ENGINEERING & COMPUTER SCIENCE

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Academic Programs	Credits
BS: Computing	40
Emphasis Areas	
Computer Science	
Software Systems	
Minor in Computing	20
BS in Engineering	
Emphasis Areas	
Electrical and Computer Engineering	66
Mechanical Engineering	66
Minor in Engineering	20
MS: Software Engineering	32

Undergraduate Programs

Computing

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

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

Degree Requirements

Admission Requirements: Computer Science foundation courses—MATH191, CPTR151, 152

Progression Requirements: No grade lower than C- may be counted toward any degree requirement. An ECS course may be repeated only once. Students may repeat only two ECS courses. Students will be asked to withdraw from the program if they fail **two** ECS courses in the same semester. Readmission will be considered on an individual basis. Transfer credits need to be submitted a minimum of **six** weeks prior to beginning of classes. Transfer students will be considered on an individual basis. Courses 200-level and above are restricted to admitted majors/minors only.

The major field examination in Computer Science is part of the senior exit test. All CS majors are required to have access to their own computers.

General Education Requirements
See professional program requirements, p. 43, and note the following requirements:
Religion: RELT100, RELT340 and , from RELB, RELG, RELT
Language/Communication: ENGL115, 220, COMM104
History: HIST118
Fine Arts/Humanities: professional degree requirements
Life/Physical Sciences: CHEM131
Mathematics: MATH191
Computer Literacy: see major
Service: BHSC100 or ENGR485
Social Sciences: take , from the following: ANTH200, ECON225, GEOG110, PLSC104, PSYC101 or SOCI119

Major requirements—40
Common core—19
CPTR151, 152, 276, 440, 460, 466

Computer Science Emphasis
Required courses—9
CPTR425, 437, 467
Major electives—12
Chosen from CPTR courses in consultation with an advisor. A minimum of 12 upper division credits required.
Cognate requirements—26–28
MATH191, 192, 355; STAT340 (14)
ENGR385 (4)
BIOL165; 166 (10)*
or CHEM131, 132 (8)*
or PHYS141, 142 (8)*
or PHYS241, 242, 271, 272 (10)*

* These courses may apply toward the general education natural science requirement

Software Systems Emphasis
Required courses—9
CPTR310, 427, 450
Major electives—12
Chosen from CPTR courses in consultation with an advisor. A minimum of 12 upper division credits required.

Cognate requirements—30–32
MATH191, 355; STAT285 (10)
Minor in an advisor-approved application area (20–22)

Minor in Computing (20)

Required courses—10
CPTR151, 152, 276
Minor electives—10
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

The engineering program at Andrews University leads to a Bachelor of Science in Engineering degree with emphases in Electrical and Computer Engineering and in Mechanical Engineering. These two emphases build on a strong traditional mathematics, science, and engineering core. The Electrical and Computer Engineering emphasis focuses on the areas of digital systems, communication systems, and computer controlled instrumentation and computer simulation. The Mechanical Engineering emphasis focuses on mechanical design and the electromechanical elements of smart machines.

The mathematics courses listed as cognates for the engineering degree satisfy the requirements for a minor in mathematics. A second major in mathematics requires 6 additional credits in mathematics, and a second major in physics requires 14–17 additional credits in physics. See the Mathematics and Physics department listings for details.

BS in Engineering

CPTR466 **(3)**
Software Engineering Group Project
The implementation of a group project and the study of topics related to the group project, including CASE tools, 4GL's, and graphical user interfaces. Emphasizes written documents and oral presentations associated with group project rather than lecture. Corerequisite: CPTR460. *Fall*

CPTR467 **Alt (3)**
Database Concepts and Theory
Study of issues relevant to abstract and concrete aspects in both the creation of database management system software and its use. Indexing, buffering and other internal and physical database design issues. Relational model algebra, calculus and query languages. Functional dependencies and normalization. Study of and modeling using Entity-Relationship and other relevant paradigms. Common application databases. Introduction to the use of transactions, query optimization and non-relational database models. Design and programming assignments using databases. Prerequisite: CPTR152. *Spring* (even years)

CPTR475 **(1–4)**
Topics in _______________
Selected topics of current interest in computer science such as Robotics, advanced languages, or others. Repeatable with different subjects.

CPTR485 **Alt (3)**
Computer Graphics
Introduction to computer graphics focusing on the algorithms

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* (even years)

CPTR625 **Alt (3)**
Analysis of Algorithms
Techniques for analyzing and designing algorithms, including average/worst case analysis, asymptotics, recurrences, empirical studies, intractability proofs (i.e., NP-Completeness) and heuristic alternatives. Application of techniques such as divide-and-conquer, graph, greedy, dynamic programming, backtracking, branch-and-bound, and probabilistic algorithms. Prerequisites: CPTR152, MATH192, STAT340. *Spring* (even years)

CPTR637 **Alt (3)**
Formal Methods
A survey of the different paradigms associated with formal methods. Applies formal methods to the specification, verification, and validation of software systems. Case studies are examined and a programming project is included. Prerequisites: CPTR460, MATH215, STAT285. *Fall*

CPTR660 **(0)**
Thesis/Project Extension

CPTR689 **(1–4)**
Topics in ____________
Topics in computer science such as graphics, parallel processors, compiler design and optimization, communications and signal processing, distributed systems, graph theory, artificial intelligence, and formal theory. Repeatable with different topics to 6 credits. Prerequisite: Depends upon topic.

CPTR690 **(1–4)**
Independent Study
Directed study of material of special interest chosen in consultation with the instructor. May be repeated to 6 credits. Grade S/U.

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.

Engineering

ENGR120 **$ (2)**
Introduction to Engineering & Design
An introductory course in engineering and design. It teaches the basic principles of design and related design tools from a basic level. Students will be taught to use computer tools for engineering analysis.

ENGR125 **$ (3)**
Engineering Graphics
Fundamentals of drawing as applied to mechanical engineering problems. Orthographic projections, auxiliary and sectional views, dimensioning and tolerancing, oblique and isometric views, detail and assembly drawing. Sketching and computer-aided drafting. Weekly: Two 1-hour lectures and two 1.5-hour labs. *Fall*

ENGR135 **(1)**
Descriptive Geometry
Solution of basic space problems. Determination of distances and angles, intersections of lines and surfaces, intersections of lines and development of surfaces. Prerequisite: ENGR125. *Spring*

ENGR180 **$ (4)**
Materials Science
Introduction to the study of materials. Deals with the fundamentals of structure and classification of materials. A weekly hands-on laboratory helps demonstrate the relationship of properties of materials studied in lecture. Weekly: 3 hours lecture and a 3-hour lab. Prerequisite: CHEM131. *Spring*

ENGR185 **(3)**
Engineering Statics
Principles of statics and their application to engineering problems; forces, moments, couples, friction, centroids and moments of inertia. Prerequisite or Corequisite: MATH191. *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 hours lecture and a 3-hour lab. Prerequisite MATH191. Corequisite or prerequisite MATH192. *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 **$ (3)**
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 registers80(Spring)Tjodesthe

body thermal radiation, solar radiation, heat exchangers, and mass transfer. Prerequisites: ENGR360, MATH286. *Spring*

ENGR450 **(2)**
Engineering 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. Prerequisites: MATH145 or MATH191. *Fall*

ENGR455 **$ (4)**
Communication Systems
Introduction to analog and digital communication systems; including topics in modulation; baseband and bandpass signals; power spectral density and bandwidth; random processes; noise, signal-to-noise ratio, and error probability; and system perfor