

**EXECUTIVE COMMITTEE
COLLEGE OF NATURAL AND AGRICULTURAL SCIENCES
REPORT TO THE RIVERSIDE DIVISION
MAY 29, 2018**

To be adopted:

Proposed Changes to the undergraduate major requirements in Physics

PRESENT:

Transfer Students

Students transferring to the Physics major must complete courses comparable to the following one-year sequences before they transfer:

1. ~~General physics (calculus-based) equivalent to PHYS 040A, PHYS 040B, PHYS 040C, each course completed with a grade of "B" or better~~
2. ~~First year calculus, equivalent to MATH 009A, MATH 009B, MATH 009C, each course completed with a grade of "B" or better~~

At least one of the following one-year sequences:

1. ~~General chemistry, equivalent to CHEM 001A, CHEM 001B, CHEM 001C, CHEM 011A, CHEM 011B, CHEM 011C, each course completed with a grade of "C" or better~~
2. ~~Second year calculus, equivalent to MATH 010A, MATH 010B, MATH 046, each course completed with a grade of "C" or better~~
3. ~~Organic chemistry (one year lower division), each course completed with a grade of "B" or better~~

Students must have a minimum grade point average of 2.70 in transferable college courses. UCR has articulation agreements with most of the California community colleges. These agreements list specific community college courses that have been designated

PROPOSED:

Transfer Students

Students transferring to the Physics major must complete courses comparable to the following one-year sequences before they transfer:

1. General physics (calculus-based) equivalent to PHYS 040A, PHYS 040B, PHYS 040C
2. First-year calculus, equivalent to MATH 007A or MATH 009A, MATH 007B or MATH 009B, MATH 009C

Students must have a minimum grade point average of 2.70 in transferable college courses. UCR has articulation agreements with most of the California community colleges. These agreements list specific community college courses that have been designated

as comparable to UCR courses (see the statewide articulation Web site at www.assist.org). Transfer students will usually find it advantageous to complete most or all sequences before starting at UCR. All prospective transfers should try to complete the sequences they begin rather than divide a sequence between two campuses.

University Requirements

See Undergraduate Studies section.

College Requirements

See College of Natural and Agricultural Sciences, Colleges and Programs section. Some of the following requirements for the major may also fulfill some of the college's breadth requirements. Consult with a department advisor for course planning.

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) 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 007A or MATH 009A, MATH 007B or 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.

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1. Lower-division requirements (70 units)
 - a) one of the following sequences: PHYS 041A, PHYS 041B, PHYS 041C, or PHYS 040A or PHYS 40HA, PHYS 040B or PHYS 40HB, PHYS 040C or PHYS 40HC, PHYS 040D, PHYS 040E. The first sequence is preferred for the B.S. in Physics.
 - b) PHYS 39
 - c) MATH 007A or MATH 009A or MATH 09HA, MATH 007B or MATH 009B or MATH 09HB, MATH 009C, MATH 010A, MATH 010B, MATH 046
 - d) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
 - e) CS 010. A higher-level CS course may satisfy the CS 010 requirement with approval.

2. Upper-division requirements (41 to 42 units) No Change.

a) PHYS 130A, PHYS 130B, PHYS 132,
PHYS 135A, PHYS 135B, PHYS 156A,
PHYS 156B

b) PHYS 139L (5 units), PHYS 142L (4
units) or PHYS 142W (5 units). Note
that PHYS142W satisfies the ENGL 1C
requirement.

c) 4 units of upper division Physics
electives. Upper division math, science
of engineering may be substituted with
approval.

Physics: Standard Track (B.S. degree)

No Change.

1. Additional upper-division requirements (16 to
17 units)

a) PHYS 136

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) 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)

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1. Additional lower-division requirements (25
units)

a) BIOL 005A, BIOL 005B, BIOL 005C, BIOL
05LA or BIOL 020.

b) CHEM 008A, or 08HA, CHEM 008B or
08HB, CHEM 008C or 08HC CHEM 08LA
or 08HLA, CHEM 08LB or 08HLB, CHEM
08LC or 08HLC

1. Additional lower-division requirements (25
units)

a) BIOL 005A, BIOL 005B, BIOL 005C, BIOL
05LA or BIOL 020.

b) CHEM 008A, or CHEM 08HA, CHEM
008B or CHEM 08HB, CHEM 008C or
CHEM 08HC, CHEM 08LA or CHEM
08HLA, CHEM 08LB or CHEM 08HLB,
CHEM 08LC or CHEM 08HLC

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) EDUC 003, EDUC 004

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.~~

Physics: Applied Physics and Engineering Track (B.S degree)

~~1. Additional upper division requirements (16 to 17 units)~~

~~a) 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.~~

~~b) 4 additional units of upper division Physics electives.~~

~~c) 8 units of upper division Engineering electives.~~

~~Students seeking an emphasis in environmental~~

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) EDUC 003, EDUC 004

2. Additional upper-division requirements (8 units)

- a) Choose two courses from the following list: EDUC 109 or EDUC 109S, EDUC 110 or EDUC 110S, EDUC 116 or EDUC 116S, EDUC 174 or EDUC 174S, EDUC 175 or EDUC 175S

Physics: Applied Physics and Engineering Track (B.S degree)

1. 16 additional units of approved Engineering electives including a minimum of 8 units at the upper-division level. A list of approved CS, EE, ME, CEE, CHE, and BIEN courses is available upon request from your physics faculty academic advisor or your advisor in the CNAS Advising Center. Example course plans can be found in the department web pages.

~~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.).

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:

Changes to the Admissions Criteria for Transfer Students:

In 2012, the department introduced criteria that transfer students must satisfy to be eligible for admission to UCR as a physics major. We now believe these criteria are too strict. We studied the success rate of transfer students admitted before 2012 to evaluate which requirements are correlated with success as a physics major. We found that the minimum course grade requirements are unnecessary, and that first-year physics and math is sufficient preparation. Most students in the study also had second year math and chemistry completed. For details of this study, please see the attached pdf file.

Changes to the Physics Education Track:

These changes are based on the feedback from Thomas Smith, Dean of the UCR Graduate School of Education.

Regarding the removal of LING 020 or LING 021: it was a prerequisite for EDUC 177A, which was a required course for the Physics Education Track. EDUC 177A no longer exists and none of the current EDUC courses in the track require LING 020 or LING 021, so it is no longer needed for the track. The change to the additional upper-division requirements for the Physics Educational Track requirement makes the track more flexible. All the courses listed in the revision are useful preparation for a teaching credential program. However, we do not want to increase the number of required units for the track. We propose to allow the student to choose two courses from the list.

Changes to the Applied Physics and Engineering Track:

The tracks within the physics major replace 16 units of physics requirements with 16 units from another concentration. The current Applied Physics and Engineering Track consists of 8 units of physics requirements and 8 units of upper division engineering electives. The upper division engineering classes typically require 4 to 8 units of lower division engineering classes as prerequisites, increasing the effective number of units required for the track. The proposed change would make the engineering track

more flexible and allow students to take classes in computer science, electrical engineering, and mechanical engineering without increasing the number of required units for the major.

Addition of Honors versions of introductory physics (2 and 40 series):

The addition of honors versions is meant to allow instructors to spend more time on active engagement activities, such as problem solving in small groups, and provide more direct instructor contact with the advanced students. The instruction will be at a higher level of rigor and include advanced topics. Having an honors option for Physics will make the UCR undergraduate program more attractive to potential and current students. Five of the other UC campuses have some form of honors physics.

Approvals:

Approved by the faculty of the Department of Physics and Astronomy:	November 17, 2017
Approved by the Executive Committee of the College of Natural and Agricultural Sciences:	January 16, 2018
Reviewed by the Committee on Undergraduate Admissions:	April 10, 2018
Approved by the Committee on Educational Policy:	May 7, 2018

Courses that will satisfy the revised Applied Physics and Engineering Track for the Physics major

January 10, 2018

Contact person: Owen Long (owen.long@ucr.edu)

The Applied Physics and Engineering Track for the B.S. degree for the Physics major will be changed to require the following:

1. Additional upper- and lower-division requirements (16 units).
 - a) 16 units of approved Engineering electives including a minimum of 8 units at the upper-division level.

The courses listed below are all approved for the track. Courses not listed may be approved by a physics faculty academic advisor.

Computer Science, lower division

CS 010 Introduction to computer science for science, mathematics, and eng. (4)
CS 011 Introduction to Discrete Structures (4)
CS 012 Introduction to computer science for science, mathematics, and eng. II (4)
CS 013 Introductory computer science for engineering majors (4)
CS 014 Introduction to data structures and algorithms (4)
CS 030 Introduction to computational science and engineering (4)
CS 061 Machine organization and assembly language programming (4)

Computer Science, upper division

CS 100 Software construction (4)
CS 111 Discrete structures (4)
CS 120A Logic design (5)
CS 120B Introduction to embedded systems (4)
CS 121 Programming embedded systems (4)
CS 121L Laboratory in programming embedded systems (2)
CS 122A Intermediate Embedded and Real-Time Systems (5)
CS 122B Advanced Embedded and Real-Time Systems (5)
CS 130 Computer graphics (4)
CS 134 Video game creation and design (4)
CS 141 Intermediate data structures and algorithms (4)
CS 145 Combinatorial optimization algorithms (4)
CS 150 Automata and formal languages (4)
CS 152 Compiler design (4)
CS 153 Design of operating systems (4)
CS 160 Concurrent programming and parallel systems (4)
CS 161 Design architecture of computer systems (4)
CS 161L Laboratory in Design and Architecture of Computer Systems (2)
CS 162 Computer Architecture (4)

CS 164 Computer Networks (4)
CS 165 Computer Security (4)
CS 166 Database Management Systems (4)
CS 168 Introduction to Very Large Scale Integration (VLSI) Design (4)
CS 169 Mobile Wireless Networks (4)
CS 171 Introduction to Machine Learning and Data Mining (4)
CS 172 Introduction to Information Retrieval (4)
CS 175 Entrepreneurship in Computing (4)
CS 177 Modeling and Simulation (4)
CS 179 (E-Z) Project in Computer Science (4)
CS 179E Compilers (4)
CS 179F Operating Systems (4)
CS 179G Database Systems (4)
CS 179-I Networks (4)
CS 179J Computer Architecture and Embedded Systems (4)
CS 179K Software Engineering (4)
CS 179M Artificial Intelligence (4)
CS 179N Graphics and Electronic Games (4)
CS 180 Introduction to Software Engineering (4)
CS 181 Principles of Programming Languages (4)
CS 182 Software Testing and Verification (4)
CS 183 UNIX System Administration (4)

Electrical and Computer Engineering, lower division

EE 001A Engineering Circuit Analysis I (3)
EE 001B Engineering Circuit Analysis II (4)
EE 01LA Engineering Circuit Analysis I Laboratory (1)
EE 020 Linear Methods for Engineering Analysis and Design Using MATLAB (4)

Electrical and Computer Engineering, upper division

EE 100A Electronic Circuits (4)
EE 100B Electronic Circuits (4)
EE 105 Modeling and Simulation of Dynamic Systems (4).
EE 110A Signals and Systems (4)
EE 110B Signals and Systems (4)
EE 111 Digital and Analog Signals and Systems (4)
EE 114 Probability, Random Variables, and Random Processes in Electrical Engineering (4)
EE 115 Introduction to Communication Systems (4)
EE 116 Engineering Electromagnetics (4)
EE 117 Electromagnetics II (4)
EE 120A Logic Design (5)
EE 120B Introduction to Embedded Systems (4)
EE 123 Power Electronics (4)
EE 128 Data Acquisition, Instrumentation, and Process Control (4)

EE 132 Automatic Control (4)
EE 133 Solid-State Electronics (4)
EE 135 Analog Integrated Circuit Layout and Design (4)
EE 136 Semiconductor Device Processing (4)
EE 137 Introduction to Semiconductor Optoelectronic Devices (4)
EE 138 Electrical Properties of Materials (4)
EE 139 Magnetic Materials (4)
EE 141 Digital Signal Processing (4)
EE 144 Introduction to Robotics (4)
EE 145 Robotic Planning and Kinematics (4)
EE 146 Computer Vision (4)
EE 150 Digital Communications (4)
EE 151 Introduction to Digital Control (4)
EE 152 Image Processing (4)
EE 153 Electric Drives (4)
EE 155 Power System Analysis (4)
EE 162 Introduction to Nanoelectronics (4)
EE 165 Design for Reliability of Integrated Circuits and Systems (4)
EE 168 Introduction to Very Large Scale Integration (VLSI) Design (4)

Mechanical Engineering, lower division

ME 002 Introduction to Mechanical Engineering (4)
ME 018 Introduction to Engineering Computation (4)

Mechanical Engineering, upper division

ME 100A Thermodynamics (4)
ME 100B Thermodynamics (4)
ME 103 Dynamics (4)
ME 110 Mechanics of Materials (4)
ME 113 Fluid Mechanics (4)
ME 114 Introduction to Materials Science and Engineering (4)
ME 116A Heat Transfer (4)
ME 116B Heat Transfer (4)
ME 117 Combustion and Energy Systems (4)
ME 118 Mechanical Engineering Modeling and Analysis (4)
ME 120 Linear Systems and Controls (4)
ME 121 Feedback Control (4)
ME 122 Vibrations (4)
ME 130 Kinematic and Dynamic Analysis of Mechanisms (4)
ME 131 Design of Mechanisms (4)
ME 133 Introduction to Mechatronics (4)
ME 135 Transport Phenomena (4)
ME 136 Environmental Impacts of Energy Production and Conversion (4)
ME 137 Environmental Fluid Mechanics (4)
ME 138 Transport Phenomena in Living Systems (4)
ME 140 Ship Theory (4)

ME 144 Introduction to Robotics (4)
ME 145 Robotic Planning and Kinematics (4)
ME 153 Finite Element Methods (4)
ME 156 Mechanical Behavior of Materials (4)
ME 170A Experimental Techniques (4)
ME 170B Experimental Techniques (4)
ME 174 Machine Design (4)
ME 176 Sustainable Product Design (4)
ME 180 Optics and Lasers in Engineering (4)

Chemical and Environmental engineering, upper division

CEE 125 Analytical Methods for Chemical and Environmental Engineers (4)
CEE 132 Green Engineering (4)
CEE 135 Chemistry of Materials (4)
CEE 136 Aerosol Technology (4)
CEE 140A Biomaterials (4)
CEE 140B Biomaterials (4)
CEE 159 Dynamics of Biological Systems (4)
CHE 100 Engineering Thermodynamics (4)
CHE 102 Catalytic Reaction Engineering (4)
CHE 105 Introduction to Nanoscale Engineering (4)
CHE 110A Chemical Process Analysis (3)
CHE 110B Chemical Process Analysis (3)
CHE 114 Applied Fluid Mechanics (4)
CHE 116 Heat Transfer (4)
CHE 117 Separation Processes (4).
CHE 118 Process Dynamics and Control (4)
CHE 120 Mass Transfer (4)
CHE 122 Chemical Engineering Kinetics (4)
CHE 124 Biochemical Engineering Principles (4)
CHE 124L Biochemical Engineering Laboratory (2)
CHE 130 Advanced Engineering Thermodynamics (4)
CHE 131 Electrochemical Engineering (4)
CHE 136 Advanced Topics in Heat Transfer (4)
CHE 140 Cell Engineering (4)
CHE 150 Biosensors (4)
CHE 160A Chemical and Environmental Engineering Laboratory (3)
CHE 160B Chemical Engineering Laboratory (3)
CHE 160C Chemical Engineering Laboratory (3)
CHE 161 Nanotechnology Processing Laboratory (3)
CHE 171 Pollution Control for Chemical Engineers (4)

Bioengineering, lower division

BIEN 010 Overview of Bioengineering (4)

Bioengineering, upper division

BIEN 101 Quantitative Biochemistry (4)
BIEN 105 Circulation Physiology (4)
BIEN 110 Biomechanics of the Human Body (4)
BIEN 115 Quantitative Physiology (4)
BIEN 120 Biosystems and Signal Analysis (4)
BIEN 125 Biotechnology and Molecular Bioengineering (4)
BIEN 130 Bioinstrumentation (4)
BIEN 130L Bioinstrumentation Laboratory (2)
BIEN 135 Biophysics and Biothermodynamics (4)
BIEN 136 Tissue Engineering (4)
BIEN 137 Advanced Biomechanics (4)
BIEN 138 Fundamental Principles of Wound Repair (4)
BIEN 140A Biomaterials (4)
BIEN 140B Biomaterials (4)
BIEN 142 Introductory Biomedical Optical Imaging (4)
BIEN 155 Biotechnology Laboratory (2)
BIEN 159 Dynamics of Biological Systems (4)
BIEN 160 Biomedical Imaging (4)
BIEN 165 Biomolecular Engineering (4)
BIEN 166 Bioinspired Engineering for Sustainable Energy (4)
BIEN 167 Medical Diagnostics (4)