ENGINEERING, COMPUTER SCIENCE, AND ENGINEERING TECHNOLOGY

Haughey Hall, Room 312
(269) 471-3420
FAX: (269) 471-3797
engr-info@andrews.edu cs-info@andrews.edu
http://www.andrews.edu/COT/

Faculty
William Wolfer, *Acting Chair*
George S. Agoki
Gerald W. Coy
Ronald L. Johnson
Gunnar Lovhoiden
Steve Ng
Nadine Shillingford

Academic Programs	Credits
BS: Computing	40
Computer Science Emphasis	
Software Systems Emphasis	
Minor in Computer Science	20
BS: Engineering	
Electrical and Computer Engineering	63
Mechanical Engineering	63
BSET: Computer Engineering Technology	40
BSET: Mechatronics Engineering Technology	40
Minor in Engineering Technology	20
MS: Software Engineering	32
MSA: Engineering Management	
See the School of Business	

Undergraduate Programs

COMPUTING

Two emphases are available in Computing—**Computer Science** and **Software Systems**.

Computer Science focuses on a study of the computing as well as on its role in an application area. Areas of interest include artificial intelligence, compilers, computer architectures, computer graphics, computer networks, operating systems, program development, and analytical theory. A degree in computing with the Computer Science emphasis prepares students for graduate study, employment in computer systems/networks, administration/development, software development/maintenance, and for careers in education.

Software Systems is an applied study of computing, focusing on the development and maintenance of software in an application area. A minor in an application area is included as part of the degree. Typical minors might include one of the sciences, behavioral science, or business. Supervised "real-world" projects are a requirement for this degree. A degree in Computing with the Software Systems emphasis prepares students for employment in developing and maintaining commercial applications and for graduate studies in applied computing such as software engineering.

BS: Computing

Major requirements—40
Common core—15
CPTR125, 151, 152, 275, 461

Computer Science Emphasis

Required courses—12
CPTR425, 436 or 437, 462, 485 or 487
Major electives—13
Chosen from CPTR courses in consultation with an advisor. A minimum of 12 upper division credits required.
Cognate requirements—32-34
MATH141, 142, 215, 286, 355; STAT340 (20)
ELCT335 (4)
BIOL165; 166 (10)*
or CHEM131, 132 (8)*
or PHYS141, 142 (8)*
or PHYS241, 242, 271, 272 (10)*
or ELCT141, 142 (8)
* This course will also meet the general education natural science requirement

Software Systems Emphasis

Required courses—11
CPTR427, 460, 466; INFS428
Major electives—14
Chosen from CPTR courses in consultation with an advisor. A minimum of 12 upper division credits required.
Cognate requirements—32-34
MATH182, 215, 355; STAT340 (12)
Minor in an advisor-approved application area (20-22)

Minor in Computing—20

Required courses—12
CPTR125, 151, 152, 275
Minor electives—8
Chosen from CPTR courses in consultation with an advisor.

Notes:

No course grade below a C- may apply to a major or minor in Computing.

A minimum GPA of 2.25 may apply to a major or minor in Computing.

A secondary-education endorsement is available for students seeking either a major or minor in Computing. In such cases, CPTR459 must be taken. Consult the School of Education for further information.

ENGINEERING

Andrews University is presently accepting freshmen and sophomore students into a new four-year professional engineering program. This program leads to a Bachelor of Science in Engineering degree with concentrations in Electrical and Computer Engineering and in Mechanical Engineering. These two concentrations build on a strong traditional mathematics, science, and engineering core. The Electrical and Computer Engineering con-

centration focuses on the areas of digital systems, communication systems, and computer controlled instrumentation and computer simulation. The Mechanical Engineering concentration focuses on mechanical design and the electromechanical elements of smart machines. The upper division engineering courses for these programs will be added during the 2004-5 and 2005-6 academic years, so consult with the department about specific course availability during this transition period.

BS in Engineering

Major requirements–63
Common core–30

ments for computing majors. Only 3 credits of CPTR125 may apply toward a computing major or minor. *Fall, Spring*

CPTR151 **$ (3)**
Computer Science I
An introduction to programming methodology using C++, UNIX usage, problem-solving, algorithm development, control structures, arrays, program style, design correctness and documentation techniques, as well as a brief overview of computer systems and computer history. *Fall, Spring*

CPTR152 **$ (3)**
Computer Science II
A continuation of CPTR151 examines program specifications, design, coding, correctness, and style with additional coverage of pointers and arrays, and an in-depth study of recursion and data structures. Includes files, lists, stacks, queues, trees, graphs, and an overview of computer ethics. Prerequisites: CPTR151. *Fall, Spring*

CPTR275 **$ (3)**
Computer Organization and Assembler
Covers data representation, number base conversion, representation for integer fractions and floating numbers, Boolean algebra, truth table digital logic and circuit representations of basic computational building blocks, introduction to computer architecture; interrupt schemes; an introduction to system software including assemblers, loaders and linkers, and operating systems. Includes assembly language programming using a macro-assembler. Prerequisite: CPTR152. *Spring*

CPTR295 **(1-3)**
Directed Computer Language Study
Directed study of computer language in consultation with the instructor. Normally, the language is not included in other courses taught by the department. A programming project may be required. Prerequisites: CPTR151 or equivalent.

CPTR416 **g $ (3)**
Internet Technologies
A study of current technologies and their effects, including web server software, e-commerce, various scripting languages, human-computer interfacing, perception, and related issues. Prerequisite: CPTR152. *Spring, Summer*

CPTR425 **g $ (3)**
Programming Languages
Survey of current programming languages, including structure, runtime systems, the specification of syntax, and semantics. Definition of syntax for formal languages with emphasis on context-free languages. Techniques for scanning and parsing programming languages. Automated grammar analysis parsers. A major programming project is required. Prerequisite: CPTR275. *Fall*

CPTR427 **g $ (3)**
Object-Oriented Design and Programming
Emphasizes the study of object-oriented analysis and design methodologies and the application of these to the development of advanced software. Includes survey of object-oriented programming languages and environments. A major programming project is required. Prerequisite: CPTR152. *Fall*

CPTR436 **g $ Alt (3)**
Numerical Methods and Analysis
A study of common numerical techniques applicable on the computer. Includes interpolation, extrapolation, approximation techniques, numerical methods for linear problems, root finding, function fitting, numerical integration, location of extremes, efficiency of numerical algorithms, and minimization of computational error. Prerequisites: CPTR275 and MATH215 or 281. *Spring* (even years)

CPTR437 **g $ Alt (3)**
Formal Theory of Computation
Includes post productions, Turing machines, and recursive functions. Recursive and recursively enumerable sets. Undecidability results of computation. Prerequisites: CPTR152 and MATH235, 281 or 355. *Spring* (odd years)

CPTR459 **Alt (2)**
Secondary Methods: Computer Science
Considers computer science programs in the secondary school and presents information and materials for teaching computer science in secondary school. Topics include organization and maintenance of equipment, publications, legal issues, dealing with diversity of abilities, problem-solving skills, and strategies for debugging programs. Prerequisite: CPTR275.

CPTR460 **g $ (3)**
Software Engineering
Surveys basic software engineering topics associated with the processes, documents, and products of the entire software life cycle. Topics include software evolution, project organization, and management, feasibility studies, product definition, design, implementation, and testing issues, and the role of the software engineer within the life cycle. Prerequisite: CPTR152. *Fall*

CPTR461 **g $ (3)**
Operating Systems I
Process management, including asynchronous concurrent processes and deadlock. Virtual storage management and job and process scheduling. Hgineer withiOEiT*(scr witDisk Hgineer ws)TJfilsivelydata

CPTR487 **g $ Alt (3)**
Artificial Intelligence
Provides the conceptual basis for understanding current trends in Artificial Intelligence. Topics include both symbolic and numeric processing, intelligent search methods, problem representation, machine learning, expert systems, and a survey of some social implications of AI. Prerequisite: CPTR152. *Fall* (even years)

CPTR495 **(1-3)**
Independent Study
Directed study of material of special interest chosen in consultation with the instructor. No more than 6 credits may be earned in CPTR495. Graded S/U.

CPTR496 **(1-3)**
Special Projects
Project chosen in consultation with instructor. No more than 6 credits may be earned in CPTR495. Graded S/U.

CPTR536 **Alt (3)**
Compiler Construction
Storage allocation for programs, subroutine linkage, and code generation and optimization. Simple translator written in course. Prerequisites: CPTR275, 425. *Spring* (odd years)

CPTR548 **Alt (3)**
Advanced Database Design and Implementation
Database design and theory. Concurrency, distributed databases, integrity, security, query optimization. A survey of the design and implementation tradeoffs involved in using various available database packages. Includes a term project and reading from the literature. Prerequisite: CPTR275, INFS428. *Fall* (even years)

CPTR550 **(3)**
Network Architecture
A study of the concepts and implementation of the client/server model of computing. Examines four implementations of the client/server model. Surveys the hardware and software used in network communications, including the specifications and protocols associated with thin and thick coax, twisted pair, fiber optics, slow IP mediums, UDP/IP and TCP/IP. Prerequisite: CPTR275.

CPTR555 **Alt (3)**
Advanced Operating Systems
May include system structures and algorithms, reliability, security, distributed systems, study of operating systems highlighting these concepts, and recently published research in these and other areas. Includes a term project and readings from the literature. Prerequisite: CPTR461. *Spring* (odd years)

CPTR556 **(3)**
Real Time Systems
A survey of the system architecture and software engineering aspects of real time systems such as operating systems, and process-control software. Includes a term project and readings from current literature. Prerequisite: CPTR275.

CPTR560 **(3)**
Advanced Software Engineering
A study of applied software product development issues, including requirement analysis, systems and software design methodologies, software-project planning models (e.g., COCOMO), implementation, testing and reuse, language, tool and hardware selection, software economics, productivity measurement, risk management, statistical process evaluation, and control. Prerequisites: CPTR460, MATH182 or 141, STAT285. *Spring*

CPTR561, 562 **(2, 3)**
Software Engineering Group Project I, II
The implementation of a group project and the study of topics related to the group project in cluding CASE tools, 4GL's, graphical user interfaces. Generally, the project begun in CPTR561 carries over to CPTR562. Corequisites: CPTR460, 560 respectively. *Fall, Spring*

CPTR565 **(3)**
Computer Architecture
Functional analysis of computer hardware and software systems including a comparative study of past, present, and proposed architecture as well as computer performance analysis and optimization. Prerequisite: CPTR275. *Fall*

CPTR585 **Alt (3)**
Advanced Computer Graphics
Advanced topics and current research in computer imaging—may include shading, ray tracing, radiosity, color spaces, lighting models, texture mapping, and recently published research in computer imagery. Includes term project and readings from the literature. Prerequisite: CPTR485. *Spring* (even years)

CPTR587 **Alt (3)**
Advanced Artificial Intelligence
Provides a forum for exploring current topics in machine intelligence through a survey of recent research results, independent readings, and hands-on projects. Typical topics include machine vision, speech recognition, natural language processing, and machine learning systems. Prerequisite: CPTR487. *Spring* (odd years)

CPTR625 **Alt (3)**
Analysis of Algorithms
Technique for analyzing and designing algorithms, including average/worst case analysis, assymptotics, recurrences, empirical experimentation, intractability proofs (i.e., NP-Completeness) and heuristic alternatives. Application of such techniques as divide-

CPTR698 **(1-4)**
Master's Research Project
Special project chosen in consultation with student's advisor and instructor. To be repeated to 6 credits. Grade S/U.

CPTR699 **(1-6)**
Master's Thesis
To be repeated to 6 credits. Graded S/U.

ELECTRONICS

ELCT141, 142 **$ (4, 4)**
Basic Electronics
Study of AC and DC electric circuit theory, characteristics of diodes, transistors, and linear integrated circuits and their behavior in simple circuits. Weekly: a 3-hour lab. Prerequisite for ELCT141: MATH166, 167. Prerequisite for ELCT142: ELCT141. *Spring (ELCT141), Fall (ELCT142)*

ELCT235 **$ (4)**
Digital Electronics
Binary numbers and codes, Boolean algebra, logic circuits, flipflops and registers, arithmetic circuits, counters, multiplexors, demultiplexors, design of state machines, and comparison of IC logic families. Weekly: a 3-hour lab. Prerequisite: ELCT142. *Spring*

ELCT307 **$ (4)**
Instrumentation and Process Control
Theory and application of electrical transducers and recording devices. Emphasis on signal conditioning in process control applications. Measurement errors and calibration. Wr lab. Prerequisite: EL3-hnepringELCT3074)

ties are correlated with internal structure and service environment. Weekly: a 3-hour lab. Prerequisite: CHEM131. *Spring*

ENGR225 **$ (3)**
Circuit Analysis
Resistive circuit analysis, network theorems, dependent sources, energy storage elements, 1st and 2nd order circuit transient responses, ac circuit analysis using phasors and impedances, and ac complex power. Weekly: 2 lectures and a 3-hour lab. Prerequisite: MATH142. *Fall*

ENGR248 **(1-4)**
Workshop
Provides flexibility for the occasional workshop where it is appropriate to offer engineering credit. Workshop requirements must be approved by the department.

ENGR275 **(4)**
Electronics I
Introduction to diodes and transistors and their applications in switching and amplification circuits. Introduction to the basic op-amp circuits and their characteristics. Binary numbers and codes, Boolean algebra, logic circuits, flip-flops and registers. Digital circuit applications. Weekly: a 3-hour lab. Prerequisite: ENGR225. *Spring*

ENGR280 **(5)**
Engineering Mechanics
Principles of statics and their application to engineering problems; forces, moments, couples, friction, centroids, and moments of inertia. Vectorial kinematics of moving bodies in fixed and moving reference frames. Kinetics of particles, assemblies of particles, and rigid bodies, with emphasis on the concept of momentum. Keplerian motion, elementary vibrations, and conservative dynamic systems. Prerequisite: MATH142. *Spring*

ENGR310 **(3)**
Linear System Analysis
Convolution, analysis and spectra of continuous time domain signals, Fourier and Laplace transforms, discrete time domain signals, and the z-transform. Corequisite: MATH286. *Spring*

ENGR320 **(3)**
Manufacturing Processes
Study of manufacturing processes used in molding, joining, forming, and machining of metals, plastics, and other materials. Prerequisite: ENGR180. *Fall*

ENGR325 **(4)**
Electronics II
Modeling of transistors, biasing of transistors in amplifier circuits, and amplitude and frequency limitations of transistors. Linear and switching electronic circuits with an emphasis on op-amps. Weekly: a 3-hour lab. Prerequisite: ENGR275. *Fall*

ENGR330 **(3)**
Thermodynamics
Introduction to the nature of energy and study of energy transport conservation in closed and flowing systems; properties and states of solids, liquids, vapors, and gases; enthalpy; meaning and production of entropy and introduction to cyclic systems. Prerequisite: PHYS242. *Fall*

ENGR335 **(3)**
Logic Circuit Design
Modern digital logic families, state machines, design of digital logic circuits in FPGAs, and VHDL specification of logic circuits. Prerequisite: ENGR275. *Fall*

ENGR340 **(3)**
Strength of Materials
Study of stresses and strain, deformations and deflections of posts, shafts, beams, columns; combined stresses; elasticity. Prerequisite: ENGR280. *Fall*

ENGR350 **(3)**
Sensors and Actuators
Study of temperature, mechanical, and optical sensors; sensor signal conditioning; ac, dc, and stepping motors; and the motor control requirements. Weekly: 2 lectures and a 3-hour lab. Prerequisite: ENGR275. *Spring*

ENGR360 **(3)**
Fluid Dynamics
Fluid statics and dynamics of fluid motion. Conservation of mass, momentum, and energy in laminar and turbulent flow. Boundary layer flow, lift and drag forces, viscous flow in conduits, open channel flow, flow measurements. Prerequisite: ENGR330. *Spring*

ENGR370 **(2)**
Technical World and Man
Gives students a general understanding of how modern technologies affect society. Topics include how humans respond to technological change, the social consequences of technology, and technological issues in national decisions. *Spring*

ENGR380 **(2)**
Programmable Controllers
Introduction to typical programmable logic controllers and their applications. Emphasis on programming and interfacing to electromechanical systems. Weekly: 1 lecture and a 3-hour lab. Prerequisite: ENGR275. *Spring*

ENGR385 **(4)**
Microprocessor Systems
Introduction to computer organization, microprocessors, assembly language programming, memory devices, I/O devices, interfacing with emphasis on control applications. Weekly: a 3-hour lab. Prerequisite: ENGR335. *Spring*

ENGR390 **(2)**
Mechanical Engineering Lab
Mechanical engineering lab work in thermodynamics, heat transfer, fluid mechanics, and material stress and strain. Weekly: Two 3-hour labs. Prerequisites: ENGR330, 340, Corequisites: ENGR350, 360. *Spring*

ENGR410 **(4)**
Feedback Control Systems
Study of both analog and digital feedback control systems. Performance criteria and design and analysis methods. Weekly: 3 lectures and a 3-hour lab. Prerequisites: ENGR275, 280, and 310. *Fall*

ENGR415 **(3)**
Virtual Instrumentation
Introduction to virtual instrumentation with emphasis on the sampling requirements and the signal conditioning requirements. Data logging and control applications. Prerequisite: ENGR325. *Fall*

engineering technology. Repeatable to 4 credits. Prerequisite: a fundamental course in the area.

ENGT396 **(1-4)**
Cooperative Work Experience
Work experience in industry directed by a faculty member. 120 hours of work is required per credit. A report must be submitted indicating what the student learned. Grade S/U. Repeatable to 4 credits. Prerequisite: Junior/Senior standing.

ENGT475 **(1-4)**
Topics in _____
Repeatable in different subjects (prerequisites depend on topic.)

ENGT491, 492 **(2, 2)**
Senior Design Project I, II
A significant design project which culminates in a working system. Prerequisite: at least one of the following courses: ELCT335, 360; MECT375 or 415. *Fall, Spring*

INDUSTRIAL TECHNOLOGY

INDT310 **(3)**
Industrial Supervision
Introduction to and overview of the fundamentals of industrial supervision. Topics include organization, duties, human relations, training, evaluation, promotion, grievances, management-employee relationships. *Spring*

INDT315 **(3)**
Succeeding in the Workplace
Focus on the development of attitudes, performance, and communication that will assist in making the transition from the classroom to the workplace an enjoyable and profitable experience. *Fall*

INDT320 **(3)**
Work Methods and Measurements
Principles and applications of basic methods and techniques for improvement of the man-job-time relationships; job standards, time and motion studies, and work-space design for efficient use of manpower. *Spring*

INDT410 **(3)**
Project Management
Methodology used successfully to carry out a technical project including proposals, planning, work breakdown, scheduling, creativity, monitoring progress, and documentation. *Fall*

INDT440 **(3)**
Quality Control
Analysis of the factors affecting product quality during manufacturing. Topics include basic statistics, sampling, control charts, measurements methods, inspection systems, reliability, and motivation programs. If this course is taken to fulfill degree requirements at the undergraduate level, it cannot also be taken at the graduate level to fulfill degree requirements for a graduate degree. Prerequisite: STAT285 or 340. *Spring*

INDT450 **(3)**
Industrial Economy
Study of engineering decision methodology and criteria used to include economic factors in determining the best alternative in the design and selection of equipment, structures, methods, and processes. Prerequisite: MATH165 or MATH141. *Fall*

INDT460 **(3)**
Production Planning and Control
Planning and coordination of manufacturing facilities and materials for economic production: forecasting, estimating, process planning, plant layout, product flow, scheduling, production controls, materials acquisition and handling, and inventory. If this course is taken to fulfill degree requirements at the undergraduate level, it cannot also be taken at the graduate level to fulfill degree requirements for a graduate degree. Prerequisites: MATH166 or equivalent, STAT285 or 340. *Fall*

MECHANICAL TECHNOLOGY

MECT120 **$ (3)**
Computer-Aided Drawing
An introduction to the use of AutoCad, graphics generation and editing, file maintenance, plotting, and 2- and 3-dimensional drawings. Weekly: a 3-hour lab. Credit may not be earned in MECT120 and MECT121. *Fall*

MECT121 **$ (2)**
Mechanical Drawing I
Fundamentals of drawing as applied to mechanical engineering problems. Orthographic projections, auxiliary and sectional views, dimensioning, oblique and isometric views. Sketching and computer-aided drafting. Weekly: a 3-hour lab. *Fall*

MECT122 **$ (3)**
Mechanical Drawing II
Limit dimensioning, drawing, and interpretation of weld symbols. Solid modeling and production drawings using CAD. Weekly: a 3-hour lab. Prerequisite: MECT121. *Spring*

MECT235 **$ (4)**
Materials Technology
Study of industrial materials. Properties of materials correlated with the internal structure. Includes metals, plastics, and ceramics. Weekly: a 3-hour lab. Prerequisites: MATH166, CHEM131. *Spring*

MECT285 **(4)**
Statics and Strength of Materials
Analysis of static force systems. Forces, moments, resultants, free-body diagrams, equilibrium, center of mass, moment of inertia, and friction. Assignments designed to develop problem-solving abilities. Study of internal stress and deformation of elastic bodies. A minimum grade of C required in order to enroll in MECT355. Prerequisite: MATH182. *Fall*

MECT326 **$ Alt (4)**
Fluid Power Systems
Principles and applications of fluid power systems to actuate and/or control machines. Electro-hydraulic-pneumatic systems studied. Principles of fluids introduced. Weekly: a 3-hour lab. Prerequisite: MECT285. *Fall*

MECT355 **(4)**
Dynamics and Kinematics
Fundamentals and applications of dynamics; displacement, velocities, acceleration, work, energy, power impulse, momentum, and impact. Also a study of the basic theories and techniques in the analysis of relative motion, acceleration, and acceleration of machine parts such as linkages, cams, gears, and other mechanisms. Prerequisites: MATH182, MECT285. *Fall*

MECT370 **$ Alt (4)**
Heat Power
Thermodynamics properties, first and second law of thermodynamics, ideal gas law, the Carnot Cycle, power and refrigeration cycles, heat transfer power and refrigeration cycles, non-flow gas processes, mixtures of ideal gasses, psychrometric chart, air conditioning, fluid statics, kinematics, dynamics. Weekly: a 3-hour lab. Prerequisite: MECT355. *Fall*

MECT375 **$ Alt (4)**
Fluid Mechanics
Dimensionless parameters, compressible flow, flow-in pipes, open channel flow, drag, lift. Weekly: a 3-hour lab. Prerequisite: MECT355. *Spring*

MECT415 **(3)**
Mechanical Design and Fabrication
The design of machine elements and the calculations necessary in determining the size and shape of machine parts. The selection of materials and the application of standard machine components. Includes bearings, gears, clutches, and couplings. Prerequisite: MECT355. *Spring*

IMAGING AND APPLIED TECHNOLOGY

Harrigan Hall, Room 227
(269) 471-3450 or (800) 909-8812
FAX: (269) 471-6655
launr@andrews.edu
http://www.andrews.edu/COT/

Faculty
Laun L. Reinholtz, *Chair*