FACULTY CURRICULUM COMMITTEE
SIGNATURE PAGE

- In section A, list ALL of the forms covered by this signature page. If you submit a form that is not listed in A, your proposal will be held back until we receive a new, updated signature page.
- You must obtain the signature of your department chair and dean before submitting your proposal.

A. FORMS COVERED BY THIS SIGNATURE PAGE. List each form you are submitting—for instance, PSYC 383, Course Form; PSYC, Change of Major Form; PSYC, Change of Minor Form.

ASTR B.A. Change Program Form, ASTR B.S. Change Program Form, ASTR B.A. checklist, ASTR B.S. checklist

B. APPROVAL AND SIGNATURES.

1. Signature of Department Chair or Program Director:

   [Signature] Date: 1/23/2014

2. Signature of Academic Dean:

   [Signature] Date: 2/6/2014

3. Signature of Provost:

   [Signature] Date: 3/35/14

4. Signature of Business Affairs (only for course fees):

   [Signature] Date: ________________

   □ fee approved on ____________

   □ BOT approval pending

5. Signature of Curriculum Committee Chair:

   [Signature] Date: ________________

6. Signature of Budget Committee Chair (only for new programs):

   [Signature] Date: ________________

7. Signature of Academic Planning Committee Chair (only for new programs):

   [Signature] Date: ________________

8. Signature of Faculty Senate Secretary:

   [Signature] Date: ________________

Date Approved by Faculty Senate: ________________
January 9, 2014

The Astronomy Curriculum Committee within the Department of Physics & Astronomy is proposing that the newly created PHYS 394 - Digital Signal and Image Processing with Biomedical Applications course (and its accompanying lab) be added to the list of electives for both the Astrophysics B.S. and Astronomy B.A. degrees.

The proposed change would give students a bit more flexibility in what electives they can choose. It may also increase slightly the enrollment in PHYS 394.

There should be no cost or other impact to the department.

Regards,

[Signature]

P. Chris Fragile, Chair
Astronomy Curriculum Committee
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: fragile@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.

☐ 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.

This form was last updated on 6/6/2013 and replaces all others.

Page 1 of 3
A new course, PHYS 394 Digital Signal and Image Processing with Biomedical Applications, has recently been created within the department; this course (and its accompanying lab) will now count as an elective for the Astronomy B.A.

E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it.
Digital Signal and Image Processing is a scientific technique that spans many disciplines, including Astronomy. Although the focus of this course is on Biomedical Applications, the content is sufficiently applicable to astronomy for the course to count as an elective.

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 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>

Additional Outcomes or Comments:
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 higher enrollment in PHYS 394.

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

☒ 1 have completed all relevant parts of the form.

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

☒ 1 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: fragile@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 (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, 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.

This form was last updated on 6/6/2013 and replaces all others.  

Page 1 of 3
A new course, PHYS 394 Digital Signal and Image Processing with Biomedical Applications, has recently been created within the department; this course (and its accompanying lab) will now count as an elective for the Astrophysics B.S.

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

Digital Signal and Image Processing is a scientific technique that spans many disciplines, including Astrophysics. Although the focus of this course is on Biomedical Applications, the content is sufficiently applicable to astrophysics for the course to count as an elective.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
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<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 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>

Additional Outcomes or Comments:  

This form was last updated on 6/6/2013 and replaces all others.
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 higher enrollment in PHYS 394.

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.

This form was last updated on 6/6/2013 and replaces all others.
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.coa.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 111
☐ 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
☐ ASTR 200 Planetary Astronomy (3) PR: PHYS 111 and 111L (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission.)
☐ ASTR 311 Stellar Astronomy and Astrophysics (3) PR: ASTR 200 and PHYS 112 and 112L (PHYS 102 and MATH 220 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 Intelligent Life in the Universe (3) PR: None
☐ ASTR 306
☐ ASTR 231
☐ ASTR 200 Planetary Astronomy (3) PR: PHYS 111 and 111L (PHYS 101 and MATH 120 may substitute for PHYS 111 with instructor permission)
☐ ASTR 231 and MATH 221
☐ ASTR 311 Stellar Astronomy and Astrophysics (3) PR: PHYS 200
☐ ASTR 231 and MATH 221
☐ ASTR 312 Galactic and Extragalactic Astronomy (3) PR: ASTR 311 and MATH 221 or Instructor permission
☐ ASTR 231
☐ ASTR 377 Experimental Astronomy (4) PR: PHYS 200 or Instructor permission
☐ ASTR 231
☐ ASTR 413 Astrophysics (3) PR: PHYS 301 and MATH 323 or Instructor permission
☐ PHYS 390 Research (ASTR topic required) PR: Instructor and department chair permission
☐ PHYS 412 Special Topics (ASTR topic required) (1-3) 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

☐ 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 210</td>
<td>Black Holes in the Universe (3) PR: PHYS 111 or 111L or PHYS 101 or MATH 120 may substitute for PHYS 111 with instructor permission</td>
<td></td>
</tr>
<tr>
<td>ASTR 260</td>
<td>NASA Space Mission Design (2) PR: ASTR 130 or PHYS 102 or PHYS 112 or HONS 158 or instructor permission; CO: ASTR 260/GEOL 260/PHYS 260/ASTR 460/GEOL 460/PHYS 460</td>
<td></td>
</tr>
<tr>
<td>ASTR 260L</td>
<td>NASA Space Mission Design Lab (1) PR: ASTR 260</td>
<td></td>
</tr>
<tr>
<td>ASTR 460L</td>
<td>NASA Space Mission Design Leadership Lab (1) PR: Instructor permission; CO: ASTR 260</td>
<td></td>
</tr>
<tr>
<td>ASTR 311*</td>
<td>Stellar Astronomy and Astrophysics (3) PR:</td>
<td></td>
</tr>
<tr>
<td>ASTR 312*</td>
<td>Galactic and Extragalactic Astronomy (3) PR:</td>
<td></td>
</tr>
<tr>
<td>ASTR 413*</td>
<td>Astrophysics (3) PR: PHYS 301 and MATH 323 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>ASTR 377*</td>
<td>Experimental Astronomy (4) PR: TBC or instructor permission</td>
<td></td>
</tr>
<tr>
<td>ASTR 410</td>
<td>Black Holes: Advanced Topics (1) PR: PHYS 112 or permission of instructor; CO: ASTR</td>
<td></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></td>
</tr>
<tr>
<td>GEOL 412</td>
<td>Crustal Geophysics (3) PR: GEOL 101 and 101L or GEOL 103 and 103L or HONS 155 and 155L and HONS 156 and 156L and MATH 120 and GEOL 352 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 301</td>
<td>Classical Mechanics (3) PR: PHYS 112, PHYS 112L or HONS 158 and MATH 323</td>
<td></td>
</tr>
<tr>
<td>PHYS 340</td>
<td>Photonics (4) PR: PHYS 112, PHYS 112L or HONS 158</td>
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</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></td>
</tr>
<tr>
<td>PHYS 394</td>
<td>Digital Signal &amp; Image Processing with Biomedical Applications (3) PR: PHYS 112, PHYS 112L or HONS 158</td>
<td></td>
</tr>
<tr>
<td>PHYS 403</td>
<td>Introductory Quantum Mechanics (3) PR: PHYS 230 and MATH 323 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 403L</td>
<td>Digital Signal &amp; Image Processing with Biomedical Applications Lab (1) CO: PHYS 394</td>
<td></td>
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<tr>
<td>PHYS 404</td>
<td>Introductory Quantum Mechanics (a continuation of PHYS 403) (3) PR: PHYS 403 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 405</td>
<td>Thermal Physics (3) PR: PHYS 230</td>
<td></td>
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<tr>
<td>PHYS 407</td>
<td>Introduction to Nuclear Physics (3) PR: PHYS 230 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 409</td>
<td>Electricity and Magnetism (3) PR: PHYS 112, PHYS 112L or MATH 323 or instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 410</td>
<td>Electricity and Magnetism (3) PR: PHYS 409</td>
<td></td>
</tr>
<tr>
<td>PHYS 412</td>
<td>Special Topics (1-3) PR: Instructor permission</td>
<td></td>
</tr>
<tr>
<td>PHYS 415</td>
<td>Fluid Mechanics (3) PR: MATH 323 and PHYS 301 or instructor permission</td>
<td></td>
</tr>
</tbody>
</table>

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

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.
Text in blue reflects changes approved earlier this academic year.

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-education 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 231 Planetary Astronomy (3) PR: PHYS 111 (PHYS 112 and MATH 120 may substitute for PHYS 111 with instructor permission)

- ASTR 311  Stellar Astronomy and Astrophysics (3) PR: PHYS 233

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

- ASTR 377  Experimental Astronomy (4) PR: PHYS 233 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.

Insert section below

Select 3 additional credit hours from the following:

- 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 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 394  Digital Signal & Image Processing with Biomedical Applications (3) PR: PHYS 112, PHYS 112L or HONS 158

- PHYS 404  Introductory Quantum Mechanics II (3) PR: Instructor permission

- PHYS 394L  Digital Signal & Image Processing with Biomedical Applications Lab (1) CO: PHYS 394

- 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 II (4) PR: MATH 120 or HONS 115
☐ MATH 221  Calculus III (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 applies 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

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