements/Evaluation: evaluation will be based on programming assignments, homework and/or examinations
Prerequisites: CSCI 134 or equivalent; fulfilling the Discrete Mathematics Proficiency requirement is recommended, but not required
Enrollment Limit: 60
Enrollment Preferences: If the course is over-enrolled, enrollment will be determined by lottery
Expected Class Size: 60
Distributions: (D3) (QFR)
Attributes: BGNP Recommended Courses;

CSCI 256 (F) 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: lecture

Requirements/Evaluation: evaluation will be based on problem sets and programming assignments, and midterm and final examinations

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

Enrollment Limit: 30

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 30

Distributions: (D3) (QFR)

Attributes: BGNP Recommended Courses;

Fall 2018
LEC Section: 01 MWF 11:00 am - 11:50 am William J. Lenhart

Spring 2019
LEC Section: 01 MWF 12:00 pm - 12:50 pm William J. Lenhart

CSCI 315 (S) Computational Biology (QFR)
Crosslistings: PHYS315 / CSCI315

Secondary Crosslisting

This course will provide an overview of Computational Biology, the application of computational, mathematical, statistical, and physical problem-solving techniques to interpret the rapidly expanding amount of biological data. Topics covered will include database searching, DNA sequence alignment, clustering, RNA structure prediction, protein structural alignment, methods of analyzing gene expression, networks, and genome assembly using techniques such as string matching, dynamic programming, hidden Markov models, and expectation-maximization.

Class Format: lab three hours per week plus weekly tutorial meeting

Requirements/Evaluation: evaluation will be based on weekly Python programming assignments, problem sets, a few quizzes and a final project

Extra Info: may not be taken on a pass/fail basis, not available for the fifth course option

Prerequisites: programming experience (e.g., CSCI 136), mathematics (PHYS/MATH 210 or MATH 150), and physical science (PHYS 142 or 151, or CHEM 151 or 153 or 155), or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: based on seniority

Expected Class Size: 8

Distributions: (D3) (QFR)

Attributes: BGNP Recommended Courses;

Not offered current academic year

STAT 101 (F) 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: lecture

Requirements/Evaluation: evaluation will be based primarily on performances on quizzes and exams

Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)

Enrollment Limit: 50

Expected Class Size: 40

Department Notes: Students with calculus background and social science interest should consider STAT 161. Students with MATH 150 should enroll
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:** lecture

**Requirements/Evaluation:** evaluation will be based primarily on performance on quizzes and exams

**Prerequisites:** MATH 150 or equivalent. Not open to students who have completed STAT 101 or STAT 161 or equivalent.

**Enrollment Limit:** 40

**Expected Class Size:** 40

**Department Notes:** Students with a 5 on AP Stats should enroll in STAT 202. Students with a 4 on AP Stats should consult the department. Students with MATH 130/140 background should consider STAT 161. Students with no calc. should consider STAT 101.

**Distributions:** (D3) (QFR)

**Attributes:** BGNP Recommended Courses; COGS Related Courses; EVST Methods Courses; PHLH Statistics Courses;
principles of enzymatic assays.

**Class Format:** lecture, three hours per week; laboratory, four hours per week

**Requirements/Evaluation:** evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

**Extra Info:** may not be taken on a pass/fail basis

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

**Enrollment Limit:** 16/lab

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

**Expected Class Size:** 16/lab

**Department Notes:** does not satisfy the distribution requirement in the Biology major

**Distributions:** (D3) (QFR)

**Attributes:** BGNP Related Courses; BIMO Required Courses;

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**Spring 2019**

LAB Section: 02    M 1:00 pm - 4:00 pm     Katie M. Hart
LAB Section: 03    T 1:00 pm - 4:00 pm     Katie M. Hart
LAB Section: 04    W 1:00 pm - 4:00 pm     Amy Gehring

LEC Section: 01    MWF 10:00 am - 10:50 am     Katie M. Hart

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**Fall 2018**

LAB Section: 02    M 1:00 pm - 4:00 pm     Katie M. Hart
LAB Section: 03    T 1:00 pm - 4:00 pm     Katie M. Hart
LAB Section: 04    W 1:00 pm - 4:00 pm     Amy Gehring

LEC Section: 01    MWF 10:00 am - 10:50 am     Katie M. Hart

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

**Crosslistings:** CHEM322 / BIMO322 / BIOL322

**Primary Crosslisting**

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; laboratory, three hours per week

**Requirements/Evaluation:** evaluation is based on several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the data generated

**Extra Info:** may not be taken on a pass/fail basis; not available for the fifth course option

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

**Enrollment Limit:** 64

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

**Expected Class Size:** 64

**Department Notes:** does not satisfy the distribution requirement in the Biology major

**Distributions:** (D3) (QFR)

**Attributes:** BGNP Related Courses; BIMO Required Courses;

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**Spring 2019**
BIOL 321 (F) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Crosslistings: BIOL321 / CHEM321 / BIMO321

Secondary Crosslisting

This course introduces the basic 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 laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

Class Format: lecture, three hours per week; laboratory, four hours per week
Requirements/Evaluation: evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports
Extra Info: may not be taken on a pass/fail basis
Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256
Enrollment Limit: 16/lab
Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators
Expected Class Size: 16/lab
Department Notes: does not satisfy the distribution requirement in the Biology major
Distributions: (D3) (QFR)
Attributes: BGNP Related Courses; BIMO Required Courses;

Fall 2018
LAB Section: 04  M 1:00 pm - 4:00 pm  Katie M. Hart
LAB Section: 02  M 1:00 pm - 4:00 pm  Amy Gehring
LAB Section: 03  T 1:00 pm - 4:00 pm  Katie M. Hart
LEC Section: 01  MWF 10:00 am - 10:50 am  Katie M. Hart

Spring 2019
LEC Section: 01  MWF 9:00 am - 9:50 am  Bob Rawle
LAB Section: 03  T 8:00 am - 12:00 pm  Bob Rawle
LAB Section: 02  M 1:00 pm - 4:00 pm  Bob Rawle

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

Crosslistings: CHEM322 / BIMO322 / BIOL322

Secondary Crosslisting

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

This course introduces the basic 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 laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

Class Format: lecture, three hours per week; laboratory, four hours per week
Requirements/Evaluation: evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports
Extra Info: may not be taken on a pass/fail basis
Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256
Enrollment Limit: 16/lab
Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators
Expected Class Size: 16/lab
Department Notes: does not satisfy the distribution requirement in the Biology major
Distributions: (D3) (QFR)
Attributes: BGNP Related Courses; BIMO Required Courses;
**CHEM 322 (S)  Biochemistry II: Metabolism (QFR)**

Crosslistings: CHEM322 / BIMO322 / BIOL322

**Secondary Crosslisting**

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; laboratory, three hours per week

**Requirements/Evaluation:** evaluation is based on several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the data generated

**Extra Info:** may not be taken on a pass/fail basis; not available for the fifth course option

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

**Enrollment Limit:** 64

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

**Expected Class Size:** 64

**Department Notes:** does not satisfy the distribution requirement in the Biology major

**Distributions:** (D3) (QFR)

**Attributes:** BGNP Related Courses; BIMO Required Courses;

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

Macroscopic objects are made up of huge numbers of fundamental particles interacting in simple ways–obeying the Schrödinger 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; laboratory, three hours per week

**Requirements/Evaluation:** evaluation will be based on weekly problem sets, exams, and labs, all of which have a substantial quantitative component

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

**Enrollment Limit:** 24

**Expected Class Size:** 15

**Distributions:** (D3) (QFR)

**Attributes:** BGNP Related Courses;