

# EP and EE & Society ELECTIVES

(effective fall 2017)

Professional and technical electives are an integral part of the ECE major curriculum. They allow students course flexibility as well as the unique opportunity to tailor their major to their personal interests and professional goals.

## Please note:

- ALL COURSES USED TO SATISFY MAJOR REQUIREMENTS MUST BE TAKEN FOR A LETTER GRADE AND RECEIVE A GRADE OF C- OR BETTER.
- This is a comprehensive list of courses that will count towards your electives, but it is not a guarantee that they will be offered every year/quarter or that you will be able to enroll as prerequisites must be completed prior to enrolling. Enrollment and offering of courses depend on respective departments' schedules, prerequisites, and policies. Please follow all department policies.
- EP majors are required to complete 3 Technical Electives and 2 Professional Electives.
- EE & Society majors are required to complete 4 upper division Technical Electives only.
- ECE graduate classes may count towards your electives.

Be sure to scroll *all the way down* to see the full list of electives and read any important **notes**.

## Professional Electives ONLY

Professional electives are acceptable courses taken in one department. Normally, these will be upper-division courses in engineering, mathematics, or physics. Students may also choose upper-division courses from other departments provided that they fit into a coherent professional program. In such cases, a lower-division prerequisite may be included in the electives. Courses other than upper-division engineering, mathematics, or physics must be justified in terms of such a program, and must be approved by the ECE department. Please keep in mind that there are courses not listed that are acceptable Professional Electives.

<p><b>BIOLOGICAL SCIENCES</b> 1 lower division and 2 upper division Biology courses OR 3 upper division Biology courses will satisfy Professional Electives BILD 1 The Cell BILD 2 Multicellular Life BILD 3 Organismic and Evolutionary Biology BIBC 140 Introduction to Biofuels BICD 100 Genetics BIEB 140 Biodiversity BIEB 166 Animal Behavior and Communication BIPN 146 Computational Neurobiology</p> <p><b>CHEMISTRY (CHEM)</b> 1 lower division and 2 upper division CHEM courses OR 3 upper division CHEM courses will satisfy Professional Electives 6B General Chemistry II 6C General Chemistry III 140A Organic Chemistry I 140B Organic Chemistry II 140C Organic Chemistry III 143A Organic Chemistry Laboratory</p> <p><b>COGNITIVE SCIENCE (COGS)</b> <i>Any upper division COGS courses will satisfy Professional Electives ONLY</i> 109 Modeling and Data Analysis 118A Natural Computation I 118B Natural Computation II 185 Advanced Machine Learning Methods 189 Brain Computer Interfaces</p> <p><b>Note:</b> Lower division COGS courses will NOT count as either professional or technical elective credit.</p>	<p><b>COMPUTER SCIENCE &amp; ENGINEERING (CSE)</b> 12 Basic Data Structures and Object-Oriented Design 20 Discrete Mathematics 21 Mathematics for Algorithms and Systems</p> <p><b>Note:</b> CSE 3, 4GS, 6GS, 5A, 7, 8A-B, 11,15L, 30, 42, 80, 86, 91, 123A, 140, 140L, 141L will not count as either professional or technical elective credit.</p> <p><b>ECONOMICS (ECON)</b> Students must follow one of the tracks below: <b>Note:</b> If economics is chosen for professional electives, only 1 technical elective is required for engineering physics major.</p> <p>ECON 1 and 3 followed by the courses in one of the following tracks: → Macroeconomics: ECON 110A-B → Monetary economics: ECON 111, and another economics upper division elective</p> <p>ECON 1 and 2 followed by two courses in one of the following tracks: → Public and Environmental: ECON 118, 130, 131, 132, 133, 137, 145 → Labor and Human Resources: ECON 137, 139, 140 Note: ECON 100A can be substituted for ECON 2.</p> <p>ECON 1 and 100A followed by 2 courses in one of the following tracks: → Microeconomics: ECON 100B-C → Financial Markets: ECON 120B and 173A → Operations Research: ECON 172A-B (after taking ECE 109 and MATH 20F) → Human Resources: ECON 100B and 136 <b>Note:</b> ECON 120A, and 158-159 will not be allowed as professional electives.</p> <p><b>ELECTRICAL AND COMPUTER ENGINEERING</b> 180 Topics in ECE: Entrepreneurship counts towards one Professional Elective ONLY</p>	<p><b>GlobalTIES (ENG)</b> <i>12 units of GlobalTIES courses will satisfy 3 Professional Electives ONLY</i></p> <p><b>MATHEMATICS (MATH)</b> 163 History of Mathematics</p> <p><b>Note:</b> Lower division Math, Math 180A-B, 183, and 186 will NOT count as either professional or technical elective credit.</p> <p><b>MANAGEMENT, RADY SCHOOL OF (MGT)</b> 1 lower division and 2 upper division MGT courses OR 3 upper division MGT courses 103 Product Marketing and Management 105 Product Promotion and Brand Management 106 Sales and Sales Management 121A Innovation to Market A 121B Innovation to Market B 164 Organizational Leadership 166 Business Ethics and Corporate Responsibility 172 Business Project Management 174 Supply Chain and Operations Management</p> <p><b>Note:</b> Lower division MGT courses will NOT count for technical elective credit.</p> <p><b>SPECIAL STUDIES</b> 197-199: At most, 4 units of 195-199 may be used for elective credit. 197: will count towards Professional Elective ONLY</p>
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## Professional OR Technical Electives

Technical electives must be upper-division engineering, math or physics courses. EP majors: at most **one** lower-division course in engineering may be used but it must receive prior approval from the ECE department.

### COMPUTER SCIENCE & ENGINEERING (CSE)

100 Advanced Data Structures  
101 Design and Analysis of Algorithms  
103 A Practical Introduction to Probability and Statistics  
105 Theory of Computability  
107 Introduction to Modern Cryptography  
110 Software Engineering  
112 Advanced Software Engineering  
118 Ubiquitous Computing  
120 Principles of Computer Operating Systems  
121 Operating Systems: Architecture and Implementation  
124 Networked Services  
125 Software System Design and Implementation  
127 Introduction to Computer Security  
130 Programming Languages: Principles and Paradigms  
131 Compiler Construction  
132A Database System Principles  
132B Database Systems Applications  
134B Web Client Languages  
135 Server-side Web Applications  
141 Introduction to Computer Architecture  
143 Microelectronic System Design  
144 Computer-Aided Design of VLSI Circuits  
145 Embedded System Design Project  
148 Advanced Processor Architecture Design Project  
150 Intro to Artificial Intelligence: Search & Reasoning  
151 Intro to Artificial Intelligence: Statistical Approaches  
152 Introduction to Computer Vision  
153 Cognitive Modeling  
160 Introduction to Parallel Computing  
164 GPU Programming  
165 3D User Interaction  
166 Image Processing  
167 Computer Graphics  
168 Computer Graphics II: Rendering  
169 Computer Animation  
170 Introduction to Human-Computer Interaction Design  
181 Molecular Sequence Analysis  
182 Biological Databases  
184 Computational Molecular Biology  
190 Topics in Computer Science and Engineering  
252B Computer Vision II

**Note:** CSE 3, 4GS, 6GS, 5A, 7, 8A-B, 11, 15L, 30, 42, 80, 86, 91, 123A, 140, 140L, 141L will not count as either professional or technical elective credit. The CSE Department strictly enforces prerequisites.

### BIOENGINEERING (BENG)

The following series of courses will provide “core” preparation in bioengineering and will satisfy up to five (5) courses of the ECE elective requirements:  
BILD 1, BILD 2, BE 100, BE 140A-B.

The Bioengineering department will guarantee admission to these courses for ECE students on a space available basis. All five courses must be completed in order to receive elective credit.

### ELECTRICAL & COMPUTER ENGINEERING (ECE)

**Note:** Any course(s) used for your Breadth, Depth or Design may not be used towards your electives

16 Rapid Hardware and Software Design for Interfacing with the World  
111 Advanced Digital Design Project  
115 Fast Prototyping  
118 Computer Interfacing 120 Solar System Physics  
121 Energy Conversion  
123 Antenna Systems Engineering  
125A Power Electronics I  
125B Power Electronics II  
134 Electronic Materials Science of Integrated Circuits  
135A Semiconductor Physics  
135B Electronic Devices  
136L Microelectronics Laboratory  
138L Microstructuring Processing Technology Laboratory  
139 Semiconductor Device Design & Modeling  
145AL-BL-CL Acoustics Laboratory  
146 Introduction to Magnetic Recording  
153 Probability and Random Processes for Engineers  
154A Communications Systems I  
154B Communications Systems II  
154C Communications Systems III  
155A Digital Recording Systems  
155B Digital Recording Projects I  
155C Digital Recording Projects II  
156 Sensor Networks  
157A Communications Systems Laboratory I  
158A Data Networks I  
158B Data Networks II  
161A Introduction to Digital Signal Processing  
161B Digital Signal Processing I  
161C Applications of Digital Signal Processing  
163 Electronic Circuits and Systems  
164 Analog Integrated Circuit Design  
165 Digital Integrated Circuit Design  
166 Microwave Systems and Circuits

### ECE Continued

171A-B Linear Control System Theory  
172A Intro to Intelligent Systems: Robotics and Machines  
174 Introduction to Linear and Nonlinear Optimization with Applications  
175A Elements of Machine Intelligence: Pattern Recognition and Machine Learning  
175B Elements of Machine Intelligence: Probabilistic Reasoning and Graphical Models  
180 Topics in Electrical and Computer Engineering  
\*180 Topics in ECE: Entrepreneurship counts for 1 Professional Elective only  
181 Physical Optics and Fourier Optics  
182 Electromagnetic Optics, Guided-Wave, & Fiber Optics  
183 Optical Electronics  
184 Optical Information Processing and Holography  
185 Lasers & Modulators  
187 Introduction to Biomedical Imaging and Sensing  
188 Topics in ECE with Laboratory  
190 Engineering Design  
191 Engineering Group Design Project  
193H Honors Project  
202 Medical Devices and Interfaces  
212AN Principles of Nanoscience and Nanotechnology  
222C Applied Electromagnetic Theory – Computational Methods for Electromagnetics  
230A Solid State Electronics I  
240A Lasers and Optics  
250 Random Processes  
251A Digital Signal Processing I  
253 Fundamentals of Digital Image Processing  
260A VLSI Digital System Algorithms and Architectures  
264B CMOS Analog Integrated Circuits and Systems II  
265A Communication Circuit Design I  
271A Statistical Learning I  
289 Special Topics in Electrical & Computer Engineering

### MATHEMATICS (MATH)

100A Abstract Algebra  
100B Abstract Algebra II  
100C Abstract Algebra III  
102 Applied Linear Algebra  
103A Modern Algebra I  
103B Modern Algebra II  
104A Number Theory I  
104B Number Theory II  
104C Number Theory III

### **Mathematics continued**

109 Mathematical Reasoning  
110A Intro to Partial Differential Equations  
110B Elements of Partial Differential & Integral Equations  
111A Mathematical Modeling I  
111B Mathematical Modeling II  
120A Elements of Complex Analysis  
120B Applied Complex Analysis  
121A Foundations of Teaching and Learning Mathematics  
121B Foundations of Teaching and Learning Math II  
130A Ordinary Differential Equations I  
130B Ordinary Differential Equations II  
140A Foundations of Real Analysis I  
140B Foundations of Real Analysis II  
140C Foundations of Real Analysis III  
142A Introduction to Analysis I  
142B Introduction to Analysis II  
150A Differential Geometry  
150B Calculus on Manifolds  
152 Applicable Mathematics and Computing  
153 Geometry from Secondary Teachers  
154 Discrete Mathematics and Graph Theory  
155A Geometric Computer Graphics  
160A Elementary Mathematical Logic I  
160B Elementary Mathematical Logic II  
168A Topics in Applied Mathematics – Computer Science  
170A Introduction to Numerical Analysis: Linear Algebra  
170B Introduction to Numerical Analysis: Approximation and Nonlinear Equations  
170C Intro to Numerical Analysis: Ordinary Differential Equations  
171A Intro to Numerical Optimization: Linear Programming  
171B Intro to Numerical Optimization: Nonlinear Programming  
174 Numerical Methods for Physical Modeling  
175 Numerical Methods for Partial Differential Equations  
179 Projects in Computational and Applied Mathematics  
180C Introduction to Stochastic Processes II  
181A Introduction to Mathematical Statistics I  
181B Introduction to Mathematical Statistics II  
181C Mathematical Statistics – Nonparametric Statistics  
181E Mathematical Statistics – Time Series  
184A Combinatorics  
185 Introduction to Computational Statistics  
187 Introduction to Cryptography  
189 Exploratory Data Analysis and Inference  
190 Introduction to Topology

**Note:** Lower division Math, Math 180A–B, 183, or 186 will not count as either professional or technical elective credit

### **MECHANICAL & AEROSPACE ENGINEERING (MAE)**

101A Introductory Fluid Mechanics  
101B Advanced Fluid Mechanics  
101C Heat Transfer  
104 Aerodynamics  
107 Computational Methods in Engineering  
110A Thermodynamics  
110B Thermodynamic Systems  
113 Fundamentals of Propulsion  
117A Elementary Plasma Physics  
118 Introduction to Energy Systems  
119 Introduction to Renewable Energy: Solar and Wind  
120 Introduction to Nuclear Energy  
121 Air Pollution Transport and Dispersion Modeling  
122 Flow and Transport in the Environment  
123 Introduction to Transport in Porous Media  
124 Environmental Challenges: Science and Solutions  
126A Environmental Engineering Laboratory  
126B Environmental Engineering Design  
130A Mechanics I: Statistics  
130B Mechanics II: Dynamics  
130C Mechanics III: Vibrations  
131A Solid Mechanics I  
131B Fundamentals of Solid Mechanics II  
131C Solid Mechanics III  
132 Intermediate Dynamics  
133 Finite Element Methods in MAE  
142 Dynamics and Control of Aerospace Vehicles  
143A Signals and Systems  
143C Digital Control Systems  
149 Sensor Networks  
150 Computer-Aided Design  
154 Product Design and Entrepreneurship  
155A Aerospace Engineering Design  
155B Aerospace Engineering Design II  
156A Fundamental Principles of Mechanical Design I  
156B Fundamental Principles of Mechanical Design II  
160 Mechanical Behavior of Materials  
165 Fatigue and Failure Analysis of Engineering Components  
166 Nanomaterials  
167 Wave Dynamics in Materials  
168 MEMS Materials, Fabrication, and Applications  
171A Mechanical Engineering Laboratory I  
171B Mechanical Engineering Laboratory II  
175A Aerospace Engineering Laboratory I  
180A Spacecraft Guidance I  
181 Space Mission Analysis and Design

**Note:** MAE 2, 3, 5, 8, 9, 20, 105, 108, 139, 140, 143B, and 170 will not count as either professional or technical

### **NANOENGINEERING (NANO)**

100L Physical Properties of Materials Lab  
101 Introduction to Nanoengineering  
102 Foundations in Nanoengineering: Chemical Principles  
103 Foundations in Nanoengineering: Biochemical Principles  
104 Foundations in Nanoengineering: Physical Principles  
106 Crystallography of Solids  
107 Electronic Devices and Circuits for Nanoengineers  
108 Materials Science and Engineering  
110 Modeling of Nanoengineering Systems  
111 Characterization of Nanoengineering Systems  
112 Synthesis and Fabrication of NANO Systems  
114 Probability and Statistical Methods for Engineers  
120A Nanoengineering System Design I  
120B Nanoengineering System Design II  
134 Polymeric Materials  
141A Engineering Mechanics I: Analysis of Equilibrium  
143 Nanomedicine  
146 Nanoscale Optical Microscopy and Spectroscopy  
148 Thermodynamics of Materials  
150 Mechanics of Nanomaterials  
156 Nanomaterials  
158 Phase Transformations and Kinetics  
158L Materials Processing Laboratory  
161 Material Selection in Engineering  
164 Advanced Micro- and Nano-materials for Energy Storage and Conversion  
168 Electrical, Dielectric, and Magnetic Properties of Engineering Materials  
174 Mechanical Behavior of Materials  
174L Mechanical Behavior Laboratory  
247B BioElectronics

### **PHYSICS (PHYS)**

100A Electromagnetism I  
100B Electromagnetism II  
100C Electromagnetism III  
105A Mathematical and Computational Physics I  
105B Mathematical and Computational Physics II  
110A Mechanics I  
110B Mechanics II  
111 Introduction to Ocean Waves  
120 Circuits and Electronics  
122 Experimental Techniques  
124 Laboratory Projects  
130A Quantum Physics I  
130B Quantum Physics II  
130C Quantum Physics III  
133 Condensed Matter/Materials Science Laboratory  
137 String Theory  
139 Physics Special Topics

	elective credit	
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**Physics continued**

- 140A Statistical and Thermal Physics I
- 140B Statistical and Thermal Physics II
- 141 Computational Physics I: Probabilistic Models and Simulations
- 142 Computational Physics II: PDE and Matrix Models
- 151 Elementary Plasma Physics
- 152A Condensed Matter Physics
- 152B Electronic Materials
- 154 Elementary Particle Physics
- 160 Stellar Astrophysics
- 161 Black Holes
- 162 Cosmology
- 163 Galaxies and Quasars
- 170 Medical Instruments: Principles and Practice
- 173 Modern Physics Lab: Biological and Quantum Physics
- 175 Fundamentals of Biological Physics
- 176 Quantitative Molecular Biology
- 177 Physics of the Cell
- 178 Biophysics of Neurons and Networks

**Note:** Lower division PHYS courses will not count as either professional or technical elective credit

**STRUCTURAL ENGINEERING (SE)**

- 101A Mechanics I: Statics
- 101B Mechanics II: Dynamics
- 101C Mechanics III: Vibrations
- 102 Numerical, Computational, and Graphical Tools for Structural Engineering I
- 103 Conceptual Structural Design
- 110A Solid Mechanics I
- 110B Solid Mechanics II
- 111A-B Steel Bridge Design Competition
- 112A-B Concrete Canoe Design Competition
- 115 Fluid Mechanics for Structural Engineering
- 120 Engineering Graphics & Computer Aided Structural Design
- 121 Computational and Graphical Tools for Structural Engineering II
- 125 Statistics, Probability and Reliability
- 130A-B Structural Analysis
- 131 Finite Element Analysis
- 140 Structures and Materials Laboratory
- 142 Design of Composite Structures
- 150 Design of Steel Structures
- 151A Design of Reinforced Concrete
- 151B Design of Prestressed Concrete
- 152 Seismic Design of Structures
- 154 Design of Timber Structures
- 160A Aerospace Structural Mechanics I
- 160B Aerospace Structural Mechanics II
- 163 Nondestructive Evaluation
- 165 Structural Health Monitoring
- 168 Structural System Testing and Model Correlation
- 171 Aerospace Structures Repair
- 180 Earthquake Engineering
- 181 Geotechnical Engineering
- 182 Foundation Engineering
- 184 Ground Improvement

**Note:** Lower division SE courses will not count as either professional or technical elective credit

**SPECIAL STUDIES**

- 197-199: At most, 4 units of 195-199 may be used for elective credit.
- 197: will count towards Professional Elective ONLY