CHEMICAL AND MATERIALS ENGINEERING

<http://www.csupomona.edu/~chemmat>

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The Department of Chemical and Materials Engineering is actively pursuing outcomes assessment to evaluate its effectiveness in promoting student learning and achieving its vision and objectives. The department welcomes input on the following statement of our vision and educational objectives.

The mission of the Chemical Engineering program is to prepare baccalaureate graduates with the skills necessary to contribute through their professional careers to a highly technical society that is global in scope, while paying particular attention to the needs of the State of California. The philosophy of the Chemical Engineering program is to provide a strong theoretical foundation coupled with practical application of that knowledge, which is consistent with the missions of the College of Engineering and the University.

The educational outcomes of the Chemical Engineering Program are to develop the abilities of our students to:

A. critically analyze engineering problems and find feasible solutions through the application of math, chemistry, physics and engineering fundamentals and the use of engineering materials and modern computational tools;

B. effectively search the literature, design and conduct experiments and analyze and interpret laboratory and plant data;

C. demonstrate the grasp of basic principles underlying stoichiometry, thermodynamics, transport phenomena, unit operations and chemical reaction engineering;

D. design and control chemical engineering equipment and processes with attention to economics, the environment, health and safety;

E. function as practicing engineers including the ability to communicate (written and oral) effectively, work collaboratively, learn independently, act appropriately in professional duties, and plan and execute projects successfully, and

F. understand contemporary issues and the impact of engineering solutions on society, and the ethical considerations of engineering decisions.

CHEMICAL ENGINEERING

Chemical Engineering is the branch of engineering that embraces the development and application of industrial processes which involve chemical and physical changes of material. These processes must be accomplished in a competitive economy and in an environmentally safe manner to create products which are useful and essential to the modern world. Chemical Engineering includes the design, development, and production of many products such as fuels and petrochemicals, plastics, fibers, paper, foods, building materials and pharmaceuticals. A chemical engineering degree is also good preparation for careers in pollution prevention or waste minimization.

This accredited program blends the basic sciences with engineering science and design to focus upon the design, development and engineering of industrial processes and plants. Students are well prepared upon graduation to begin either their professional career or a program of graduate study.

The chemical engineering curriculum in addition to a sound foundation in general education includes basic courses in chemistry, physics, mathematics, and materials, electrical, and mechanical engineering. In addition, coursework in the major includes computer programming, engineering statistics, material and energy balances, transport phenomena, unit operations and process control synthesis and design, thermodynamics, kinetics, reactor design, and pollution abatement. The design aspect of chemical engineering is present throughout the curriculum and culminates in the senior-level, three-quarter capstone design sequence. Student project opportunities enable students to develop essential planning, experimenting and reporting skills in individual or theme-based projects. Extensive laboratory and computerized test facilities exist for process and materials investigations, as well as complete pilot plant scale equipment for extended development and confirmatory studies.

Students desiring to major in Chemical Engineering should have a particularly high aptitude for science and mathematics, and first-time college students should have taken substantial college preparatory courses in these disciplines in high school including one year of chemistry. Incoming transfer students should have completed at least one year of college calculus, one year of college chemistry, and one year of college physics (with laboratory) prior to beginning the program at Cal Poly Pomona. The community college student planning to transfer into this department should consult a school counselor or this department to determine which courses meet the program requirements.

Chemical and Materials Engineering students are encouraged to become active in the student chapters of the American Institute of Chemical Engineers (AIChE), American Society for Materials (ASM), and the Society for the Advancement of Materials and Process Engineering (SAMPE). Qualified students are invited to join the student chapter of Omega Chi Epsilon, the chemical engineering honor society.

CORE COURSES FOR MAJOR

Required of all students. A 2.0 cumulative GPA is required in core courses in order to receive a degree in the major.

Introduction to Chemical and Materials Engineering	CHE	131/141L	(2/1)
CME Analysis/Laboratory	CHE	132/142L	(2/1)
CME Data Analysis and Design of Experiments/Laboratory	CHE	143L	(1)
Stoichiometry I	CHE	201/211L	(5)
Stoichiometry II	CHE	202/212L	(5)
Chemical and Materials Engineering Thermodynamics I	CHE	302	(4)
Chemical Engineering Thermodynamics II	CHE	303	(4)
Kinetics and Reactor Design	CHE	304	(4)
Momentum Transport	CHE	311	(4)
Energy Transport	CHE	312/322L	(5)
Mass Transport Laboratory	CHE	333L	(1)
Unit Operations I	CHE	425/435L	(5)
Unit Operations II and Process Control Laboratory	CHE	436L	(1)
Process Control	CHE	426	(2)
Chemical Process Synthesis and Design I	CHE	441/451L	(4)
Chemical Process Synthesis and Design II	CHE	442/452L	(4)
Chemical Process Synthesis and Design III	CHE	443/453L	(5)
Undergraduate Project	CHE	463	(2)
Project Design Principles and Applications*(B4)	EGR	481/482	(2)(2)

*May be used to satisfy GE requirement

SUPPORT COURSES

General Chemistry*(B2)	CHM	121/L	(4)
General Chemistry	CHM	122/L	(4)
General Chemistry	CHM	123	(3)
Organic Chemistry	CHM	314/317L	(4)
Organic Chemistry	CHM	315	(3)
Organic Chemistry	CHM	316	(3)
Biochemistry	CHM	327/L	(4)
Elements of Electrical Engineering	ECE	231/L	(4)
Ethical Considerations in Technology and Applied Science*(C4)	EGR	402	(4)
Analytic Geometry and Calculus I*(B1)	MAT	114	(4)
Analytic Geometry and Calculus II	MAT	115	(4)
Analytic Geometry and Calculus III	MAT	116	(4)
Calculus of Several Variables I	MAT	214	(3)
Calculus of Several Variables II	MAT	215	(3)
Differential Equations	MAT	216	(4)
Vector Statics	ME	214	(3)
Materials Science and Engineering	MTE	207	(3)
Materials Science and Engineering Laboratory	MTE	317L	(1)
Corrosion and Materials Degradation	MTE	401/L	(4)
General Physics*(B2)	PHY	131/L	(4)
General Physics	PHY	132/L	(4)
General Physics	PHY	133/L	(4)
Upper Division MTE Elective			(4)

*May be used to satisfy GE requirement

GENERAL EDUCATION COURSES

An alternate pattern from that listed here for partial fulfillment of Areas A, C, and D available for students in this major is the Interdisciplinary General Education (IGE) Program. Please see the description of IGE elsewhere in this catalog.

Area A (12 units)

1. Written Communication
2. Oral Communication
3. Critical Thinking

Area B (16 units)

1. Math/Quantitative Reasoning
2. Physical Science
3. Biological Science
4. Science and Technology Synthesis*

Area C (16 units)

1. Fine and Performing Arts
2. Philosophy and Civilization
3. Literature and Foreign Languages
4. Humanities Synthesis*

Area D (20 units)

1a. and 1b. U.S. History, Constitution, and American Ideals
2. History, Economics, and Political Science
3. Sociology, Anthropology, Ethnic, and Gender Studies
4. Social Science Synthesis*

Area E (4 units)

Lifelong Understanding and Self-development

*Consult Department

CHEMICAL ENGINEERING COURSE DESCRIPTIONS

Lecture and laboratory courses listed together are to be taken concurrently.

CHE 131/141L Introduction to Chemical and Materials Engineering/Laboratory (2/1)

Introduction to the professions of Chemical and Materials (CME) engineering and CME analysis. Analysis of selected processes and discussions of contemporary issues and their impacts on society. Use of computer tools to solve engineering problems. Process variables and basic techniques of material balance. 2 lectures/problem-solving, 1 three-hour laboratory. Prerequisites: MAT 105; English remediation completed or not required.

CHE 132/142L Chemical and Materials Engineering Analysis/Laboratory (2/1)

Introduction to data analysis and experimental design using statistical concepts and techniques applied to chemical and materials engineering systems. Analysis of plant and laboratory data. Multiple regression. Correlations and significance of correlations. Analysis of variance. Introduction to statistical process control. 2 lectures/problem solving, 1 three-hour laboratory. Prerequisites: MAT 105; English remediation completed or not required.

CHE 143L Chemical and Materials Engineering Data Analysis and Design of Experiments Laboratory (1)

Introduction to the use of instrumentation to monitor Chemical Engineering processes. Measurement of the properties of materials. Introduction to design of experiments. 1 three-hour laboratory. Prerequisite: CHE 132/142L or equivalent.

CHE 201/211L Stoichiometry I/Laboratory (4/1)

Material balances for chemical and materials engineering processes. Use of process flow diagrams for plant mass balance calculations. Solving multi-component mass balance, simple and multiple mixing or separation problems, and chemical reaction problems including recycle and equilibrium. Use of CHE data sources. Plant trip, 4 lecture/problem solving and 1 three-hour computational laboratory. Prerequisites: CHM 122, MAT 115.

CHE 202/212L Stoichiometry II/Laboratory (4/1)

Analysis of single and multiple phase systems for chemical and materials engineering systems. Energy balances for both nonreactive and reactive systems. A plant trip and the use of the computer for energy balance analysis of nonreactive, reactive, and transient processes. Application of stoichiometry to environmental systems. 4 lectures/problem solving and 1 three-hour laboratory, Prerequisites: C- or better in CHE 201 and CHE 211L.

CHE 299/299A/299L Special Topics for Lower Division Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units, with a maximum of 4 units per quarter. Instruction is by lecture, laboratory, or a combination.

CHE 301 Applied Mathematics in Chemical and Materials Engineering (3)

A study in the application of basic linear algebra, derivative, and integral concepts to solve chemical and materials engineering problems. Use of first-order ordinary differential equations to solve transient materials and energy balances. 3 lectures/problem-solving. Prerequisites: ENG 104 or equivalent, MAT 216 and C- or better in CHE 202 and 212L.

CHE 302 Chemical and Materials Engineering Thermodynamics I (4)

The study of classical thermodynamics from both a chemical and materials engineering perspective. Energy and its transformations; heat and work effects; first and second law analysis; property relationships; equilibrium and phase behavior; equations of state; heat engines, heat pumps, steam power plant cycles, refrigeration cycles, gas power cycles. Ideal gas heat capacity. 4 lectures/problem-solving. Prerequisites: MAT 215 and PHY 132/L.

CHE 303 Chemical Engineering Thermodynamics II (4)

Phase equilibria of ideal and non-ideal systems. Concepts of electrochemistry fugacity, activity, and activity coefficient. Group contributions. Calculation of thermodynamic properties from experimental data. Enthalpy changes of mixing and phase changes. Microscopic thermodynamics and statistical mechanics applied to macroscopic properties and behavior of materials. Chemical reaction equilibria. Thermodynamic study of processes involving phase equilibria. 4 lectures/problem-solving. Prerequisites: CHE 302.

CHE 304 Kinetics and Reactor Design (4)

Homogeneous and heterogeneous reaction kinetics for both chemical and materials engineering systems. Analysis of kinetic data. Reactor design, including batch, mixed flow, and plug flow reactors. Diffusional transformations, solidification, diffusionless transformations, and nonequilibrium thermodynamics. 4 lectures/problem-solving. Prerequisites: CHE 303.

CHE 310L Chemical Engineering Computer Applications Laboratory (1)

Introduction to software applications and the numerical solution of chemical engineering problems. Programming concepts. 1 three-hour computational laboratory. Prerequisites: CHE 202/212L; CHE 132/142L or equivalent.

CHE 311 Transport Phenomena I (4)

Basic course in fluid mechanics with emphasis on real fluids and applications to unit operations of chemical engineering, including topics in dimensional analysis, fluid properties, kinematics, and dynamics of fluid flow, friction, boundary conditions, and piping calculations. Introduction to energy transfer by conduction, convection, and radiation. 4 lectures/problem-solving. Prerequisites: ME 214, MAT 215.

CHE 312 Transport Phenomena II (4)

Basic course in heat and mass transfer with application to the unit operations of chemical and materials engineering, including topics in energy transfer by conduction, convection and radiation, and diffusional and convective mass transfer. 4 lectures/problem-solving. Prerequisites: CHE 302, and CHE 311.

CHE 313 Mass Transport (3)

Mass transfer and its application to the unit operations of chemical engineering. Topics will include molecular diffusion, convective diffusion, and process design of distillation and absorption towers. 3 lectures/problem-solving. Prerequisites: CHE312/322L, CHE 303

CHE 322L Transport Laboratory I (1)

Applying experimental design and the basic concepts in transport phenomena and thermodynamics in experimental study of systems that may involve pressure drop in pipes, flow measurement, viscosity measurement, heat of combustion measurement, energy and entropy balance, pump operating characteristics and measurement of transport properties of both chemical and materials engineering systems. 1 three-hour laboratory. Prerequisites: C or better in CHE 202/212L,

CHE 333L Transport Laboratory II (1)

Applying experimental design and the basic concepts in transport phenomena in experimental study of both chemical and materials engineering systems that may involve diffusivity measurement, batch distillation, heat exchanger, membrane separation, droplet evaporation, heat transfer in extended surfaces and others. 1 three-hour laboratory. Prerequisites: CHE 312/322L, CHE 303.

CHE 400 Special Study for Upper Division Students (1–2)

Individual or group investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.

CHE 425 Unit Operations I (4)

Treatment of mass, momentum and heat transport viewed with the traditional unit operations emphasis. Multi-component and multiphase systems are considered, with some problems involving design. Distillation, absorption and heat exchanger design. 4 lectures/problem-solving. Prerequisite: CHE 312.

CHE 426 Process Control (2)

Introduction to theory, design, and application of automatic control systems to chemical and physical processes. 2 lectures/problem-solving. Prerequisites: CHE 304, CHE 312.

CHE 432 Pollution Abatement and Hazardous Materials Management (2)

Improve the understanding of natural processes and the fundamentals that govern the concentrations of contaminants in water, air, and other media. Topics in air pollution, water pollution, and solid waste. Group project involving study and preliminary design, including cost analysis. 2 lectures/problem-solving. Prerequisites: CHE 302, CHE 311.

CHE 435L Unit Operations I Laboratory (1)

Applying the basic concepts in kinetics, thermodynamics, and transport phenomena in experimental study of systems that may involve binary distillation, batch reactor, column operating characteristics, fluidized bed, and others. 1 three-hour laboratory. Prerequisites: CHE 304, CHE 312.

CHE 436L Process Controls Laboratory (1)

Experimental study of the dynamics and control of chemical engineering processes using single-loop, PID controllers. Simulation of real control systems. Hardware requirements for real control systems. 1 three-hour laboratory. Prerequisite: CHE 425/435L.

CHE 441/451L Chemical Process Synthesis and Design I/Laboratory (3/1)

Design of major equipment and control systems common to most chemical industries. Emphasis on how equipment fits together and interacts in an integrated process. Optimization strategies in process design. Use of process simulators. 3 lectures/problem-solving and 1 three-hour computational laboratory. Prerequisites: CHE 304, CHE 312.

CHE 442/452L Chemical Processes Synthesis and Design II/Laboratory (3/1)

Treatment of process design methodology. Energy integration in plant design. On-site study of selected process industries. Design problems related to process industries visited. Basic engineering economics including cost estimating. Discussion of contemporary economic issues. Emphasis on use of process simulators. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: CHE 304, CHE 312.

CHE 443/453L Chemical Process Synthesis and Design III/Laboratory (4/1)

Team project to perform process design and cost estimating of a complete plant with attention to environmental constraints including state and Federal laws. Emphasis on team effort, effective communication, plant design procedure, plant management and control. Use of process simulators. 4 lectures/problem-solving and 1 three-hour computational laboratory. Prerequisites: CHE 441/451L and CHE 442/452L.

CHE 461, 462 Senior Project (2), (2)

Formal encounter with a professional assignment, simulating the graduate chemical or materials engineer at work and culminating in a final engineering report. Emphasis will be placed on engineering design. Prerequisites: GPAs (major and overall) at least 2.0.

CHE 463 Undergraduate Project (2)

Final state of major project work. Emphasis on effective communication of project results. 2 seminars. Prerequisites: EGR 481 and EGR 482.

CHE 499/499A/499L Special Topics for Upper Division Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units, with a maximum of 4 units per quarter. Instruction is by lecture, laboratory, or a combination. Prerequisites: CHE 302 and CHE 311.

MATERIALS ENGINEERING COURSE DESCRIPTIONS

All students in engineering and engineering technology curricula must satisfy ENG 104 prior to enrolling in any 300-level or higher course in the College of Engineering. Lecture and laboratory courses listed together are to be taken concurrently.

MTE 205L Materials Engineering in Industry (1)

Exploration of the role of materials engineering in manufacturing industries. Plant trips to study the processes in the materials conversion industry. Study of the methodology for production, cost reduction, quality, reproducibility, inventory control, and management. 1 three-hour laboratory. Prerequisites: CHM 122/122L.

MTE 207 Materials Science and Engineering (3)

Introduction to the fundamentals and applications of materials engineering. Atomic, molecular, and crystalline structures and properties of materials with their relevance to engineering. Topics will include: diffusion, defects, phase diagrams, heat treatment, mechanical behavior, and will cover the different materials classes, i.e., metals, ceramics, polymers, composites, and semiconductors. 3 lectures/problem-solving. Prerequisites: CHM 121/121L, PHY 131/131L and MAT 116.

MTE 208 Introduction to Electronic Materials and Properties (3)

Introduction to the concepts of bonding, structure, and defects as applied to the materials used in electrical engineering. Band theory as it applies to conductors, semiconductors, and insulators, conduction mechanisms. Electronic devices and methods of fabrication. Fundamentals of dielectric, optical and magnetic materials. Review of relevant mathematical concepts as it applies to understanding and solving problems. 3 lecture/problem-solving. Prerequisites: CHM 121/121L, PHY 131/131L, and MAT 116.

MTE 299/299A/299L Special Topics for Lower Division Students (1–4)

Study of a selected topic, the title to be specified in advance. Total credit limited to 8 units with a maximum of 4 units per quarter. Instruction is by lecture, laboratory or a combination.

MTE 303/L Polymer Engineering/Laboratory (3/1)

Introduction to the structure, properties, behavior, and processing of polymers as engineering materials. Design of reinforced and unreinforced polymers, and the processing methods used in the manufacture of products. Labs will include polymer testing and plant trips. 3 lectures/problem-solving, and 1 three-hour laboratory. Prerequisites: MTE 207 or ME 315; and MTE 317L or ME 350L; and CHE 311 or ME 311.

MTE 317L Materials Science and Engineering Laboratory (1)

Hands-on experiences to reinforce fundamental materials engineering concepts. Crystal models, microscopy, hardness tests, strengthening, and heat treatment. Materials selection and design. Emphasis on technical written and oral communication skills. Safety awareness reinforced throughout the course. Elements of statistics and experimental design. 1 three-hour laboratory. Corequisite: MTE 207 (or ME 315).

MTE 320/L Mechanical Metallurgy/Laboratory (3/1)

A comprehensive exploration of the field of mechanical metallurgy. Topics include the continuum description of stress and strain, the flow and fracture of metals from the defect mechanism point of view, the tests used for determining mechanical properties, and the fundamental/analytical techniques applied to the various metalworking processes used in industry. Labs will include demonstrations, plant trips, and problem solving. Relevant mathematical topics will be reviewed, 3 lectures/problem-solving, and 1 three-hour laboratory. Prerequisites: MTE 207 (or ME 315); and MTE 317L (or ME 350L).

MTE 327/L Properties of Materials/Laboratory (3/1)

A comprehensive exploration of electronic, thermal, magnetic and optical properties of materials. Relationships between structure and properties will be emphasized. The influence of processing on properties and subsequent applications will be highlighted. Labs will include development of experiments, and problem solving. 3 lectures and 1 three-hour laboratory. Prerequisites: MTE 207, MTE 317L, PHY 133/133L.

MTE 328 Thermodynamics of Solids (3)

Macroscopic thermodynamics, the study of energy and its transformations as it applies to the field of materials. First and second law, property relationships, equilibrium, electrochemistry, solutions and mixing, phase rule and phase diagrams. Introduction to statistical thermodynamics will be included as it applies to the understanding of the macroscopic properties and behavior of materials. 3 lectures/problem-solving. Prerequisites: MTE 207 (or ME 315).

MTE 337/L Joining of Materials/Laboratory (2/1)

Introduction to the principles, methods and applications of joining as they apply to the metals, ceramics, plastics, and electronic industries. Included are fasteners, welding, brazing, soldering, adhesives, diffusion and ultrasonic bonding. Principles of mechanical, chemical, and physical phenomena related to surfaces and the mechanics of joints. The approach will be to unify the principles underlying diverse engineering technologies to the basic science of the joining processes. 2 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: MTE 207 (or ME 315); and MTE 317L (or ME 350L).

MTE 338 Kinetic Processes in Materials (3)

Physical chemistry applied to materials engineering. Topics include: surfaces and interfaces; nucleation and growth theory; diffusional and non-diffusional transformations; precipitation from the solid solution, reaction kinetics, and introduction to non-equilibrium thermodynamics. 3 lectures/problem-solving. Prerequisites: MTE 207 or equivalent, CHE 302 or ME 301.

MTE 400 Special Study for Upper Division Students (1–2)

Individual or group investigation, research, studies or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisites: ENG 104 or equivalent.

MTE 401/401L Corrosion and Materials Degradation (3/1)

Fundamental principles of corrosion science, application of these principles to corrosion engineering problems and materials selection. Topics to be covered include: Thermodynamics and kinetics of metallic corrosion; corrosive/destructive environments; the different forms of corrosion and degradation, corrosion/degradation prevention; principles of materials selection. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: CHE 303 or ME 302, MTE 207 (or ME 315).

MTE 404 Electronic Materials(4)

Advanced concepts of electronic materials and their engineering applications. Free electron model, introduction to band theory, and Schrodinger wave equation, crystal bonding and lattice vibrations. Introduction to processing and materials selection for electronic applications. 4 lectures/problem-solving. Prerequisites: MTE 327/L, CHE 302 or ME 301.

MTE 405 Physical Metallurgy--Mechanical Properties (4)

Basic principles underlying the structure and properties of crystalline solids. Metallic and covalent bonding theories; crystallography; solid solutions, intermetallic compounds and alloys. Crystal imperfections; elastic and plastic deformation. Ductile and brittle fracture, fatigue and creep. 4 lectures/problem-solving. Prerequisites: MTE 207 (or ME 315); CHE 302 (or ME 301).

MTE 406/416L Physical Metallurgy—Solidification and Strengthening Reactions/ Laboratory (3/1)

Principles of solid-state reactions including elementary kinetics, nucleation and growth theory; annealing of cold-worked metals; diffusionless transformation, precipitation reactions and tempering; physical metallurgy of steels; relation between properties and microstructure. Laboratory experiments related to phase transformations in steel, solidification structures, precipitation hardening, and plant trips. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: MTE 207 (or ME 315); CHE 302 (or ME 301).

MTE 407/L Ceramic Materials/Laboratory (3/1)

The composition, structure, and properties of ceramic bodies employed as structural and non-structural materials, with an emphasis on processing and their physical state, elasticity, strength, and optical, thermal, and electrical properties. Laboratory experiments related to fabrication, testing, statistical analysis, and plant trips. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: MTE 207 and MTE 317L (or ME 315 and ME 350L).

MTE 408/418L Introduction to Composite Materials/Laboratory (3/1)

Introduction to composite materials engineering processing and mechanics. Properties and processing of fibers and matrices. Polymer matrix composites, metal matrix composites, ceramic composites and carbon/carbon. Lamina and laminate constitutive equations. Laminate strength analysis. Laboratory experiments related to composite fabrication, characterization, testing, and plant trips. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: MTE 207 and MTE 317L (or ME 315 and ME 350L).

MTE 420/L Materials Selection and Design I/Laboratory (2/1)

Integration of the undergraduate courses in the basic sciences, engineering sciences, materials engineering, economics, business, and general education in the integrated solution of materials selection and design problems. Analysis, selection, and evaluation of materials and processes aimed at product development. Use of numeric based selection criteria will be emphasized culminating in professional reports and presentations. 2 lecture discussions, and 1 three-hour laboratory/ problem-solving. Prerequisites: senior standing, GWT, and MTE 338.

MTE 421 Materials Characterization and Testing (4)

Overview of materials characterization and testing methods. Topics include: fundamentals of crystallography, properties of X-rays and X-ray diffraction, determination of crystal structures, IR spectroscopy, electron microscopy, ultrasound evaluation techniques. 4 lectures/problem-solving. Prerequisites: MTE 327/L.

MTE 422 Fracture and Failure Analysis (4)

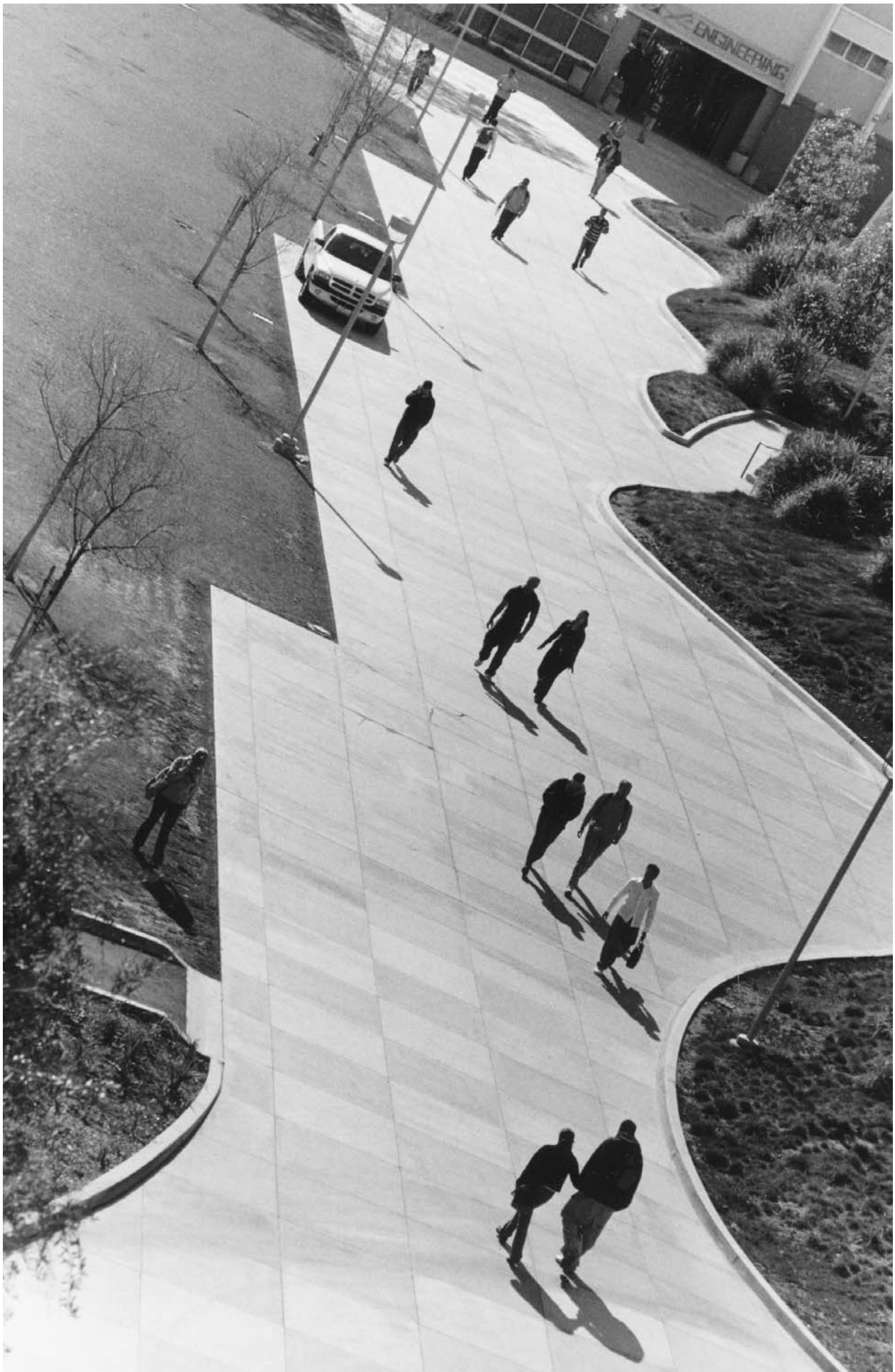
Basic principles of fracture mechanics, and applications to failure analysis. Topics include: elements of fracture mechanics, ductile and brittle fracture, residual stresses, creep, fatigue, environmental effects, statistical distributions, and design issues. The approach will emphasize case histories (including guest lectures from practicing engineers on actual studies) and student presentations. Topics include: 4 lectures/problem-solving. Prerequisites: MTE 207 (or ME 315); and MTE 317L (or ME 350L).

MTE 430/L Materials Selection and Design II/Laboratory (2/1)

Integrated approach to materials selection and design utilizing engineering sciences, materials engineering, economics, business and general education. Analysis, selection, and evaluation of materials and processes in design. Use of numeric-based selection criteria emphasized, culminating in professional reports and presentations. 2 lecture discussions, and 1 three-hour laboratory/problem. Prerequisites: MTE 420/L.

MTE 499/499A/499L Special Topics for Upper Division Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units, with a maximum of 4 units per quarter. Instruction is by lecture, laboratory, or a combination.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