To be adopted:

Proposed changes to the undergraduate major requirements in Physics and Astronomy.

**PRESENT:**

**Major Requirements**

The major requirements consist of a core curriculum and additional requirements for various B.S. degrees. The core requirements for the B.A. and B.S. degrees in Physics are as follows:

1. Lower-division requirements (60 units)
   a) One of the following sequences: PHYS 041A, PHYS 041B, PHYS 041C, or PHYS 040A, PHYS 040B, PHYS 040C, PHYS 040D, PHYS 040E. The first sequence is preferred for the B.S. in Physics.
   b) PHYS 39
   c) MATH 008B or MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 046
   d) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
   e) CS 010 or CS 010V. A higher-level CS course may satisfy the CS 010 requirement with approval.

2. Upper-division requirements (46 units)
   a) PHYS 130A, PHYS 130B, PHYS 132, PHYS 135A, PHYS 135B, PHYS 156A, PHYS 156B
   b) PHYS 139L (5 units), PHYS 142L (5 units). Note that PHYS 142L satisfies the ENGL 1C requirement.
   c) 8 units of upper division Physics electives. Upper division math, science of engineering may be substituted with approval. A student may take up to a maximum of 4 units of undergraduate research (PHYS 195A, PHYS 195B, PHYS 195C, and/or PHYS 195D). This may include a Physics internship at an approved government or industrial laboratory.

**PROPOSED:**

**Major Requirements**

The major requirements consist of a core curriculum and additional requirements for various B.S. degrees. The core requirements for the B.A. and B.S. degrees in Physics are as follows:

1. Lower-division requirements (70 units)
   a) No change.
   b) No change.
   c) MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 046
   d) No change.
   e) No change.

2. Upper-division requirements (41 to 42 units)
   a) No change.
   b) PHYS 139L (5 units), PHYS 142L (4 units) or PHYS 142W (5 units). Note that PHYS 142W satisfies the ENGL 1C requirement.
   c) 4 units of upper division Physics electives. Upper division math, science of engineering may be substituted with approval.
a) PHYS 133, PHYS 136

b) PHYS 142L (additional 5 units - 1 quarter).
   Approved undergraduate research (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D) in
   physics or an internship (PHYS 198-I) in physics at a government or industrial laboratory
   can be used in place of up to 5 units of PHYS 142L.

c) 8 additional units of upper division Physics electives. PHYS 156C is highly recommended
   for those planning to go to graduate school in physics.

Physics: Biophysics Track (B.S. degree)
1. Additional lower-division requirements (42 units)
   a) BIOL 005A, BIOL 005B, BIOL 005C, BIOL 05LA

2. Additional upper-division requirements (24 units)
   a) CHEM 112A, CHEM 112B which may be used to satisfy the core requirement 2c.
   b) 16 additional upper division units taken from CHEM 112C, BCH 110A, BCH 110B, BCH
      110C or BIOL 107A (other upper division CHEM/BIOL/BCH may be substituted upon
      approval)

Physics Education Track (B.S. degree only)
1. Additional lower-division requirements (10 units)
   a) EDUC 003, EDUC 004
   b) LING 020 or LING 021

2. Additional upper-division requirements (46 units)
   a) EDUC 110, EDUC 177A, and either EDUC 142 or EDUC 174.

3. Upper division recommendations (4 units)
   a) EDUC 104/MATH 104

Physics: Applied Physics and Engineering Track
(B.S degree)
1. Additional upper-division requirements (21 units)
   a) PHYS 142L (additional 5 units - 1 quarter).
      Approved undergraduate research (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D)

   b) One additional quarter of either PHYS 142L (4 units) or PHYS 142W (5 units).
      Approved undergraduate research (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D) in
      physics or an internship (PHYS 198-I) in physics at a government or industrial laboratory
      can be used in place of up to 4 units of PHYS 142L.

c) No change.

Physics: Biophysics Track (B.S. degree)
1. Additional lower-division requirements (25 units)
   a) No change.
   b) CHEM 12A, CHEM 12B, CHEM 12C

2. Additional upper-division requirements (8 units)
   a) 8 additional upper division units taken from
      BCH 110A, BCH 110B, BCH 110C or BIOL 107A (other upper division CHEM/BIOL/BCH
      may be substituted upon approval)

Physics Education Track (B.S. degree only)
1. Additional lower-division requirements (10 units)
   a) No change.
   b) LING 020 or LING 021. Note that this satisfies 4 units of the CNAS Humanities
      requirement.

2. Additional upper-division requirements (8 units)
   a) EDUC 110 or EDUC 110S, EDUC 174 or
      EDUC 174S.
in physics or an internship (PHYS 198-I) in physics at a government or industrial laboratory can be used in place of up to 5 units of PHYS 142L.

b) 8 additional units of upper division Physics electives.

c) 8 units of upper division Engineering electives.

Students seeking an emphasis in environmental physics or chemical physics should consult with an advisor. The physics electives may be selected on an individual basis to stress one of these concentrations.

Students continuing on to graduate school are encouraged to take additional upper-division courses in Mathematics, such as MATH 146A, MATH 146B, MATH 146C, MATH 165A, MATH 165B, and MATH 113.

Students may wish to earn a Minor in Mathematics which requires an additional 24 units of upper division math.

To graduate, a minimum grade point average of 2.00 (C) is necessary overall and in the upper-division courses taken for the major (courses listed under 2.).

**Justification:**
The Physics and Astronomy Department has revised the degree requirements based on our review of the undergraduate requirements prompted by the Major Requirements Project. A summary of the changes and their rationale is provided in the attached report. The justification for every single change follows:

- Major Requirements, 1 unit total was changed from 69 to 70, correcting a mistake.
- Major Requirements 1c, Math 8B was removed because it no longer exists.
- Major Requirements 2 unit total updated to reflect the change in 2c, the change in units for Phys 132 from 5 to 4, and the change in the units for Phys 142L from 5 to 4. The old total was also off by 1 unit and should have been 47. Please see attachments if you want a check of the revised sums.
- Major Requirements 2b, The Phys142L requirement was replaced by either Phys 142W or 142L. The physics content of these is the same. Phys 142W has additional writing instruction.
- Major Requirements 2c, The number of required elective units was reduced from 8 to 4. This is part of the overall effort to reduce the number of required upper division units for each track of the major. As part of this change, we removed the option of using undergraduate research to satisfy this requirement. Undergraduate research may still be used to satisfy half of the Phys 142 requirement.
- Standard Track 1 unit total was updated from 21 to “16 to 17” to reflect the removal of one required course (Phys 133) and the change in units for Phys 142L from 5 to 4.
- Standard Track 1a, Phys 133 is no longer required. It is an elective.
• Standard Track 1b, the Phys 142L requirement is now 142W (5 units) or 142L (4 units). Since the minimum total Phys 142 requirement is now 8 units (2x142L), we changed the substitution units for Phys 195 from 5 to 4 to correspond to half of the minimum required.

• Biphysics Track, 1 unit total was updated from 12 to 25 units, due to the CHEM 112 to 12 changes. CHEM 12C was added as an explicit requirement, in addition to CHEM 12AB, since it is a prerequisite for all of the classes in section 2a of the Biophysics Track.

• Biophysics Track, 1b, See above about CHEM 112 to 12.

• Biophysics Track, 2 units were adjusted to take into account CHEM 112 becoming CHEM 12 and also the reduction in what was the 2b requirement (16 to 8 units).

• Biophysics Track, the new 2a is the old 2b, except the requirement is now 8 instead of 16 units. This unit reduction is part of the overall effort to reduce the number of required upper division units for each track of the major.

• Education Track, 1b, added a helpful comment.

• Education track, 2 units were reduced from 16 to 8. The old 16 units was incorrect, since it counted the recommended EDUC 104, which was a recommendation, not a requirement. In addition to that, we changed what should have been 12 to 8 as part of the overall effort to reduce the number of required upper division units for each track of the major.

• Education track, 3, this recommendation was eliminated because, upon reflection, this was not a good recommendation and the course is no longer offered anyway.

• Engineering Track, 1 unit total was updated to reflect the PHYS 142L unit change and the reduction in requirements by 4 units.

• Engineering Track 1a, updated to reflect the change in 142L units and the existence of 142W. Since the minimum total Phys 142 requirement is now 8 units, we changed the substitution units for Phys 195 from 5 to 4 to correspond to half of the minimum required.

• Engineering Track 1b, reduced the requirement from 8 to 4 units as part of the overall effort to reduce the number of required upper division units for each track of the major.

**Approvals:**
Approved by the faculty of the Department of Physics and Astronomy: January 12, 2016
Approved by the Executive Committee College of Natural and Agricultural Sciences: April 19, 2016
Approved by the Committee on Educational Policy: May 11, 2016