

Physics—PHY

- 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**
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. This course is given in the competency based instruction format.
- 425B Mathematical Physics**
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. This course is given in the competency based instruction format.
- 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.
- 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)
Schrödinger 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) RB: (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. RB: (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.

- 410 Computational Problem Solving in Physiology**
Fall, Spring. 3(3-0) RB: (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.
- 420 Membrane Biophysics: An Introduction**
Fall, Spring. 2(2-0) RB: One year of college physics or chemistry, and one year of college mathematics.
Biophysical and chemical aspects of biomembranes. Experimental model membrane systems including planar lipid bilayers and liposomes. Biotechnological applications of lipid bilayer sensors.
- 431 Human Physiology I**
Fall. 3(3-0) RB: (BS 111 and CEM 142)
Neural function including autonomic nervous system, physiological control systems, endocrinology, reproduction and digestive function.
- 432 Human Physiology II**
Spring. 3(3-0) RB: (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) RB: (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.

PHYSIOLOGY PSL

Department of Physiology College of Natural Science

- 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.
- 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 years. Summer of even 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.
- 331 Cell Physiology: Function of Specialized Cells**
Fall. 3(3-0) P:M: (BS 111 or LBS 145)
Functions of differentiated cells, including mechanisms of cell communication, excitable membranes, contraction, motility, transport, secretion, and extra cellular matrix.
- 441 Topics in Endocrinology**
Fall, Spring. 2(2-0) RB: (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) RB: (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 years. 2(2-0) RB: (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.
- 445 Topics in Environmental Physiology**
Spring of odd years. 2(2-0) RB: (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 years. 2(2-0) RB: (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) RB: (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) RB: (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) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.
Development of the nervous system in invertebrate and vertebrate animals.

473 Environmental Fish Physiology
Spring of odd years. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (BS 111 or LBS 145 or LBS 149H) R: Not open to freshmen or sophomores.
Physiological adaptations of fish to environmental factors; bioenergetics, homeostasis, senses adaptations to diverse and extreme aquatic environments.

475 Capstone Laboratory in Physiology
Spring. 2(1-3) RB: (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. RB: (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 Department of Zoology. P:M: (BS 110 or LBS 144 or LBS 148H) and (BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151 or CEM 181H or LBS 171) and completion of Tier I writing requirement.
Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.

PLANT BIOLOGY PLB

Department of Plant Biology College of Natural Science

105 Plant Biology
Fall, Spring. 3(3-0) SA: BOT 105
Plant structure, function, development, genetics, diversity and ecology.

106 Plant Biology Laboratory
Fall, Spring. 1(0-3) P:M: (PLB 105 or concurrently) SA: BOT 106
Cell structure, anatomy, physiology, growth and development, and diversity of plants.

111L Cell and Molecular Biology Laboratory
Fall, Spring, Summer. 2(1-3) Interdepartmental with Biological Science; Microbiology and Molecular Genetics; Zoology. Administered by College of Natural Science. P:M: (BS111 or concurrently) Not open to students with credit in LBS 159H.
Principles and applications of common techniques used in cell and molecular biology.

202 The Plant Kingdom
Spring. 3(2-3) P:M: (BS 110 or BS 111 or PLB 105 or LBS 144 or LBS 148H or LBS 149H) SA: BOT 202
Morphology of the major plant groups with an emphasis on structure, reproduction and evolution. Field trips required.

218 Plants of Michigan
Fall. 3(2-3) P:M: (BS 110 or PLB 105 or LBS 144 or LBS 148H) SA: BOT 218
Plant taxa of Michigan and the Great Lakes region and the major habitats in which they occur. Principles and rationale of classification. Relationships between life histories, morphology and environment. Field trips required.

301 Introductory Plant Physiology
Fall, Spring. 3(2-3) P:M: (CEM 141 or CEM 151 or LBS 171 or CEM 181H) and (CEM 161 or LBS 171L) and (PLB 105 or BS 111 or LBS 145 or LBS 149H) and completion of Tier I writing requirement. SA: BOT 301
General principles of plant physiology relating plant structure to function. Cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.

319 Introduction to Earth System Science
Fall. 3(3-0) Interdepartmental with Entomology; Geological Sciences; Zoology; Sociology. Administered by Department of Entomology. RB: Completion of one course in biological or physical science.
Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.

335 Plants Through Time
Spring of odd years. 3(3-0) Interdepartmental with Geological Sciences. P:M: (BS 110 or PLB 105 or GLG 201 or LBS 144 or LBS 148H) R: Open only to juniors or seniors. SA: BOT 335
Evolutionary history of plants, development of ecosystems, and use of plant fossils in the reconstruction of ancient environments and climate.

336 Useful Plants
Fall of odd years. 3(3-0) P:M: (CEM 142 or CEM 143 or CEM 152 or CEM 182H) and (PLB 105 or LBS 145) or (BS 110 and BS 111 and BS 111L) or (LBS 148H and LBS 149H) SA: BOT 336
Use of plants for myriad purposes from food and construction materials to medicines and perfumes. Potential for expanding the uses of plants through biotechnology.

341 Fundamental Genetics
Fall, Spring, Summer. 4(4-0) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (BS 111 or LBS 145 or LBS 149H)
Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.

355 Ecology
Fall, Spring, Summer. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (BS 110 or LBS 144 or LBS 148H) SA: ZOL 250
Plant and animal ecology. Interrelationships of plants and animals with the environment. Principles of population, community, and ecosystem ecology. Application of ecological principles to global sustainability.

355L Ecology Laboratory
Fall, Spring, Summer. 1(0-3) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (ZOL 355 or concurrently or PLB 355 or concurrently) and completion of Tier I writing requirement.
Population, community, and ecosystem ecology, utilizing plant and animal examples to demonstrate general field principles.

402 Biology of Fungi
Fall. 3(2-3) Interdepartmental with Plant Pathology. P:M: (BS 110 or BS 111 or PLB 105 or LBS 145 or LBS 148H or LBS 149H) SA: BOT 402
Major groups of fungi: characteristics, habitats and diversity. Significance of fungi in nature and their economic importance.

407 Diseases and Insects of Forest and Shade Trees
Spring. 4(3-3) Interdepartmental with Plant Pathology; Entomology. Administered by Department of Plant Pathology. P:M: (PLB 105 or BS 110 or LBS 144 or LBS 148H) and (PLB 218 or FOR 204 or HRT 211) and completion of Tier I writing requirement. SA: BOT 407
Diseases, insects, and environmental problems affecting trees in forests, parks, suburbs, and nurseries. Methods of control.

412 Environmental Plant Physiology
Fall. 3(3-0) P:M: (PLB 105 or BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151) and (CEM 161) SA: BOT 412
General concepts underlying interactions between plants and the environment. Light sensing and utilization. Energy budgets. Water uptake and utilization. Mineral nutrition.

414 Plant Physiology: Metabolism
Fall. 3(3-0) P:M: (CEM 251 or CEM 351) and (PLB 105 or LBS 145) or (BS 110 and BS 111 and BS 111L) or (LBS 148H and LBS 149H) SA: BOT 414
General principles underlying metabolic processes of plants. Photosynthesis, translocation and water relations, nitrogen metabolism, cell wall biosynthesis, and structures associated with these processes.

415 Plant Physiology: Growth, Development and the Environment
Spring. 3(3-0) P:M: (PLB 105 or BS 111 or LBS 145 or LBS 149H) and (CEM 251) SA: BOT 415
Principles of plant growth and development with emphasis on environmental and hormonal factors that control progression of the plant through its life cycle. Tissue culture and genetic engineering in plants.