To be adopted:
Proposed changes in the core requirements for Bachelor of Science and Bachelor of Arts in Physics

Major Requirements
The major requirements for the B.S. and B.A. degrees in Physics are as follows:

1. Lower-division requirements (63–64 units)
   a) PHYS 040A, PHYS 040B, PHYS 040C, PHYS 040D, PHYS 040E
   b) MATH 008B or MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 046
   c) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC

2. Upper-division requirements (55 units)
   a) PHYS 130A, PHYS 130B, PHYS 134, PHYS 135A, PHYS 135B, PHYS 136, PHYS 156A, PHYS 156B
   b) PHYS 139L, PHYS 142L (6 units). An approved senior thesis (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D) in experimental physics or an internship (PHYS 198-1) in experimental physics at a government or industrial laboratory can be used in place of up to 3 units of PHYS 142L.
   e) A student may take up to a maximum of 8 units of undergraduate research in pursuit of a senior thesis (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D) in experimental physics or an internship (PHYS 198-1) in experimental physics at a government or industrial laboratory can be used in place of up to 3 units of PHYS 142L.
   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
d) During the junior or senior years, a Physics internship (PHYS 198-I) of up to 12 units can be taken at an approved government or industrial laboratory. A maximum of 3 out of the 12 units may be used to satisfy the major requirements.

e) Three elective courses to be taken in consultation with a faculty advisor. Specialized skills can be developed by taking physics electives from the following:

- PHYS 111 (Astrophysics and Stellar Astronomy)
- PHYS 150A, PHYS 150B (Introduction to Condensed Matter Physics)
- PHYS 151 (Topics in Modern Condensed Matter Physics)
- PHYS 163 (Atomic Physics and Spectroscopy)
- PHYS 164 (Introduction to Nuclear Physics)
- PHYS 165 (Introduction to Particle Physics)
- PHYS 166 (Cosmology)
- PHYS 168 (Environmental Physics)
- PHYS 177 (Computational Methods for Physical Sciences)

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, with approval.

Additional requirements for a B.S. in Physics: Standard Track
1. Additional upper-division requirements (21 units)
   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.

Biophysics option (B.S. degree only)

1. Lower-division requirements (76-77 units)
   a) PHYS 040A, PHYS 040B, PHYS 040C, PHYS 040D, PHYS 040E
   b) MATH 008B or MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 046
   c) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
   d) BIOL 005A, BIOL 005B, BIOL 005C, BIOL 05LA

2. Upper-division requirements (88 units)
   a) PHYS 130A, PHYS 130B, PHYS 134, PHYS 135A, PHYS 135B, PHYS 136, PHYS 145A, PHYS 145B, PHYS 145C, PHYS 156A
   b) STAT 155
   c) CHEM 112A, CHEM 112B, CHEM 112C
   d) BIOL 105
   e) BCH 110A, BCH 110B, BCH 110C. Students may substitute BIOL 107A for BCH 110C
   f) 4 units of experimental research in either special studies (PHYS 190, PHYS 190L), an approved senior thesis (PHYS 195A, PHYS 195B, PHYS 195C, PHYS 195D), undergraduate research (PHYS 197), or an internship (PHYS 198-I).
   g) 12 units of elective courses (chosen after consultation with a faculty advisor)

Additional requirements for a B.S. in Physics: Biophysics Track

1. Additional lower-division requirements (12 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 option

1. Lower-division requirements (73-74 units)
   - a) PHYS 040A, PHYS 040B, PHYS 040C, PHYS 040D, PHYS 040E
   - b) MATH 008B or MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 014
   - c) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
   - d) EDUC 003, EDUC 004
   - e) LING 020 or LING 021

2. Upper-division requirements (75 units)
   - a) PHYS 130A, PHYS 130B, PHYS 134, PHYS 135A, PHYS 135B, PHYS 136, PHYS 156A, PHYS 156B
   - b) PHYS 139L, PHYS 142L (3 units)
   - c) Two electives from the following list (8 units): PHYS 111, PHYS 145A, PHYS 145B, PHYS 145C, PHYS 150A, PHYS 150B, PHYS 151, PHYS 163, PHYS 164, PHYS 165, PHYS 166, PHYS 168, PHYS 177
   - d) EDUC 100B, EDUC 109, EDUC 110, EDUC 116, EDUC 139, EDUC 174, EDUC 177A

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

Additional requirements for 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 (17 units)
   - a) EDUC 110, EDUC 177A, and either EDUC 172 or EDUC 174.

3. No Change

Additional requirements for a B.S. in Physics with Applied Physics and Engineering Track

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) 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
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.

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). Although no foreign languages are required for the B.S. degree, the student who is planning to proceed to graduate work is reminded that reading proficiency in one or more foreign languages is required in some physics graduate programs.

Bachelor of Arts
For the B.A. degree, additional units are required in Humanities, Social Sciences, and foreign language to meet the breadth requirements.

Minor
The minor in Physics consists of 26 upper-division units in Physics. A minimum of 16 units must be unique to the minor and may not be used to satisfy major requirements.

1. First Tier (16 units)
   a) PHYS 130A
   b) PHYS 134
   c) PHYS 135A
   d) One Upper Division Physics elective from PHYS 111, PHYS 150A, PHYS 151, PHYS 164, PHYS 165, PHYS 166, PHYS

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).
2. Second Tier: at least 10 units from any upper-division Physics courses not chosen in the First Tier. The combined units from the First and Second Tiers should add to at least 26.
3. No more than 4 units of 190-199 courses may be used to fulfill the upper-division units for the minor.
See Minors under the College of Natural and Agricultural Sciences in the Colleges and Programs section of this catalog for additional information on minors.
**JUSTIFICATION:** General Statement

The Physics and Astronomy Department has reviewed its curriculum in light of the preparation of incoming freshman, creation of a manageable program that can be completed in 4 years, and curriculum requirements for BA and BS degrees at UCSB, UCLA and UCSD. In the past the UCR Physics BA and BS requirements were the same. Because the BA breadth requirements are so much more extensive, no student has undertaken the BA in Physics in the last 20 years. The BA degree requirements are now reduced by 3 upper division courses and in line with BA requirements at UCSB, UCLA and UCSD. The BS degree requirements were increased by 1 upper division required course and 1 additional required elective to provide extra preparation for technical careers and students preparing for graduate school. A freshman year introductory course 41ABC is introduced. It is a double course (8 units per quarter) intended to jump start Physics majors into research and upper division courses and to provide many of the cohort-cohesion advantages of the Learning Community. By starting upper division physics in sophomore year, majors will now be able to finish all core lecture courses needed to prepare for the GRE by the end of Year 3. This will make UCR physics majors more competitive for graduate school admission. The BS in Physics had developed 2 new tracks in recent years: a Biophysics track for students planning on going to health professional schools or biophysics, biomaterials, or bioengineering graduate programs and a Physics Education Track for students planning on careers in high school teaching. Both of those tracks had too many requirements and were impossible to finish in 4 years. The requirements have been reduced to make them only slightly more units than the BS: Standard Track and the department expects that this will make those programs more attractive to students. A new track, BS in Physics: Applied Physics and Engineering Track is introduced. Upper division electives are divided between Physics and Engineering. This track should be especially attractive to Physics majors who seek immediate employment in the technical sector or go to engineering grad school.

**JUSTIFICATION:** Education Track

The physics department would like to reduce the number of required upper-division units for the Physics Education Track. In the past, the Graduate School of Education required five upper-division education courses (109, 110, 116, 139, and 172 or 174) as prerequisites for their Masters of Education program. This was the motivation for including these courses in the original Physics Education Track requirements. The Graduate School of Education has recently proposed eliminating this requirement. In order to give the Physics Education Track students more flexibility in their upper-division courses, we would like to reduce the required set of upper-division education courses to

- EDUC 110 – Learning and instruction
- EDUC 177A – Language Development in Content Areas
- and
- EDUC 172 – Reading and Language Development (for multiple-subject credential)
- or
- EDUC 174 – Reading and Writing in the Content Areas (for single-subject credential)
These three courses will qualify the students for intern teaching during the UCR GSOE credential program, for those who don’t opt for the GSOE M.Ed. program. For those that do enter the GSOE M.Ed. program, EDUC 177A and either EDUC 172 or EDUC 174 are part of the M.Ed. program.

**APPROVALS:**

Approved by the faculty of the department of Physics and Astronomy: March 2, 2010
Approved by the Executive Committee of the College of Natural and Agricultural Sciences: March 30, 2010
Approved by the Committee on Educational Policy: April 24, 2010