¶ national prominence in high technology and research has been beneficial to the Lyle School of Engineering and its students. Corporate support for the Lyle School has generated a remarkable array of equipment and laboratories. Recent additions include the AT&T Mixed Signals Lab, the Texas Instruments Digital Signal Processing Lab, the Procter and Gamble Biomedical Research Lab, and the Nokia Wireless Communication Lab. Other laboratories include the Laser Micro-machining Laboratory, the Nanoscale Electro-Thermal Sciences Laboratory and the Enterprise Systems Design Laboratory. In addition, the Lyle School is the home of the following facilities:

Research Center for Advanced Manufacturing. RCAM provides the intellectual foundation for industry to collaborate with faculty and students to resolve generic, long-range challenges, thereby producing the knowledge base for steady advances in technology and their speedy transition to the marketplace.

Center for Laser Aided Manufacturing. CLAM addresses a number of research and development issues related to laser-aided intelligent manufacturing processes.

Center for Lasers and Plasmas for Advanced Manufacturing. The center conducts research of interest to the industry and SMU as part of a multiple university team and with support from the Industry and University Cooperative Research Centers Program of the National Science Foundation.

National Science Foundation Industrial/University Cooperation Research Center for Net-Centric Software and Systems. The Center for Net-Centric Software and Systems addresses fundamental software and systems research for the modeling, analysis, design, implementation, testing, deployment and evolution of net-centric and embedded systems.

Darwin Deason Institute for Cyber Security. The institute advances the science, policy, application and education of cyber security through basic and problem-driven, interdisciplinary research, and conducts broad programs of research that

B Apply an interdisciplinary approach to challenging problems and incorporate elements from disciplines not traditionally associated with cyber security, such as law, business and the social sciences

Policies of the Cooperative Engineering Education Program

Since 1925, the school has created and maintained numerous corporate relationships. Many factors contribute to these relationships, including the quality of SMU¶ academics and research, the achievements of alumni, and SMU¶ close proximity to high-tech corporations. Each SMU Co-op Program student directly benefits from the program¶ strong corporate relationships and bears an obligation to preserve these relationships by

The environmental teaching and research laboratories have sophisticated analytical capabilities for performing chemical analyses of air samples and for assessing the quality of water supplies and wastes and the effectiveness of water and waste treatment procedures. Major equipment includes a Thermo Scientific ozone analyzer, a Dynamax absorbance detector, a Hach DR 2500 scanning spectrophotometer for water quality analysis of numerous parameters, a Thermo Scientific inductively coupled plasma mass spectrometer, a PerkinElmer Fourier transform infrared spectrometer with attenuated total reflectance, a Dionex ion chromatography unit , a Cary bio UV-visible spectrometer with temperature control, and an Agilent gas chromatography and mass spectrometry unit for identifying and measuring numerous permanent inorganic gases and organic compounds in environmental samples. Other miscellaneous equipment includes continuous ambient air monitoring devices, a UV-visible spectrophotometer, pH and other specific ion meters, incubating ovens, microscopes, furnaces, centrifuges, dissolved oxygen meters, a Mettler titrator for chemical and acid/base surface experiments, several temperature control baths, and a tumbler for constant temperature studies. An autoclave, microscopes and a UV light reader support basic engineering microbiological work.

Civil engineering teaching and research laboratories include dedicated space for mechanics of materials and structural engineering, hydraulics and hydrology, geotechnical engineering and transportation materials, and intelligent transportation systems. The Structural and Mechanics of Materials Laboratory is eq

environmental engineering, including stress transformation, numerical integration to obtain beam deflection, numerical solution of Euler's buckling equation, roots of the equation for fluid flow in frictional pipe, optimization techniques applied to minimum potential energy, and solutions to the system of equations representing force-displacement relationship of a structure or the concentration of carbon monoxide in a space. Corequisite: MATH 2343.

learning to stay abreast of changing technology and public policy through active participation in professional societies, self-study, and continuing education. Students prepare and present periodic progress reports, reviews, and a final report. *Prerequisite:* CEE 4380.

CEE 4418 (4). ENGINEERING MICROBIOLOGY. Examines aspects of microbiology that are particularly valuable to the practice of environmental engineering. Specific areas of focus include enzyme and growth kinetics, cell structure and physiology, process of biotransformation, microbial and/or environmental interactions, and biogeochemical cycles. Elements of molecular biology and biotechnology are also presented as appropriate. Students gain a basic understanding and appreciation of microbial processes that are applicable in the field of environmental engineering. *Prerequisites:*

CEE 5315 (3). INTEGRATED WASTE MANAGEMENT. Comprehensive introduction to the fundamentals of the complex interdisciplinary field of hazardous waste management. Covers current management practices, treatment and disposal methods, and site remediation. Includes detailed case studies and design examples to evaluate the effectiveness of different treatment and containment technologies in addressing today's hazardous waste situations.

CEE 5317 (3). ENVIRONMENTAL ORGANIC CHEMISTRY. Examines the fundamental processes that govern the transformation of organic chemicals in natural and engineering systems. Includes an overview of organic chemistry, with a focus on the basic properties of organic compounds, such as nomenclature and structures. Covers the physical transformations of organic compounds to provide an understanding of processes (e.g., sorption and volatilization) that control the distribution of organic chemicals between different phases such as air, water, and soil. Also, organic chemical reactions in the environment, with an emphasis on environmentally mediated reactions (e.g., hydrolysis and photolysis) that control the breakdown of organic chemicals.

CEE 5319 (3). SOIL CHEMISTRY AND MINERALOGY. Examines soil solution chemistry and reactivity. Covers distribution and significance of common soil minerals, weathering, and general solid phase reactivity. Lab covers mineral structures, techniques of mineral identification, and solution-solid phase partitioning. *Prerequisite:* CEE 2421 or permission of instructor.

CEE 5321 (3). PHYSICAL AND CHEMICAL WASTE TREATMENT. Introduces waste minimization techniques and objectives, and thoroughly reviews chemical equilibrium and chemical reaction kinetics. Design and analysis equations and procedures are rigorously derived for chemical reactors and physical unit operations. The treatment objectives examined include 1) solids-liquid separation accomplished by coagulation and flocculation, sedimentation, filtration, to vehicle technologies, alternative energy, and smart cities. Presents findings from national and international case studies. *Prerequisite:* Senior standing or permission of instructor.

CEE 5327 (3). OPTIMIZATION AND RELIABILITY FOR INFRASTRUCTURE AND ENVIRONMENTAL SYSTEMS. Introduces the concepts of engineering systems optimization, reliabil-

CEE 5363 (3). ARCHITECTURAL AND STRUCTURAL ENGINEERING. Introduces the basic principle s of structural analysis and mechanics of deformable bodies. Presents structural systems and principles, with an emphasis on architectural design. Provides students with a conceptual introduction to structures, emphasizing the integration of structural and

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CEE 5387 (3). GEOTECHNICAL EARTHQUAKE ENGINEERING. Provides fundamental

i) The ability to use the techniques, skills and modern computing and software engineering tools necessary for computing practice.

For graduates with degrees in computer engineering

a) The ability to apply knowledge of mathematics, science and engineering to software and hardware design problems.
b) The ability to design and conduct experiments and to analyze and interpret data related to software and hardware design solutions.
c) The ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability , and sustainability.
d) The ability to function on multidisciplinary teams using current computer engineering tools and technologies.
e) The ability to identify, formulate and solve engineering problems based on a fundamental understanding of concepts of computer engineering topics.
f) An understanding of personal, professional and ethical responsibility.
g)

Many of the computer science core courses (CSE 2341, 3345, 3353, 4345, 4351 and 4352) contain major project-oriented components to prepare students for applying their theoretical knowledge in teams.

The free electives in the B.A. in computer science program can be used to individually tailor a student's study plan. For example, students who want a program even more intensive than the computer science major could satisfy their free electives with more computer science courses. Students interested in a broader education could satisfy these electives with courses offered by any department in the University.

The B.S. degree allows students to major in any of five concentration tracks or to

CSE 3353 (3). FUNDAMENTALS OF ALGORITHMS. Introduces algorithm analysis; big -Oh, omega, and theta notation; and algorithm classification by efficiency. Also, basic algorithm design strategies and approaches to problem-solving (e.g., greedy, divide and conquer, and dynamic programming), an introduction to graph algorithms, and intractability. *Prerequisites:* C- or better in CSE 2341, 2353.

CSE 3365 (3). INTRODUCTION TO SCIENTIFIC COMPUTING. An elementary survey course that includes techniques for root-finding, interpolation, functional approximation, linear equations, and numerical integration. Gives special attention to MATLAB programming, algorithm implementations, and library codes. Students registering for this course must also register for an associated computer laboratory. *Prerequisites:* C- or better in MATH 1338 or 1340, and in CSE 1341 or 1342. Corequisite: MATH 3353.

CSE 3381 (3). DIGITAL LOGIC DESIGN. Covers the history of logic and its application to digital switching circuitry. Topics include algebraic, combinational, and sequential circuitry.

CSE 4294 (2). UNDERGRADUATE SEMINAR. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4297 (2). RESEARCH EXPERIENCE FOR UNDERGRADUATES. Provides research experience for junior/senior undergraduate students. Permission from the advising CSE faculty member is required before registration. *Prerequisites:* Junior/senior standing; computer science or computer engineering major with GPA above 3.000.

CSE 4340 (3). STATISTICAL METHODS FOR ENGINEERS AND APPLIED SCIENTISTS.

CSE 4393 (3). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4394 (3). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4397 (3). RESEARCH EXPERIENCE FOR UNDERGRADUATES. Provides research experience for junior/senior undergraduate students. Permission from the advising CSE faculty member is required before registration. *Prerequisites:* Junior/senior standing; computer science or computer engineering major with GPA above 3.000.

CSE 4490 (4). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4491 (4). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4492 (4). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4493 (4). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 4494 (4). UNDERGRADUATE PROJECT. An opportunity for the advanced undergraduate student to undertake independent investigation, design, or development. Written permission of the supervising faculty member is required before registration.

CSE 5050 (0). UNDERGRADUATE INTERNSHIP.

CSE 5096 (0). SENIOR THESIS. *Prerequisite:* Admission to the departmental distinction program.

CSE 5111 (1). INTELLECTUAL PROPERTY AND INFORMATION TECHNOLOGY. Presents fundamentals in the nature, protection, and fair use of intellectual property, including patent, copyright, trademark, trade secret, and antitrust principles, with an emphasis on Internet, software, databases, and digital transmission technologies. Investigates the open source and creative commons alternatives for disseminating intellectual property. Examines the professional and ethical responsibilities of the engineer, scientist, manager, and creative artist, and their opportunities regarding intellectual property. Also, investigates the rapid change in types and uses of intellectual property spawned by computers, digital media, e commerce, and biotechnology.

CSE 5190 (1). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5191 (1). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5192 (1). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5193 (1). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5194 (1). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5196 (1). SENIOR THESIS. *Prerequisite:* Admission to the departmental distinction program.

CSE 5290 (2). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5291 (2). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5292 (2). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5293 (2). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5294 (2). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5296 (2). SENIOR THESIS. *Prerequisite:* Admission to the departmental distinction program.

CSE 5311 (3). FUNDAMENTALS OF COMPUTER SCIENCE. A comprehensive foundation course covering the major aspects of computer science. Covers hardware and software fundamentals, operating systems concepts, data structures, discrete structures, algorithms, and programming languages. Also, addresses issues related to software engineering and object-oriented programming. Prepares students without a computer science background for the master's program in software engineering at SMU.

CSE 5313 (3). SOFTWARE CONFIGURATION MANAGEMENT. Successful software development and maintenance requires an understanding and application of many activities and functions throughout the software engineering process. One of the key areas is software configuration management. Students explore the principles and practices of the software configuration management function and mandatory role, including how CM is defined, planned, implemented, and measured over the life cycle of any development or maintenance project. Focuses on understanding specific roles of project team members and the tasks they plan and execute: managers who must support the CM efforts; project managers who must plan and design the CM system for their projects; those who implement the system; those who manage and administer the system; and the testers, engineers, and quality assurance personnel who are affected by the system. *Prerequisites:* CSE major and junior, senior, or graduate-level standing.

CSE 5314 (3). SOFTWARE TESTING AND QUALITY ASSURANCE. Examines the relationship of software testing to quality, with an emphasis on testing techniques and the role of testing in the validation of system requirements. Topics include module and unit testing, integration, code inspection, peer reviews, verification and validation, statistica(u)195stesting the J ET BT 1

and use of a recursive high-level language to implement a complete compiler. *Prerequisites:* C- or better in CSE 3342, 3353.

CSE 5342 (3). CONCEPTS OF LANGUAGE THEORY AND THEIR APPLICATIONS. Formal languages and their relation to automata; introduction to finite-state automata, context-free languages, and Turing machines; theoretical capabilities of each model; applications in terms of grammars, parsing, and operational semantics; and decidable and undecidable problems about computation. *Prerequisite:* Ces major design methodologies, with emphasis on structured, full-custom design. Also, the MOS device, CMOS inverter static characteristics, CMOS inverter dynamic characteristics, CMOS transistor fabrication technology, combination logic circuit, alternative static logic circuit, sequential logic circuit, dynamic logic circuit, propagation delay and interconnect, power dissipation and design for low power, memory device (DRAM, SRAM, ROM), ESD protection, packaging, testing, and VLSI design flow. Students use state-of-the-art CAD tools to verify designs and develop efficient circuit layouts. *Prerequisites:* C- or better in EE 2181, 2381, 3311.

CSE 5359 (3). SOFTWARE SECURITY. As software is delivered across networks and Web-based environments, security is critical to successful software deployment. This course focuses on software security issues that pertain to the network application layer in the classic OSI model. At the network application layer, issues related to encryption, validation, and authentication are handled programmatically rather than at the network level. Students work with APIs for cryptography, digital signatures, and third-party certificate authorities. The course also explores issues related to XML and Web services security by examining standards and technologies for securing data and programs across collaborative networks. *Prerequisite:* Programming experience in Java and/or C++.

CSE 5360 (3). INTRODUCTION TO 3-D ANIMATION. Introduces computer graphics, with an emphasis on the popular software package Maya. Focuses on the user interface, creation of 3-

CSE 5387 (3). DIGITAL SYSTEMS DESIGN. Modern topics in digital systems design, including the use of HDLs for circuit specification and automated synthesis tools for realization. Programmable logic devices are emphasized and used throughout the course. Includes heavy laboratory assignment content and a design project. *Prerequisite:* C- or better in CSE 3381 or in EE 2381.

CSE 5390 (3). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5391 (3). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5392 (3). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5393 (3). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5394 (3). SPECIAL TOPICS. Individual or group study of selected topics in computer science. *Prerequisite:* Permission of instructor.

CSE 5396 (3). SENIOR THESIS. *Prerequisite:* Admission to the departmental distinction program.

- Be successful in designing a variety of engineering systems, products or experiments.
- Be successful in careers and/or graduate study in engineering or other areas such as business, medicine and law.
- Have the ability to assume leadership and entrepreneurial positions.
- Successfully function and effectively communicate both individually and in multi disciplinary teams.
- Understand the importance of lifelong learning, ethics and professional accountability.

The Electrical Engineering Department undergraduate student outcomes as related to the above educational objectives are as follows:

All graduates of the electrical engineering program are expected to have the following:

- The ability to apply knowledge of mathematics, science and engineering.
- The ability to design and conduct experiments, as well as to analyze and interpret data.
- The ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- The ability to function on multidisciplinary teams.
- The ability to identify, formulate and solve engineering problems.
- An understanding of professional and ethical responsibility.
- The ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- The recognition of the need for and the ability to engage in lifelong learning.
- A knowledge of contemporary issues.
- The ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

The Electrical Engineering Department is engaged in an ongoing assessment process that evaluates the success in meeting the educational objectives and outcomes and enhances the development of the program.

The undergraduate program in electrical engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

The Electrical Engineering Department emphasizes the following major areas of research interest:

- Biomedical Engineering. Overview of biomedical engineering, biomedical devices and instrumentation, biomedical signal capture, processing, and modeling.
- Communications and Information Technology. Detection and estimation theory, digital communications, computer networks, spread spectrum, cellular communications, coding, encryption, compression, and wireless and optical communications.
- Control Systems. Linear and nonlinear systems control, robotics, and computer and robot vision.
- Digital Signal Processing. Digital filter design, system identification, spectral estimation, adaptive filters, neural networks and DSP implementations.

- **Image Processing and Computer Vision.** Digital image processing, computer vision and pattern recognition.
- **Lasers, Optoelectronics, Electromagnetic Theory and Microwave Electronics.** Classical optics, fiber optics, laser recording, integrated optics, dielectric waveguides, antennas, transmission lines, laser diodes and signal processors, and super

work analyzer. Workstations are available for antenna design and theoretical computation. Radiation characteristics are measured at the Dallas-SMU Antenna Characterization Lab located in Richardson, Texas.

Biomedical Engine ering Laboratory. This laboratory contains instrumentation etcher, a turbo-pumped methane hydrogen reactive ion etcher, a four-target sputtering system, a plasma-enhanced chemical vapor deposition reactor, a diffusion-pumped four pocket e-beam evaporator, an ellipsometer, and profilometers. Other equipment includes a boron-trichloride reactive ion etcher, a chemical-assisted ion-beam etcher and a four-tube diffusion furnace. The cleanroom is capable of processing silicon, compound semiconductors and piezo materials for microelectronic, photonic and nanotechnology devices.

Curriculum in Electrical Engineering

The undergraduate curriculum in electrical engineering provides the student with basic principles through required courses, and specialization through a guided choice of elective courses.

Areas of Specialization

Due to the extensive latitude in course selection and to the wide variety of courses available within the Department of Electrical Engineering and within the University

Engineering Leadership Specialization:

CSE 1341, 1342
Three of EMIS 3308, 3309; CEE 3302; CSE 4360
One of EE 5356, 5357, 5381, 5385, 5387
One of EE 5310, 5312, 5314, 5321, 5330, 5332, 5333
One of EE 5352, 5360, 5362, 5370, 5371, 5372, 5373, 5374, 5375, 5376, 5377, 5378, 5379
3 hours from any EE 5000-level course listed above

Computer Engineering Specialization:

CSE 1341, 1342, 2341, 2353, 3353
EE 5381, 5385
One of EE 5357, 5387 or CSE 5343
3 hours from EE 5000-level courses chosen with adviseU ¶ V approval

Smart Wireless and Embedded Systems Specialization:

CSE 1341, 1342, 2341, 2353
Two of EE 5330, 5333, 5357, 5378, 5379, 5381, 5387
EE 5377, 5385 (or CSE 5385)
3 hours from EE 5000- O H Y H O F R X U V H V F K R V approval

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Note: EE 8000-level courses are primarily for graduate students but may be taken by highly qualified undergraduates with the approval of the adviser and the instructor. Special topics courses also are available.

Each student is expected to complete and file a plan of study with his or her academic adviser. The plan should state specific choices to meet the foregoing requirements and develop an area of specialization when specialization is desired.

Bachelor of Science in Electrical Engineering and Bachelor of Science With a Major in Mathematics

The Electrical Engineering Department and the Mathematics Department offer an integrated curriculum that enables a student to obtain both a B.S.E.E. degree and a B.S. degree with a major in mathematics.

Curriculum Notes. In addition to the University -

Curriculum Notes. In addition to the University -wide requirements, which include the completion of a minimum of 120 academic credit hours for any degree, the credit hours within this curriculum are distributed as follows:

Requirements for the Specialization	*Credit Hours*
Mathematics and Science	53
MATH 1337, 1338, 2339, 2343	
3-hour elective MATH course at the 3000 level or above	
BIOL 1401, 1402, 3304, 3350	
CHEM 1303/1113, 1304/1114, 3371/3117, 3372/3118	

TV. Designed for nontechnical students who want to be more knowledgeable. Not open to EE majors.

EE 1350 (3). INTRODUCTION TO ELECTRICAL ENGINEERING. Introduces contemporary electrical and electronic devices, concepts, and systems. Includes principles of engineering design; electrical components and systems such as generators, motors, relays, transistors, and integrated circuits; physical laws; signals and systems for audio and images; signal conversion and manipulation; digital logic; binary representation and coding; radio transmissi on; and electrical power.

EE 2122 (1). EE LABORATORY: ELECTRONIC CIRCUITS I. Experimental study of basic MOS and bipolar transistors in analog and digital applications. Logic gates and linear and nonlinear applications of operational amplifiers. *Prereq(n)3(r)13( )-eeETBT1inaACCTRICALtONIC C). INTR* basic operation of diodes, bipolar transistors, field effect transistors, light -emitting diodes, semiconductor lasers, and other photonic devices. Additional lectures discuss the basics of device processing, which include photolithography, oxidation, diffusion, ion-implantation, metalization, and etching. Laboratory reports describing the fabrication and testing of devices account for a major portion of the course grade. *Prerequisites:* CHEM 1303, C- or better in EE 2350.

EE 3322 (3). ELECTRONIC CIRCUITS II. Introduction to MOSFET analog electronic circuits. Provides a background for understanding modern electronic circuits such as digital-to-analog and analog-to-digital converters, active filters, switched-capacitor circuits, and phase-locked loops. Topics include MOSFET SPICE models, basic MOSFET, single-stage amplifiers, current-mirrors, differential amplifier stages, source -follower buffer stages, high-gain common-source stages, operational amplifier, frequency response, and negative feedback. *Prerequisites:* C- or better in EE 2122, 2322, and 2350. Corequisite: EE 3122.

EE 3330 (3). ELECTROMAGNETIC FIELDS AND WAVES. Vector analysis applied to static electric and magnetic fields, development of Maxwell's equations, elementary boundary-value problems, and determination of capacity and inductance. Introduction to time -varying fields, plane waves, and transmission lines. *Prerequisites:* EE 2350, MATH 2339.

EE 3352 (3). FUNDAMENTALS OF ELECTRIC POWER ENGINEERING. Introduction to electric power generation and distribution. Topics include energy resources such as fossil, hydraulic, wind, solar, and nuclear energies. Also, three-phase power generators and transformers, and electric machines such as induction motors, synchronous generators, DC and stepper motors, and power converters. *Prerequisite:* EE 2350 or permission of instructor.

EE 3360 (3). STATISTICAL METHODS IN ELECTRICAL ENGINEERING. An introduction to probability, elementary statistics, and random processes. Topics include fundamental concepts of probability, random variables, probability distributions, sampling, estimation, elementary hypothesis testing, basic random processes, stationarity, correlation functions, power-spectral-density functions, and the effect of linear systems on such processes. *Prerequisites:* C- or b.86 37.567(f)8(:

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proposed by the student and approved by the faculty. Depending upon the specifics of the project, a team designs, constructs, and tests a solution and then submits a formal report to the faculty in charge of the project. *Prerequisite:* EE 4311.

EE 4396 (3). SENIOR THESIS. *Prerequisite:* Admission to the departmental distinction program.

EE 4490 (4). SENIOR PROJECT.

EE 5050 (0). UNDERGRADUATE INDUSTRIAL INTERNSHIP. Represents a term of industrial work experience for noncooperative education students. Designates a student as full time for the term but carries no academic credit. Students register for the course in the same manner as for other SMU courses except that no tuition is charged. The course grade is determined by the grading of a written report by the student's adviser at the end of the term.

EE 5176 (1). NETWORK SIMULATION LABORATORY. An introductory, hands -on course in simulations of computer networks intended to be taken simultaneously with EE 5 376 or other networks courses. Lab exercises use OPNET and other simulation software to visualize network protocols and performance. Students run a number of simulation exercises, which are designed to complement classroom instruction, to set up various network models, specify protocols, and collect statistics on network performance. General familiarity with PCs is recommended. *Corequisites:* EE 5376 and senior standing.

EE 5190 (1). SPECIAL TOPICS. This special topics course must have a section number associated with a faculty member. The department offers special topics courses with a range of credit hours; the last digit in the course number represents courses with different topics.

EE 5290 (2). SPECIAL TOPICS. This special topics course must have a section number associated with a faculty member. The department offers special topics courses with a range of

EE 5353 (3). POWER SYSTEM PLANNING. Overview of power system planning, including basics of restructuring in power systems, reliability analysis in power systems, long-term demand forecast, power system production simulation, introduction to stochastic programming, midterm maintenance scheduling, mathematic al model for generation expansion planning, transmission expansion planning, coordinated expansion planning, and other practices, such as transmission switching and demand response, which affect the expansion planning. *Prerequisite:* EE 5352/7352, EE 3352, or permission of instructor.

EE 5356 (3). VLSI DESIGN AND LABORATORY. Explores the design aspects involved in the realization of CMOS integrated circuits from device up to the register subsystem level. Addresses major design methodologies, with emphasis placed on structured, full-custom design. Also, the MOS device, CMOS inverter static characteristics, CMOS inverter dynamic characteristics, CMOS transistor fabrication technology, combination logic circuit, alternative static logic circuit, sequential logic circuit, dynamic logic circuit, propagation delay and interconnect, power dissipation and design for low power, memory device (DRAM, SRAM, ROM), electrostatic discharge protection, packaging, testing, and VLSI design flow. Students use state-of-the-art CAD tools to verify designs and develop efficient circuit layouts. *Prerequisites:* C- or better in EE 2181, 2322, 2381.

EE 5357 (3). CAE TOOLS FOR STRUCTURED DIGITAL DESIGN. Concentrates on the use of CAE tools for the design and simulation of complex digital systems. Discusses and uses Verilog hardware description language for behavioral and structural hardware modeling. Emphasizes structured modeling and design. Design case studies include a pipelined processor, cache memory, UART, and a floppy disk controll er. *Prerequisites:* C- or better in EE 2381 and junior standing, or permission of instructor.

EE 5360 (3). ANALOG AND DIGITAL CONTROL SYSTEMS. Feedback control of linear continuous and digital systems in the time and frequency domain. Topics include plant r epresentation, frequency response, stability, root locus, linear state variable feedback, and design of compensators. *Prerequisite:* EE 3372.

EE 5370 (3). COMMUNICATION AND INFORMATION SYSTEMS. An introduction to communication in modulation systems in discr ete and continuous time, information content of signals, and the transition of signals in the presence of noise. Also, amplitude, frequency, phase and pulse modulation, and time and frequency division multiplexing. *Prerequisite:* EE 3360.

EE 5371 (3). ANALO G AND DIGITAL FILTER DESIGN. Covers approximation and analog design of Butterworth, Chebyshev, and Bessel filters; basic frequency transformations for designing low-pass, band-pass, band-reject, and high-pass filters; concept of IIR digital filters using impulse-invariant and bilinear transformations; design of FIR digital filters using frequency sampling and window methods; canonical realization of IIR and FIR digital filters; wave digital filters; and an introduction to two -dimensional filters. *Prerequisite:* EE 3372.

EE 5372 (3). TOPICS IN DIGITAL SIGNAL PROCESSING. Provides an extended coverage of processing of discrete-time signals. Reviews discrete-time signals and the analysis of systems in both the time and frequency domains. Topics include multirate signal processing, digital filter structures, filter design, and power spectral estimation. *Prerequisite:* EE 3372.

EE 5373 (3). DSP PROGRAMMING LABORATORY. Utilizes a hands-on approach that focuses on the essentials of programming digital signal processors (programmable semiconductor devices used extensively in digital cellular phones, high-density disk drives, and high-speed modems) while minimizing signal processing theory. Focuses on programming the Texas Instruments TMS320C50, a fixed-point processor. Emphasizes assembly language programming, and Topics include implementation of FIR and IIR filters, the FFT, and a real -time spectrum analyzer. Recommended: Basic knowledge of discrete-time signals and digital logic systems. *Prerequisite:* EE 3372.

EE 5374 (3). DIGITAL IMAGE PROCESSING. Introduces the basic concepts and techniques of digital image processing. Topics include characterization and representation of images, image enhancement, image restoration, image analysis, image coding, and reconstruction. *Prerequisite:* EE 5372.

EE 5375 (3). RANDOM PROCESSES IN ENGIN6(u)19r.ING.

tic processes, autocorrelation and power spectral densities, and an introduction to estimation and queuing theory. *Prerequisite:* EE 3360.

EE 5376 (3). INTRODUCTION TO COMPUTER NETWORKS. Surveys basic topics in communication n etworks, with an emphasis on layered protocols and their design. Topics include OSI protocol reference model, data link protocols, local area networks, routing, congestion control, network management, security, and transport layer protocols. Network techno logies include

EE 5393 (3). SPECIAL TOPICS. This special topics course must have a section number associated with a faculty member. The department offers special topics courses with a range of credit hours; the last digit in the course number represents courses with different topics.

EE 5395 (3). SPECIAL TOPICS. This special topics course must have a section number associated with a faculty member. The department offers special topics courses with a range of credit hours; the last digit in the course number represents courses with different topics.

EE 5490 (4). SPECIAL TOPICS. This special topics course must have a section number associated with a faculty member. The department offers special topics courses with a range of credit hours; the last digit in the course number represents courses with different topics.

Telecommunication Courses (EETS)

EETS 5301 (3). INTRODUCTION TO TELECOMMUNICATIONS. Overview sbgicu475(d)13( )] TJ ET BT

ware and Web hosting to all engineering students. Windows- and Linux-based PCs and workstations are the primary desktop equipment. All computing facilities are networked via high-speed Ethernet, with Gigabit Ethernet connections to Internet 1, Internet 2 and the National Lambda Rail research network. Open computing labs and wireless services provide additional facilities access points for students.

Curriculum in Management Science

tered in business and government. *Prerequisite:* Knowledge of college-level algebra. *Corequisites:* MATH 1337, CSE 1341. Students are limited to a maximum of two enrollments in the course; medical withdrawals will be reviewed on a case by case basis.

EMIS 2360 (3). ENGINEERING ECONOMY. Evaluation of engineering alternatives by equivalent uniform annual cost, present worth, and rate-of-return analysis. Use of a computerized financial planning system. Credit not allowed for both EMIS 2360 and EMIS 8361. *Prerequisites:* C- or better in MATH 1337 and knowledge of introductory probability and statistics. *Corequisites:* MATH 1338 and CSE 1342 (must enroll in lab).

EMIS 2375 (3). CULTURAL AND ETHICAL IMPLICATIONS OF TECHNOLOGY. Explores the pervasive use of technology in today's society, the impact of technology on daily life, and the tie between technology and ethical responsibility. Students learn how their lives are being shaped by technology and how they in turn help shape technology.

EMIS 3150 (1). ETHICS IN COMPUTING. Computer professionals have a special responsibility to ensure ethical behavior in the design, development, and use of computers and computer networks. This course focuses on the education of the undergraduate through the study of ethical concepts and the social, legal, and ethical implications involved in computing. Issues to be studied include computer crimes, software theft, hacking and viruses, intellectual property, unreliable computers, technology issues in the workplace, and professional codes of ethics. *Prerequisite:* Junior standing.

EMIS 3308 (3). ENGINEERING MANAGEMENT. Examines planning, financial analysis,

EMIS 5315 (3). SYSTEMS QUALITY ENGINEERING.

In combination with a solid liberal arts foundation, the program prepares students for graduate studies not only in engineering but also in other professional fields such as business, medicine and law. SMU mechanical engineering graduates have found success in graduate school and in employment, and regularly attain graduate degrees in engineering, medicine, business and law Graduates are employed as engineers or consulting engineers for major engineering, pharmaceutical, environmental, financi al, banking and real estate companies.

The undergraduate program in mechanical engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

The program§ mission is to educate mechanical engineers who are innovative, entrepreneurial and equipped to become global leaders in research and technology. Specific educational objectives of the mechanical engineering undergraduate program are to produce graduates who meet the following:

1. The ability to be innovative problem solvers and critical thinkers addressing

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Bachelor of Science in Mechanical Engineering

(with an engineering management and entrepreneurship specialization)

Students may pursue combined degree programs offered in conjunction with Dedman College. The combined degree programs include a B.S. in Mechanical Engineering and a B.S. anical Engineering

Research Center for Advanced Manufacturing. The RCAM center supports research and development activities in areas of rapid prototyping and manufacturing (laser-based and welding-based deposition), laser materials processing (welding, forming, surface modification), welding (including electrical arc welding, variable polarity plasma arc welding, friction stir welding, and micro plasma arc welding), waterjet/abrasive waterjet materials processing, sensing and control of manufacturing processes, and numerical modeling of manufacturing processes.

Center for Laser Aided Manufacturing. This facility, which is housed in the Research Center for Advanced Manufacturing facility, collaborates with RCAM.

Energy Harvesting Materials Laboratory.

Instructional Laboratories

In support of the teaching and research endeavors of the department, several instructional laboratories are available. They include the following:

Information Technology Computer Laboratory. The laboratory features 25 computer workstations, printers, scanners and an overhead projector with an Internet connection used to support mechanical engineering and non-Lyle School of Engineering undergraduates in meeting the SMU-wide IT requirement for all students.

Computational/Design Laboratory. Dedicated computational facilities that include personal computers and high-resolution color X-terminals, all connected through a high-speed network that allows communication with the school¶ and University¶ computers, as well as with off-campus systems via NSFNet. Available Lyle School of Engineering computational facilities include several high-speed, multiprocessor workstations and servers. Educational software includes Parametric Technologies Pro-Engineer CAD system, MATLAB, ANSYS structural analysis package, MacroFlow and Fluent CFD packages.

Graphics Laboratory. Used primarily for first-year graphics, this facility is available for students working on design projects. A special design projects library is located adjacent to the drafting room.

Mechanics of Materials (Structures) Laboratory. This laboratory is equipped for instruction and research on the behavior of materials under various loading conditions such as fatigue, impact, hardness, creep, tension, compression and flexure.

Systems, Measurement and Control Laboratory. This facility is equipped for instruction in the design and analysis of analog and digital instrumentation and control systems. Modern measurement and instrumentation equipment is used for experimental control engineering, system identification, harmonic analysis, simulation and real-time control applications. Equipment also is used for microprocessor interfacing for control and instrumentation.

Thermal and Fluids Laboratory. Equipment in this laboratory is used for instruction in experimental heat transfer, thermodynamics and fluid mechanics. Modern equipment is available for conducting experiments on energy conservation; aerodynamics; internal combustion engines; heating, ventilation and air conditioning systems; convective cooling of electronics; heat exchangers; and interferometric visualization. State-of-the-art systems support automatic control and data acquisition. A partial list of the equipment in this lab includes a refrigeration training

Tracks (continued)	
Thermofluids Track	
Required: ME 4338, 5371	
Electives: Two from ME 3360, 5332, 5333, 5383	
One from dynamics and controls required or elective courses	
One from solid mechanics, materials, and manufacturing required or elective courses	
Dynamics and Controls Track	
Required: ME 5320, 5322	
Electives: Two from ME 3360, 5302, 5326	
One from thermofluids required or elective courses	
One from solid mechanics, materials, and manufacturing required or elective courses	
Solid Mechanics, Materials, and Manufacturing Track	
Required: ME 5374, 5338	
Electives: ME 5361, 5364	
One from thermofluids required or elective courses	
One from dynamics and controls required or elective courses	
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Bachelor of Science in Mechanical Engineering and Bachelor of Science With a Major in Physics

The Mechanical Engineering Department and the Physics Department offer a curriculum that enables a student to obtain both a B.S.M.E. degree and a B.S. degree with a major in physics.

In addition to the University-wide requirements, which include the completion of a minimum of 120 academic credit hours for any degree, the credit hour requirements within this curriculum are distributed as follows:

Requirements for the Major	*Credit Hours*
Mathematics and Science	58
MATH 1337, 1338, 2339, 2343, 3353	
STAT 4340 *or* equivalent	

Requirements for the Specialization	*Credit Hours*
Mathematics and Science	56
MATH 1337, 1338, 2339, 2343, 3353 STAT 4340 *or* equivalent BIOL 1401, 1402, 3304, 3350 CHEM 1303/1113, 1304/1114, 3371/3117, 3372/3118 PHYS 1303/1105, 1304/1106	
Engineering	52
ME 1302, 2310, 2320, 2331/2131, 2340/2140, 2342/2142, 2350, 2372, 3332/3132	

ME 1304 (3). GREEN ENGINEERING: DESIGNING TOMORROW TODAY. Presents how design choices for materials, manufacturing processes, energy usage, and end-of-life disposal affect economic and natural environments. Also, case studies in design for the environment for various industries. In lab, students use computer modeling to create designs and then analyze and compare the designs' total life cycle impact through eco-audits of energy and carbon footprints. Students also use software to compare and select materials best suited for a particular design and its constraints.

ME 1305 (3). INFORMATION TECHNOLOGY AND SOCIETY. A comprehensive survey of information technologies and the growing interconnectivity between them as currently utilized throughout society. Students acquire portable IT skills in the use of word processing, spreadsheets, presentation tools, graphics applications, and the Internet that will prepare them for success in the workplace and beyond. Discusses issues surrounding IT, including history, ethics, legal questions, use in producing and maintaining a competitive advantage, effects on society, and associated costs and benefits.

ME 2131 (1). THERMODYNAMICS LABORATORY. One 3-hour laboratory session per week. Basic thermal-property and power-device measurements to complement lecture material of ME 2331. *Prerequisites:* MATH 1337 and sophomore standing. Prerequisite or corequisite: ME/CEE 2331.

ME 2140 (1). MECHANICS OF MATERIALS LABORATORY. Experiments in mechanics of deformable bodies, to complement ME 2340. Simple tension tests on structural materials, simple shear tests on riveted joints, stress and strain measurements, engineering and true stress, engineering and true strain, torsion testing of cylinders, bending of simple supported beams, deflection of simply supported beams, buckling of columns, strain measurements of pressure vessels, Charpy impact tests, and the effect of stress concentrators. Prerequisite or corequisite: CEE/ME 2340.

ME 2142 (1). FLUID MECHANICS LABORATORY. One 3-hour laboratory session per week. Experiments in fluid friction, pumps, boundary layers, and other flow devices to complement lecture material of ME 2342. *Prerequisite or corequisite:* ME/CEE 2342.

ME 2310 (3). STATICS. Equilibrium of force systems, computations of reactions and internal forces, and determinations of centroids and moments of inertia. Also, introduction to vector mechanics. *Prerequisite:* MATH 1337.

ME 2320 (3). DYNAMICS. Introduction to kinematics and dynamics of particles and rigid bodies. Also, Newton's laws, kinetic and potential energy, linear and angular momentum, work, impulse, and inertia properties. *Prerequisite:* C or better in CEE/ME 2310.

ME 2331 (3). THERMODYNAMICS. The first and second laws of thermodynamics and thermodynamic properties of ideal gases, pure substances, and gaseous mixtures are applied to power production and refrigeration cycles. *Prerequisites:* CHEM 1303, MATH 2339, and a C or better in ME/CEE 2310.

ME 2340 (3). MECHANICS OF DEFORMABLE BODIES. Introduction to analysis of deformable bodies, including stress, strain, stress-strain relations, torsion, beam bending and shearing stresses, stress transformations, beam deflections, statically indeterminate problems, energy methods, and column buckling. *Prerequisite:* C or better in CEE/ME 2310.

ME 2342 (3). FLUID MECHANICS. Fluid statics, fluid control volume, and applications; irrotational flow; Bernoulli's and Euler's equations; similitude and dimensional analysis; differential analysis of fluid flow; incompressible viscous flow; and boundary layer theory. *Prerequisites:* MATH 2339, PHYS 1303 and C or better in CEE/ME 2310. Corequisite: MATH 2343. ME/CEE 2320 is recommended but not required.

ME 2350 (3). ELEMENTS OF MECHANICAL ENGINEERING MEASUREMENTS. Introduces basic engineering experimentation and measurements, including techniques for measurement and experimentation; data acquisition; signal processing; and analysis, interpretation, and reporting of results. *Prerequisite:* C or better in CEE/ME 2310. Prerequisite or corequisite: CEE/ME 2320.

ME 2372 (3). INTRODUCTION TO CAD. Introduces mechanical computer-aided design. Surveys technical topics related to CAD and computer-aided manufacturing, with emphasis on the hands-on use of interactive computer graphics in modeling, drafting, assembly, and analysis using a state-of-the-art CAD system.

ME 3132 (1). HEAT TRANSFER LABORATORY. One 3-hour laboratory session per week. Experiments in conduction, convection, and radiation to complement lecture material of ME 3332. Prerequisite or corequisite: ME 3332.

ME 3332 (3). HEAT AND MASS TRANSFER.

ME 4380 (3). MECHANICAL ENGINEERING DESIGN I. A study of design methodology and development of professional project-oriented skills, including communication, team management, creative problem-solving, interpersonal management, and leadership skills. Uses team-project activities to apply project-oriented skills to solution of design problems. Investigates nontechnical considerations in design, including patents, ethics, aesthetics, safety, and economics. Prerequisite or corequisite: ME 3370.

ME 4381 (3). MECHANICAL ENGINEERING DESIGN II. Student design teams have full responsibility for conducting a full-term design project for an industrial client. Periodic design reports and design reviews are presented to and critiqued by the industrial client, the faculty, and the design team. *Prerequisite:* ME 4380. Prerequisite or corequisite: ME 4370.

ME 5050 (0). UNDERGRADUATE INTERNSHIP.

ME 5190 (1). UNDERGRADUATE SEMINAR: ETHICS IN ENGINEERING AND TECHNOLOGY. Covers ethical issues, hard choices, and human failures in life. Discusses practical, ethical issues with examples from everyday life. Presents ethical issues encountered in copyright law and intellectual property, along with issues involved in telephone communications and email. Discusses principles, methods, and bases for ethical decision-making and action.

ME 5290 (2). UNDERGRADUATE SEMINAR. An opportunity for the advanced undergraduate student to undertake independent investigation, design, and development. The project and the supervising faculty must be approved by the chair of the department in which the student expects to receive the degree.

ME 5302 (3). LINEAR SYSTEM ANALYSIS. Introduces topics within the domain of modern control theory, with emphasis on the application of the developed concepts in designing linear systems and casting their responses in prescribed forms. Includes state representation of linear systems, controllability, observability, minimal representation, linear state variable feedback, observers, and quadratic regulator theory.

ME 5303 (3). ORGANIZATIONAL LEADERSHIP. This course in personnel and organizational leadership covers the scientific structure of organizations and methods used to improve the productivity and quality of life of people working in the organization. Introduces industrial organizational psychology as applied to the manufacturing organization, with a focus on understanding individual behavior and experiences in industrial and organizational settings. Also introduces industrial psychology as it addresses the human resource functions of analyzing jobs and appraising, selecting, placing, and training people. Addresses the psychology of work, including employee attitudes, behavior, emotions, health, motivation, and well-being, as well as the social aspects of the workplace.

ME 5314 (3). INTRODUCTION TO MICROELECTROMECHANICAL SYSTEMS AND DEVICES. Develops the basics for MEMS and devices, including microactuators, microsensors, and tion, exami nation and interpretation of failure surfaces, failure modes, and causes of failure. *Prerequisite:* ME 3340.

ME 5322 (3). VIBRATIONS. Review of fundamentals of vibrations with application of simple machine and structural members,33e/PaginatE 532 e.

ME 5335 (3). CONVECTIVE COOLING OF ELECTRONICS. Reviews the fundamental concepts of convection heat transfer and applications of these principals to the convective cooling of electronic components and systems, with emphasis on the design of natural and forced convection heat sinks with air and liquid cooling, fan and pump selection procedures (e.g., piezoelectric fans and micropumps), acoustic fan noise and noise measurement techniques, augmentation of convection heat transfer in the form of plate-fin and pin-fin extended surfaces, spray cooling, jet impingement cooling, microchannel cooling, heat pipes, and capillary pumped loops. Covers pool boiling and flow boiling as applied to the thermal management of electronics, and the design of electronic chassis with flow through coldwalls and edge-cooled PWBs. Uses several industry-related applications as examples. *Prerequisite:* ME 3332.

ME 5336 (3). INTERMEDIATE FLUID DYNAMICS. Reviews fundamental concepts of undergraduate fluid mechanics and introduces advanced fluid dynamics, including irrotational flow, tensor notation, and the Navier-Stokes equations. *Prerequisite:* ME/CEE 2342 or equivalent.

ME 5337 (3). INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS. Concepts of stability, convergence, accuracy, and consistency; applications to linear and nonlinear model partial differential equations; curvilinear grid generation; and advanced topics in grid generation. Also, the Beam-Warming factored implicit technique; MacCormack techniques; and solution methods for the Reynolds equation of lubrication, the boundary layer equations, and the Navier-Stokes equations. *Prerequisites:* ME 2342 or equivalent, MATH 2343 or equivalent, or permission of instructor.

ME 5338 (3). NONTRADITIONAL MANUFACTURING PROCESSES. Explores difficult-to-machine materials and the increased geometrical complexity of components that have resulted in the development of nontraditional manufacturing processes based on the application of electrical, chemical, ultrasonic, magnetic, and photonic sources of energy. Introduces fundamentals of materials processing by laser beam, electron beam, ion beam, abrasive waterjet, ultrasonic machining, electro-discharge machining, chemical and electrochemical machining, and hybrid machining (laser beam, plasma arc, and waterjet assisted machining). Emphasizes the additive manufacturing processes as one of the fastest developing disciplines in materials processing. Covers theoretical problems and practical considerations related to the nontraditional manufacturing processes. *Prerequisites:* ME 3340, 3370; a basic understanding of manufacturing processes, mechanical and physical properties of materials, and physics.

ME 5340 (3). INTRODUCTION TO SOLID MECHANICS. Three-dimensional stress and strain, failure theories, introduction to two-dimensional elasticity, torsion of prismatic members, beams on elastic foundation, introduction to plates and shells, and energy methods. *Prerequisites:* MATH 2343 and C or better in ME/CEE 2340.

ME 5341 (3). STRUCTURAL PROPERTIES OF SOLIDS. Develops an understanding of the structural aspect of solids and their relationship to properties and applications. Topics include structural defects, bonding and crystal structure, solid-state reactions and phase transformations, degradation, and deformation. *Prerequisite:* ME 3340 or permission of instructor.

ME 5342 (3). INTRODUCTION TO THERMAL MANAGEMENT OF ELECTRONICS. Emphasizes the thermal design of electronic packages and systems. Topics include the basics of conduction, convection (natural and forced), and radiation heat transfer. Also, pool boiling and flow boiling, extended surfaces as applied to the design of heat exchangers and cold plates, and thermal interface resistance as applied to the design of electronic packages. Introduces modern cooling technologies such as single-phase cooling and two-phase cooling, heat pipes, and thermoelectric coolers. *Prerequisite:* ME 3332.

ME 5343 (3). ELECTRONIC PACKAGING MATERIALS: PROCESSES, PROPERTIES, AND TESTING. Focuses on an overview of materials used in electronic packaging. Examines solderability, microscopic processes, and alloy selection. Also, composites and applying conducting polymer matrix composites, metal films, and vacuum processes. Covers the importance of encapsulation, temperature humidity bias testing, and temperature cycle testing, as well as the measurement of properties of material in electronic packaging, thermal properties, physical properties, manufacturing properties, and materials selection. *Prerequisite:* ME 3340.

ME 5344 (3). CONDUCTIVE COOLING OF ELECTRONICS. Reviews the fundamental concepts of conduction heat transfer and applications of these principals to the conductive cooling of electronic components and systems, with emphasis on contact conductance, interface thermal resistance, heat spreaders, thermal interface materials, phase change materials, thermoelectric devices, Stirling cycle refrigerators, and the cooling of special electronic components such

ME 5360 (3). ELECTRONIC PRODUCT DESIGN AND RELIABILITY.

ME 5377 (3). ADVANCED STEEL DESIGN. The behavior and design of steel structures, including general methods of plastic analysis, plastic moment distribution, steel frames, unbraced and braced frames, and composite construction. *Prerequisite:*

ENGR 4199 (1). ENGINEERING INTERNSHIP. Represents a term of practicum experience in the student's field of study. For students taking more than one internship course, internship courses are taken in numerical sequence. Tuition is charged for the course. The course grade is based on the student's written report due within 2 we eks of the final day of employment.

ENGR 5090 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5091 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5092 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5093 (0). SPECIAL TOPICS. Individual or group study of selected topics in e ngineering. *Prerequisite:* Permission of instructor.

ENGR 5094 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5095 (0). SPECIAL TOPICS. Individual or group study of selected top ics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5096 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5097 (0). SPECIAL TOPICS. Individual or group study of sele cted topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5098 (0). SPECIAL TOPICS. Individual or group study of selected topics in engineer-
ing. Pre[illegible]

ENGR 5099 (0). ENGINEERING INTERNSHIP. Repr[illegible]k activity in connection with the Engineering Cooperative Program. Internship courses are taken in numerical sequence. Students register for this course in the same manner as for other SMU courses except that no tuition is charged. Each course grade is determined by the student's written report and fhe erical seque's wri(t)12()-5(4(a)-3(n)20 [123(P)-3(m)8(.)-123(I)-6(n)20(t)-3(e)7(rn

Pr6.02 Tm [( )] TJ ET 76.3459 355 1 0 050 5099 (0). ENGINNTP.

ENGR 5293 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5294 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5295 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5296 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5297 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5298 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5299 (2). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5390 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5391 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5392 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5393 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5394 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5395 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5396 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5397 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5398 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

ENGR 5399 (3). SPECIAL TOPICS. Individual or group study of selected topics in engineering. *Prerequisite:* Permission of instructor.

Ways of Knowing Courses (KNW)

KNW 2300 (3). INTRODUCTION TO ENGINEERING DESIGN. Introduces engineering design methodologies and basic teaming skills. Students participate on a team in a term-long, multidisciplinary design experience in which each student provides basic engineering capabili-

General Information

While Army ROTC courses are not offered on the SMU campus, students can participate in the Army ROTC program at the University of Texas at Arlington by enrolling as they enroll for other SMU courses. Further program information and application procedures may be obtained by contacting the UTA Department of Military Science at 817-272-3281. Students who participate in the UTA Army ROTC program are responsible for their own travel and other physical arrangements.

Army ROTC offers students the opportunity to graduate as officers and serve in the U.S. Army, the Army National Guard or the U.S. Army Reserve. Army ROTC scholarships are awarded on a competitive basis. Each scholarship pays for tuition and required educational fees, and provides a specified amount for textbooks, supplies and equipment. Each scholarship also includes a subsistence allowance of up to $1,000 for every year the scholarship is in effect.

Students can enroll in the Army ROTC on-campus program as they enroll for other SMU courses. Army ROTC courses are listed under ROTC in the Access.SMU schedule of classes, and permission to enroll must be obtained from Betsy Willis at bwillis@lyle.smu.edu or 214-768-1732.

For information about Air Force ROTC, see the Aerospace Studies: Air Force ROTC section in the Dedman College of Humanities and Sciences portion of the catalog.

The Courses (ROTC)

ROTC 1141 (1). FOUNDATIONS OF LEADERSHIP. Fundamental concepts of leadership in a profession, with classroom and outdoor laboratory environments. Studies time management skills, basic drill, ceremony, physical fitness, repelling, leadership reaction, first aid, presentations, and marksmanship. Corequisite: ROTC 1180. Includes mandatory participation in independent physical fitness training, plus optional participation in a weekend field training exercise.

ROTC 1142 (1). INTRODUCTION TO LEADERSHIP. Application of principles of leadership through participation in physically and mentally challenging exercises with upper-division ROTC students, with a focus on communication skills, organizational ethics, and time management techniques. Corequisite: ROTC 1180. Includes mandatory participation in individual physical fitness training, plus optional participation in a weekend field training exercise.

ROTC 1143 (1). ARMY ROTC: INTRODUCTION TO LEADERSHIP I. Introduces basic military skills, including principles of emergency first aid, evacuation of casualties, map and compass reading, terrain association, cross-country navigation, principles of physical fitness training, and military inspections. Corequisite: ROTC 1180.

ROTC 1180 (1). LEADERSHIP LABORATORY. A practical laboratory of applied leadership and skills. Students plan, organize, and conduct training that is oriented toward leadership development. Topics include marksmanship and small-unit tactics. Multitier programs focus on individual skill levels. Uniform and equipment provided. May be repeated for credit.

ROTC 2248 (2). EVOLUTION OF CONTEMPORARY MILITARY STRATEGY. A review of contemporary military conflicts. Selected battles from World War II, Korea, Vietnam, and the Yom Kippur War are examined for impact upon current U.S. military doctrine, strategy, and weapons systems. Corequisite: All military science students must enroll or participate in ROTC 1180 unless exception is given by the PMS.

ROTC 2251 (2). INDIVIDUAL AND TEAM DEVELOPMENT. Application of ethics-based leadership skills and fundamentals of the ROTC's Leadership Development Program. Develops skills in oral presentations, concise writing, event planning, coordination of group efforts, advanced first aid, land navigation, and military tactics. Corequisite: ROTC 1180. Includes mandatory participation in individual physical fitness training, plus optional participation in a weekend field training exercise.