

880 Seminar in Philosophy of Science
Spring. 2 to 4 credits. A student may earn a maximum of 10 credits in all enrollments for this course. R: Open only to graduate students in Philosophy or approval of department.

Selected topics in the philosophy of the special sciences, in the metatheory of science, and in the social studies of science.

890 Independent Study
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 20 credits in all enrollments for this course. R: Approval of department.

Special projects, directed reading, and research arranged by an individual graduate student and a faculty member in areas supplementing regular course offerings.

894 Practicum in Philosophy of Health Care
Fall, Spring. 1 to 6 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHL 344) R: Open only to graduate students in Philosophy or approval of department.

Study of ethical and policy issues in hospital and governmental agency settings.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.

Directed research leading to a master's thesis in partial fulfillment of Plan A master's degree requirements.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 50 credits in all enrollments for this course. R: Approval of department.

Doctoral dissertation research.

PHYSICAL MEDICINE AND REHABILITATION PMR

Department of Physical Medicine and Rehabilitation College of Osteopathic Medicine

501 Osteopathic Manipulative Medicine I
Fall. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. R: Open only to students in the College of Osteopathic Medicine.

Basic osteopathic palpatory skills. Building on their basic palpatory skills, students will learn skills in the osteopathic manipulative treatment areas of counterstrain and muscle energy.

502 Osteopathic Manipulative Medicine - II
Spring. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. P:M: (OMM 501) R: Open only to students in the College of Osteopathic Medicine.

Students will continue to learn skills in the osteopathic manipulative treatment area of muscle energy as well as high velocity low amplitude (mobilization with impulse).

503 Osteopathic Manipulative Medicine - III
Summer. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. P:M: (OMM 502) R: Open only to students in the College of Osteopathic Medicine.

Students will use their palpatory skills as they learn the principles of functional (indirect) and myofascial release osteopathic manipulative treatment.

504 Osteopathic Manipulative Medicine - IV
Fall. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. P:M: (OMM 503) R: Open only to students in the College of Osteopathic Medicine.

Basic cranio-sacral osteopathic manipulative medicine. Exposure to various osteopathic approaches to the extremities.

505 Osteopathic Manipulative Medicine - V
Spring. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. P:M: (OMM 504) R: Open only to students in the College of Osteopathic Medicine.

Use of patient complaints/conditions to integrate material presented in OMM 501, 502, 503, 504 while preparing the student for OMM 506.

506 Osteopathic Manipulative Medicine - VI
Summer. 1(0-2) Interdepartmental with Osteopathic Manipulative Medicine. Administered by Department of Osteopathic Manipulative Medicine. P:M: (OMM 505) R: Open only to students in the College of Osteopathic Medicine.

The osteopathic component in the context of total patient care in disorders of various systems.

590 Special Problems
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 24 credits in all enrollments for this course.

Each student works under faculty direction on an experimental, theoretical or applied problem in physical medicine and rehabilitation.

601 Physical Medicine and Rehabilitation Clerkship
Fall, Spring, Summer. 2 to 12 credits. Fall: Michigan Capital Med. Spring: Michigan Capital Med. Summer: Michigan Capital Med. A student may earn a maximum of 12 credits in all enrollments for this course.

Physical medicine and rehabilitation inpatient and ambulatory setting clinical experience, didactic sessions, case documentation and presentation, hospital rounds. Strong emphasis on evaluation of neuromusculoskeletal disorders and treatment of function deficits.

620 Directed Studies
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to juniors or seniors in the College of Osteopathic Medicine. Completion of Semester 6 in the graduate-professional program.

Individual or group projects on special problems related to physical medicine and rehabilitation.

656 Neurology Clerkship
Fall, Spring, Summer. 2 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate-professional students in the College of Osteopathic Medicine upon completion of Units I and II.

Clinical exposure in neurology. Program structure developed to achieve proficiency in motor skills, aptitudes; comprehension of concepts and principles; patient evaluation, diagnosis, management, and therapy.

806 Advanced Neuroscience Techniques Laboratory
Summer. 3(0-9) Interdepartmental with Neuroscience; Psychology; Pharmacology and Toxicology; Radiology. Administered by Department of Neuroscience. P:M: (NEU 804 or concurrently) P:NM: (PHM 827 and ANT 839 and PSY 811) R: Open only to doctoral students in the Neuroscience major.

Methods of neuroscience research and the underlying principles on which these methods are based.

PHYSICS PHY

Department of Physics and Astronomy College of Natural Science

101 Concepts in Physics
Fall. 1(1-0)

Conceptual foundations of physics emphasizing key experiments.

102 Physics Computations I
Spring. 1(0-3) P:M: (PHY 183 or concurrently or PHY 183B or concurrently or PHY 193H or concurrently or PHY 181B or concurrently) P:NM: (CSE 101 or CSE 231)
Use of Mathematica to solve, analyze and graph equations and data from mechanics.

170 Investigations in Physics
Fall. 3(0-6) R: Approval of department.

Experiments in optics, electronics, sound and mechanics; analysis of data using computers, library research and oral presentations.

181B Basic Physics I, CBI
Fall, Spring, Summer. 3 credits. P:M: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or PHY 233B.

Newton's laws of motion, conservation of momentum and angular momentum, energy conservation, thermal physics, waves, and sound. Competency based instruction.

182B Basic Physics II, CBI
Fall, Spring, Summer. 3 credits. P:M: (PHY 183 or PHY 183B or PHY 181B or LBS 271 or PHY 193H) or (PHY 231 or concurrently and PHY 233B) or (PHY 231B or concurrently and PHY 233B) and (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 272 or PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H.

Electricity and magnetism, optical phenomena, interference and diffraction of light, atomic and subatomic topics. Competency based instruction.

Physics–PHY

- 183 Physics for Scientists and Engineers I**
Fall, Spring, 4(5-0) P:M: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 181B or PHY 183B or PHY 193H or PHY 231 or PHY 231B.
Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves.
- 183A Physics I, CBI**
Fall, Spring, Summer, 1 credit. P:M: (PHY 181B) Not open to students with credit in LBS 164 or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C.
Topics from: frames of reference, special relativity, rocket equation, forced oscillations, resonances, fluid motion, numerical solutions, moments of inertia, gyroscopic motion. This course plus PHY 181B is equal to PHY 183B.
- 183B Physics for Scientists and Engineers I, CBI**
Fall, Spring, Summer, 4 credits. P:M: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 193H or PHY 231 or PHY 231B or PHY 231C.
Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves. Competency based instruction.
- 184 Physics for Scientists and Engineers II**
Fall, Spring, 4(5-0) P:M: (PHY 183 or PHY 183B or PHY 193H or PHY 233B or PHY 183A) or (LBS 164 and PHY 233B) and (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 267 or PHY 182B or PHY 184B or PHY 232 or PHY 232B or PHY 294H.
Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction.
- 184A Physics II, CBI**
Fall, Spring, Summer, 1 credit. P:M: (PHY 182B) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H or PHY 232C or LBS 267.
Topics from: standing wave phenomena, atoms, electromagnetic fields, alternating currents, optics, quantum mechanics, elementary particles. This course plus PHY 182B is equivalent to PHY 184B. 182B is exactly 3/4 of 184B and 184A is the other 1/4. It is a competency based instruction course.
- 184B Physics for Scientists and Engineers II, CBI**
Fall, Spring, Summer, 4 credits. P:M: (PHY 183 or PHY 183B or PHY 193H) or (PHY 181B and PHY 183A) or (PHY 231B and PHY 233B) or (LBS 271 and PHY 233B) P:NM: (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 272 or PHY 182B or PHY 184 or PHY 232 or PHY 232B or PHY 294H.
Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction. Competency based instruction.
- 191 Physics Laboratory for Scientists, I**
Fall, 1(0-3) P:M: (PHY 183 or concurrently or PHY 183B or concurrently or PHY 193H or concurrently or PHY 231 or concurrently or PHY 231B or concurrently or LBS 271 or concurrently or PHY 181B or concurrently) Not open to students with credit in PHY 251 or LBS 271L.
Error analysis, exercises in motion, forces, conservation laws and some electricity and magnetism studies.
- 192 Physics Laboratory for Scientists, II**
Spring, 1(0-3) P:M: (PHY 191 or MSM 211 or MSM 250) and (PHY 184 or concurrently or PHY 182B or concurrently or PHY 184B or concurrently or PHY 294H or concurrently or PHY 232 or concurrently or PHY 232B or concurrently or LBS 272 or concurrently) Not open to students with credit in PHY 252 or LBS 272L.
Electric and magnetic fields, circuits, wave optics, modern physics.
- 193H Honors Physics I-Mechanics**
Spring, 3(4-0) P:M: (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently) Not open to students with credit in PHY 183 or PHY 183B or PHY 231 or PHY 231B or LBS 164 or PHY 181B.
Mechanics and waves.
- 201 Physics Computations II**
Fall, 1(0-3) P:M: (PHY 184 or concurrently or PHY 184B or concurrently or PHY 294H or concurrently) P:NM: (PHY 102) RB: (MTH 133)
Computer methods to analyze and visualize physics problems. Tools used will include programming languages (Fortran) and mathematical software (Mathematica, etc).
- 205 Directed Studies**
Fall, Spring, Summer, 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department.
Guided individualized study in an area of physics.
- 215 Thermodynamics and Modern Physics**
Fall, Spring, 3(4-0) P:M: (PHY 184 or concurrently or PHY 184B or concurrently or PHY 294H or concurrently or LBS 272 or concurrently or PHY 234B or concurrently) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) Not open to students with credit in PHY 215B.
Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles.
- 215B Thermodynamics and Modern Physics, CBI**
Fall, Spring, Summer, 3 credits. P:M: (PHY 184 or concurrently or PHY 184B or concurrently or LBS 267 or concurrently or PHY 294H or concurrently or PHY 234B or concurrently) and (MTH 234 or MTH 254H or LBS 220) Not open to students with credit in PHY 215.
Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles. Competency based instruction.
- 231 Introductory Physics I**
Fall, Spring, 3(4-0) P:M: (MTH 103 or MTH 116 or LBS 117 or MTH 124 or MTH 132 or concurrently) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231B or PHY 231C.
Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound.
- 231B Introductory Physics I, CBI**
Fall, Spring, Summer, 3 credits. P:M: (MTH 103 or MTH 116 or LBS 117 or MTH 124 or MTH 132 or concurrently) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231C.
Mechanics, Newton's laws, momentum, energy, conservation laws, thermodynamics, waves, sound. Competency based instruction.
- 231C Introductory Physics I, Virtual**
Fall, Spring, 3 credits. P:NM: (MTH 116) Not open to students with credit in PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or LBS 164.
Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound. Offered using CD and WWW technology.
- 232 Introductory Physics II**
Fall, Spring, 3(4-0) P:M: (PHY 231 or PHY 231B or PHY 181B or PHY 183 or PHY 183B or LBS 164 or PHY 193H or PHY 231C) Not open to students with credit in PHY 184 or PHY 184B or PHY 232B or LBS 267 or PHY 182B.
Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.
- 232B Introductory Physics II, CBI**
Fall, Spring, Summer, 3 credits. P:M: (PHY 231 or PHY 231B or PHY 231C or PHY 181B or PHY 183B or PHY 193H or LBS 271) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or PHY 182B or LBS 272.
Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Competency based instruction.
- 232C Introductory Physics II, Virtual**
Fall, Spring, 3 credits. P:M: (PHY 182B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 271) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H or LBS 272.
Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.
- 233B Calculus Concepts in Physics I, CBI**
Fall, Spring, Summer, 2 credits. P:M: (PHY 231) and (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in PHY 183 or PHY 193H.
Kinematics, dynamics, applications of Newton's laws. Competency based instruction. PHY 231B plus PHY 233B is equivalent to PHY 183B.

- 234B Calculus Concepts in Physics II, CBI**
Fall, Spring, Summer. 2 credits. P:M: (PHY 232 or PHY 232B) and (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently)
Electricity and magnetism. Competency based instruction. PHY 232B plus PHY 234B equals PHY 184B.
- 251 Introductory Physics Laboratory I**
Fall, Spring, Summer. 1(0-3) P:M: (PHY 231 or concurrently or PHY 231B or concurrently or LBS 271 or concurrently or PHY 181B or concurrently or PHY 183 or concurrently or PHY 183B or concurrently or PHY 231C or concurrently or PHY 193H or concurrently) P:NM: (MTH 103) Not open to students with credit in PHY 191 or LBS 271L.
Laboratory exercises involving simple mechanical systems.
- 252 Introductory Physics Laboratory II**
Fall, Spring, Summer. 1(0-3) P:M: (PHY 251 or PHY 191 or LBS 271L) and (PHY 232 or concurrently or PHY 232B or concurrently or PHY 232C or concurrently or PHY 182B or concurrently or PHY 184 or concurrently or PHY 184B or concurrently or PHY 294H or concurrently or LBS 272 or concurrently) Not open to students with credit in PHY 192 or LBS 272L.
Laboratory exercises involving simple electromagnetic and optical systems.
- 294H Honors Physics II-Electromagnetism**
Fall. 3(4-0) P:M: (PHY 193H) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 182B or LBS 267.
Electricity and magnetism, electromagnetic waves and optics.
- 301 Physics Computations III**
Spring. 1(0-3) P:M: (PHY 471) P:NM: (CSE 232)
Use of computer software to solve, analyze and graph equations and data from physics problems. Tools include Mathematica, Fortran 90 and C++.
- 305 Directed Studies**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. P:M: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 272) R: approval of department.
Guided individualized study in an area of physics.
- 321 Classical Mechanics I**
Spring, Summer. 3(3-0) P:M: (PHY 184 or PHY 184B or PHY 294H or LBS 272) and (PHY 215 or concurrently or PHY 215B or concurrently) and (MTH 235 or concurrently or MTH 255H or concurrently or LBS 220 or concurrently)
Newtonian point particles. Oscillations. One-particle chaos. Central force motion. Systems of particles.
- 351B Computational Physics, CBI**
Fall, Spring, Summer. 3 credits. P:M: (PHY 215 or PHY 215B) P:NM: (CSE 131 or CSE 230)
Computer applications in physics research: printer graphics, Schrodinger equation solution, physics-symbol processing, physics information retrieval. Analysis of typical research data. Competency based instruction.
- 357B Topics in Contemporary Physics, CBI**
Fall, Spring, Summer. 3 credits. P:M: (PHY 215 or PHY 215B) P:NM: (PHY 184 or PHY 184B or PHY 294H or PHY 234B or LBS 267) R: Not open to students in the Department of Physics and Astronomy.
Atoms and nuclei, weak decay interaction, weak bosons, strong interaction, conservation laws, quarks and gluons. Competency based instruction.
- 390 Physics Journal Seminar**
Spring. 1(3-0) P:M: Completion of Tier I writing requirement. R: Open only to juniors or seniors in the Department of Physics and Astronomy or Lyman Briggs School.
Written and oral reports on selected articles in the current literature. Critique of presentations by peers.
- 405 Directed Studies**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P:M: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 272) R: Approval of department.
Guided independent study of special topics.
- 410 Thermal and Statistical Physics**
Spring. 3(3-0) P:M: (PHY 471)
Equilibrium statistical mechanics and thermodynamics, kinetic theory, phase transformations.
- 422 Classical Mechanics II**
Fall. 3(3-0) P:M: (PHY 321)
Hamiltonian and Lagrangian mechanics. Non-inertial frames. Coupled oscillations. Continuous systems.
- 423B Special Relativity, CBI**
Summer. 3 credits. P:M: (PHY 321) RB: Some understanding about electric and magnetic fields.
Concepts of special relativity applied to coordinate transformations, mechanics, and electrodynamics. Competency Based Instruction.
- 425B Mathematical Physics, CBI**
Summer. 3 credits. RB: Calculus through differential equations. Some experience with complex variables.
Fourier series and complex variables as applied to problems in quantum mechanics, electrodynamics, and mechanics. Competency based instruction.
- 431 Optics I**
Fall. 3(2-3) P:M: (PHY 192) and (PHY 184 or PHY 184B or PHY 234B or PHY 183A or PHY 294H) and (PHY 215 or PHY 215B) and completion of Tier I writing requirement. SA: PHY 331
Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.
- 440 Electronics**
Spring. 4(3-3) P:M: (PHY 192) and (MTH 235 or concurrently or MTH 255H or concurrently or LBS 220 or concurrently) and (PHY 184 or concurrently or PHY 184B or PHY 294H or LBS 272)
Concepts of electronics used in investigating physical phenomena. Circuits, amplifiers, diodes, LEDs, transistors.
- 451 Advanced Laboratory**
Fall. 3(1-6) P:M: (PHY 440) and completion of Tier I writing requirement. R: Completion of Tier I writing requirement.
General research techniques, design of experiments, and the analysis of results based on some historical experiments in modern physics.
- 452 Advanced Projects Laboratory**
Spring. 3(0-6) P:M: (PHY 451 and PHY 431)
A projects laboratory that builds on optics, electronics and advanced lab courses.
- 471 Quantum Physics I**
Fall. 3(3-0) P:M: (PHY 215 or PHY 215B) and (PHY 321 or concurrently) and (MTH 235 or MTH 255H or LBS 220)
Schrodinger equation, hydrogen atom, harmonic oscillator, and other one-dimensional systems.
- 472 Quantum Physics II**
Spring. 3(3-0) P:M: (PHY 471) RB: A Mathematics course on Boundary-Value Problems
Matrix formulation of quantum mechanics, perturbation theory, scattering.
- 480 Computational Physics**
Spring of even years. 3(3-0) P:NM: (CSE 131 or CSE 230)
Applications of scientific computational techniques to solutions of differential equations, matrix methods, and Monte Carlo methods used in physics.
- 481 Electricity and Magnetism I**
Fall. 3(3-0) P:M: (MTH 234 or MTH 254H or LBS 220) R: Open only to juniors or seniors or graduate students.
Electrostatics, dielectrics, magnetic fields of steady state currents, Faraday law of induction.
- 482 Electricity and Magnetism II**
Spring. 3(3-0) P:M: (PHY 481) RB: A Mathematics course on Boundary-Value Problems.
Maxwell's equations, scalar and vector potentials, electromagnetic plane waves.
- 490 Senior Thesis**
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P:M: (PHY 390) and completion of Tier I writing requirement.
Design, carry out, and analyze an original experiment or computation. A written and oral report is required.
- 491 Atomic, Molecular, and Condensed Matter Physics**
Fall. 3(3-0) P:M: (PHY 471 and PHY 410) and completion of Tier I writing requirement.
Many-electron atoms. Molecules, crystal structure, lattice dynamics. Band models of metals and semiconductors. Transport properties.
- 492 Nuclear and Elementary Particle Physics**
Spring. 3(3-0) P:M: (PHY 471) and completion of Tier I writing requirement. P:NM: (PHY 472)
Properties of nuclei, nuclear models, nuclear reactions. High-energy accelerators. Weak, electromagnetic and strong interactions. Symmetries and conservation laws. Elementary particle spectrum, quarks, gluons.
- 800 Research Methods**
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course.
Design and setup of experiments in various faculty research areas. Data collection and analysis. Study and practice of theoretical methods.
- 810 Methods of Theoretical Physics**
Fall. 3(3-0)
Theoretical methods used in classical mechanics, quantum mechanics, electrodynamics, and statistical mechanics.

Physics-PHY

- 820 Classical Mechanics**
Fall. 3(3-0)
Two-body central force problem, Hamilton's principle, Lagrangian and Hamiltonian equations of motion, variational methods, small oscillations, classical fields.
- 825 Epidemiologic Modeling**
Spring of odd years. 3(3-0) Interdepartmental with Epidemiology. Administered by Epidemiology. P:NM: (EPI 810 and STT 422)
R: Approval of department. SA: HM 825
Mathematical modeling of epidemics. Stochastic and chaotic systems approaches. Applications through personal computer software.
- 831 Statistical Mechanics**
Spring. 3(3-0)
Equilibrium statistical mechanics and thermodynamics. Boltzmann transport equations and hydrodynamics. Brownian and Langevin motion.
- 832 Topics in Statistical Mechanics (MTC)**
Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHY 831)
Advanced topics in statistical matter physics and nuclear physics.
- 841 Classical Electrodynamics I**
Spring. 3(3-0) P:NM: (PHY 810)
Electrostatics, magnetostatics, time-varying fields and Maxwell's equations. Gauge transformations. Poynting's theorem and conservation laws.
- 842 Classical Electrodynamics II**
Fall. 3(3-0) P:NM: (PHY 841 and PHY 810 or concurrently)
Plane electromagnetic waves, polarization states, reflection, refraction. Wave guides and resonant cavities. Radiating systems, dipole fields, radiated power. Special theory of relativity.
- 850 Electrodynamics of Plasmas**
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering; Astronomy and Astrophysics. Administered by Department of Electrical and Computer Engineering. P:NM: (EE 835 or PHY 488) SA: AST 850, EE 850
Plasma kinetic and macroscopic plasma transport theory. Electromagnetic wave propagation and charged particle diffusion processes in plasma. Electromagnetic energy absorption via elastic and inelastic collisions. Dc, rf, and microwave discharges.
- 851 Quantum Mechanics I**
Fall. 3(3-0) R: Open only to graduate students in the College of Engineering or College of Natural Science.
Axioms of quantum and wave mechanics, applications to spherically symmetric potentials. Hydrogen atom, harmonic oscillator, matrix mechanics, angular momentum theory, rotations.
- 852 Quantum Mechanics II**
Spring. 3(3-0) P:NM: (PHY 851)
Approximation methods, perturbation theory, atomic physics applications, scattering theory, identical particles, Pauli principle, Bose and Einstein statistics, Hartree-Fock approximation, collisions of identical particles, radiation.
- 853 Advanced Quantum Mechanics**
Fall. 3(3-0) P:NM: (PHY 852)
Quantum description of relativistic particles and fields. Dirac equation, interpretation of negative energy states, Lagrangian field theory, quantization of free fields, interactions, perturbation theory, S matrix, and Feynman rules.
- 854 Quantum Electrodynamics**
Spring of odd years. 3(3-0) P:NM: (PHY 853)
Application of quantum field theory to the interaction of electrons and photons: pair annihilation, Compton scattering. Bound states, renormalization theory.
- 861 Beam Physics (MTC)**
Spring of odd years. 3(3-0) P:NM: (PHY 820 and PHY 841)
Particle accelerator theory and design.
- 871 Condensed Matter Physics**
Spring. 3(3-0) P:NM: (PHY 852)
Structure and vibrations of solids. Electrons in solids, electron gas, Bloch's theorem. Cohesion. Electron states in solids. Electronic properties of solids, electron transport, conductivity, semiconductors. Cooperative phenomena.
- 881 Subatomic Physics**
Fall. 3(3-0) P:NM: (PHY 851)
Application of conservation laws and physical principles to basic quantum mechanical problems in MeV energy range and femtometer size range. Application to nuclear data.
- 891 Elementary Particle Physics**
Spring. 3(3-0) P:NM: (PHY 853)
Nonabelian gauge theory, spontaneously broken gauge theory, electroweak interaction, QCD, W and Z boson coupling to quarks and leptons, charm, top and bottom quarks, particle generations.
- 899 Master's Thesis Research**
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to graduate students in Physics.
Master's thesis research.
- 901 Frontiers in Physics and Astronomy**
Spring. 1(1-0)
Seminar and discussions in physics. Attendance at weekly colloquium.
- 902 Case Studies in Physics Applications**
Fall, Spring, Summer. 1 to 3 credits. P:NM: (PHY 471 and PHY 481)
Assessment of an application of physics; written report and oral presentation required. Projects from industry and government agencies; optional internship.
- 905 Special Problems**
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Physics and Astronomy.
In-depth study of a topic in physics or in astrophysics and astronomy.
- 962 Topics in Beam Physics (MTC)**
Fall, Spring, Summer. 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHY 861)
Selected topics in accelerator physics.
- 972 Topics in Condensed Matter Physics (MTC)**
Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHY 831 and PHY 852 and PHY 871)
Advanced topics in many -body problems, disordered solids, superfluidity superconductivity magnetism, or macroscopic systems.
- 980 Advanced Reading in Physics**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.
- 982 Topics in Nuclear Physics (MTC)**
Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHY 852 and PHY 881)
Heavy ion reactions or nuclear structure.
- 992 Quantum Chromodynamics (MTC)**
Fall. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P:NM: (PHY 891)
Hadron-hadron interactions, interaction of hadrons with leptons.
- 999 Doctoral Dissertation Research**
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to graduate students in Physics.
Doctoral dissertation research.