ENGINEERING PHYSICS

The Engineering Physics degree at Mount Wachusett Community College provides students with the opportunity to earn an Associate of Science Degree in Engineering Physics. Upon completion of the program, students are prepared for the rigors of a four-year institution to complete a baccalaureate degree. This degree offers a student the opportunity to complete the STEM Transfer Core, including calculus and calculus-based physics, while exploring various engineering disciplines through project-based learning.

ENGINEERING PHYSICS (ENPH)

An Associate in Science Degree in Engineering Physics

This program is designed to prepare graduates for transfer in engineering physics. Since many of these classes are two-semester sequential courses, it is recommended that students start this program in the fall.

Year 1		
Fall		**Credits**
ENG 101	College Writing I	3
CHE 107	General Chemistry I	4
MAT 211	Calculus I	4
Social Science Elective [1]		3
PHY 120	Physics for Engineering and Science I	4
Spring		
ENG 102	College Writing II	3
MAT 212	Calculus II	4
Humanities Elective [2]		3
PHY 121	Physics for Engineering and Science II	4
Year 2		
Fall		
Science Elective [3]		3-4
Science Elective [3]		3-4
CAD 101	Introduction to CAD	3
Social Science Elective [1]		3
MAT 213	Calculus III	4
Spring		
MAT or Science Elective [4]		4
Science Elective [3]		3-4
PHL Elective [5]		3
MAT 230	Ordinary Differential Equations	4
	Total Credits:	**62-65**

1. Social Science Elective: See Elective Courses by Abbreviation (http://catalog.mwcc.edu/electivecoursesbyabbreviation/). ECO 101 Macroeconomics or ECO 102 Microeconomics is recommended
2. Humanities Elective: See Elective Courses by Abbreviation (http://catalog.mwcc.edu/electivecoursesbyabbreviation/).
3. Any 3-credit or 4-credit course except PHY 101, PHY 105, PHY 106. See Elective Courses by Abbreviation (http://catalog.mwcc.edu/electivecoursesbyabbreviation/).
4. Any 4-credit 200-level MAT or 200-level science courses. See Elective Courses by Abbreviation (http://catalog.mwcc.edu/electivecoursesbyabbreviation/).
5. Any PHL course.

See Engineering Physics program student learning outcomes and technical standards

Campus

This program is offered on the Gardner campus only.

Student Success Tips

This program is designed for a fall start with attendance taking place primarily in Gardner during the daytime. Students are encouraged to follow the sequence of courses as presented in the catalog.

Transfer Options

Please click here for transfer options (http://catalog.mwcc.edu/academicresources/#transferinformationtext) and also consult with your advisor.

MASSTRANSFER

Students who plan to transfer to a Massachusetts State University or a University of Massachusetts campus may be eligible to transfer under the MassTransfer (http://www.mass.edu/masstransfer/) agreement, which provides transfer advantages to those who qualify.

Special Requirements

Technical standards must be met with or without accommodations.

PROGRAM STUDENT LEARNING OUTCOMES FOR ENPH

Upon graduation from this program, students shall have the ability to:

- Formulate clear and precise questions about complex problems and ideas relevant to a variety of disciplines — math, science, the humanities, and the social sciences — and gather, assess, and interpret information to reach well-reasoned conclusions and solutions.
- Demonstrate an understanding of complex written texts that demand an appreciation of subtext, irony, metaphor, and the subtlety and nuances of language.
- Successfully complete a substantial scientific research paper that demonstrates the ability to formulate a research question, conduct research using the library’s databases, and synthesize information from a variety of sources into a cohesive and in-depth analysis of a topic.
- Demonstrate knowledge of important ideas and events that have shaped, and continue to shape, their world.
- Demonstrate scientific literacy, which can be defined as the matrix of knowledge needed to understand enough about the universe to deal with issues that come across the horizon of the average citizen, in the news or elsewhere.
- Demonstrate the ability to collect, record and organize scientific data correctly.
- Demonstrate the ability to work safely in a laboratory environment.
- Demonstrate the ability to manipulate and use scientific tools, such as the microscope, pH meter, measurement tools, glassware and other scientific instrumentation. This would include independently conducting an experiment using written directions such as lab manuals or Standard Operating Procedures as a guide.
- Demonstrate the ability to use mathematical tools as applied to science. This could include building and interpreting graphs, using equations and formulas to solve problems, and fitting data to a mathematical model.
- Demonstrate the ability to search scientific literature and use the information.
- Successfully transfer to a baccalaureate degree-granting institution if desired, with the proper educational foundation for transition into a chosen field of study.

TECHNICAL STANDARDS FOR EPHY [1]

1 For general information about technical standards and accommodation, see Technical Standards. (http://catalog.mwcc.edu/academicresources/academicandgradingpolicies/technicalstandards/)

Students entering this program must be able to demonstrate the ability to:

- Comprehend textbook material at a college level.
- Communicate and assimilate information either in spoken, printed, signed, or computer voice format.
- Gather, analyze, and draw conclusions from data.
- Differentiate by touch: hotness/coldness, wetness/dryness, and hardness/softness.
- Use the small muscle dexterity necessary to do such tasks as gloving, gowning, and operating controls on laboratory instrumentation.
- Respond promptly to spoken words, as well as monitor signals and instrument alarms.
- Identify behaviors that would endanger a person’s life or safety and intervene quickly in a crisis situation with an appropriate solution.
- Remain calm, rational, decisive, and in control at all times, especially during emergency situations.

- Manipulate small parts, and make fine hand adjustments to machines and test equipment.
- Operate a computer.

PHY 101. Introduction To Physical Science. 4 Credits.
This course will provide the non-science major with a basic background in physics and chemistry that affects everyone's life. Fundamental concepts of force, motion, energy, and chemistry are covered. Laboratory work complements the classroom presentation. Prerequisites: ENG 098, FYE 101, MAT 092 or MAT 096, RDG 098, or placement.

PHY 103. Physics of Light and Sound. 4 Credits.
The study of light and sound as applied to visual and auditory mediums. The study of vision, light in nature, photography, and artistic media and the study of hearing, musical sound, musical instruments, and room acoustics are included. Laboratory work complements the classroom presentation. Three hours lecture and two hours lab per week. Prerequisites: ENG 098, FYE 101, MAT 092 or MAT 096, RDG 098, or placement.

PHY 105. College Physics I. 4 Credits.
This course is designed to give students an appreciation of the progress that has been made in understanding the basic nature of the universe. Topics considered include vectors, statics, force and motion, kinematics in one and two dimensions, dynamics, work and energy, impulse and momentum, and conservation of energy. Lab work is correlated with class discussions. Prerequisites: ENG 098, FYE 101, MAT 162 (or corequisite), RDG 098, or placement.

PHY 106. College Physics II. 4 Credits.
This course is a continuation of PHY 105. Topics to be covered include rotation, elasticity, fluid mechanics, temperature and heat transfer, electricity and electric circuits, waves and acoustic phenomena. Lab work is correlated with class discussions. Prerequisite: PHY 105. Spring.

PHY 120. Physics for Engineering and Science I. 4 Credits.
This course is designed provide the student with a clear and logical presentation of the basic concepts and principles of physics, to strengthen an understanding of the concepts and principles through a broad range of interesting real-world applications, and to develop strong problem solving skills through an effectively organized approach. Topics considered include measurement, vectors, statics, force and motion, kinematics in one and two dimensions, dynamics, circular motion, work and energy, impulse and momentum, and conservation of energy. Lab work is correlated with class discussions. Prerequisite: MAT 211 with a C or higher (or corequisite).

PHY 121. Physics for Engineering and Science II. 4 Credits.
This course is designed to provide the student with a clear and logical presentation of the basic concepts and principles of physics, to strengthen an understanding of the concepts and principles through a broad range of interesting real-world applications, and to develop strong problem solving skills through an effectively organized approach. Topics considered include the principles of simple harmonic motion, wave motion, sound, geometric optics, wave nature of light, charge, coulomb force, electric field and flux, Gauss' law, electric potential, voltage, resistance, current, DC circuits, Kirchoff's Laws, capacitance, RC time constant, magnetic field and flux, Faraday's Law, Lens' Law, Ampere's Law, Electromagnetic induction, electromagnetic waves, and Maxwell's equations. This course is intended to serve students who plan to major in science or engineering at the four-year college level. Laboratory work is correlated to the classroom presentations. Prerequisite: PHY 120 with a C or higher; MAT 212 with a C or higher (or corequisite). Spring.

PHY 201. Mechanics I: Statics. 3 Credits.
This course explores a vector treatment of equilibrium of particles and rigid bodies. Forces, moments, couples, equations of equilibrium, free-body diagrams, constraints, structures, machines, friction, and centroids. Distributed forces, shear and bending moment diagrams and virtual work. Prerequisites: MAT 212 and PHY 120.

PHY 202. Mechanics II: Dynamics. 3 Credits.
This course explores a vector treatment of dynamics. Kinematics of a particle in two dimensions. Dynamics of a particle; momentum, moment of momentum, and work-energy. Rigid bodies in plane motion; kinematics and dynamics. Relative motion. Work and energy methods; impulse and momentum; Vibrations. Prerequisites: MAT 211 and PHY 201.

PHY 210. Modern Physics. 3 Credits.
An introduction to the pivotal ideas and developments of twentieth-century physics. Topics include: special theory of relativity, experimental basis of quantum theory, photoelectric effect, X-rays, Compton scattering, blackbody radiation, wave properties of matter, DeBroglie waves, uncertainty principle, Bohr theory of the atom, atomic nuclei, nuclear interactions, radioactivity, and elementary particles. Prerequisite: PHY 121.

PHY 221. Circuit Theory 1. 4 Credits.
Terminal characteristics of ideal elements, active and passive. Ohm's law and Kirchhoff's Laws. Equivalent resistance, voltage division, current division. Introduction to network topology, independent variables, mesh and nodal analysis with matrix methods. Definition and consequences of linearity. Superposition theorem. Concept of excitation and response. Passive equivalent circuits;

active equivalent circuits. Thevenin's and Norton's theorems. Ideal inductance and capacitance, volt-ampere characteristics, energy relations. First-order transients: initial conditions, natural response, and natural frequencies. Network response to unit step function and unit impulse. Second-order transients: RLC circuits, natural frequencies and the complex-frequency s-plane. Introduction to matrices and their use in circuit analysis. Prerequisites: PHY 121; MAT 220 (or corequisite).

PHY 222. Circuit Theory 2. 4 Credits.
This is the second engineering course in basic circuit theory and design. Analysis techniques in this course include application of Laplace transforms and differential equations with initial conditions to provide solutions to switched and steady state multi-ordered circuits. Circuit stability, the understanding of poles/zeros, and the use of Fourier transforms are also covered to introduce the student to circuit frequency response and Bode plot analysis and specification. Students are also introduced to graphical convolution and Fourier series as it applies to circuit analysis. Assignments and lab project activities require the design, implementation, and measurement of filters and other circuits to meet design specifications. Extensive lab work along with various circuit simulations. Prerequisites: PHY 221 with C or better.

PHY 242. Thermodynamics. 3 Credits.
The first and second laws of thermodynamics are introduced and applied to the analysis of thermodynamic systems in terms of work, heat, energy transformation, and system efficiency. The use of tables, graphs, and equations of state is introduced to obtain various properties of pure substances. The concepts of work, heat and energy, as well as their relationships, are studied. The theory and application of reversible and irreversible thermodynamic process, Carnot cycles, and entropy are studied in relation to the energy analysis of engineering systems. Energy balances and ideal efficiencies of steady flow engineering systems are analyzed. Prerequisites: CHE 107, PHY 121, MAT 212.

PHY 269. Physics for Engineering and Science III. 4 Credits.
Statics and dynamics of fluids, pressure, viscosity, Archimedes and Bernoulli principles, mechanical properties of solids, stress and strain, shear, electric and magnetic properties of materials, para- dia- and ferromagnetism, electro-mechanical and magneto-mechanical effects, hysteresis, advanced topics in waves and vibrations, damping, resonance in mechanical and AC oscillators, thermodynamics, Maxwell's velocity distribution, blackbody radiation, and the limits of classical physics, introduction to special relativity. Prerequisites: PHY 121.