Physics—Professional Emphasis

### Freshman Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 1371 Calculus I (placement into course, or pre-req) 4</td>
<td>Math 1372 Calculus II (1371) 4</td>
</tr>
<tr>
<td>Phys 1301W Intro Physics I (&amp;Math 1371) 4</td>
<td>Phys 1302W Intro Physics II (1301, &amp; Math 1372) 4</td>
</tr>
<tr>
<td>CSE 1001 1st Yr Experience 1</td>
<td>Liberal Education course 3/4</td>
</tr>
<tr>
<td>Liberal Education course 3/4</td>
<td>Liberal Education course or Writ 1301 3/4</td>
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<tr>
<td>Liberal Education course or Writ 1301 3/4</td>
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</tbody>
</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>Math 2373 Lin Alg/ Diff Eq (1372) 4</td>
<td>Math 2374 Multivariable Calc (1372) 4</td>
</tr>
<tr>
<td>Phys 2503 Phys III: Waves, Optics (1302, Math 1372) 4</td>
<td>Phys 2601 Quantum Physics (2503, &amp;3605, &amp;Math 2373) 4</td>
</tr>
<tr>
<td>Phys 2201 Thermo &amp; Stat Phys (1302, Math 1372) 4</td>
<td>Phys 3041 Math for Physics* (1302, Math 2373) 3</td>
</tr>
<tr>
<td>Technical Elective I (recommend CSCI 1103/1113/1133) 3/4</td>
<td>Phys 3605W Modern Phys Lab previously 2605 (&amp;2503) 3</td>
</tr>
</tbody>
</table>

*Not required for students admitted prior to Fall 2017; recommend as UD Math Elective.

### Junior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>Phys 4001 Analytical Mech (2503 or 2601, 3041, Math 2374) 4</td>
<td>Phys 4002 Elect &amp; Magnetism (2503 or 2601, 3041, Math 2374) 4</td>
</tr>
<tr>
<td>Phys 4051 Experimental Phys I (1605 or equiv lab exp or instr consent) 5</td>
<td>Phys 4052W Experimental Phys II (4051) 5</td>
</tr>
<tr>
<td>Technical Elective II 4</td>
<td>Technical Elective III 4</td>
</tr>
<tr>
<td>Liberal Education course 3/4</td>
<td>Liberal Education course 3/4</td>
</tr>
</tbody>
</table>

### Senior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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</thead>
<tbody>
<tr>
<td>Phys 4101 Quantum Mech (2503 or 2601 or Chem 4301 or 4502) 4</td>
<td>Technical Elective IV 3/4</td>
</tr>
<tr>
<td>Phys 4201 Stat Therm Phys (2601) 3</td>
<td>UD Physics Elective 3/4</td>
</tr>
<tr>
<td>Phys 4303 Electrodynamics (4002) 3</td>
<td>Open Elective (If needed to reach 120 credits) 3/4</td>
</tr>
<tr>
<td>Open Elective (If needed to reach 120 credits) 3/4</td>
<td>Open Elective (If needed to reach 120 credits) 3/4</td>
</tr>
</tbody>
</table>

### About This Plan

- **This plan is not a contract. Curriculum can change. The APAS is the official method for tracking completion of University degree requirements.**
- **Shaded courses are only offered in the indicated semester.**
- **Course pre-requisites and co-requisites (designated by &) are listed below the course number and title.**
- **Students may take either the CSE-only or University-wide versions of math courses (Math 1371/1271, 1372/1272, 2373/2243, 2374/2263).**
- **Students applying to the major prior to Fall 2018 are eligible based on completion of either Math 2373 or Math 2374 (or equivalent).**

### Applying to your Major

**Students who have completed the required courses for admission to this major (indicated with double boxes on plan) and have a 3.2 UM-TC technical GPA at the end of the fall semester will be guaranteed admission. All other students who have completed the required courses will be considered for admission on a space-available basis. Admission following the spring semester is only based on space availability. The major application database is available at z.umn.edu/csemajorapp.**

**Total Credits Needed for Degree: 120**

### Department Contact Information

- **Website:** www.physics.umn.edu/undergrad/
- **Main Phone:** 612-624-7375
- **Main Office:** Tate Hall
- **Director of Undergraduate Studies:** Jeremy Mans
- **Departmental Contact:** physics@umn.edu

### University Degree Requirements

All students must complete the following Writing & Liberal Education requirements, as noted on their APAS report.

See link for full Core & Theme names: z.umn.edu/liberaleducation

#### Writing Requirements:

**Freshman Writing:**
Writ 1301/1401 or equivalent

**Writing Intensive (WI):**
Two: 1xxx or 2xxx level **
One: 3/4/5xxx level (in major)*
One: 3/4/5xxx level (any dept.*)

Requirements with an (*) will be fulfilled by taking courses at UM-TC required for this major.

#### Liberal Education

<table>
<thead>
<tr>
<th>CORES:</th>
<th>THEMES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio</td>
<td>4 of 5:</td>
</tr>
<tr>
<td>Phy</td>
<td>Civ</td>
</tr>
<tr>
<td>Soc</td>
<td>DSI</td>
</tr>
<tr>
<td>Ltr</td>
<td>Env</td>
</tr>
<tr>
<td>AH</td>
<td>GP</td>
</tr>
<tr>
<td>Mth</td>
<td>TS</td>
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</tbody>
</table>
What can I do with a major in...

Physics

ACTIVITIES PHYSICS MAJORS DO:

Physicists explore and identify the basic principles governing the structure and behavior of matter, the generation and transfer of energy, and the interaction of matter and energy. Some physicists use these principles in theoretical areas such as the nature of time and the origin of the universe. Others work in more practical areas such as the development of materials, electronic or optical devices, and medical equipment. Physicists design and perform experiments with lasers, cyclotrons, telescopes, mass spectrometers, and other equipment. For instance, lasers are used in surgery, microwave devices function in ovens, and measuring instruments can analyze blood or the chemical content of foods. Physicists also find ways to apply mathematics and physical laws and theories to problems in nuclear energy, electronics, optics, materials, communications, aerospace technology, navigation equipment, and medical instrumentation. Many physicists work in research and development. Some do basic research to increase scientific knowledge or applied research to build on basic knowledge. For example, knowledge gained through basic research in solid-state physics led to the development of transistors and then integrated circuits used in computers. A small number of physicists work in inspection, testing, quality control, and other production-related jobs in industry. Physicists generally specialize in one of the following areas: acoustics, astronomy, astrophysics, atmospheric physics, biophysics, chemical physics, cryogenics, electromagnetism, energy, environmental physics, fluid mechanics, geophysics, medical physics, metallurgy, nuclear physics, optical physics, plasma physics, rheology, solid state physics, or vacuum physics. Research in physics often requires a Ph.D.

INDUSTRIES PHYSICS MAJORS WORK IN (SAMPLE LISTING):

- Petroleum/mining
- Telecommunications
- Government agencies
- Consulting
- Engineering consulting
- Research and development
- Observatories
- Automotive
- Optics/electronics
- Nuclear plants
- Information technology
- Materials supply
- Educational institutions
- Biomedical
- Aerospace/aeronautical
- Aerospace/aeronautical

EMPLOYERS WHO HIRE PHYSICS MAJORS (SAMPLE LISTING):

- 3M
- Alliant Techsystems
- Applied Materials
- D.E. Shaw Research
- Bose Corporation
- Epic
- ExxonMobil
- Starkey Hearing Technologies
- Graco Inc.
- Intel Corporation
- General Electric
- NAVAIR Weapons Division
- NASA
- Black River Systems Co.
- Seagate Technology
- MIT Lincoln Laboratory
- IBM
- Microsoft Corporation
- Schlumberger
- Garmin International
- Polar Semiconductor, LLC
- LasX Industries Inc.
- John Hopkins Applied Phys. Lab

TYPES OF POSITIONS FOR PHYSICS MAJORS (SAMPLE LISTING):

- **Physical scientist**: Conducts research, testing, evaluation, and analysis related to the identification and evaluation of products and features such as counterfeit deterrent security features for Federal Reserve Notes. Specifically, physical scientists advise on and administer scientific work in the investigation and application of optical/light principles.

- **Field test engineer**: Performs electro-optical (EO) or infrared (IR) measurements, both on site and at field test sites as part of a small team. Field test engineers develop/upgrade instrumentation and software for control and analysis, document test procedures and experimental setups, and analyze and document the results of the tests and measurements.

- **Thin film deposition engineer**: Conducts product development on thin film deposition using vacuum systems. Duties include operation and maintenance of a vacuum system; designing and constructing part of the system as needed; analysis of the deposited thin film; and designing of experiments, analyzing results, and reporting.

- **Rheologists**: Applies physics to the study of the deformation and flow of matter. For instance, rheologists apply the principles behind the observation in the differences in the flow of ketchup from a bottle before and after shaking the bottle.

**Some of these positions may require an advanced degree.**