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Engineering Curriculum Map 2013-2014

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This map displays degree requirements, courses, faculty information, clubs & organizations, and Library resources associated with American Studies across the seven Claremont Colleges (7Cs) for the 2013-14 academic year. It was compiled using public information drawn from Colleges websites, course schedules and catalogs, and the Claremont Colleges Library website. **These maps should be understood as a snapshot of the consortium in time, and not representative of current information beyond 2013-14.**
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Claremont Colleges Library: Engineering (Harvey Mudd College) - 2013-2014

Additional Programs

- Engineering Clinic
- Engineering Internship Program (EIP)
- Fellowships

Classes

- Engineering Core
  - Fall
    - E4: Introduction to Design and Manufacturing (4; Fall & Spring)
      - Design problems are, typically, open-ended and ill-structured. Students work in small teams applying techniques for solving design problems that are, normally, posed by not-for-profit clients. The project work is enhanced with lectures and reading on design theory and methods, and introduction to manufacturing techniques, project management techniques and engineering ethics.
    - E59: Introduction to Engineering Systems (3; Fall & Spring)
      - An introduction to the concepts of modern engineering, emphasizing modeling, analysis, synthesis and design. Applications to chemical, mechanical and electrical systems.
    - E82: Chemical and Thermal Processes (3; Fall & Spring)
      - The basic elements of thermal and chemical processes, including: state variables, open and closed systems, and mass balance; energy balance, First Law of Thermodynamics for reactive and non-reactive systems; entropy balance, Second Law of Thermodynamics, thermodynamic cycles and efficiency.
    - E83: Continuum Mechanics (3; Fall & Spring)
      - The fundamentals of modeling continuous media, including: stress, strain and constitutive relations; elements of tensor analysis; basic applications of solid and fluid mechanics (including beam theory, torsion, statically indeterminate problems and Bernoulli's principle); application of conservation laws to control volumes.
    - E84: Electronic and Magnetic Circuits and Devices (2; Fall & Spring)
      - Introduction to the fundamental principles underlying electronic and magnetic devices and applications of these devices in circuits. Topics include electrical and magnetic properties of materials; physical electronics (with emphasis on semiconductors and semiconductor devices); passive linear electrical and magnetic circuits; active linear circuits (including elementary transistor amplifiers and the impact of non-ideal characteristics of operational amplifiers on circuit behavior); operating point linearization and load-line analysis; electromagnetic devices such as transformers; and selection criteria for motors.
    - E85: Digital Electronics and Computer Engineering (3; Fall & Spring)
      - This course provides an introduction to elements of digital electronics, followed by an introduction to digital computers. Topics in digital electronics include: Boolean algebra; combinational logic; sequential logic; finite state machines; transistor-level implementations; computer arithmetic; and transmission lines. The computer engineering portion of the course includes computer architecture and micro-architecture: levels of abstraction; assembly-language programming; and memory systems.
    - E101-102: Advanced Systems Engineering (3/semester; Year Long Sequence)
      - Analysis and design of continuous-time and discrete-time systems using time domain and frequency domain techniques. The first semester focuses on the connections and distinctions between continuous-time and discrete-time signals and systems and their representation in the time and frequency domains. Topics include impulse response, convolution, continuous and discrete Fourier series and transforms, and frequency response. Current applications, including filtering, modulation and sampling, are presented and simulation techniques based on both time and frequency domain representations are introduced. In the second semester additional analysis and design tools based on the Laplace- and z-transforms are developed and the state space formulation of continuous and discrete-time systems is presented. Concepts covered during both semesters are applied in a comprehensive treatment of feedback control systems including performance criteria, stability, observability, controllability, compensation and pole placement.
    - E106: Materials Engineering (3; Fall & Spring)
      - Introduction to the structure, properties and processing of materials used in engineering applications. Topics include: material structure (bonding, crystalline and non-crystalline structures, imperfections); equilibrium microstructures; diffusion, nucleation, growth, kinetics, non-equilibrium processing; microstructure, properties and processing of: steel, ceramics, polymers and composites; creep and yield; fracture mechanics; and the selection of materials and appropriate performance indices.
    - E111: Engineering Clinic I (3; Fall & Spring)
      - Participation in engineering projects through the Engineering Clinic. Emphasis is on design of solutions for real problems, involving problem definition, synthesis of concepts, analysis and evaluatio
    - E112-113: Engineering Clinic II-III (3; Fall & Spring)
      - Participation in engineering projects through the Engineering Clinic. Emphasis is on design of solutions for real problems, involving problem definition, synthesis of concepts, analysis and evaluation.
    - E121-124: Engineering Seminar (No Credit; Year Long Sequence)
      - Weekly meetings devoted to discussion of engineering practice.
  - Spring
    - E4: Introduction to Design and Manufacturing (4; Fall & Spring)
      - Design problems are, typically, open-ended and ill-structured. Students work in small teams applying techniques for solving design problems that are, normally, posed by not-for-profit clients. The project work is enhanced with lectures and reading on design theory and methods, and introduction to manufacturing techniques, project management techniques and engineering ethics.
    - E59: Introduction to Engineering Systems (3; Fall & Spring)
      - An introduction to the concepts of modern engineering, emphasizing modeling, analysis, synthesis and design. Applications to chemical, mechanical and electrical systems.
    - E80: Experimental Engineering (3; Spring)
      - A laboratory course designed to acquaint the student with the basic techniques of instrumentation and measurement in both the laboratory and in engineering field measurements. Emphasis on experimental problem solving in real systems.
    - E82: Chemical and Thermal Processes (3; Fall & Spring)
      - The basic elements of thermal and chemical processes, including: state variables, open and closed systems, and mass balance; energy balance, First Law of Thermodynamics for reactive and non-reactive systems; entropy balance, Second Law of Thermodynamics, thermodynamic cycles and efficiency.
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    - E121-124: Engineering Seminar (No Credit; Year Long Sequence)
      - Weekly meetings devoted to discussion of engineering practice.
  - Unspecified
    - E72: Engineering Mathematics
- Engineering Electives
  - Fall
    - E85A: Digital Electronics (1.5; Fall & Spring)
      - This course provides an introduction to elements of digital electronics, intended for non-engineering majors who may be interested in pursuing other advanced engineering courses that require this background.
    - E115: Project Management (3; Fall)
      - This course teaches tools and techniques commonly used in managing engineering projects, including work breakdown structures, PERT/CPM analysis, and budgeting, forecasting and aspects of project control. It also introduces use of models and operations research techniques in selecting and assigning resources to projects. Students are required to develop and implement a work plan for a small-scale project, typically a Clinic project.
    - E117: Economics of Technical Enterprise (3; Fall)
      - Time value of money, interest rates, depreciation and depletion, personal and corporate taxes, investment yardsticks such as present worth, rate of return, payback period and cost/benefit analysis, venture analysis and comparison of alternative projects, cost estimation and inflation, personal economics and investments, current business economic topics, tempering economics with judgment.
    - E119: Preliminary Design (3; Fall every other year)
      - This course examines the general principles associated with functional analysis and preliminary design, and applies these principles to a particular design problem. Students in the course will be expected to demonstrate competency in the application of functional analysis techniques and setting of performance specifications, design of artifacts to meet the functional specifications, and documentation of successful designs. Students will be offered a choice of several design problems, which may come from one of the traditional engineering disciplines (chemical, civil, electrical, mechanical, etc.) or may cut across several boundaries.
    - E131: Fluid Mechanics (3; Fall)
      - The flow of incompressible fluids. Primarily a study of momentum transport in continuous media. Included are the treatment of viscosity, the equations of continuity and of motion, and turbulence. Applications to analysis and design.
    - E133: Chemical Reaction Engineering (3; Fall every other year)
      - The fundamentals of chemical reactor engineering: chemical reaction kinetics, interpretation of experimental rate data, design of batch and continuous reactors for single and multiple reactions including temperature and pressure effects, and the importance of safety considerations in reactor design.
    - E151: Engineering Electronics (3; Fall)
      - Analysis and design of circuits using diodes, bipolar junction transistors and field-effect transistors, following a brief treatment of solid state electronics and the physics of solid state devices. Analysis and design of single and multi-transistor linear circuits including operational amplifiers
    - E153: Electronics Laboratory (1; Fall)
      - Experimental evaluation of electronic devices and circuits.
    - E155: Microprocessor-based Systems: Design and Applications (4; Fall)
      - Introduction to digital design using programmable logic and microprocessors. Combinational and sequential logic. Finite state machines. Hardware description languages. Field programmable gate arrays. Microcontrollers and embedded system design. Students gain experience with complex digital system design, embedded programming, and hardware/software trade-offs through significant laboratory and project work.
    - E159: Engineering Electromagnetics (3; Fall every other year)
      - Analysis of electrostatic systems, magnetostatic systems, Maxwell's equations, eddy current systems, transmission lines, radar, wave guides and antennae.
    - E161: Computer Image Processing and Analysis (3; Fall every other year)
      - An introduction to both image processing, including acquisition, enhancement and restoration; and image analysis, including representation, classification and recognition. Discussion on related subjects such as unitary transforms, and statistical and neural network pattern recognition methods. Project oriented.
    - E171: Dynamics of Elastic Systems (3; Fall)
      - Free and forced response of single- degree-of-freedom systems. Eigenvalue problem for multi-degree-of-freedom systems; natural modes of free vibration. Forced response of undamped and viscously damped, multi-degree-of-freedom systems by modal analysis.
    - E173: Applied Elasticity (3; Fall every other year)
      - Introduction to the concepts of stress and strain. Application to the theory of bending and torsion. Topics in elementary elasticity.
    - E175: Dynamics of Rigid Bodies (3; Fall)
      - Kinematics, mass distribution and kinetics of systems of particles and rigid bodies. Formulation of equations of motion with: Newton/Euler equations; angular momentum principle; power, work, and energy methods. Numerical solutions of nonlinear algebraic and ordinary differential equations governing the behavior of multiple degree of freedom systems. Computer simulation of multi-body dynamic systems. Construction of physical systems for comparison with simulation
    - E179: Deformation and Fracture of Solids (3; Fall every other year)
      - Elements of stress and strain, elastic and plastic deformations of solid materials, fracture mechanics, strengthening mechanisms, thermal and thermo-mechanical processing, effects of microstructure, failure modes and analysis of service failures.
    - E205: Systems Simulation (3; Fall)
      - An examination of the use of high-speed digital computers to simulate the behavior of engineering and industrial systems. Both continuous and discrete systems are treated.
  - Spring
    - E85A: Digital Electronics (1.5; Fall & Spring)
      - This course provides an introduction to elements of digital electronics, intended for non-engineering majors who may be interested in pursuing other advanced engineering courses that require this background.
    - E116: Cost Estimation and Modeling (3; Spring every other year)
      - Principles of cost and schedule estimation and modeling for capital projects, and for estimation and budgeting of operations and maintenance of ongoing processes. Hardware and software and integrated design projects are included. Advantages and disadvantages of different estimation methods are explored.
    - E118: Engineering Management (3; Spring)
      - Introduction to the concepts of modern management including the scientific, behavioral and functional schools of thought, motivational models, leadership styles, organizational structures, project management, and other areas of student interest.
    - E132: Heat Transfer (3; Spring)
      - A study of conduction, convection and radiation phenomena with application to selected problems in several fields of engineering
    - E134: Advanced Engineering Thermodynamics (3; Spring every other year)
      - The application of classical thermodynamics to engineering systems. Topics include power and refrigeration cycles, energy and process efficiency, real gases and non-ideal phase and chemical reaction equilibria.
    - E136: Mass Transfer and Separation Processes (3; Spring every other year)
      - Principles of mass transfer, application to equilibrium-stage and finite-rate separation processes. Extension of design principles to multistage systems and to countercurrent differential contacting operations. Applications from the chemical processing industries and from such fields as desalination, pollution control and water reuse.
    - E138: Introduction to Environmental Engineering (3; Spring every other year)
      - Introduction to the main concepts and applications in modern environmental engineering. Included are surface and groundwater pollution (both classical pollutants and toxic substances); risk assessment and analysis; air pollution; and global atmospheric change.
    - E140: Introduction to Compressible Flow (3; Spring every other year)
      - The effects of compressibility in the governing integral and differential equations for fluids. The effects of friction, heating and shock waves in steady one-dimensional flow. Unsteady wave motion and the method of characteristics. Two-dimensional flow over air foils, linearized potential flow and the method of characteristics for supersonic flow.
    - E156: Introduction to Communication and Information Theory (3; Spring)
      - Comprehensive treatment of explicit and random signal transmission through linear communication networks by generalized harmonic analysis including signal sampling and modulation theories. Treatment of noise in communication systems including design of optimum linear filters and systems for signal detection. Introduction to information theory including the treatment of discrete noiseless systems, capacity of communication channels and coding processes.
    - E158: Introduction to CMOS VLSI Design (3; Spring)
      - Introduction to digital integrated system design. Device and wire models, gate topologies, logical effort, latching, memories and timing. Structured physical design and CAD methodology. Final team project involves design and fabrication of custom chips.
    - E164: Introduction to Biomedical Engineering (3; Spring every other year)
      - The application of engineering principles to help pose and solve problems in medicine and biology. Focus on different aspects, particularly biomedical measurements, bio systems analysis, biomechanics and biomaterials.
    - E166: High-Speed PC Board Design (3; Spring every other year)
      - This course provides the student exposure to fundamental and practical issues in the design and fabrication of printed circuit boards (PCBs), with primary emphasis on boards for high-speed digital circuits. Students work in teams to design a high-speed PCB, which is then fabricated and subsequently tested by the students. Upon completing this course, students should be able to use appropriate CAD tools to capture a circuit schematic, choose a board cross-section, place components on a board and route wiring. Further, the course should enable students to recognize when circuit speed/size combinations are likely to make "high-speed effects" such as reflections and crosstalk important, know how to quantify these effects and their impact on performance, and to design their boards to reduce the deleterious effects to an acceptable level.
    - E168a: Introduction to Fiber Optic Communication Systems (3; Spring every other year)
      - This course provides the fundamentals of optics and its applications in communication systems. The physical layer of optical communication systems will be emphasized. Topics include optical materials; dispersion and nonlinear effects; polarization and interference; and the basic elements of system implementation such as laser sources, optical amplifiers and optical detectors. The course will include a multiple channel system design
    - E172: Structural Mechanics (3; Spring)
      - Introduction to elementary structural systems: trusses, beams. Force and deflection analysis. Energy methods. Stability. Introduction to finite element methods.
    - E174: Practices in Civil Engineering (3; Spring every other year)
      - The student is exposed to the practice of civil engineering through a series of case studies discussed within the context of a broad-based engineering curriculum. Engineering fundamentals related to the selection and use of construction materials, stress and strain, and to the analysis and design of structural and transportation systems may be discussed. Types and specifics of case studies vary depending upon the instructor.
    - E176: Numerical Methods in Engineering (3; Spring every other year)
      - This course focuses on the application of a variety of mathematical techniques to solve real-world problems that involve modeling, mathematical and numerical analysis, and scientific computing. Concepts, calculations and the ability to apply principles to physical problems are emphasized. Ordinary differential equations, linear algebra, complex analysis, numerical methods, partial differential equations, probability and statistics, etc., are among the techniques that would be applied to problems in mechanical, electrical, chemical and civil engineering. Examples are drawn from fluid mechanics, heat transfer, vibration of structures, electromagnetics, communications and other applied topics. Program development and modification are expected as well as learning to use existing codes.
    - E206: Optimization Techniques in Engineering Design (3; Spring)
      - Presentation of techniques for making optimum choices among alternatives; applications to engineering design problems.
    - E231: Advanced Transport Phenomena (3; Spring)
      - Integrated approach to the subjects of fluid mechanics, heat transfer, and mass transfer, through the study of the governing equations common to all three fields. Applications drawn from a wide variety of engineering systems.
    - E276: Experimental Techniques in Dynamics and Vibrations (3; Spring every other year)
      - Response characteristics of motion transducers and associated signal conditioning circuitry. Digital signal processing, data acquisition and reduction with special reference to structural dynamics. Small- and full-scale vibration tests in laboratory and field.
    - E278: Advanced Structural Dynamics (3; Spring every other year)
      - Free and forced response of continuous systems, including the vibration of strings, rods, shafts, membranes, beams and plates. One dimensional finite element methods: discretization of a continuum, selection of interpolation functions, and determining the element mass and stiffness matrices and the corresponding load vector. Introduction to special topics, including the effects of parameter uncertainties on the dynamics of periodic structures and model updating in structural dynamics.
  - Unspecified
    - E190: Special Topics in Engineering (3)
      - An upper division or graduate technical elective treating topics in engineering not covered in other courses, chosen at the discretion of the engineering department.
    - E191: Advanced Problems in Engineering (Credit hours to be arranged)
      - Independent study in a field agreed upon by student and instructor.
- Not Listed in Current Catalog
  - Common Core [Engineering]
    - E11: Autonomous Vehicles
    - E13 Introduction to Energy Systems Engineering
  - E177: Manufacturing Principles

Faculty

- Lori Bassman
  - All of my work is in the field of computational mechanics. Specifically I work on developing finite element methods for specific applications. Check back soon for a detailed page here, but in summary the application fields I have worked in are:
  - Coupled mechanics-composition problems in thin films (with integrated circuit structures as motivation).
  - Reliability of metal interconnects in integrated circuits.
  - Orthopedic biomechanics.
- Anthony (Tony) Bright
- Mary Cardenas
- Philip (Phil) Cha
- Christopher (Chris) Clark
- Ziyad H. (Zee) Duron
- Clive Dym
- Okitsugu (Oki) Furuya
- Kash Gokli
- Sarah Harris
- David Money Harris
- Adrian Hightower
- Nancy Lape
- Patrick Little
- John I. Molinder
- Elizabeth J. (Liz) Orwin
- Donald S. (Don) Remer
- R. Erik Spjut
- Ruye Wang
- Qimin Yang

Course Requirements

- Common Core
- Engineering Core
  - Engineering Design
  - Systems Courses
  - Engineering Science
  - Integrative Experience
- Humanities, Social Sciences and the Arts

Library Resources

- Sean Stone - Engineering Liaison Librarian
- Engineering Research Guide

Learning Outcomes

- Harvey Mudd
  - Program Educational Objectives
    - Produce graduates who are exceptionally competent engineers whose work is notable for its breadth and its technical excellence
    - Provide a hands-on approach to engineering so that graduates develop an understanding of engineering judgment and practice;
    - Prepare and motivate students for a lifetime of independent, reflective learning;
    - Produce graduates who are fully aware of the impact of their work on society, both nationally and globally;
    - Offer a curriculum that is current, exciting and challenging for both students and faculty but can be completed in four years by any motivated student who is admitted to HMC.