September 24, 2013

The Astronomy Curriculum Committee within the Department of Physics & Astronomy is proposing the creation of a new sophomore-level course, ASTR 231 - Introduction to Astrophysics, to bridge the gap between Introductory Physics (PHYS 111 & 112) and upper-level astrophysics courses (such as ASTR 306, 311, 312, and 377). This new course will be offered every year and serve as the main prerequisite for all upper-level astrophysics classes.

In order to keep the total number of hours required for both the Astrophysics B.S. and Astronomy B.A. degrees the same, we have modified the requirements of both degrees. ASTR 231 will now be required in both cases. However, for the Astrophysics B.S., instead of requiring students to take all 3 of ASTR 306, 311, and 312, they will now only be required to take 2 upper-level ASTR electives (from 306, 311, 312, 413 or PHYS 412 when astrophysics related). Similarly, for the Astronomy B.A., students will no longer be required to take either ASTR 306 or 311, as they have in the past. The new course will also count as one of the core-course options within the Astronomy Minor, replacing ASTR 306/311 in this role.

Note that I am using the proposed new number for Planetary Astronomy, ASTR 306, instead of the old ASTR 206. Our motivation for this change is that since Planetary Astronomy no longer needs to be offered as a sophomore-level course; it can now be made more rigorous, on par with ASTR 311 and 312.

The proposed changes should greatly benefit the students. First, they eliminate the difficulties faced by students who came in during “odd” years under the old program; these students either had to wait until their junior year to take any of their astrophysics courses, or else start as freshmen, when they were not well prepared. Second, the new course should provide a strong, common foundation for all upper-level astrophysics classes, something that has been missing up to this point. Furthermore, the new curriculum provides greater flexibility for students to be able to choose their astrophysics electives and take them when they are offered (instead of in a prescribed order).

There is some overall cost to the department in the sense that, because ASTR 231 will be offered every year, the teaching load for the astronomy and astrophysics degree programs will increase by 3 contact hours each year. However, it is anticipated that this extra load can be absorbed by either offering fewer special topics courses (such as General Relativity, which was offered in Spring 2013) or by shifting some of the teaching load for common courses like Thermal Physics and Fluid Dynamics to our new Atmospheric Physics faculty.

Regards,
P. Chris Fragile
Associate Professor
FACULTY CURRICULUM COMMITTEE
CHANGE/DELETE PROGRAM FORM

Instructions:

- Please fill out all of the portions of the form that are specified in section B. **You must do this before your request can move forward!**
- Remember that your changes will not be implemented until the next catalog year at the earliest.
- If you have questions, please start by checking the detailed instructions on the website.
- Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: P. Chris Fragile                      Phone: 953-3181               Email: fragilep@cofc.edu

School: SSM                                  Department or Program: Physics & Astronomy

Name and Acronym of Major: Astronomy (ASTR) B.A.

B. CATEGORY OF REVIEW. Please check all that apply, then fill out the specified parts of the form.

- [X] Change Request (fill out all sections)
  - [ ] Add an existing course to requirements or electives
  - [ ] Add a new course to requirements or electives (attach completed course form for each)
  - [ ] Delete courses from requirements or electives
  - [ ] Add or modify concentration*
  - [ ] Add or modify cognate*

  *Note: Only concentrations and cognates requiring 18 or more credit hours will be tracked in Banner and Degree Works and noted on the transcript.

- [ ] Terminate Program (fill out E, G, H, and I)
  - [ ] Terminate degree
  - [ ] Terminate major
  - [ ] Terminate concentration
  - [ ] Terminate cognate

C. GENERAL INFORMATION

Number of Current Credit Hours (for existing program): ___42+________
Number of Proposed Credit Hours (for changed program): ___42+________
Catalog Year in which changes will take effect: FALL _2014________

D. CURRICULUM. Please list every change you are making below AND attach the current Program of Study Worksheet for this major (https://registrar.cofc.edu/program-of-study-worksheets/index.php) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions. Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee's Course Form and a sample syllabus.
1. A new course, ASTR 231 Introduction to Astrophysics, is being created; its prerequisite will be PHYS 112. This course will now be a required component of the Astronomy B.A. It will also be one of the required prerequisites for most of the upper-level astrophysics courses.

2. In order to keep the total number of credit hours the same, students will no longer be required to take ASTR 306 or 311. However, these will remain on the list of recommended electives for the degree. Students will also no longer be required to take these courses in sequence; they can be taken in any order and any combination.

3. We also noticed that ASTR 410 is not listed as an approved elective for the Astronomy B.A. This was simply an oversight from when that course was created.

E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it.

The Astronomy Curriculum Committee within the Physics & Astronomy Department has decided that our department needs to add a “bridge” course within the Astronomy and Astrophysics degree program. This assessment is based on evidence from 4 years of offering our Astronomy B.A. and Astrophysics B.S. degrees. Without this bridge course, too much time in our upper division classes has been spent on introductory astrophysics material. We also have the problem that, with no regularly recurring astrophysics offering, students who come in during “odd” years do not have an astrophysics course available that they can take in their sophomore year. This has led many students to try to force their way through the curriculum earlier than intended, and consequently struggle. The proposed course is intended address all of these program deficiencies.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
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<tbody>
<tr>
<td>What will students know and be able to do when they complete the major or program?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1. Students are able to answer general questions in the field of astronomy.</td>
<td>All students will be assessed in ASTR 231, the main required course in the Astronomy B.A. Questions on the final exam will be used to assess student performance.</td>
</tr>
<tr>
<td>2. Students use critical thinking and apply astronomy-related knowledge to solve problems.</td>
<td>All students will be assessed in ASTR 377. This is a research-based experience, where students must apply knowledge to design and execute experiments. Students will be assessed using their project reports.</td>
</tr>
<tr>
<td>3. Students effectively communicate in scientific discussions and presentations.</td>
<td>All students will be assessed in PHYS 420 or 499, which are required capstone research courses. Final reports, gathered at the end of each semester, will be used to assess student performance.</td>
</tr>
</tbody>
</table>
G. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a program, please describe the effect on all programs that will be impacted; if you are adding or changing a program, please explain any overlap with existing programs at the College.

This change should have relatively minor impacts on other programs and courses. About the only consequence we foresee is perhaps slightly lower enrollment in ASTR 306, Planetary Astronomy. If that comes to pass, that would actually be a good thing since ASTR 306 has been overcrowded in recent years.

H. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings (including new faculty/staff requests, library, or equipment) associated with your request.

None.

I. CHECKLIST

☒ I have completed all relevant parts of the form.

☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.

☒ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☒ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the description and course list, exactly as it should appear in the catalog.

☒ I have submitted one Signature Form that lists all of the different forms I am submitting.
FACULTY CURRICULUM COMMITTEE
CHANGE/DELETE PROGRAM FORM

Instructions:
• Please fill out all of the portions of the form that are specified in section B. You must do this before your request can move forward!
• Remember that your changes will not be implemented until the next catalog year at the earliest.
• If you have questions, please start by checking the detailed instructions on the website.
• Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: P. Chris Fragile  Phone: 953-3181  Email: fragilep@cofc.edu

School: SSM  Department or Program: Physics & Astronomy

Name and Acronym of Major: Astrophysics (ASTR) B.S.

B. CATEGORY OF REVIEW. Please check all that apply, then fill out the specified parts of the form.

☒ Change Request (fill out all sections)
☐ Add an existing course to requirements or electives
☒ Add a new course to requirements or electives (attach completed course form for each)
☐ Delete courses from requirements or electives
☐ Add or modify concentration*
☐ Add or modify cognate*

*Note: Only concentrations and cognates requiring 18 or more credit hours will be tracked in Banner and Degree Works and noted on the transcript.

☐ Terminate Program (fill out E, G, H, and I)
☐ Terminate degree
☐ Terminate major
☐ Terminate concentration
☐ Terminate cognate

C. GENERAL INFORMATION

Number of Current Credit Hours (for existing program): ___58+_______
Number of Proposed Credit Hours (for changed program): ___58+_______
Catalog Year in which changes will take effect: FALL _2014_______

D. CURRICULUM. Please list every change you are making below AND attach the current Program of Study Worksheet for this major (https://registrar.cofc.edu/program-of-study-worksheets/index.php) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, corequisites, sequencing, or other restrictions. Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee's Course Form and a sample syllabus.
1. A new course, ASTR 231 Introduction to Astrophysics, is being created; its prerequisite will be PHYS 112. This course will now be a required component of the Astrophysics B.S. It will also be one of the required prerequisites for most of the upper-level astrophysics courses.

2. In order to keep the total number of credit hours the same, students will no longer be required to take ASTR 306, 311, and 312. Instead, they will only be required to take 2 upper-level ASTR electives (from 306, 311, 312, 413 or PHYS 412, when astrophysics related). They will also no longer be required to take these courses in sequence; they can be taken in any order and any combination.

E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it.

The Astronomy Curriculum Committee within the Physics & Astronomy Department has decided that our department needs to add a “bridge” course within the Astrophysics degree program. This assessment is based on evidence from 4 years of offering our Astrophysics B.S. degree. Without this bridge course, too much time in our upper division classes has been spent on introductory astrophysics material. We also have the problem that, with no regularly recurring astrophysics offering, students who come in during “odd” years do not have an astrophysics course available that they can take in their sophomore year. This has led many students to try to force their way through the curriculum earlier than intended, and consequently struggle. The proposed course is intended address all of these program deficiencies.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<td>What will students know and be able to do when they complete the major or program?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1. Students apply classical and relativistic motion principles correctly in astrophysics problems.</td>
<td>All students will be assessed first in ASTR 231 using questions on tests and the final exam. Students will be assessed again in either ASTR 306 or 312. Again, test and final exam questions will be used.</td>
</tr>
<tr>
<td>2. Students are able to answer questions on the level of the Physics GRE.</td>
<td>This will be assessed among those students who take the GRE test-prep course. Assessment will be based upon student scores on practice GRE physics subject tests.</td>
</tr>
<tr>
<td>3. Students demonstrate competency in oral and written scientific communication.</td>
<td>This will be assessed first in ASTR 377 and then again in PHYS 420 or 499. Students will be assessed based upon their written reports and oral presentations.</td>
</tr>
<tr>
<td>4. Students apply a range of experimental and computational techniques to solve astrophysics-related problems.</td>
<td>This will be assessed first in ASTR 377 and then again in PHYS 420 or 499. Students will be assessed based upon their written reports.</td>
</tr>
</tbody>
</table>
G. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a program, please describe the effect on all programs that will be impacted; if you are adding or changing a program, please explain any overlap with existing programs at the College.

The addition of a 200-level bridge course in the Astrophysics B.S. degree program means that students will not qualify for the Physics B.S. simply by taking PHYS 370; they will be short one 300- or 400-level PHYS or ASTR course. However, the hope is that most Astrophysics B.S. students will still pursue the Physics B.S. by taking one additional course.

H. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings (including new faculty/staff requests, library, or equipment) associated with your request.

None.

I. CHECKLIST

☒ I have completed all relevant parts of the form.

☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.

☒ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☒ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the description and course list, exactly as it should appear in the catalog.

☒ I have submitted one Signature Form that lists all of the different forms I am submitting.
FACULTY CURRICULUM COMMITTEE
CHANGE/DELETE PROGRAM FORM

Instructions:
• Please fill out all of the portions of the form that are specified in section B. You must do this before your request can move forward!
• Remember that your changes will not be implemented until the next catalog year at the earliest.
• If you have questions, please start by checking the detailed instructions on the website.
• Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: P. Chris Fragile  Phone: 953-3181  Email: fragilep@cofc.edu
School: SSM  Department or Program: Physics & Astronomy

Name and Acronym of Major: Physics (PHYS)

B. CATEGORY OF REVIEW. Please check all that apply, then fill out the specified parts of the form.

☐ Change Request (fill out all sections)
   ☐ Add an existing course to requirements or electives
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   ☐ Add or modify concentration*
   ☐ Add or modify cognate*

*Note: Only concentrations and cognates requiring 18 or more credit hours will be tracked in Banner and Degree Works and noted on the transcript.

☐ Terminate Program (fill out E, G, H, and I)
   ☐ Terminate degree
   ☐ Terminate major
   ☐ Terminate concentration
   ☐ Terminate cognate

C. GENERAL INFORMATION

Number of Current Credit Hours (for existing program): ____58+_____
Number of Proposed Credit Hours (for changed program): ____58+_____
Catalog Year in which changes will take effect: FALL _2014_______

D. CURRICULUM. Please list every change you are making below AND attach the current Program of Study Worksheet for this major (http://registrar.cofc.edu/program-of-study-worksheets/index.php) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, corequisites, sequencing, or other restrictions. Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus.

One course that is listed as an elective for the Physics B.S. degree (ASTR 206) is changing its number to ASTR 306. Also, some of the prerequisites are changing for other Physics B.S. electives.
E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it.

The Astronomy Curriculum Committee within the Physics & Astronomy Department has decided that our department needs to add a sophomore-level course within the Astrophysics degree program (ASTR 231 – Introduction to Astrophysics). This assessment is based on evidence from 4 years of offering our Astrophysics B.S. degree. The course will be the main prerequisite for all upper-level astrophysics courses. This also means that Planetary Astronomy no longer needs to be taught at the sophomore level; commensurate with its change to a junior-level course, we are changing its number from 206 to 306.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1. Students use appropriate computational techniques to solve problems in the fields of quantum mechanics and electromagnetism.</td>
<td>All students will be assessed first in PHYS 230 using questions on tests and the final exam. Students will be assessed again in either PHYS 403 or 409. Again, test and final exam questions will be used.</td>
</tr>
<tr>
<td>2. Students are able to answer questions on the level of the Physics GRE.</td>
<td>This will be assessed among those students who take the GRE test-prep course. Assessment will be based upon student scores on practice GRE physics subject tests.</td>
</tr>
<tr>
<td>3. Students are competent and creative in experimental design and analysis.</td>
<td>This will be assessed first in PHYS 370 and then again in PHYS 420 or 499. Students will be assessed based upon their written reports.</td>
</tr>
<tr>
<td>4. Students are competent in a range of experimental techniques and they use the techniques appropriately.</td>
<td>This will be assessed first in PHYS 370 and then again in PHYS 420 or 499. Students will be assessed based upon their written reports.</td>
</tr>
<tr>
<td>5. Students demonstrate competency in oral and written communication.</td>
<td>This will be assessed first in PHYS 370 and then again in PHYS 420 or 499. Students will be assessed based upon their written reports and oral presentations.</td>
</tr>
</tbody>
</table>
G. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a program, please describe the effect on all programs that will be impacted; if you are adding or changing a program, please explain any overlap with existing programs at the College.

The addition of a 200-level bridge course in the Astrophysics B.S. degree program means that students will not qualify for the Physics B.S. simply by taking PHYS 370; they will be short one 300- or 400-level PHYS or ASTR course. However, the hope is that most Astrophysics B.S. students will still pursue the Physics B.S. by taking at least one additional course.

H. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings (including new faculty/staff requests, library, or equipment) associated with your request.

None.

I. CHECKLIST

☒ I have completed all relevant parts of the form.

☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.

☒ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☒ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the description and course list, exactly as it should appear in the catalog.

☒ I have submitted one Signature Form that lists all of the different forms I am submitting.
FACULTY CURRICULUM COMMITTEE
MINOR FORM

Instructions:
• Please fill out all of the portions of the form that are specified in section B. You must do this before your request can move forward!
• Remember that your changes will not be implemented until the next catalog year at the earliest.
• If you have questions, please start by checking the detailed instructions on the website. Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: P. Chris Fragile Phone: 953-3181 Email: fragilep@cofc.edu
School: SSM Department or Program: Physics & Astronomy
Name and Acronym of Minor: Astronomy (ASTR) Minor

B. TYPE OF REQUEST. Please check all that apply, then fill out the specified parts of the form.

☐ Add a New Minor (complete all portions)
☐ Change an Existing Minor (complete C, D, E, G, H, and I)
☐ Add existing course or courses to requirements or electives
☐ Add new course(s) to requirements or electives (attach completed course form for each)
☐ Delete courses from requirements or electives
☐ Terminate a Minor (complete E, G, H, and I)

C. GENERAL INFORMATION.

Number of Current Credit Hours (for existing minors): __18__
Number of Proposed Credit Hours (for new or changing minors): __18__

Catalog year in which changes will take effect: FALL _2014_______

☐ Interdisciplinary (please see guidelines on the Curriculum Committee website and include acknowledgments from relevant departments)

According to academic policy, students may not obtain a major/concentration and minor in the same subject. Will students in specific majors be prohibited from declaring this minor because of this policy?
☐X☐ Yes—Which major(s) or concentration(s)? _Astronomy and Astrophysics_
☐☐☐ No

D. CURRICULUM. For a changed minor, please list every change you are making below AND attach the current catalog entry for this minor (from the Minor Requirements section) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus.

This form was last updated on 6/6/2013 and replaces all others.
a new program, please submit the complete curriculum and catalog description exactly as they should appear in the catalog.
A new course, ASTR 231 Introduction to Astrophysics, is being created; its prerequisite will be PHYS 112. This course will replace ASTR 206 and 311 as one of the core course options. ASTR 129/130 and Honor Astronomy will remain as alternate options for the minor.

E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it. In addition, for a new minor, please address its objectives, provide evidence of student interest (e.g., interviews with student focus groups, enrollment in special-topics courses in this area), and explain how the minor supports the liberal arts tradition as well as the mission of the institution.

The Astronomy Curriculum Committee within the Physics & Astronomy Department has decided that our department needs to add a sophomore-level “bridge” course within the Astrophysics degree program. This assessment is based on evidence from 4 years of offering our Astrophysics B.S. degree. Although this course is not specifically targeted at the Astronomy Minor program, it would serve those students well.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>What will students know and be able to do when they complete the minor? Attach a Curriculum Map.</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
</tbody>
</table>
How does this minor align with the student learning outcomes articulated for the major, program, or general education? What program-level outcome or outcomes does it support? Is the content or skill introduced, reinforced, or demonstrated in this minor?

G. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a minor, please identify all programs that will be affected. If you are adding or changing a minor, please explain any overlap with existing programs at the College.

The impact of this change should be minimal. It is anticipated that most students will enter the Astronomy Minor program through ASTR 129/130 or Honors Astronomy, but this new course, ASTR 231, should certainly count for any student who chooses that route.

H. COSTS. List all of the new costs or cost savings (including new faculty/staff requests, library, equipment, etc.) associated with your request.

None.

I. CHECKLIST.

☒ I have completed all relevant parts of the form.

☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.

☒ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☒ I have provided the complete curriculum for the minor, including the description and course list, exactly as it should appear in the catalog.

☒ I have submitted one Signature Form that lists all of the different forms I am submitting.
Astronomy Major Requirements
Catalog Year: 2013-14
Degree: Bachelor of Arts
Credit Hours: 42+

“PR” indicates a pre-requisite. “CO” indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

**Required Courses**

- **PHYS 111** General Physics I (3) PR or CO: MATH 120 or equivalent or instructor permission; CO: PHYS 111L
- **PHYS 111L** General Physics I Lab (1) CO: PHYS 111
- **PHYS 112** General Physics II (3) PR: PHYS 111 or HONS 157; CO or PR: MATH 220 or equivalent or instructor permission; CO: PHYS 112L
- **PHYS 112L** General Physics II Lab (1) CO: PHYS 112
- **PHYS 230** Introduction to Modern Physics I (3) PR: PHYS 112 or HONS 158; PR or CO: MATH 221 or instructor permission
- **PHYS 419** Research Seminar (1) PR or CO: PHYS 370 or ASTR 377 or instructor permission
- **PHYS 420** Senior Research (3) PR: PHYS 419; instructor and department chair permission

**OR**

- **PHYS 499** Bachelor’s Essay (6) PR: PHYS 419 or department chair permission; credit will not be awarded for both PHYS 420 and PHYS 499
- **ASTR 231** Introduction to Astrophysics (3) PR: PHYS 112 or HONS 158

**OR**

- **ASTR 200** Planetary Astronomy (3) PR: PHYS 111 and 111L (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission)

**OR**

- **ASTR 311** Stellar Astronomy and Astrophysics (3) PR: ASTR 206 and PHYS 112 and 112L (PHYS 101 and MATH 120 may substitute for PHYS 112 with instructor permission)

**Note:** * Upon completion of PHYS 101 with a grade of B or better and successful completion of MATH 120, a student may transfer to PHYS 112. **Credit will not be awarded for both PHYS 420 and PHYS 499. ***With department approval, PHYS 499 may be substituted for PHYS 420.

**Complete an additional 12 credit hours. At least 6 of the credit hours must be selected from:**

- **ASTR 205 306** Intelligent Life in the Universe (3) PR: None
- **ASTR 206** Planetary Astronomy (3) PR: PHYS 111 and 111L (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission)

**OR**

- **ASTR 311** Stellar Astronomy and Astrophysics (3) PR: PHYS 230 and MATH 221

**OR**

- **ASTR 312** Galactic and Extragalactic Astronomy (3) PR: ASTR 311 and MATH 221 or instructor permission

- **ASTR 377** Experimental Astronomy (4) PR: PHYS 230 or instructor permission

- **ASTR 413** Astrophysics (3) PR: PHYS 301 and MATH 323 or instructor permission

**PHYS 390** Research (ASTR topic required) (1-3, Repeatable up to 6) PR: Instructor and department chair permission

**Note:** When not used to fulfill the other above requirements.

**Select an additional 6 credit hours from the following:**

- **ASTR 205** Intelligent Life in the Universe (3) PR: None
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 200</td>
<td>Planetary Astronomy (3) PR: PHYS 111 and 111L (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission)</td>
<td>ASTR 210</td>
</tr>
<tr>
<td>ASTR 210</td>
<td>Black Holes in the Universe (3) PR: ASTR 130 or PHYS 102 or PHYS 112 or HONS 158</td>
<td>ASTR 260</td>
</tr>
<tr>
<td>ASTR 260</td>
<td>NASA Space Mission Design (2) PR: ASTR 130 or ASTR 206 or HONS 160 or GEOL 206 or PHYS 102 or PHYS 112 or HONS 158 or instructor permission; CO: ASTR 260L/GEOL 260L/PHYS 260L or ASTR 460L/GEOL 460L/PHYS 460L</td>
<td>ASTR 260L</td>
</tr>
<tr>
<td>ASTR 260L</td>
<td>NASA Space Mission Design Lab (1) CO: ASTR 260</td>
<td>ASTR 260L</td>
</tr>
<tr>
<td>ASTR 311*</td>
<td>Stellar Astronomy and Astrophysics (3) PR: PHYS 230</td>
<td>ASTR 312*</td>
</tr>
<tr>
<td>ASTR 312*</td>
<td>Galactic and Extragalactic Astronomy (3) PR: ASTR 311 and MATH 221 or Instructor permission</td>
<td>ASTR 413*</td>
</tr>
<tr>
<td>ASTR 413*</td>
<td>Astrophysics (3) PR: PHYS 301 and MATH 323 or Instructor permission</td>
<td>ASTR 410</td>
</tr>
<tr>
<td>ASTR 377*</td>
<td>Experimental Astronomy (4) PR: PHYS 230 or Instructor permission</td>
<td>GEOL 206</td>
</tr>
<tr>
<td>ASTR 410</td>
<td>Black Holes: Advanced Topics (1) PR: PHYS 112 or permission of instructor; CO: ASTR 210</td>
<td>GEOL 412</td>
</tr>
<tr>
<td>GEOL 206</td>
<td>Planetary Geology (3) PR: GEOL 101 and 101L or GEOL 103 and 103L or HONS 155 and 155L</td>
<td>GEOL 412</td>
</tr>
<tr>
<td>GEOL 412</td>
<td>Crustal Geophysics (3) PR: GEOL 101 and 101L or GEOL 103 and 103L and GEOL 105 and 105L or HONS 155 and 155L and HONS 156 and 156L and MATH 120 and GEOL 352 or instructor permission</td>
<td>GEOL 412</td>
</tr>
<tr>
<td>PHYS 301</td>
<td>Classical Mechanics (3) PR: PHYS 112, PHYS 112L or HONS 158 and MATH 323</td>
<td>PHYS 301</td>
</tr>
<tr>
<td>PHYS 340</td>
<td>Photonics (4) PR: PHYS 112, PHYS 112L or HONS 158</td>
<td>PHYS 390*</td>
</tr>
<tr>
<td>PHYS 390*</td>
<td>Research (ASTR topic required) (1-3, Repeatable up to 6) PR: Instructor and department chair permission</td>
<td>PHYS 403</td>
</tr>
<tr>
<td>PHYS 403</td>
<td>Introductory Quantum Mechanics (3) PR: PHYS 230 and MATH 323 or Instructor permission</td>
<td>PHYS 404</td>
</tr>
<tr>
<td>PHYS 404</td>
<td>Introductory Quantum Mechanics (a continuation of PHYS 403) PR: PHYS 403 or Instructor permission</td>
<td>PHYS 405</td>
</tr>
<tr>
<td>PHYS 405</td>
<td>Thermal Physics (3) PR: PHYS 230</td>
<td>PHYS 407</td>
</tr>
<tr>
<td>PHYS 407</td>
<td>Introduction to Nuclear Physics (3) PR: PHYS 230 or Instructor permission</td>
<td>PHYS 409</td>
</tr>
<tr>
<td>PHYS 409</td>
<td>Electricity and Magnetism (3) PR: PHYS 112, PHYS 112L or HONS 158 and MATH 323 or Instructor permission</td>
<td>PHYS 410</td>
</tr>
<tr>
<td>PHYS 410</td>
<td>Electricity and Magnetism (3) PR: PHYS 409</td>
<td>PHYS 412</td>
</tr>
<tr>
<td>PHYS 412</td>
<td>Special Topics (1-3) PR: Instructor permission</td>
<td>PHYS 415</td>
</tr>
<tr>
<td>PHYS 415</td>
<td>Fluid Mechanics (3) PR: MATH 323 and PHYS 301 or Instructor permission</td>
<td>Note: *When not used to fulfill the other above requirements.</td>
</tr>
</tbody>
</table>

**Math Requirement**

- [ ] MATH 120  Introductory Calculus (4) PR: Placement or C or better in MATH 111
- [ ] MATH 220  Calculus II (4) PR: MATH 120 or HONS 115
- [ ] MATH 221  Calculus III (4) PR: MATH 220

**Notes:**

- With department approval, completion with grades of at least “B” in PHYS 101/101L and PHYS 102/102L, together with MATH 120 and MATH 220 may be substituted for PHYS 111/111L and PHYS 112/112L.
Astrophysics Major Requirements
Catalog Year: 2013-14
Degree: Bachelor of Science
Credit Hours: 58+

“PR” indicates a pre-requisite. “CO” indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

- PHYS 111  General Physics I (3) PR or CO: MATH 120 or equivalent or instructor permission; CO: PHYS 111L
- PHYS 111L  General Physics I Lab (1) CO: PHYS 111
- PHYS 112*  General Physics II (3) PR: PHYS 111 or HONS 157; CO or PR: MATH 220 or equivalent or instructor permission; CO: PHYS 112L
- PHYS 112L  General Physics II Lab (1) CO: PHYS 112
- PHYS 230  Introduction to Modern Physics I (3) PR: PHYS 112 or HONS 158; CO or PR: MATH 221 or instructor permission
- PHYS 301  Classical Mechanics (3) PR: PHYS 112 or HONS 158, and MATH 323 or instructor permission
- PHYS 403  Introductory Quantum Mechanics (3) PR: PHYS 230 and MATH 323 or instructor permission
- PHYS 405  Thermal Physics (3) PR: PHYS 230; CO: MATH 323 or instructor permission
- PHYS 409  Electricity and Magnetism (3) PR: PHYS 112 or HONS 158 and MATH 323 or instructor permission
- PHYS 419  Research Seminar (1) PR or CO: PHYS 370 or ASTR 377 or instructor and department chair permission
- PHYS 420**  Senior Research (3) PR: PHYS 419 and instructor and department chair permission
- **OR**
- PHYS 499***  Bachelor’s Essay (6) PR: PHYS 419 or department chair permission; credit will not be awarded for both PHYS 420 and PHYS 499
- ASTR 231  Introduction to Astrophysics (3) PR: PHYS 112
- ASTR 260  Planetary Astronomy (3) PR: PHYS 111 (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission)
- ASTR 311  Stellar Astronomy and Astrophysics (3) PR: PHYS 230
- ASTR 312  Galactic/Extragalactic Astronomy (3) PR: ASTR 311 and MATH 221 or instructor permission
- ASTR 377  Experimental Astronomy (4) PR: PHYS 230 or instructor permission

Note: * Upon completion of PHYS 101 with a grade of B or better and successful completion of MATH 120, a student may transfer to PHYS 112. **Credit will not be awarded for both PHYS 420 and PHYS 499. ***With department approval, PHYS 499 may be substituted for PHYS 420.

Select 3 additional credit hours from the following:

- ASTR 410  Black Holes: Advanced Topics (1) PR: PHYS 112 or instructor permission; CO: ASTR 210
- ASTR 413*  Astrophysics (3) PR: PHYS 301 and MATH 323 or instructor permission
- ASTR 460L  NASA Space Mission Design Leadership Lab (1) PR: Instructor permission; CO: ASTR 260
- PHYS 390  Research (astronomy topic required) (1-3; repeatable up to 6 credit hours) PR: Instructor and department chair permission
- PHYS 404  Introductory Quantum Mechanics II (3) PR: Instructor permission
- PHYS 407  Introduction to Nuclear Physics (3) PR: PHYS 230 or instructor permission
- PHYS 410  Electricity and Magnetism (3) PR: PHYS 409
- PHYS 412*  Special Topics (Astronomy topic required) (3) PR: Instructor permission
PHYS 415  Fluid Mechanics (3) PR: MATH 323 and PHYS 301 or instructor permission

Note: *When not used to fulfill the above requirements.

Math Requirement

☐ MATH 120  Introductory Calculus (4) PR: Placement or C or better in MATH 111
☐ MATH 220  Calculus I(4) PR: MATH 120 or HONS 115
☐ MATH 221  Calculus II(4) PR: MATH 220
☐ MATH 323  Differential Equations (3) PR: MATH 221 and either MATH 203 or instructor permission

Notes:

- Computer Programming I (CSCI 220 and 220L) is strongly recommended.
- With department approval, completion with grades of at least “B” in PHYS 101/101L and PHYS 102/102L, together with MATH 120 and MATH 220 may be substituted for PHYS 111/111L and PHYS 112/112L.
- Except for the substitution of ASTR 377 for PHYS 370, this qualifies for the B.S. in Physics. If the student takes ASTR 377 and PHYS 370,” then they have a double major in Physics and Astronomy.
- Suggested programs of study leading to graduate school in physics, astronomy, astrophysics, meteorology and engineering are available from the department.

Insert this section where noted above.

Complete 9 additional credit hours. At least 6 of the credit hours must be selected from:

____________________  ____________________

ASTR 306 Planetary Astronomy (3) PR: ASTR 231
ASTR 311 Stellar Astronomy and Astrophysics (3) PR: ASTR 231 and MATH 221
ASTR 312 Galactic/Extragalactic Astronomy (3) PR: ASTR 231 and MATH 221
ASTR 413 Astrophysics (3) PR: PHYS 301 and MATH 323 or instructor permission
PHYS 412 Special Topics (Astronomy topic required) (3) PR: Instructor permission
Physics Major Requirements
Catalog Year: 2013-14
Degree: Bachelor of Science
Physics Major Credit Hours: 58+

“The” indicates a pre-requisite. “CO” indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

☐ PHYS 111 General Physics I (3) PR or CO: MATH 120 or equivalent or instructor permission; CO: PHYS 111L
☐ PHYS 111L General Physics I Lab (1) CO: PHYS 111
☐ PHYS 112* General Physics II (3) PR: PHYS 111 or HONS 157; CO or PR: MATH 220 or equivalent or instructor permission; CO: PHYS 112L
☐ PHYS 112L General Physics II Lab (1) CO: PHYS 112
☐ PHYS 230 Introduction to Modern Physics I (3) PR: PHYS 112 or HONS 158; CO or PR: MATH 211 or instructor permission
☐ PHYS 301 Classical Mechanics (3) PR: PHYS 112 or HONS 158, and MATH 323 or instructor permission
☐ PHYS 370 Experimental Physics (4) PR: PHYS 230 or instructor permission
☐ PHYS 403 Introductory Quantum Mechanics (3) PR: PHYS 230; CO or PR: MATH 323 or instructor permission
☐ PHYS 409 Electricity and Magnetism (3) PR: PHYS 112 or HONS 158 and MATH 323 or instructor permission
☐ PHYS 419 Research Seminar (1) PR or CO: PHYS 370 or ASTR 377 or instructor and department chair permission
☐ PHYS 420** Senior Research (3) PR: PHYS 419 and instructor and department chair permission
OR
☐ PHYS 499** Bachelor’s Essay (1-6) PR: PHYS 419 or department chair permission. Credit will not be awarded for both PHYS 420 and PHYS 499

Notes: *Upon completion of PHYS 101 with a grade of B or better and successful completion of MATH 120, a student may transfer to PHYS 112. **Credit will not be awarded for both PHYS 420 and PHYS 499.

☐ Select 15 credit hours from the following electives with department approval. Please note a maximum of 6 credit hours are allowed from PHYS 381, 390 and 399.

☐ ASTR 206 Planetary Astronomy (3) PR: PHYS 111, 112, or PHYS 101, 102, and MATH 120 or equivalent or instructor permission
☐ ASTR 231 and MATH 221
☐ ASTR 311 Stellar Astronomy and Astrophysics (3) PR: PHYS 230
☐ ASTR 231 and MATH 221
☐ ASTR 312 Galactic and Extragalactic Astronomy (3) PR: ASTR 311 and MATH 221
☐ ASTR 377 Experimental Astronomy (4) PR: PHYS 230 or instructor permission
☐ ASTR 410 Black Holes: Advanced Topics (1) PR: PHYS 112, PHYS 112L or instructor permission; PR or CO: ASTR 210
☐ ASTR 413 Astrophysics (3) PR: PHYS 301 and MATH 323 or instructor permission
☐ ASTR 460L NASA Space Mission Design Leadership Lab (1) PR: Instructor permission; PR or CO: ASTR 260
☐ PHYS 296 Biophysics Model and Excitable Cells (3) PR: BIOL 111 or HONS 152 or PHYS 112 or HONS 158) OR (BIOL 211 and BIOL 305 and PHYS 102) or instructor permission

☐ PHYS 301 Classical Mechanics (3) PR: PHYS 112, PHYS 112L or HONS 158 and MATH 323
PHYS 302  Classical Mechanics (3) PR: PHYS 301
PHYS 308  Atmospheric Physics (3) PR: PHYS 112, PHYS 112L or HONS 158 or instructor permission
PHYS 320  Intro to Electronics (4) PR: PHYS 102 and MATH 120 or PHYS 112 or HONS 158 or instructor permission
PHYS 331  Intro to Modern Physics II (3) PR: PHYS 230
PHYS 340  Photonics (4) PR: PHYS 112, PHYS 112L or HONS 158
PHYS 350  Energy Production (4) PR: CHEM 111, CHEM 111L; (PHYS112, 112L or HONS 158) or (PHYS 102, 102L and MATH 120)
PHYS 381  Internship (1-4) PR: Declared PHYS major, PHYS 370, and coordinator permission
PHYS 390  Research (1-3; repeatable up to 6) PR: Department chair and instructor permission
PHYS 394  Digital Signal and Image Processing with Biomedical Applications (3) PR: PHYS 112 and 112L or HONS 158 and 158L; CO: PHYS 394L
PHYS 394L  Digital Signal and Image Processing with Biomedical Applications Laboratory (1) PR: PHYS 112 and 112L or HONS 158 and 158L; CO: PHYS 394
PHYS 397  Research Experience Physics and Astronomy (0) PR: Only declared majors can take a Zero Credit Research course. Instructor and department chair permission required.
PHYS 399  Tutorial (3, repeatable up to 12) PR: Junior standing and department chair and instructor permission
PHYS 400  Introductory Quantum Mechanics (3) PR: PHYS 230 and MATH 323 or instructor permission
PHYS 405  Thermal Physics (3) PR: PHYS 230
PHYS 407  Introduction to Nuclear Physics (3) PR: PHYS 230 or instructor permission
PHYS 408  Introduction to Solid State Physics (3) PR: PHYS 230 or instructor permission
PHYS 409  Electricity and Magnetism (3) PR: PHYS 112, PHYS 112L or HONS 158 and MATH 323 or instructor permission
PHYS 410  Electricity and Magnetism (3) PR: PHYS 409
PHYS 412  Special Topics (1-3) PR: Instructor permission
PHYS 415  Fluid Mechanics (3) PR: MATH 323 and PHYS 301 or instructor permission
PHYS 456  Air Pollution Meteorology (4) PR: PHYS 112, PHYS 112L or (PHYS 102, PHYS 102L and MATH 120) or HONS 158; CHEM 112, CHEM 112L or instructor permission
PHYS 457  Satellite Meteorology (3) PR: PHYS 308 or PHYS 456 or (PHYS 105 and PHYS 112, PHYS 112L) or (PHYS 105 and PHYS 102, PHYS 102L and MATH 120) or (PHYS 105 and HONS 158)
PHYS 458  Climate Change (4) PR: PHYS 112, PHYS 112L or HONS 158
PHYS 460L  NASA Space Mission Design Leadership Lab (1) PR: Instructor permission; CO: PHYS 260

Mathematics Requirement:

- MATH 120  Introductory Calculus (4) PR: Placement or C or better in MATH 111
- MATH 220  Calculus II (4) PR: MATH 120 or HONS 115
MATH 221  Calculus III (4) PR: MATH 220 or equivalent  

MATH 323  Differential Equations (3) PR: MATH 221 and MATH 203 or equivalent or permission of instructor  

Optional: Students may also select a concentration in Computational Neuroscience, Energy Production or Meteorology.  

Notes:  

- With department approval, completion with grades of at least “B” in PHYS 101/101L and PHYS 102/102L, together with MATH 120 and MATH 220 may be substituted for PHYS 111/111L and PHYS 112/112L.  

- Suggested programs of study leading to graduate school in physics, astronomy, astrophysics, meteorology and engineering are available from the department.
MJNP 313  Conversation and Composition I
MJNP 314  Conversation and Composition II
MJNP 343  Advanced Japanese Conversation and Composition
MJNP 390  Special Topics
LTAR 220  Modern Arabic Fiction in Translation
LTAR 221  Islamic World Literature (in English Translation)
LTAR 250  Arabic Literature in (English) Translation
LTAR 270  Studies in Arab Cinema
LTAR 382  Arab Women Writers
LTCH 210  Traditional Chinese Literature in Translation
LTCH 220  Modern Chinese Literature in Translation
LTCH 250  Chinese Literature in Translation
LTJP 250  Japanese Literature in Translation
LTJP 350  Japanese Literature in Translation
LTJP 390  Special Topics in Japanese Literature in Translation
PHIL 234  Eastern Philosophy
POLI 343  Politics of East Asia
POLI 344  Politics of the Middle East
POLI 345  Politics of China
POLI 346  Politics of Southeast Asia
POLI 359  Special Topics in Comparative Politics (as appropriate to Asian studies)
RELS 205  Sacred Texts of the East
RELS 235  The Islamic Tradition
RELS 240  The Buddhist Tradition
RELS 245  Religions of India
RELS 248  Religions of China and Japan
RELS 340  Advanced Topics in Asian Religions
RELS 348  Asian Religions in America

### Astronomy Minor

Credit Hours: 18

**Minor Requirements:**
At least nine hours in the minor at the 200 level or above must be earned at the College of Charleston.

**Core courses:**

- ASTR 129/129L and 130/130L or one year of Honors Astronomy
- ASTR 206 Planetary Astronomy and ASTR 311 Stellar Astronomy

**Electives:**

- ASTR 205 Intelligent Life in the Universe
- ASTR 260 Planetary Astronomy
- ASTR 210 Black Holes in the Universe
- ASTR 260 NASA Space Mission Design
- ASTR 260L NASA Space Mission Design Lab
- ASTR 460L NASA Space Mission Design Leadership Lab
- ASTR 311 Stellar Astronomy and Astrophysics
Biology Minor

Credit Hours: 23

**Minor Requirements:**
At least nine (9) hours in the minor at the 200 level or above must be earned at the College of Charleston.

BIOL 111/111L Introduction to Cell and Molecular Biology (with laboratory)
BIOL 112/112L Evolution, Form, and Function of Organisms (with laboratory)
BIOL 211/211D Biodiversity, Ecology, and Conservation
BIOL 305 Genetics
MATH 250 Statistical Methods I (or equivalent course in statistics)

5 additional hours in biology, with at least three (3) hours at the 300 level or above.

See course listings for a complete list of courses offered.

Biomedical Physics Minor

Credit Hours: 18

**Minor Requirements:**
Students must take a minimum of 18 credit hours in physics and biology as listed below. At least 9 credit hours in the minor at the 200 level or above must be earned at the College of Charleston. A maximum of 3 credit hours of biology or chemistry courses at the 200-level and above may be counted toward the minor.

PHYS 102/102L Introductory Physics II (with laboratory) or
PHYS 111/111L General Physics I (with laboratory) or
PHYS 112/112L General Physics II (with laboratory)
PHYS 298 Special Topics* (astronomy related topic)