101. Concepts in Physics  
FALL, 11-0-0  
Conceptual foundations of physics emphasizing key experiments.

102. Physics Computations I  
SPRING, 10-0-3  
PHY 183 or concurrently or PHY 183B or concurrently or PHY 193H or concurrently or PHY 181B or concurrently (CSE 101 or CSE 231)  
Use of computer software to solve, analyze and graph equations and data from mechanics.

170. Investigations in Physics  
FALL, 20-0-6  
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: (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, 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: (PHY 183 or PHY 183B or PHY 181B or LBS 164 or PHY 193H or PHY 231 or 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 267 or PHY 184 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.

183. Physics for Scientists and Engineers I  
FALL, SPRING, 4(5-0) P: (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, PHY 233B.  
Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves.

183A. Physics I, CBI  
FALL, SPRING, SUMMER. 1 credit.  
P: (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. 1 credit.  
P: (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: (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: (PHY 182B) Not open to students with credit in PHY 184 or PHY 184B or PHY 233B or PHY 294H or PHY 232 or PHY 232B or PHY 294H.  
Topics: from standing wave phenomena, atoms, electromagnetic fields, alternating currents, optics, quantum mechanics, elementary particles. This course plus PHY 182B is equivalent to PHY 181B. PHY 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: (PHY 183 or PHY 183B or PHY 193H or PHY 182B or PHY 232 or PHY 233B or PHY 181B) and (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 267 or PHY 184 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.

191. Physics Laboratory for Scientists, I  
FALL, 10-0-3 P: (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C) or (LBS 164 and PHY 232 or PHY 232B) Not open to students with credit in PHY 252 or LBS 267L.  
Error analysis, exercises in motion, forces, conservation laws and some electricity & magnetism studies.

192. Physics Laboratory for Scientists, II  
SPRING, 10-0-3 P: (PHY 191) and (PHY 184 or PHY 182B or PHY 184B or PHY 294H or PHY 232 or PHY 232B or PHY 232C) Not open to students with credit in PHY 252 or LBS 267L.  
Electric and magnetic fields, circuits, wave optics, modern physics.

193H. Honors Physics I—Mechanics  
SPRING, 3(4-0) P: (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently or PHY 183 or PHY 183B or PHY 181B or PHY 231 or PHY 231B or PHY 231C or PHY 182B or LBS 164 or PHY 183B).  
Mechanics and waves.
232B. Introductory Physics II, CBI
Fall, Spring, Summer. 3 credits. P: (PHY 231 or PHY 231B or PHY 231C or PHY 183B or PHY 193H or LBS 164) 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 267. Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Competency based instruction.

232C. Introductory Physics II, Virtual University
Fall, Spring, 3 credits. P: (PHY 182B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 164) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H or LBS 267. Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Offered using CD and WWW technology.

233B. Calculus Concepts in Physics I, CBI
Fall, Spring, Summer. 2 credits. P: (PHY 231) and (MTH 132 or MTH 152H or MTH 261 or LBS 118) Not open to students with credit in PHY 183 or PHY 193H.

234B. Calculus Concepts in Physics II, CBI
Fall, Spring, Summer. 2 credits. P: (PHY 232 or PHY 232B) and (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently) Kinematics, dynamics, applications of Newton's laws. Competency based instruction. PHY 231B plus PHY 231B is equivalent to PHY 183B.

251. Introductory Physics Laboratory I
Fall, Spring, Summer. 1(0-3) P: (PHY 231 or PHY 231B or PHY 231C or PHY 181B or PHY 183 or PHY 183B or PHY 231C or PHY 183H) (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently) Laboratory exercises involving simple mechanical systems.

252. Introductory Physics Laboratory II
Fall, Spring, Summer. 1(0-3) P: (PHY 251 or PHY 181 or LBS 164L) and (PHY 232 or PHY 232B or PHY 232C or PHY 182B or PHY 184 or PHY 294 or PHY 294H or LBS 267) Not open to students with credit in PHY 191 or LBS 164L. Laboratory exercises involving simple electromagnetic and optical systems.

294H. Honors Physics II—Electromagnetism
Fall, 3(4-0) P: (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 322 or PHY 232B or PHY 232C or PHY 182B or LBS 267. Electricity and magnetism, electromagnetic waves and optics.

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: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 267) R: Approval of department. Guided individualized study in an area of physics.

321. Classical Mechanics I
Spring, 3(3-0) P: (PHY 184 or PHY 184B or PHY 294H) and (PHY 215 or PHY 215B) and (MTH 235 or MTH 255H or LBS 220) Newtonian point particles. Oscillations. One-particle chaos. Central-force motion. Systems of particles.

351B. Computational Physics, CBI
Fall, Spring, Summer. 3 credits. P: (PHY 215 or PHY 215B) (CSE 131 or CSE 230) Computer applications in physics research: printer graphics, Schroedinger 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: (PHY 215 or PHY 215B) (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: Completion of Tier I writing requirement. R: Open only to juniors in the Physics major. 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: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 267) R: Approval of department. Guided independent study of special topics for seniors and some graduate students.

410. Thermal and Statistical Physics
Spring. 3(3-0) P: (PHY 471) Equilibrium statistical mechanics and thermodynamics, kinetic theory, phase transformations.

422. Classical Mechanics II
Fall, 3(3-0) P: (PHY 321) Hamiltonian and Lagrangian mechanics. Non-inertial frames. Coupled oscillations. Continuous systems.

423B. Special Relativity, CBI
Spring, 3 credits. P: (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(3-0) P: (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. Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.

432. Optics II
Spring. 3(3-0) P: (PHY 431) Experimental projects involving advanced topics in optics. Holography, spatial filtering, study of physical systems using optical devices.

440. Electronics
Spring. 4(3-0) P: (PHY 192) and (PHY 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 PHY 234B or PHY 234C or LBS 267) and completion of Tier I writing requirement. Concepts of electronics used in investigating physical phenomena. Circuits, amplifiers, diodes, LEDs, transistors.

451. Advanced Laboratory
Fall. 3(1-0) P: (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: (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: (PHY 215 or PHY 215B) and (PHY 321 or concurrently) and (MTH 235 or MTH 255H or LBS 220) Schroedinger equation, hydrogen atom, harmonic oscillator, and other one-dimensional systems.

472. Quantum Physics II
Spring. 3(3-0) P: (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: (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: (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.
Descriptions—Physics of Courses

482. Electricity and Magnetism II
Spring. 3(3-0) P: (PHY 481) RIK. 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: (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: (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: (PHY 471) and completion of Tier I writing requirement. 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.

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: EPI 510, STT 422. R: Approval of department. Mathematical modeling of epidemics. Stochastic and chaotic systems approaches. Applications through personal computer software. SA: HM 325

831. Statistical Mechanics
Spring. 3(3-0)

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: (PHY 831) Advanced topics in statistical matter physics and nuclear physics.

841. Classical Electrodynamics I

842. Classical Electrodynamics II
Fall. 3(3-0) P: (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

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

853. Advanced Quantum Mechanics
Fall. 3(3-0) P: 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: PHY 852. Application of quantum field theory to the interaction of electrons and photons: pair annihilation, Compton scattering. Bound states, renormalization theory.

861. Beam Physics
Spring of odd years. 3(3-0) P: PHY 820, PHY 841. Particle accelerator theory and design.

871. Condensed Matter Physics

881. Subatomic Physics
Fall. 3(3-0) P: 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: PHY 553. 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.

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: Approval only to graduate students in the College of Engineering.

920. 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: 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: PHY 631, PHY 582, PHY 871. Advanced topics in many-body problems, disordered solids, superfluidity, superconductivity, magnetism, or macroscopic systems.

980. Advanced Reading in Physics
Fall, Summer, Spring. 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: PHY 631, PHY 581. 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: PHY 891. Hadron-hadron interactions, interaction of hadrons with leptons.

999. Doctoral Dissertation Research
Fall, Summer, Spring. 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.

PHYSIOLOGY

PSL

Department of Physiology
College of Human Medicine
College of Natural Science
College of Osteopathic Medicine
College of Veterinary Medicine

101. Current Issues in Physiology
Fall. 2(2-0) Not open to students with credit in PSL 250 or PSL 431 or PSL 432. Physiological bases of health issues of broad social significance, and new approaches for the treatment of specific disorders.