J. Richard Pomeroy, Ph.D., Lecturer, Supervisor of Teacher Education *(Education)*
Wendell Potter, Ph.D., Senior Lecturer Emeritus *(Physics)*
Patricia Quijada, Ph.D., Associate Professor *(Education)*
Gloria Rodriguez, Ph.D., Assistant Professor *(Education)*
Heather M. Rose, Ph.D., Associate Professor *(Education)*
Julie Schweitzer, Ph.D., Associate Professor *(Psychiatry & Behavioral Sciences);* Director *(ADHD Program, M.I.N.D. Institute)*
Kimberlee Shawman, Ph.D., Associate Professor *(Sociology)*
Emily Solari, Ph.D., Assistant Professor *(Education)*
Dean Tantillo, Ph.D., Professor *(Chemistry)*
Christopher Thaiss, Ph.D. (*Clark Kerr Presidential Chair and Director, University Writing Program)*
Ross Thompson, Ph.D., Professor *(Psychology)*
Thomas Timar, Ph.D., Professor Emeritus *(Education)*
Cary Trexler, Ph.D., Associate Professor *(Education)*
Yuuko Uchikoshi Tonkovich, Ed.D., Associate Professor *(Education)*
Karen Watson-Gegeo, Ph.D., Professor *(Education)*
Megan Welsh, Ph.D., Assistant Professor *(Education)*
Tobin White, Ph.D., Associate Professor *(Education)*
Carl Whithaus, Ph.D., Professor, Director *(University Writing Program)*

Graduate Study. The Graduate Group in Education offers programs of study and research leading to the Ph.D. degree. Students may concentrate in; language, literacy and culture; learning and mind sciences; mathematics education; school organization and educational policy; or science and agriculture education. Students may also combine these fields of study with designated emphasis areas such as Critical Theory; Second Language Acquisition, Women's Studies, and Writing, Rhetoric, and Composition Studies, Detailed information regarding graduate study may be obtained by writing the Graduate Coordinator or at *http://education.ucdavis.edu/programs/PhDoverview.html*.

Preparation. Students should have earned a Bachelor's or M.A. degree or the equivalent in a discipline relevant to their proposed emphasis program. For example, students applying for the mathematics education emphasis should have earned the B.A. or M.A. or M.A.T. degree in mathematics or mathematics education.

Graduate Advisers. Lee Martin, Heather Rose, and Danny Martinez

Graduate Coordinator. Mary M. Reid

Courses. See Education, School of, on page 257.

Endocrinology and Metabolism

See Internal Medicine (IMD), on page 437.

Engineering

(College of Engineering)

Jennifer Sinclair Curtis, Ph.D., Dean

S. Felix Wu, Ph.D., Associate Dean—Academic Personnel and Planning

Jean S. VanderGheynst, Ph.D., Associate Dean—Research and Graduate Studies

James A. Schaaf Ph.D., Associate Dean—Undergraduate Studies

C.P. (Case) van Dam, D. Engr., Associate Dean—Facilities and Capital Planning

Bruce White, Ph.D., Executive Associate Dean

College Office. 1042 Kemper Hall
530-752-7642;
http://engineering.ucdavis.edu
http://www.facebook.com/UCDEngineering

Undergraduate Study

The college has eight departments:

- Biological and Agricultural Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computer Science Engineering
- Electrical and Computer Engineering
- Materials Science and Engineering
- Mechanical and Aerospace Engineering

Graduate Study

Graduate degrees (M.S and Ph.D.) are offered in the following engineering disciplines:

- Biological Systems Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computer Science
- Electrical and Computer Engineering
- Materials Science and Engineering
- Mechanical and Aerospace Engineering
- Transportation Technology and Policy

The Major Programs

Eleven majors, leading to the B.S. degree, are open to students.

- Aerospace Science & Engineering
- Biochemical Engineering
- Biological Systems Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computer Science and Engineering
- Electrical Engineering
- Materials Science and Engineering
- Mechanical Engineering

Minor Programs

The College of Engineering offers nine undergraduate minors:

- Biomedical Engineering (Department of Biomedical Engineering)
- Computational Biology (Department of Computer Science)
- Construction Engineering and Management (Department of Civil and Environmental Engineering)
- Electrical Engineering (Department of Electrical and Computer Engineering)
- Energy Science and Technology (Department of Biological and Agricultural Engineering)
- Energy Policy (Department of Biological and Agricultural Engineering)
- Energy Efficiency (Department of Biological and Agricultural Engineering)
- Materials Science (Department of Materials Science and Engineering)
- Sustainability in the Built Environment (Department of Civil and Environmental Engineering)

Courses in Engineering (ENG)

Students are encouraged to carefully adhere to all prerequisite requirements. The instructor is authorized to drop students from a course for which stated prerequisites have not been completed.

Lower Division

1. Introduction to Engineering (1)
Lecture—1 hour. Open to first year students only. Introduction to the role of engineers in the acquisition and development of engineering knowledge, the differences and similarities among engineering fields, and the work ethic and skills required for engineering. (P/NP grading only.) GE credit: SE.—*F. (F.)* Schaaf

2. Creativity and Entrepreneurship for Engineers (3)
Discussion—3 hours. Introduction to entrepreneurial thinking from an engineer's perspective. Focus on identifying entrepreneurial opportunities, developing prototypes, and generating business models. Emphasis on developing a creative and entrepreneurial mindset. GE credit: SciEng or SocSci | SE or SS.

4. Engineering Graphics in Design (3)
Lecture—2 hours; laboratory—3 hours. Engineering design, descriptive geometry, pictorial sketching, computer-aided graphics, and their application in the solution of engineering problems. GE credit: SciEng | SE, VL.—*F, W. (F, W.)* Schaaf, Soshi

6. Engineering Problem Solving (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Mathematics 16A, 17A or 21A, C- or above; Mathematics 16B, 17B or 21B, C- or above (may be taken concurrently). Methodology for solving engineering problems. Engineering computing and visualization based on MATLAB. Engineering examples and applications. GE credit: SciEng | QL, SE.—*F, W, S. (F, W, S.)*

7. Technology and Culture of the Internet (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: basic computer experience recommended. Technology and culture of networked computing and the Internet. Topics include the history and development of networked computing; Internet architecture and services; basics of Web page design and hypertext markup language; political, social, cultural, economic and ethical issues related to the Internet. Offered irregularly. GE credit: SciEng | SE.

10. The Science Behind the Technology in Our Lives (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: high school algebra. Understanding of how the technology in our lives works using only basic concepts and rudimentary mathematics. GE credit: SciEng or SocSci, Wrt | SE or SS.—*F, W. (F, W.)* Orel, Parikh

11. Issues in Engineering (1)
Lecture—1 hour. Prerequisite: Participation in the MESA Engineering Program or consent of instructor. Designed to broaden student's understanding of the engineering profession, its methods, principles, design and development process, career opportunities, and professional resources. Offered irregularly.

17. Circuits I (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Mathematics 22A (C- or better recommended); Mathematics 22B (C- or better recommended) may be taken concurrently; Physics 9C or 9HD (C- or better recommended). Basic electric circuit analysis techniques, including electrical quantities and elements, resistive circuits, transient and steady-state responses of RLC circuits, sinusoidal excitation and phasors, and complex frequency and network functions. GE credit: SciEng | SE, VL.—*F, S. (F, S.)*

20. Introduction to Space Exploration: Understanding the Technological and Environmental Challenges to Our Exploration of the Solar System (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: high school level Algebra, Geometry, General Science (Physics and Chemistry). Introductory overview of the space environment. Discussion of space exploration technology including propulsion, orbital mechanics, and spacecraft engineering. Offered irregularly. GE credit: SciEng | QL, SE, SL.

35. Statics (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Physics 9A C- or better and Mathematics 21D C- or better concurrently. Force systems and equilibrium conditions with emphasis on engineering problems. GE credit: SciEng | SE.—*F, W, S. (F, W, S.)*

45. Properties of Materials (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: C- or better in Mathematics 16C or 21C, Chemistry 2A, and Physics 9A. Introductory course on the properties of engineering materials and their relation to the internal structure of materials. GE credit: SciEng, Wrt | QL, SE, SL, WE.—*F, W, S, Su. (F, W, S, Su.)*

45H. Honors Properties of Materials (1)
Discussion—1 hour. Prerequisite: enrollment in the Materials Science and Engineering Honors Program; concurrent enrollment in course 45 required. Examination of special materials science and engineering topics through additional readings, discussions, collaborative work, or special activities which may include projects, laboratory experience or computer simulations. Open only to students in the Materials Science and Engineering Honors program.—*W. (W.)*

45Y. Properties of Materials (4)
Web virtual lecture; laboratory. Prerequisite: C- or better in Mathematics 16C or 21C; Chemistry 2A and Physics 9A. Introductory course on the properties of engineering materials and their relation to the internal structure of materials. Not open for credit to students who have taken course 45. GE credit: SciEng | QL, SE, SL.—*Su. (Su.)*

98. Directed Group Study (1-4)
Restricted to College of Engineering students only. (P/NP grading only.) May be repeated for credit up to three times when content differs.

Upper Division

100. Electronic Circuits and Systems (3)
Laboratory—3 hours; lecture—2 hours. Prerequisite: course 17 (C- or better is recommended). Introduction to analog and digital circuit and system design through hands on laboratory design projects. Students who have completed Electrical and Computer Engineering 100 may receive only 1.5 units of credit. GE credit: SciEng | SE, VL.—*F, W, S. (F, W, S.)*

102. Dynamics (4)
Lecture—4 hours. Prerequisite: grade of C- or better in Engineering 35; grade of C- or better in Mathematics 22B. Open to College of Engineering students only. Kinematics and kinetics of particles, systems of particles, and of rigid bodies; application of these topics are applied to engineering problems. Only two units of credit allowed to students who have previously taken course 36. GE credit: SciEng | QL, SE, VL.—*F, W, S. (F, W, S.)* Cheng, Eke, Hess, Joshi

103. Fluid Mechanics (4)
Lecture—4 hours. Prerequisite: C- or better in each of the following: Engineering 35 and Mathematics 22B and Physics 9B. Open to students in the College of Engineering and Hydrology majors. Fluid properties, fluid statics, continuity and linear momentum equations for control volumes, flow of incompressible fluids in pipes, dimensional analysis and boundary-layer flows. GE credit: SciEng | SE.—*F, W, S. (F, W, S.)* Aldredge, Davis, Delplanque, Hwang, Kennedy, Robinson

104. Mechanics of Materials (4)
Lecture—4 hours. Prerequisite: grade of C- or better in Engineering 35 and Mathematics 22B. Uniaxial loading and deformation. Uniaxial loading and deformation. General concepts of stress-strain-temperature relations and yield criteria. Torsion of shafts. Bending of beams. Deflections due to bending. Introduction to stability and buckling. GE credit: SciEng | QL, SE.—*F, W, S. (F, W, S.)*

104L. Mechanics of Materials Laboratory (1)
Laboratory—3 hours. Prerequisite: course 104. Experiments which illustrate the basic principles and verify the analysis procedures used in the mechanics of materials are performed using the basic tools and techniques of experimental stress analysis. GE credit: SciEng | SE.—*W, S. (W, S.)*

105. Thermodynamics (4)
Lecture—4 hours. Prerequisite: grade of C- or better in Mathematics 22B and Physics 9B. Open to College of Engineering students only. Fundamentals of thermodynamics: heat energy and work, properties of pure substances, First and Second Law for closed and open systems, reversibility, entropy, thermodynamic temperature scales. Applications of thermodynamics to engineering systems. GE credit: SciEng | QL, SE, VL.—*F, W, S. (F, W, S.)* Aldredge, D'Souza, Erickson

106. Engineering Economics (3)
Lecture—3 hours. Prerequisite: upper division standing in Engineering. The analysis of problems in engineering economy; the selection of alternatives; replacement decisions. Compounding, tax, origins and cost of capital, economic life, and risk and uncertainty are applied to methods of selecting most economic alternatives. GE credit: SciEng or SocSci QL, SE, SL, SS, VL.—*W. (W.)* Hartsough, Slaughter

111. Electric Power Equipment (3)
Lecture—2 hours; laboratory—3 hours. Prerequisite: grade of C- or better in course 17. Principles of AC and DC electric motors and generators, their control systems and power sources. Selection of electric power equipment components based on their construction features and performance characteristics. Offered irregularly. GE credit: SciEng | QL, SE, VL, WE.—Delwiche, Hartsough

121. Fluid Power Actuators and Systems (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: grade of C- or better in Engineering 100 and Engineering 102. Hydraulic and pneumatic systems with emphasis on analysis and control of actuators. Design of hydraulic and pneumatic systems, specification and sizing of components, and selection of electro-hydraulics/electro-pneumatics, servo valves, and closed loop systems to solve basic control problems. Offered in alternate years. GE credit: SciEng | QL, SE, SL, VL, WE.—*(S.)* Rosa

122. Introduction to Mechanical Vibrations (4)
Lecture—4 hours. Prerequisite: C- or better in Engineering 102; C- or better in Engineering 6 or course 5 or Computer Science Engineering 30; ability to program in MATLAB. Free and forced vibrations in lumped-parameter systems with and without damping; vibrations in coupled systems; electromechanical analogs; use of energy conservation principles. GE credit: SciEng | QL, SE.—*F. (F.)*

160. Environmental Physics and Society (3)
Lecture—3 hours. Prerequisite: Physics 9D, 5C, or 10 or 1B and Mathematics 16B or the equivalent. Impact of humankind on the environment will be discussed from the point of view of the physical sciences. Calculations based on physical principles will be made, and the resulting policy implications will be considered. In the College of Engineering, students may receive only one unit of credit towards the Technical Electives requirement. (Same course as Physics 160.) GE credit: SciEng or SocSci | SE, SL.—*S. (S.)* Craig, Jungerman

180. Engineering Analysis (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: C- or better in Mathematics 21D and 22B; C- or better in Engineering 6 or Mechanical Engineering 5 or Computer Science Engineering 30. Solutions of systems of linear and nonlinear algebraic equations; approximation methods; solutions of ordinary differential equations; initial and boundary value problems; solutions of partial differential equations of Elliptic, parabolic, and hyperbolic types; Eigen value problems. GE credit: SciEng | SE.—*F. (F.)* Hafez

188. Science and Technology of Sustainable Power Generation (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: upper-division standing, Physics 7C or 9C. Focus on scientific understanding and development of power generation that is the basis of modern society. Concentration on power generation methods that are sustainable, in particular, discussion of the most recent innovations. GE credit: SocSci | SS.—*S. (S.)* Hwang

190. Professional Responsibilities of Engineers (3)
Lecture—3 hours. Restricted to upper-division students in the College of Engineering. Organization of the engineering profession; introduction to contracts, specifications, business law, patents, and liability; discussion of professional, ethical, societal, and political issues related to engineering. GE credit: SocSci | SS.—*W, S. (W, S.)* Tseregounis

198. Directed Group Study (1-5)
May be repeated for credit up to 3 times. (P/NP grading only.) GE credit: SE.

Graduate

250. Technology Management (3)
Lecture—3 hours. Prerequisite: consent of instructor. Management of the engineering and technology activity. Functions of design, planning, production, marketing, sales, and maintenance. Technological product life cycle. Research and development activity. Project planning and organization. Manufacturing issues. Case studies.—*F. (S.)*

Engineering: Applied Science

(College of Engineering)

The Graduate Program in Applied Science

The Department of Applied Science is not accepting new graduate students.

Courses in Engineering: Applied Science—Davis (EAD)

Graduate

213A. Computer Graphics (3)
Lecture—3 hours. Prerequisite: consent of instructor. Development of algorithms for perspective line drawings of three-dimensional objects, as defined by polygons or bicubic patches.—*(W.)* Max

225. Biophotonics in Medicine and the Life Sciences (3)
Lecture/discussion—3 hours. Prerequisite: Physics 108 and Biology 101-105; course 202 highly recommended; graduate standing. Introduction to the science and technology of biomedical optics and photonics, with an overview of applications in medicine and the life sciences. Emphasis on research supported by the NSF Center for Biophotonics at UC Davis Medical Center. (Same course as Biomedical Engineering 255 and Biophysics 255.)—*W. (W.)* Chuang, Matthews

230. Topics in Computational Fluid Dynamics (3)
Lecture—3 hours. Prerequisite: course 210A, 210B or consent of instructor. A hands-on approach to numerical methods for compressible fluid flow. Readings and discussions of solution strategies complemented with programming exercises and projects to give first hand experience with performance and accuracy of several computational methods; from upwind differencing to Godunov methods.—*S. (S.)* Miller

285D. Physics and Technology of Microwave Vacuum Electron Beam Devices IV (4)
Lecture—4 hours. Prerequisite: 285C. Computational models of vacuum electron beam devices. Offered in alternate years.—*(S.)* Luhmann