Physics

Physics is a broad and complex field that uses mathematical models of nature to explain the nature and behavior of all manner of physical systems from the smallest particles inside the nucleus to the entire universe in which we live.

The Department of Physics and Materials Science has an expert faculty that reflects the diversity of opportunities available within the discipline. Research areas currently being investigated include astrophysics, solar physics, biomaterials, nanoscience, condensed matter physics, applications of fractional calculus, and molecular computing. The department prides itself on the individual attention it gives its majors. Your academic and research advisors will work with you to design a curriculum and research program that will meet your needs today and tomorrow.

Many jobs require problem solving skills, including those in Engineering, Law, and Business. Opportunities include research physics, electro-optic engineering, patent law, and radiation protection administration. Physics is a large and versatile field that can extend to academia, industry, and/or government.

What does a typical selection of upper-level courses look like?

After you’ve completed introductory courses and labs in general and classical physics and in astronomy, you can explore topics such as:

- Theoretical Physics
- Medical Physics
- Biophysics
- Astrophysics
- Environmental Physics
- Electricity and Magnetism
- Mechanics
- Optics
- Thermodynamics
- Solid State Physics
- Quantum Theory
- Materials Science

What other opportunities can you enjoy as a student in Physics?

- An excellent, experienced faculty who will treat you as an individual, not a number
- Undergraduate research experiences using state-of-the-art facilities under the guidance of world-class scholars
- Membership in the University of Memphis chapter of the Society of Physics Students and the national physics honor society, Sigma Pi Sigma
- The option of pursuing a special five-year program that gives you an undergraduate degree (B.S.) in Physics, followed by a graduate degree (M.S.) in either Physics or Biomedical Engineering
# PHYSICS
## SAMPLE FOUR-YEAR PLAN

### Freshman Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ENGL 1010</td>
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</tr>
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</tr>
<tr>
<td>PHYS 2110/2111</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1110/1111</td>
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<td>PHYS 2120/2121</td>
<td>4</td>
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<tr>
<td>CHEM 1120/1121</td>
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</table>

**Semester Totals**  
15 hrs.  
15 hrs.

### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>PHYS 2130</td>
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<tr>
<td>MATH 2110</td>
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</tr>
<tr>
<td>COMM 2381</td>
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<td>PHYS 2990</td>
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<td>Elective</td>
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<tr>
<td>PHYS 3011</td>
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<tr>
<td>MATH 2120</td>
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<td>PHYS 3010</td>
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<tr>
<td>GE Social/Behavioral Science</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
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</table>

**Semester Totals**  
15 hrs.  
15 hrs.

### Junior Year

<table>
<thead>
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<th>Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PHYS 3111</td>
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<td>PHYS 3060</td>
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<td>PHYS 3990</td>
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<td>ENGL 2201 or 2202</td>
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<td>GE History</td>
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<td>UD Elective</td>
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<td>PHYS 3211</td>
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<tr>
<td>PHYS 4420</td>
<td>3</td>
</tr>
<tr>
<td>GE Humanities/Fine Arts</td>
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<tr>
<td>GE History</td>
<td>3</td>
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<tr>
<td>GE Social/Behavioral Science</td>
<td>3</td>
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</tbody>
</table>

**Semester Totals**  
15 hrs.  
15 hrs.

### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PHYS 4410</td>
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<td>PHYS 4211</td>
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<tr>
<td>UD PHYS</td>
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<td>Elective</td>
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<tr>
<td>PHYS 4510</td>
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<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

**Semester Totals**  
15 hrs.  
15 hrs.

GE = General Education Requirements  
BS = Bachelor of Science college requirements  
UD = Upper division

Foreign Language Requirement – See the Undergraduate Catalog: [http://catalog.memphis.edu](http://catalog.memphis.edu)

Degree hours = 120  
42 Upper Division hours required for graduation

No more than 2 hours of physical education courses may be counted toward a degree.

Residence – 30 of the last 60 hours must be taken at University of Memphis; at least 60 hours must be at a four-year institution; transfer students must earn at least 6 hours of a major at UM and at least 3 hours of a minor at UM
**PHYSICS COURSE DESCRIPTIONS**

**PHYS 1001 - Introductory Physics Lab.** Laboratory experiments and techniques to accompany PHYS 1010.

**PHYS 1002 - Astronomy Laboratory.** Laboratory experiments and techniques to accompany PHYS 1020.

**PHYS 1010 - Introductory Physics.** Phenomenological introduction to physics for non-technical students.

**PHYS 1020 - Survey of Astronomy I.** Concepts of motion, energy, momentum, gravity, and light, formation of our solar system.

**PHYS 1030 – Survey of Astronomy II.** Our Sun and other stars, star properties, star life cycle, our galaxy and other galaxies, the birth of the universe, dark matter, dark energy, and fate of the universe, life in the universe and other topics.

**PHYS 1031 – Survey of Astronomy II lab.**

**PHYS 1040 - Intro to Careers in Physics. (1) Overview of careers in physics, research opportunities.**

**PHYS 2010 - General Physics I/Trig.** Mechanics, heat, and sound.

**PHYS 2011 - General Physics Lab I.** Laboratory experiments and techniques to accompany PHYS 2110.

**PHYS 2020 - General Physics II/Trig.** Magnetism, electricity, light, and modern physics.

**PHYS 2021 - Gen Phys Lab II.** Laboratory experiments and techniques to accompany PHYS 2020.


**PHYS 2111 - Sci/Engr Phys Lab I.** Laboratory experiments and techniques to accompany PHYS 2110.


**PHYS 2121 - Sci/Engr Phys Lab II.** Laboratory experiments and techniques to accompany PHYS 2120.

**PHYS 2130 - Intermediate Physics. (4).** General areas of fluids static and dynamics, heat, mechanical and electrical oscillations.

**PHYS 2990 - Research in Physics I.** Introduction to research in physics.

**PHYS 3010 - Intro Modern Physics.** Special relativity; experimental origin of quantum theory; atomic structure and spectral lines; matter-wave duality; Schroedinger equation; particle in a rigid box; electron spin; structure of atomic nuclei.

**PHYS 3011 - Methods of Theoretical Phys I.** Infinite series, complex variables, linear algebra, vector analysis, Fourier series, and calculus of variations.

**PHYS 3012 - Methods of Theoretical Phys II.** Continuation of PHYS 3011.

**PHYS 3111 - Mechanics I.** Newtonian mechanics, harmonic motion, gravitation, fluid mechanics, Lagrangian and Hamiltonian mechanics.

**PHYS 3211 - Electricity/Magnetism I.** Electric fields and potentials, capacitance, dielectric materials, magnetic fields, magnetic properties of materials, electromagnetic induction, inductance, Maxwell's equations, and electromagnetic waves.

**PHYS 3050/3051 – Intermediate Astronomy and Lab.**

**PHYS 3060 - Advanced Physics Methodology.** Advanced fundamental experiments in physics.

**PHYS 3990. Research in Physics II.** Laboratory safety; MATLAB and tools of data analysis.

**PHYS 4020 - Soft Matter/Biological Physics.** Random walks, diffusion, entropic forces, colloidal suspensions, polymers, self-assemblies, lipid membranes, transitions in biomolecules, molecular machines in biomembranes.

**PHYS 4021 - Applied Radiation Physics.** Applied radiation and radioactivity; types of radiation, radiation measurement interaction with matter, and biological effects; radiation safety aspects emphasized.

**PHYS 4040 - Medical Physics.** Physics of sensory, respiratory, and circulatory systems.

**PHYS 4050 - Astrophysics I.** Principles of physics applied to the solar system, stars, light, telescopes.

**PHYS 4051 - Astrophysics II.** Principles of physics applied to star birth and death, black holes, neutron stars, galaxies, quasars, beginning and evolution of the universe.

**PHYS 4110 - Nuclear and Particle Physics.** Properties of atomic nuclei, radioactive transitions, alpha, beta, and gamma decay.

**PHYS 4112 - Mechanics II.** Hamilton's principle and Lagrangian/Hamiltonian dynamics, central force motion.

**PHYS 4211 - Waves and Optics.** Mathematical description of vibrations and waves.

**PHYS 4212 - Electric/Magnetism II.** Continuation of PHYS 3211.

**PHYS 4222 - Environmental Physics.** Application of gas laws, transport laws, and heat transfer in environmental processes; environmental radiation (solar and terrestrial), energy system of atmosphere and hydrosphere.

**PHYS 4230 – Electronics.** Theory and application of electronic devices; emphasis on scientific instrumentation.

**PHYS 4300 – Advanced Topics in Astronomy.**

**PHYS 4410 - Intro Quantum Theory.** Historical background of quantum theory.

**PHYS 4510 - Thermal and Statistical Phys.** Introduction to thermodynamics and statistical mechanics.

**PHYS 4610 - Solid State Physics.** Crystal structures, crystal bonding, x-ray diffraction, lattice vibrations and phonons, free and nearly-free electron models, energy bands of insulators, metals, and semiconductors.

**PHYS 4620 – Device Physics and Microfabrication.** Semiconductor devices and microfabrication; crystal properties and growth of semiconductors, energy bands and charge carriers, p-n junction, field-effect transistors.

**PHYS 4720 - Materials Physics.** Basic concepts in materials science emphasizing relationships between microscopic structure and properties.

**PHYS 4820 - Materials Physics Lab.** Synthesis of various materials and characterizations of their structure and properties.

**PHYS 4910 – Seminar.** Students enrolled in this course are required to attend all weekly seminars in the Physics Department.

**PHYS 4911 - Senior Honors Seminar.** Special projects, reports and investigation of current literature and research.

**PHYS 4914 - Research Methods/Tigers Teach.** Fundamental notions of scientific inquiry for students interested in teaching.

**PHYS 4990 - Research in Physics III.** Original experimental, theoretical, or computational research work.

**PHYS 4991 - Honors Research/Phys I.** Original scholarly work in physics under the direction of honors research advisor.

**PHYS 4992 - Honors Research/Phys II.** Completion of original scholarly work.

**PHYS 4994 - Research in Materials Physics.** Original experimental, computational or theoretical research.

**PHYS 4999 - Senior Honors Thesis.** Directed reading and background research culminating in a senior thesis.

*Please consult the Undergraduate Catalog at http://catalog.memphis.edu for complete descriptions.*
PHYSICS PROGRAM REQUIREMENTS

A. University General Education Program (41 hours)
See the Undergraduate Catalog for the University General Education Program requirements.
Note the following requirements specified for the Physics major: Mathematics - MATH 1910; Natural Science - CHEM 1110/1111, 1120/1121.

B. The Major: (59-66 hours in addition to University General Education Program)
1. Physics Core: (25 hours): Completion of PHYS 2110/2111, 2120/2121 (PHYS 2010/2011, 2020/2021 are acceptable, but not recommended), 2130, 3010, 3011, 3211, 4510, CHEM 1110/1111, 1120/1121 (the CHEM courses are included in the University General Education Program requirements); MATH 1920, 2110, 2120, or equivalent courses.
2. Concentrations:
a) General Physics (21 hours): PHYS 2990, 3060, 3990, 4211, 4410, 4420, plus six (6) hours of upper division PHYS courses.
b) Materials Science (21 hours): PHYS 2990, 3990, 4410, 4610, 4720, 4820, 4994, plus one of PHYS 4020, 4230, 4420, 4620, MECH 3320 or MECH/CIVL 3322.
c) Astronomy (20 hours): PHYS 3050, 3051, 4050, 4051, 4222, 4230, 4300.
d) Physics for Medical Sciences (25 hours): BIOL 1110, 1111, 1120, 1121, 3130; CHEM 3301, 3310, 3501, 3511, 4511; PHYS 4040.

D. Electives: Electives may be chosen to bring the total number of hours to 120.

E. Dual-Degree Programs
Highly motivated and talented students may pursue an undergraduate degree (B.S.) in Physics followed by a graduate (M.S.) in either Physics or Biomedical Engineering in a special five-year program. This option requires serious commitment, careful planning with the student's advisor, and summer research work leading toward a Master's thesis. Students interested in pursuing this option should contact an undergraduate advisor in the Physics and Materials Science department.

F. Second Major (26-27 hours)
MATH 1910 (4)/ 1720 (3)/1730 (4)/1830 (3)
PHYS 2010/2011 or 2110/2111 (4)
PHYS 2020/2021 or 2120/2121 (4)
PHYS 3010 (3)
6 UD in PHYS (6)*
6 UD in PHYS or student’s major (6)*
*As approved by Physics Chair or advisor

Physics Minor: Completion of 20 semester hours in physics courses, including PHYS 2110/2111, 2120/2121 (PHYS 2010/2011, 2020/2021 are acceptable but not recommended), and 12 additional upper division hours.

Honors Program: This program is open to physics majors who maintain a grade point average of at least 3.25, both overall and in physics, have achieved junior standing, and have completed PHYS 3060. Students admitted to the honors program must complete 8 hours of upper-division physics honors courses: (1) PHYS 4991/4992 Honors Research in Physics; (2) PHYS 4999 Senior Honors Thesis; (3) PHYS 4911 Senior Honors Seminar.

Accelerated B.S./M.S. Program in Physics: This program allows outstanding undergraduates to begin the coursework for the Master of Science in Physics during their senior year. Students must have a minimum 3.25 grade point average and must submit two reference letters and a copy of their transcript to the Department of Physics and Materials Science.

For more information, please contact:

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http://www.memphis.edu/physics
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Chair: Dr. Jingbiao Ciu

Undergraduate Advisor: Dr. Mohamed Laradji
901-678-1676
mlaradji@memphis.edu

The University of Memphis
http://www.memphis.edu

The College of Arts and Sciences
http://www.memphis.edu/cas

UM Career Services: http://www.memphis.edu/careerservices

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