

866. Research on Sports for Athletes with Disabilities
Fall of odd-numbered years. 3(3-0)
Performance capabilities of athletics with disabilities. Research on areas such as exercise physiology, sport biomechanics, sport psychology, sport sociology, motor development, and motor learning.

867. Practicum in Adapted Physical Activity
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
C: PES 865 or PES 866. R: Approval of department. Supervised practice in teaching physical activities and/or coaching sports for persons with disabilities.

870. Physical Activity and Well-Being
Fall. 3(3-0)
Relationship of physical activity to human well-being. Influence of growth, biological maturity, aging, body composition, nutrition, training, and rest on health and performance.

871. Research Methods in Physical Education and Exercise Science
Spring. 3(3-0)
R: Open only to graduate students in Physical Education and Exercise Science. Research and analytical methodology including survey, qualitative, historical, philosophical, descriptive, meta-analytical, creative, and experimental methods.

882. Topics in Physical Education and Exercise Science (MTC)
Fall, Spring, Summer. 2 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Selected topics in areas such as physiology of exercise, biomechanics, motor behavior, psychosocial aspects of activity, program design and evaluation, and athletic training.

890. Independent Study in Physical Education and Exercise Science
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
R: Open only to master's students. Approval of department.
Individual study in an area of physical education and exercise science under faculty supervision.

893. Internship in Physical Education and Exercise Science
Fall, Spring, Summer. 2 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
R: Open only to graduate students in Physical Education and Exercise Science.
Supervised internship in sports medicine, athletic administration, coaching, or education agencies. Capstone experience option in master's degree program.

894. Field Experiences in Physical Education and Exercise Science
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
R: Approval of department.
Supervised graduate practicum in schools or other settings.

897. Project in Physical Education and Exercise Science
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Open only to graduate students in Physical Education and Exercise Science.
Project experience under the guidance and supervision of MSU faculty. Development of products such as technical reports, instructional media, or curriculum materials to address an educationally significant problem. Capstone experience option in master's degree program.

899. Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
P: PES 871.

910. Current Issues in Exercise Physiology
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
P: PES 810.
Selected issues in exercise physiology and related fields of study.

930. Current Issues in Biomechanical Aspects of Physical Activity
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Interdepartmental with Biomechanics.
P: PES 830.
Selected issues of biomechanical analyses of sport and physical activity.

940. Current Issues in Psychosocial Aspects of Physical Activity
Fall. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Selected issues in the psychology and sociology of sport and physical activity.

950. Current Issues in the Design and Evaluation of Physical Activity Programs
Fall. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Selected issues in the design and evaluation of physical activity programs.

960. Current Issues in Motor Behavior
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
P: PES 860.
Selected issues in motor development, motor learning, adapted physical education, and related fields of study.

990. Independent Study in Physical Education and Exercise Science
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
R: Open only to doctoral students. Approval of department.
Individual study in an area of physical education and exercise science under faculty supervision.

995. Research Practicum in Physical Education and Exercise Science
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Open only to doctoral students in College of Education. Approval of department.
Supervised research practicum. Design, execution, analysis, presentation, critique, and revision of research projects.

999. Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course.
R: Open only to doctoral students.

PHYSICS

Department of Physics and Astronomy College of Natural Science

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: MTH 132 or concurrently. R: Not open to students with credit in LBS 164 or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B.
Newton's laws of motion, conservation of angular momentum, energy conservation, thermal physics, waves, and sound. Competency based instruction.

182B. Basic Physics II, CBI
Fall, Spring, Summer. 3 credits.
P: LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B. R: Not open to students with credit in LBS 267 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.

183. Physics for Scientists and Engineers I
Fall, Spring. 4(5-0)
P: MTH 132 or concurrently. R: Not open to students with credit in 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, rotational motion, oscillation, gravity, waves.

183A. Physics I, CBI
Fall, Spring, Summer. 1 credit.
P: PHY 181B. R: Not open to students with credit in PHY 183 or PHY 183B or PHY 231 or PHY 231B or PHY 193H or LBS 164.
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: MTH 132 or concurrently. R: Not open to students with credit in PHY 231 or PHY 183 or PHY 231B or PHY 193H or PHY 181B or LBS 164.
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 181B or PHY 183 or PHY 183B or PHY 193H or LBS 164; MTH 133 or concurrently. R: 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.

PHY

**Descriptions — Physics
of
Courses**

184A. Physics II, CBI

Fall, Spring, Summer. 1 credit.
P: PHY 182B. R: Not open to students with credit in PHY 184 or PHY 184B or PHY 294H or PHY 232B. 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.

184B. Physics for Scientists and Engineers II, CBI

Fall, Spring, Summer. 4 credits.
P: PHY 181B or PHY 183 or PHY 193A or PHY 183B or PHY 193H or LBS 164; MTH 133 or concurrently. R: Not open to students with credit in LBS 267 or PHY 182B or PHY 184 or PHY 184B 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

Spring. 1(0-3)
P: PHY 181B or PHY 183 or PHY 183A or PHY 183B or PHY 193H or LBS 164 or concurrently. R: Not open to students with credit in PHY 251. Error analysis, exercises in motion, forces, conservation laws and optics.

192. Physics Laboratory for Scientists, II

Fall. 1(0-3)
P: PHY 184 or PHY 184B or PHY 191 or PHY 294H or LBS 267 or concurrently. R: Not open to students with credit in PHY 252. Electric and magnetic fields, circuits, wave optics, and radioactivity.

193H. Honors Physics I-Mechanics

Spring. 3(4-0)
P: MTH 133 or MTH 153H or concurrently. Mechanics and waves.

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: PHY 184 or PHY 184A or PHY 184B or PHY 294H or LBS 267. R: 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: PHY 184 or PHY 184A or PHY 184B or PHY 294H or LBS 267. R: 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: MTH 116 or concurrently. R: Not open to students with credit in PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231B or LBS 164. Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound.

231B. Introductory Physics I, CBI

Fall, Spring, Summer. 3 credits.
P: MTH 116 or concurrently. R: Not open to students with credit in PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or LBS 164. Mechanics, Newton's laws, momentum, energy, conservation laws, thermodynamics, waves, sound. Competency based instruction.

232. Introductory Physics II

Fall, Spring. 3(4-0)
P: PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or LBS 164. R: Not open to students with credit in PHY 184 or PHY 184B or PHY 232B. Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.

232B. Introductory Physics II, CBI

Fall, Spring, Summer. 3 credits.
P: PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or LBS 164. R: Not open to students with credit in PHY 184 or PHY 184B or PHY 232. Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Competency based instruction.

233B. Calculus Concepts in Physics I, CBI

Fall, Spring, Summer. 2 credits.
P: PHY 231 or PHY 231B; MTH 132 or concurrently. 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: PHY 232 or PHY 232B; MTH 133 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: PHY 183 or PHY 183B or PHY 231 or PHY 231B or concurrently. R: Not open to students with credit in PHY 191. Laboratory exercises involving simple mechanical systems.

252. Introductory Physics Laboratory II

Fall, Spring, Summer. 1(0-3)
P: PHY 251 or PHY 191 or LBS 164L. R: Not open to students with credit in PHY 192. Laboratory exercises involving simple electromagnetic and optical systems.

294H. Honors Physics II-Electromagnetism

Fall. 3(4-0)
P: PHY 193H; MTH 234 or MTH 254H or concurrently. 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 294H. R: Approval of department.
Guided individualized study in an area of physics.

321. Classical Mechanics I

Spring, Summer. 3(3-0)
P: PHY 215 or PHY 294H or concurrently, MTH 235 or MTH 255H or concurrently. The mechanics of point particles as application of Newton's laws. Conservation of energy and momentum. Central force fields.

351B. Computational Physics, CBI

Fall, Spring, Summer. 3 credits.
P: CPS 130 or CPS 131 or CPS 230; PHY 215 or PHY 215B. 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 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H. R: Not open to students in 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)
R: Open only to juniors in Physics. Completion of Tier I writing requirement. 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 294H. R: Approval of department.
Guided independent study of special topics for seniors.

410. Thermal and Statistical Physics

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

411. Conceptual Physics

Spring, Summer. 4(3-3)
P: MTH 116. R: Not open to Physics or Astrophysics students. Physical phenomena evident in the world around us: mechanics, heat, properties of matter, waves and sound, electricity and magnetism, light, atmosphere and hydrosphere, and naked eye astronomy.

422. Classical Mechanics II

Fall, Summer. 3(3-0)
P: PHY 321, MTH 235 or MTH 255H. Analytic mechanics. Dynamics of systems of particles. Hamiltonian and Lagrangian mechanics. Vibrations and normal modes.

423B. Special Relativity, CBI

Summer. 3 credits.
P: PHY 321, PHY 481. Concepts of special relativity applied to coordinate transformations, mechanics, and electrodynamics. Competency based instruction.

425B. Mathematical Physics, CBI

Summer. 3 credits.
P: PHY 321, PHY 481. Fourier series and complex variables as applied to problems in quantum mechanics, electrodynamics, and mechanics. Competency based instruction.

431. Optics I

Spring. 3(2-3)
P: PHY 184 or PHY 184B or PHY 294H; PHY 192; PHY 215 or PHY 215B. R: Completion of Tier I writing requirement. Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.
SA: PHY 331

- 432. Optics II**
Fall. 3(2-3)
P: PHY 331.
Experimental projects involving advanced topics in optics. Holography, spatial filtering, study of physical systems using optical devices.
- 440. Electronics**
Spring. 4(3-3)
P: PHY 184 or PHY 184B or PHY 294H; PHY 192; MTH 235 or MTH 255H. R: Completion of Tier I writing requirement.
Concepts of electronics used in investigating physical phenomena. Circuits, amplifiers, diodes, LEDs, transistors.
- 451. Advanced Laboratory**
Fall. 3(1-6)
P: PHY 331 or PHY 440. 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 331 or PHY 440; PHY 451.
A projects laboratory that builds on optics and electronics courses.
- 471. Quantum Physics I**
Fall. 3(3-0)
P: PHY 215 or PHY 215B; MTH 235 or MTH 255H; PHY 321.
Schrödinger equation, hydrogen atom, harmonic oscillator, and other one-dimensional systems.
- 472. Quantum Physics II**
Spring. 3(3-0)
P: PHY 471.
Matrix formulation of quantum mechanics, perturbation theory, scattering.
- 480. Computational Physics**
Spring of even-numbered years. 3(3-0)
P: CPS 130 or CPS 131 or CPS 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, Summer. 3(3-0)
P: MTH 234 or MTH 254H. R: Open only to juniors or seniors.
Electrostatics, dielectrics, magnetic fields of steady state currents, Faraday law of induction.
- 482. Electricity and Magnetism II**
Spring. 3(3-0)
P: PHY 481.
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.
R: Open only to seniors. Completion of Tier I writing requirement. Approval of department.
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 410, PHY 471. R: 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 472. R: 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.
R: Open only to graduate students in Astronomy and Astrophysics and in Physics.
Design and setup of experiments in various faculty research areas. Data collection and analysis. Study and practice of theoretical methods.
- 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.
- 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)**
Fall. 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**
Fall. 3(3-0)
Electrostatics, magnetostatics, time-varying fields and Maxwell's equations. Gauge transformations. Poynting's theorem and conservation laws.
- 842. Classical Electrodynamics II**
Spring. 3(3-0)
P: PHY 841.
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-numbered years. 3(3-0) Interdepartmental with Electrical Engineering, and Astronomy and Astrophysics. Administered by Electrical Engineering.
P: EE 835 or PHY 488.
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 College of Engineering and 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: 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: 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-numbered years. 3(3-0)
P: 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**
Spring of odd-numbered years. 3(3-0)
P: PHY 820, PHY 841.
Particle accelerator theory and design.
- 871. Condensed Matter Physics**
Spring. 3(3-0)
P: 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: 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 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.
- 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: 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 831, PHY 852, PHY 871.
Advanced topics in many-body problems, disordered solids, superfluidity superconductivity magnetism, or macroscopic systems.

**Descriptions —Physics
of
Courses**

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: PHY 852, 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: 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.

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)
R: 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.

250. Introductory Physiology
Fall, Spring. 4(4-0)
R: Not open to students in Physiology.
Function, regulation and integration of organs and organ systems of higher animals emphasizing human physiology.

323. Physiology and Hygiene of the Eye
Fall of odd-numbered years, Summer of even-numbered years. 3(3-0)
R: Not open to Physiology majors.
Basic anatomy, physiology, and hygiene of the visual system: normal and abnormal visual function, methods of correction, and educational implications.

410. Computational Problem Solving in Physiology
Fall, Spring. 3(3-0)
P: PSL 432. R: Approval of department.
Quantitative analysis of physiological data: mathematical models, curve fitting, data analysis and interpretation. Problem solving involving exponential and logistic growth. Cerebral blood flow, convective cooling, oxygen consumption, thermoregulation, other applications.

421. Hormones and Development
Spring. 3(3-0) Interdepartmental with Zoology. Administered by Zoology.
P: ZOL 220.
Hormonal regulation of development, growth and cancer. Hormonal decline in aging.

431. Human Physiology I
Fall. 3(3-0)
P: BS 111, CEM 142.
Neural function including autonomic nervous system, physiological control systems, endocrinology, reproduction and digestive function.

432. Human Physiology II
Spring. 3(3-0)
P: PSL 431.
Continuation of PSL 431. Function and regulation of the cardiovascular, respiratory, and renal systems. Control of tissue blood flow, blood pressure, blood gases, body fluid volume and electrolytes.

440. Topics in Cell Physiology
Fall, Spring. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Critical discussion and evaluation of a selected problem of mammalian cell physiology including cell biophysics, molecular biology of the cell.

441. Topics in Endocrinology
Fall, Spring. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic on the role of hormones in the regulation of growth, metabolism, differentiation.

442. Topics in Cardiovascular Physiology
Fall. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in blood flow physiology.

443. Topics in Respiratory Physiology
Fall of odd-numbered years. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in the physiology of gas exchange and lung mechanics.

444. Topics in Renal Physiology
Spring of even-numbered years. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in the function of the kidney, regulation of salt and water balance.

445. Topics in Environmental Physiology
Spring of odd-numbered years. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in environmental physiology with an emphasis on thermoregulation.

446. Topics in Visual Physiology
Fall of even-numbered years. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in the functioning of the visual system in health and disease.

447. Topics of Brain Function
Fall. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic on the functioning of the mammalian brain.

448. Topics in Gastrointestinal Physiology
Fall. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Selected topic in the physiology of the digestive system.

449. Developmental Neurophysiology
Fall. 2(2-0)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Development of the nervous system in invertebrate and vertebrate animals.

450. Laboratory in Human Physiology
Fall. 2(1-3)
P: PSL 432. R: Open only to Physiology majors. Completion of Tier I writing requirement.
Demonstration of fundamental physiological processes. Sensory input response. Data collection and analysis.

475. Capstone Laboratory in Physiology
Spring. 2(1-3)
P: PSL 432. R: Open only to Physiology majors.
Laboratory exercises in animal physiology including osmoregulation, receptor mediated regulation, nervous and hormonal control of function.

480. Special Problems
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course.
P: PSL 432. R: Open only to Physiology majors.
Independent study under the auspices of a faculty member.

483. Environmental Physiology
Spring. 4(4-0) Interdepartmental with Zoology. Administered by Zoology.
P: ZOL 228 or ZOL 250.
Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.

501. Introductory Medical Physiology
Fall. 3(3-0)
R: Graduate-professional students in colleges of Human and Osteopathic Medicine.
Physiological basis of medical practice.

511. Veterinary Physiology
Spring. 5(5-0)
R: Open only to graduate-professional students in College of Veterinary Medicine.
Physiology of the nervous, cardiovascular, renal, respiratory, digestive, endocrine, and reproductive systems. Homeostasis.

552. Medical Neuroscience
Spring. 4(3-2) Interdepartmental with Anatomy and Radiology. Administered by Anatomy.
R: Graduate-professional students in colleges of Human and Osteopathic Medicine.
Correlation of normal structure and function of the human nervous system with clinical testing, classical lesions, and common diseases.

811. Cellular and Neurophysiology
Fall. 6(6-0) Interdepartmental with Zoology.
P: BCH 462, PSL 432.
Advanced bioenergetics, transport, regulation of metabolic reactions, specialized cell functions, and neurophysiology.

812. Advanced Systems Physiology
Spring. 6(6-0)
P: PSL 811.
Cardiovascular, renal, respiratory, endocrine, reproductive, and gastrointestinal physiology.

825. Cell Structure and Function
Spring. 3(3-0) Interdepartmental with Biochemistry and Microbiology. Administered by Biochemistry.
P: BCH 401 or BCH 461.
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrative information transfer. Original investigations in all five kingdoms.