# Form 1503 Attachment II

# *BS Degree in Computer Engineering & Systems*

## *Catalog Description*

(Version 3.0)

INSTITUTE OF TECHNOLOGY
UNIVERSITY OF WASHINGTON, TACOMA

**(Version 3.0 – April 6, 2006)**

BACHELOR OF SCIENCE

# Computer Engineering & Systems

The Computer Engineering & Systems (CES) program, a program of the UWT Institute of Technology, prepares students to enter the field of computer engineering. The program emphasizes embedded computer systems. *"If you round off the fractions, embedded systems consume 100% of all of the production of microprocessors."* Jim Turley, Editor, Computer industry Analyst.

The Institute of Technology was created through an industry/state partnership to encourage and prepare students to become leaders and innovators in the evolving fields of computer information technologies. Students develop foundations in both hardware and software design. The curriculum provides students the theoretical grounding to promote lifelong learning and evolution. The program also provides opportunities for the practicing professional to stay abreast of emerging theory and applications and is designed to accommodate students with previously earned degrees and work experience. It also offers partnerships with leading software companies and professionals to advance the field through collaborative ventures, forums, research and internships.

## Mission

The Computer Engineering and Systems Program will educate each student to be a responsible and productive computer engineer who can effectively apply emerging technologies to meet future challenges.

## Admission Requirements

Standards for admission to the Computer Engineering & Systems program:

- A cumulative GPA (grade-point average) of at least 2.75 in all college level coursework.
- A cumulative GPA of at least 3.0 in all college-level mathematics, physics and computing courses.
- Completion of admission requirements (an Associate of Science Degree program is a recommended preparation):
  - 10 Credit Hours of English Composition (or 5 Credit Hours of English Composition and 5 Credit Hours of Technical Writing)
  - 15 Credit Hours of Calculus for Engineers/Scientists
  - 5 Credit Hours of Linear Algebra
  - 5 Credit Hours of Electrical Circuits (equivalent to TCES 215)
  - 5 Credit Hours of Differential Equations
  - 5 Credit Hours of Chemistry or Biology
  - 15 Credit Hours of Calculus & Laboratory Based Physics
  - 10 Credit Hours of Object Oriented Computing (equivalent to TCSS142 & TCSS143)
  - 10 Credit Hours of Humanities
  - 10 Credit Hours of Social Science
  - 10 Credit hours of a Foreign Language (or 1 year of a Foreign Language in high school)

Some requirements may be completed after admission to the program and while in residence at UWT. Students with previous baccalaureate degrees, extensive work experience, or modest GPA deficiencies should meet with an adviser to discuss options.

Computer Engineering & Systems employs placement tools to promote student success in the program.

**Cover Letter**

A brief cover letter requesting admission to the Computer Engineering & Systems program clearly stating the applicant's name, address, phone number, e-mail address, the applicant's goals that are intended to be met by the program, the desired quarter of admission, full or part-time status, and preference for day or evening classes (for part-time) is required. This information will be used to help assess the admission candidate's qualifications and fit with the program.

**Transcripts**

Students must submit two official transcripts from every college or university attended. A high school transcript must be submitted only if a foreign language taken in high school is being used to meet the foreign language requirement.

**Recommendation**
A minimum of one professional recommendation is required for all applicants. It is preferred that this be from a previous professor. However, it may come from a professional in the computing field who is familiar with the candidate's computing skills. A form is available from the department to help ensure that all information is provided.

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## Dual Admission Program

The Dual Admission program helps students address exploring potential interest in the Computer Engineering & Systems program, and get a head start on their UWT degree. Students enrolled in a Community College 4-year bound degree program can obtain early admission to begin taking Computer Engineering & Systems Curriculum courses remaining primarily enrolled in their Community College. This allows appropriately university prepared students to experience the Computer Engineering & Systems program, its faculty, students, facilities, and UWT campus life before making a full commitment to UWT and the program. It also helps students make optimal progress toward their degree goal. Dual Admission can begin directly after high school for students who are truly university ready, i.e. have completed the following high school core university requirements:

- Composition/Literature – 4 years
- Mathematics – 3 years (a minimum of algebra, geometry and second-year algebra)
- Science – 2 years (including two semesters in the same science – biology, chemistry or physics – with a laboratory experience)
- Social Studies – 3 years
- Foreign Language – 2 years of the same language
- Fine, Visual or Performing Arts – ½ year
- Additional academic electives – ½ year

One recommendation—preferably from a math, science or computer science teacher—is also required for admission.
Students who are interested in this program should call the Institute of Technology to request information or meet with an advisor (253) 692-5860.

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## Curriculum

The curriculum leading to the baccalaureate degree in Computer Engineering & Systems emphasizes theoretical foundation and practical experience necessary for a career in the challenging and rewarding profession of computer engineering: hardware and software specification, development, design, implementation, and reengineering. The curriculum emphasizes current paradigms, languages, components and techniques of today's practitioners while building a strong base to support lifelong learning in the field. It also prepares students to pursue graduate studies and provides continuing education to current professionals. Industrial partnerships provide opportunities for a wide variety of practical experiences that complement classroom teaching and research projects.

The curriculum has been built on the following principles:

- The state of computers, computing, and potential applications continues to evolve rapidly. This can be expected to continue through the career spans of today's students. Students must, therefore, possess the foundations, tools and lifelong learning skills to maintain currency in the field. Strong communication skills, mathematical maturity and an understanding of the underlying theories of computing, computers, information and communication are essential for this.
- Computer engineering professionals must be capable of effectively employing the appropriate computing languages, hardware, and paradigms to best meet the needs of a specific application. They must be prepared to learn and proficiently exploit emerging concepts and technologies as they become available, as well as re-engineer existing applications.
- Important computing applications tend to be large and complex. The quality of its user interfaces and the interfaces to other applications is critical to its effectiveness. Systems should be error-free, robust, efficient, secure and modifiable. The adherence to accepted standards and procedures for software development is essential to the development process. It takes teams of professionals to produce them, and effective management of the participants and the processes is critical to its success and ultimate value. All participants need to understand the expected principles and norms used in making the process effective and efficient.
- Computer engineering professionals must have excellent communication skills. Software development and maintenance requires that all participants—from innovators and researchers to specification writers, designers, modelers, coders, testers, manual writers, and customer supporters—be precise and clear in communicating ideas, concepts, designs and processes for a software project to succeed.
- Computer professionals must take responsibility for their work. They must practice the highest standards of ethics and must design their systems to meet the most stringent social norms and societal expectations. The working lives of users, the value of the products and the future of the industry itself depend on practitioners being proactive in exercising their best judgment and effort.

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# Program requirements

The Computer Engineering & Systems B.S. curriculum consists of:

- 65 credit hours of core CSS, CES, and Institute courses
- 15 credit hours of advanced Computer Engineering & Systems concentration courses
- 10 credit hours of approved electives

**Core courses**
There are fourteen core courses in the Computer Engineering & Systems program:

- Programming Practicum (TCSS 305)
- Discrete Structures (TCSS 321)
- Computers, Ethics, and Society (TCSS 325)
- Data Structures (TCSS 342)
- Software Engineering & Quality Assurance (TCSS 360)
- Machine Organization (TCSS 371)
- Computer Architecture (TCSS 372)
- Computer Operating Systems (TCSS 422)
- Embedded Real-time Systems (TCSS 465)
- Introduction to Logic Design (TCES 230)
- Electrical and Analog Systems (TCES 312)
- Linear Systems and Transforms (TCES 323)
- Advanced Digital System Design (TCES 413)
- Probability & Statistics with Numerical Methods (TCES 450)

**Concentration**
Advanced concentration courses build upon knowledge gained in the core courses. Concentrations consist of 20 credit hours:

- 10 credits of approved electives. 5 credit hours may be a degree-related Internship. The electives may include courses outside the Institute for breadth.
- 10 credits of Senior Project I and II (TCES 480 and 481)

**Prerequisites**
Students are expected to complete prerequisites, including 142 and 143, with a grade of at least 2.5 before progressing. Students will not be allowed to proceed with a grade below 2.0. Students are strongly encouraged to complete as many of the core courses as possible before progressing to more advanced concentration courses. In addition to the core and concentration/elective courses, the Institute offers courses in writing, mathematics and programming for students who need to refresh skills before enrolling in core courses. Credit from these courses is not applied towards the Computer Engineering & Systems degree requirements.

## Professional Internships

Students who have completed the CES core coursework have the option to receive academic credit for degree-related professional work experience internship. Internships allow students to apply theoretical and conceptual classroom knowledge to practical work experiences, and to gain broad experience in a professional work environment. Internships also offer employers a chance to involve students in professional design, implementation and research projects. Many employers view internships as a source for qualified, experienced employees.

## Academic Standards

The following standards apply to all students in the Computer Engineering & Systems program. These standards may be in addition to other academic standards at the University of Washington, Tacoma.

- Students must satisfactorily complete all upper-division courses at UWT by achieving a minimum grade of 1.7 (2.0 in all CSS courses). If a grade below that is received, the student may repeat the course once with the approval of the program offering the course. Course credit will be awarded only once, and both grades will be used in computing the grade-point average. If a grade below 1.7 is received in an elective course outside of CSS, the course will not count toward graduation, but the student is not required to repeat the course.
- Courses in the Computer Engineering & Systems program may not be taken by correspondence (distance learning) without prior approval of the program.
- Courses in the Computer Engineering & Systems program may not be taken S/NS (satisfactory/not satisfactory).
- To substitute for a course in the major, upper-division Computer Engineering & Systems courses completed at other accredited four-year institutions may not be more than seven years old. If a course is more than seven years old, the student will be required to repeat the course at UWT. Credit will not be awarded twice for the same course.
- Upper-division courses used for transfer credit are held to the 2.0 grade standard required for all courses for Computer Engineering & Systems.
- Students changing to a Computer Engineering & Systems major from another major will be required to meet program and academic performance requirements in effect at the time the major is changed.

**Low Scholarship**
An undergraduate Computer Engineering & Systems major who is dismissed from the University for low scholarship is removed from the Computer Engineering & Systems major. To continue as a CES student in any status, matriculated or otherwise, after being removed from the Computer Engineering & Systems major, a student must re-apply for admission. The Admissions

Committee will evaluate the student's file, personal statement requesting re-admission, and any extenuating circumstances and then will recommend action.

## Computing Labs

The Institute of Technology has dedicated laboratories of specialized equipment to support the program. These laboratories are available 24 hours a day, seven days a week to students enrolled in Institute programs. Access to some facilities is also available through Internet connections.

## Graduation Requirements

To qualify for graduation with a baccalaureate degree in Computer Engineering & Systems a student must:

- Be a matriculated Computer Engineering & Systems student in good academic standing with the University of Washington, Tacoma.
- Satisfy all of the admission requirements for entrance into the Computer Engineering & Systems program.
- Complete 180 credit hours, at least 85 of which must be upper-division (300-400 level) coursework.
- Complete 30 hours of computing courses in residence at the University of Washington, Tacoma.
- Complete 75 percent of the concentration in residence at the University of Washington, Tacoma.
- Complete the final 45 credits in residence at the University of Washington, Tacoma.
- Have a minimum cumulative grade point average of 2.0 in all classes and a minimum cumulative grade-point average of 2.5 in all Computer Engineering & Systems classes.
- Apply for graduation with a Computer Engineering & Systems adviser by the application deadline posted by the Graduation and Academic Records Office for the expected date of graduation.
- Complete the specified 60 credit hours of core courses in the Computer Engineering & Systems major.
- Complete the 15 credit hours of concentration courses in the Computer Engineering & Systems major.
- Complete 15 credit hours of electives, of which 10 credit hours must be 300-400 level, and 5 credit hours may be Internship.

Students who are admitted to the Computer Engineering & Systems program with a previous baccalaureate or master's degree are required to complete the 75 credit hours of core and concentration courses with a minimum grade of 2.0. Elective credit requirements are waived. In some cases, students may petition the faculty, using the Course Waiver Petition, for permission to use previous coursework or experience in place of core or concentration-level courses. The waiver does not guarantee that credit will be awarded for a course; the petitioning student may be required to complete additional coursework in place of the waived requirement. A minimum of 45 credit hours, in addition to courses/hours taken to receive other degrees, is required to earn and a bachelor's degree in Computer Engineering & Systems.

## Course Descriptions

For the most current course information, please consult the Institute of Technology Web site at *www.insttech.washington.edu.*

### TCES 215 - Electrical Circuits

**5 Credits / Prerequisites: Physics II, Calculus II**

Introduction to electrical engineering. Basic circuit and systems concepts. Power and Energy. Mathematical models of components. Kirchoff's laws. Resistors, sources, capacitors, inductors, and operational amplifiers. Solution of first and second order linear differential equations associated with basic circuit forms. Analysis of circuits with sinusoidal signals. Laboratory Required.

### TCES 230 – Introduction to Logic Design

**5 Credits / Prerequisites: Intro to Programming, Physics II**

Boolean algebra and logic simplification techniques. Design of combinational logic networks for decoders, encoders, multiplexers, and demultiplexers. Design of sequential logic devices including flip-flops, registers, and counters. Analysis of devices used to build logic networks, including open-collector, three-state devices, CMOS, and programmable logic devices. Use of tools for schematic capture and circuit simulations. Introduction to state machines. Laboratory required.

### TCES 312 – Electronics & Analog Systems

*5 Credits / Prerequisites: TCES 215, Differential Equations*

Electronic devices, semiconductors, bipolar devices, amplifiers, analog circuits, analog/digital conversions, filters, noise, operational Amplifiers, signal shaping, discrete feedback amplifiers, and frequency analysis and response. Laboratory required.

### TCES 323 –Linear Systems & Transforms

*5 Credits / Prerequisites: TCES 312*

Circuit analysis techniques for networks with both independent and dependent sources. Network topology. Natural and forced response for RLC circuits. Complex frequency, poles and zeros. Introduction to Fourier series, Fourier, Laplace and z-transforms. Introduction to the discrete Fourier Transform and the Fast Fourier Transform (FFT) algorithm.

**TCES 413 – Advanced Digital System Design – 5 Credit hours**
*5 Credits / TCSS 372, TCES 312*
Design techniques using combinational and sequential logic synthesis and optimization, state machines, discrete components, gates, LSI, and programmable logic, interfacing, memory systems, digital communication including serial/parallel & synchronous/asynchronous architectures, hardware description languages, and hardware simulators. Emphasis on reconfigurable logic for design and implementation. Automated development systems and procedures are used throughout design. Laboratory required.

**TCES 450 - Probability and Statistics with Numerical Methods– 5 Credit hours**
*5 Credits / Differential Equations, Discrete Structures I*
Basic concepts of probability and statistics with emphasis on models used in science and engineering. Probability models for statistical estimation and hypothesis testing. Confidence limits. One- and two-sample inference, simple regression. Least squares solutions to data fitting problems, and numerical solution techniques applicable to large-scale engineering/science problems.

**TCES 480 – System Design Project I**
*5 credits / Prerequisites TCES 413, Corequisites: TCSS 465*
Under faculty supervision, each student or team prepares a plan for a senior design project. This plan includes project definition, project requirements, preliminary design, and work schedule. Requirements and design shall address human factors, safety, reliability, maintainability, and customer cost. Oral and written reports are required. This course has a significant writing component.

**TCES 481 – System Design Project II**
*5 credits / Prerequisites: TCES 480*
Continuation of TCES 490, students construct, test, and demonstrate their senior design projects. Formal oral and written reports documenting the project are required. This course has a significant writing component.

**TCES 490**
**Special Topics in CES**
*5 credits / Prerequisites: Senior Standing*
Examines current topics, issues, and emerging technologies associated with computer engineering and systems.

**TCES 497**
**Internship in CES**
*5 credits / Prerequisites: Senior Standing*
Completion of a Computer Engineering & Systems project as delineated in a contract among student, faculty adviser and industrial/community sponsor.

**TCES 498**
**Directed Readings in CES**
*2-5 credits / Prerequisites: TCSS 422*
Readings in Computer Engineering & Systems as specified in a contract with faculty member.

**TCES 499**
**Undergraduate Research in CES**
*5 credits / Prerequisites: TCSS 422*
Design and implementation of a Computer Engineering & Systems research study as specified in a contract with a faculty member.

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**Faculty**

**Orlando Baiocchi, Institute *Director and Professor***
Professor of Computer Engineering & Systems, Computing & Software Systems
Electrical Engineering; Ph.D., University College in London, 1976.

**Larry A. Crum**
Professor of Computer Engineering & Systems, Computing & Software Systems
Ph.D., Electrical Engineering; Marquette University, 1971.

**George Mobus**
Associate Professor of Computer Engineering & Systems, Computing & Software Systems
Ph.D., Computer Science; University of North Texas, 1994.

**Senior Faculty** (begins 2006)
Professor or Associate Professor of Computer Engineering & Systems, Computing & Software Systems
Ph.D., Computer Engineering, Computer Science, Electrical Engineering, or equiv.

**Sam Chung**
Assistant Professor of Computer Engineering & Systems, Computing & Software Systems
Ph.D. Computer Science; Ph.D., University of South Florida, 1995.

**Don McLane**
Lecturer of Computer Engineering & Systems, Computing & Software Systems;
M.S., Electrical Engineering; Notre Dame University, 1987.