School of Applied Science, Engineering, and Technology

Dean: John R. Wright, 106 John Mitchell Center, Gorham
Associate Dean: Andrew L. Anderson, 108 John Mitchell Center, Gorham

The School of Applied Science, Engineering, and Technology (ASET) is organized into five academic departments: Applied Medical Sciences, Computer Science, Engineering, Environmental Science, and Technology. Through these departments, the School offers bachelor's degrees, including the B.A. in environmental planning and policy, and the B.S. in computer science, electrical engineering, mechanical engineering, industrial technology, applied technical leadership, environmental science, and environmental safety and health. In addition to the engineering degrees, the first year or two of other engineering disciplines are available as part of a transfer program.

The School offers several master of science degrees: the M.S. in applied medical sciences (with concentrations in toxicology and cancer biology, immunology and infectious disease, epidemiology, and biotechnology) and the M.S. in computer science. The M.S. program in applied medical sciences emphasizes biomedical research and provides opportunities to work on research projects and to interact with adjunct faculty at Maine Medical Center, the Foundation for Blood Research, and the Maine Center for Disease Control and Prevention. The M.S. degree in computer science with an emphasis in computer engineering is offered in collaboration between the Departments of Computer Science and Engineering. Further information regarding the School's graduate programs may be found on the Office of Graduate Studies Web site.

The School's degree programs prepare students for productive and rewarding lives and provide knowledge and skills for many careers. Students, faculty, and alumni apply theory and use scientific and mathematical principles and techniques to solve practical problems. The School's academic programs are designed and delivered so that all students who are prepared and motivated can successfully complete them. Graduates have (1) technical competence with both depth and breadth, (2) a wide range of knowledge enabling them to function effectively in the professional world, (3) transferable skills such as reasoning, problem solving, verbal and written communications, teamwork, and leadership, and (4) motivation to continue to learn and grow professionally. Graduates achieve extremely good employment and graduate school placement.

Student Services

ASET is dedicated to supporting students in defining, developing, and achieving personal, academic, and career goals. Services and programs that are provided to meet the needs of ASET students include: academic advising, career counseling, mentoring, referrals, tutoring/tutorials, and career and academic skills workshops. Assistance in locating and securing cooperative education and internships are provided as well as information on various scholarships available to ASET students. For more information, contact the director of student services at (207) 780-5050.

Cooperative Education and Internships

ASET encourages students to participate in cooperative education and internship experiences. Both options integrate classroom learning with meaningful and rewarding work experience in a field related to a student's academic or career goals. Internships are sponsored by individual departments and require an academic advisor; variable credits are awarded. Co-op assignments are paid positions that are typically full time for a semester or six months. For more information, contact the coordinator of cooperative education at (207) 780-5918.

External Programs

External Programs provides credit, noncredit, and certificate programs to students who are unable to attend classes or programs on campus. Customized programs, including workshops, seminars, and short courses are available on specialized topics as requested by educational, corporate, or industrial organizations to meet their specific objectives. For further information, call (207) 780-5439.

Manufacturing Applications Center (MAC)

The Manufacturing Applications Center (MAC) works with Maine's industries to improve quality and efficiency in production operations. Interactive strategies and assistance are provided on a fee-for-services basis to help companies become more competitive via advanced technologies and world-class manufacturing strategies.

Assistance is provided in: technical training, quality assurance, product testing and analysis, reverse engineering, rapid prototyping, production control, project management, CAD/CAM/CIM technologies, lean manufacturing, metrology, plant layout, process analysis and control, push/pull strategies, supply chain management, JIT flow, 5's, and engineering design. For further information, call (207) 780-5313.

General Information

Admission to an undergraduate program in the School of Applied Science, Engineering, and Technology is initiated through the Office of Undergraduate Admission. Candidates for admission must be graduates of an approved secondary school and meet admission requirements indicated in the Admission section of this catalog and the individual departments of the School.

General academic policies will be found in the Academic Policies section of this catalog. Specific policies and requirements are indicated in the sections dealing with the individual departments of the School. All students are reminded that, in addition to meeting departmental requirements for a major, they must also meet the requirements of the University Core curriculum.

Department of Applied Medical Sciences

Chair of the Department: W. Douglas Thompson, 106 Science Building, Portland
Professors: Ng, Thompson, Wise; *Associate Professors:* Duboise, Pelsue; *Research Assistant Professors:* Meyer, Lichter, Paulu, Xie; *Adjunct Professors:* Ault, Rhodes, Rice; *Adjunct Associate Professors:* Allan, Chandler, Craig, Davidoff, Fletcher, Follansbee, Friesel, Liaw, Lindner, Smith, Vary; *Adjunct Assistant Professor:* Beckett

In addition to its graduate program (with concentrations in toxicology and cancer biology, immunology and infectious disease, epidemiology, and biotechnology) the Department of Applied Medical Sciences offers an undergraduate minor in toxicology and environmental health.

Minor in Toxicology and Environmental Health

The undergraduate minor in toxicology and environmental health provides students with a comprehensive overview of the scientific disciplines that are most relevant to understanding the effects of environmental hazards on human health. The effects of pollutants on various organ systems in humans and in marine mammals are emphasized.

Students can minor in toxicology and environmental health by completing 18 credits of curriculum involved in the minor with a grade of C (2.0) or higher. Interested students should contact the AMS office for additional information.

All students will be required to take the following core courses (11 credits):

AMS	490	Introduction to Toxicology I	(3 credits)
AMS	491	Introduction to Toxicology II	(3 credits)
AMS	435	Introduction to Epidemiologic Research	(3 credits)
AMS	495	Seminar in Biomedical Sciences	(2 credits)

Select 7 credits from below:

AMS	493	Introduction to Research Techniques in Toxicology and Environmental Health	(4 Credits)
BIO	321	Neurobiology	(3 Credits)
CHY	461	Biochemistry	(3 Credits)
ESP	375	Environmental Risk Assessment and Management	
PSY	365	Physiological Psychology	(3 Credits)
PSY	366	Drugs, Mind, and Behavior	(3 Credits)

AMS 435 Introduction to Epidemiologic Research
This course is intended to give students a basic foundation in principles for the conduct and interpretation of population-based studies of the distribution, etiology, and control of disease. Topics will include randomized experiments, non-randomized cohort studies, case-control studies, cross-sectional and ecological studies, causal inference, sources of bias, and measures of effect. Recent publications from the epidemiologic and general medical literature will be used to illustrate the application of the concepts to specific epidemiologic issues. Cr 3.

AMS 450 Principles of Immunology
An introduction to the fundamentals of immunology, especially as they relate to human diseases. Topics include history of immunology, basic elements of immune systems, principles of natural and acquired immunity, cellular and molecular basis of B cell and T cell development and diversity, and clinical aspects of immunology. Prerequisites: CHY 105 or CHY 115, junior standing, and grade of C- or higher in either BIO 109 or BIO 211; or permission of instructor. Cr 3.

AMS 490 Introduction to Toxicology I
This course introduces students to the principles and practice of toxicology. The major focus of the course is on basic principles, mechanisms, and common methods underpinning the science of toxicology. Selected target organ systems (e.g., respiratory, nervous, and immune systems) are studied with respect to understanding how representative chemicals damage and impair their ability to function. Students will develop a fundamental understanding of how chemicals may exert toxic effects and gain insight into the importance of organ specific effects. Prerequisite: admission to the minor, cell biology, or molecular biology, or biochemistry, or permission of the instructor. Cr 3.

AMS 491 Introduction to Toxicology II
The course continues to focus on basic principles, mechanisms, and common methods underpinning the science of toxicology. Selected toxicants are studied with respect to their source of exposure and mechanisms of effect. Selected disease processes (e.g. mutagenesis, carcinogenesis, and teratogenesis) are studied with respect to understanding their basic pathways and common mechanisms. Selected fields are presented to give students insight into the applications of toxicology and its relationship with other fields. Prerequisite: AMS 490, or permission of the instructor. Cr 3.

AMS 493 Introduction to Research Techniques in Toxicology and Environmental Health
The student learns a laboratory approach and techniques to study toxicology and environmental health. The term is spent under the direction of a faculty member engaged in a research project. This is a hands-on course with close supervision by technically trained personnel. For those sections in laboratories working with biohazards, laboratory safety and use of biosafety hoods are emphasized. Prerequisite: permission of instructor. Cr 4.

AMS 495 Advanced Seminar in Biomedical Sciences
The student participates in a weekly seminar on biomedical sciences. The seminar focuses on current topics in biomedical research. Prerequisite: permission of instructor. Seminar is offered in both fall and spring semesters. Cr 1.

BIO 321 Neurobiology
This course presents an overview of nervous system function, structure, and development. Content focuses on the cellular and molecular properties that underlie normal function. Prerequisite: grade of C or higher in BIO 109 or BIO 111, or permission of instructor. Cr 3.

CHY 461 Biochemistry
Application of chemical methods and principles to understanding biological processes. Topics include structure and action of nucleotides, proteins, lipids, and carbohydrates; enzyme kinetics and mechanisms; membranes and transport; and metabolism and energy conversion. This one-semester course provides a survey of the major areas of biochemistry, except for nucleic acids. Prerequisite: a grade of C- or better in CHY 253. Cr 3.

ESP 375 Environmental Risk Assessment and Management
The focus of this course is to provide students with an understanding of human health risk assessment as an organized, multidisciplinary approach to evaluating scientific data by studying basic toxicology and fate and transport of contaminants using generally accepted principles and terminology used in the field. Students will examine the limitations of current risk assessment methods and be introduced to the basics of ecological risk assessment. Finally, stu-

dents will study the scientific, political, social, ethical, and economic dimensions of managing risks. Prerequisite: ESP 101/102K or permission of instructor. Cr 3.

PSY 365 Physiological Psychology
Basic neuroanatomy, neurophysiology, and endocrinology, and the relationships between nervous system functioning and behavior. Physiological analysis of sensory function, motivation, and learning. Prerequisites: PSY 101J, 102, and BIO 111. Cr 3.

PSY 366 Drugs, Mind, and Behavior
The physiological and behavioral effects of drugs are examined in light of current research. Also considered are theories relating to the use/abuse of drugs, tolerance, addiction, and drug interactions. Prerequisites: PSY 101J and one semester of biology. Cr 3.

Department of Computer Science

Chair of the Department: Robert Boothe
Professors: Alagic, Welty; *Associate Professors:* Boothe, Briggs, MacLeod; *Research Professor:* Congdon; *Adjunct Faculty:* Bantz, El-Taha, Heath, Houser

The Department of Computer Science offers a four-year program leading to a B.S. in computer science. Computer science courses concern the theory and practice of solving problems by computer. More specifically, computer scientists build and analyze tools that allow complex problems to be solved. A component of computer science is the study and use of various programming languages, but computer science consists of much more than programming. The mathematical theory of computer science aids in determining the efficiency and correctness of algorithms and programs. In addition, a computer scientist must understand how computers are built and operate. The systematic application of general methods and computing technology to actual problems is also part of computer science.

The undergraduate degree in computer science prepares students both for careers in the computing profession and for graduate study. Course requirements ensure that students receive instruction in both practical and theoretical aspects of computer science. The B.S. degree in computer science is accredited by the Computing Accreditation Commission (CAC) of ABET, the national board that accredits computer, engineering, and technology programs (see www.abet.org).

For the objectives of the Computer Science program, please see www.usm.maine.edu/cos/undergrad_objective.html

Programs and Requirements

Bachelor of Science in Computer Science

All students are reminded that, in addition to meeting departmental requirements for a major, they must also meet the University Core curriculum requirements.

The total number of credits for graduation is 120.

Courses used to fulfill major requirements in sections A through F below must be passed with a grade of C– or better. The accumulative grade point average of all courses applied to the major must be at least 2.0.

The specific course requirements are as follows.

A. Computer Science:

COS 160	Structured Problem Solving: Java
COS 161	Algorithms in Programming
COS 170	Structured Programming Laboratory
COS 250	Computer Organization
COS 255	Computer Organization Laboratory
COS 285	Data Structures
COS 350	Systems Programming
COS 360	Programming Languages
COS 450	Operating Systems
COS 485	Design of Computing Algorithms
COS 499	Ethical Conduct and Social Responsibility

B. Software Design:

COS 420	Object Oriented Design
	or
COS 430	Software Engineering

C. Completion of four additional COS courses numbered 300 and above, excluding COS 498.

Graduate courses in the Computer Science Department can be used to fulfill the requirements in section C.

D. Mathematics requirement

(1) Completion of:

MAT	152D	Calculus A
MAT	153	Calculus B
MAT	145	Discrete Mathematics I
COS	280	Discrete Mathematics II
MAT	380	Probability and Statistics (MAT 281 and MAT 282 may together substitute for MAT 380)

(2) One additional mathematics course from the following courses:

MAT	252	Calculus C
MAT	292	Theory of Numbers
MAT	295	Linear Algebra
MAT	350	Differential Equations
MAT	352	Real Analysis
MAT	355	Complex Analysis
MAT	364	Numerical Analysis
MAT	366	Deterministic Models in Operations Research
MAT	370	Non-Euclidean Geometry
MAT	383	System Modeling and Simulation
MAT	395	Abstract Algebra
MAT	460	Mathematical Modeling
MAT	461	Stochastic Models in Operations Research
MAT	490	Topology
MAT	492	Graph Theory and Combinatorics

E. (1) Completion of a two-semester sequence of either

CHY 113K with CHY 114K and CHY 115 with CHY 116

or

PHY 121K with PHY 114K and PHY 123 with PHY 116

or

BIO 105K with BIO 106K and BIO 107

(2) Two additional courses (except introductory courses such as ELE 100) from any of the departments of Engineering, Biological Sciences, Chemistry, Physics, Geosciences, or Environmental Science and Policy, provided that the course is a course in science that can be used for credit toward the degree offered by that respective department. Courses from other departments may also be approved to satisfy this requirement, provided they have a strong emphasis on quantitative measures and the application of the scientific method. For a course with an associated lab to satisfy this requirement, the lab must also be taken. ELE 172 and ELE 271 are excluded because of similarity to COS courses.

F. Communication skills requirement:

(1) Completion of THE 170F

(2) Completion of ITP 210

G. Successful completion of 30 credit hours in the humanities, arts, or social sciences. Courses in these disciplines that satisfy Core curriculum requirements also satisfy this requirement.

Suggested Schedule

The following schedule of mathematics and computer science courses is typical for the freshman and sophomore years.

	Fall	*Spring*
First year	COS 160	COS 161
	COS 170	MAT 152D
	MAT 145	
Second year	COS 280	COS 250
	COS 285	COS 255
		MAT 153

Double Majors

Students who opt to pursue a double major with computer science as one of the major fields of study must satisfy all computer science degree requirements. The

general requirements for a double major are listed under the heading Double Major in this catalog.

Minor in Computer Science

A minor in computer science may be obtained by successfully completing the following courses with an accumulative grade point average of 2.0 in these courses: COS 160 and COS 170; COS 161; COS 250 and COS 255; COS 285, and two additional COS courses numbered 250 or greater, excluding COS 498 and COS 499.

Course Fees

Course fees to cover the cost of materials and supplies are assessed in some computer science courses.

COS 120E Deductive Logic
This course will teach the formal techniques that allow one to infer valid conclusions from valid premises in ordinary English discourse. These rules of propositional and predicate logic are based solely on the logical form of statements, independent of their content, and can be used to analyze rational arguments in any discipline. English sentences will be translated into a more precise symbolic language that elucidates their structure. Prerequisite: successful completion of the USM mathematics proficiency requirement. Cr 3.

COS 131 Web Programming
In this course students develop actual Web pages and acquire basic skills in Web programming languages such as JavaScript, VBScript, and Active Server Pages. Other topics include: object model, event model, dynamic HTML, Web-enabled databases, and XML. Prerequisite: a programming course or instructor permission. Cr 3.

COS 141 Visual Basic I
Visual Basic is used to introduce students to the fundamental skills of problem solving and programming. The class includes both classroom presentation and instructor-guided laboratory sessions. Small to medium size programming projects are completed. Prerequisite: a working knowledge of the Windows operating system. Cr 3.

COS 142 Visual Basic II
The concepts of COS 141 are extended to present programming in an application development environment. Topics covered in this course include static and dynamic arrays, user defined data types, class modules and dynamic link library development, serial and random access files, database connectivity, advanced Visual Basic controls, ActiveX controls, and Web programming using Active Server Pages. Component Object Modeling (COM) topics will be included. Small to medium size programming projects and a comprehensive final project will be completed. Prerequisite: COS 141 or permission of the instructor. Cr 3.

COS 160 Structured Problem Solving: Java
An introduction to the use of digital computers for problem solving, employing the Java programming language as a vehicle. Content includes elementary control structures and data representation methods provided by Java and the top-down programming methodology. Course requirements include a substantial number of programming projects. This course must be taken concurrently with COS 170. Prerequisite: successful completion of the USM mathematics proficiency requirement. Cr 3.

COS 161 Algorithms in Programming
The development of algorithms and their implementations in a higher-level programming language, with emphasis on proper design principles and advanced programming concepts. Introduction to the performance analysis of algorithms. Course requirements include substantial programming projects. Prerequisites: COS 160, and working knowledge of word processing and Web browsing. Cr 3.

COS 170 Structured Programming Laboratory
Computational experiments will be designed to teach students how to construct reliable software using Java. Topics to be covered include: Windows system, conditional program flow, iteration, procedures and functions, and symbolic debugging. This course must be taken concurrently with COS 160. Cr 1.

COS 211 The C Programming Language
A first course in the C programming language. This course should provide students with fundamental skills of C programming. Small to medium size programming projects will be written. Prerequisite: A previous course in problem solving and programming (e.g., COS 160) or instructor's permission. Cr 3.

COS 212 The UNIX Operating System
Introduction to the UNIX system, system commands, standard editors, shells, and more. Prerequisite: Experience with some computer operating system. Cr 1.

COS 214 C++ for Programmers
Introduces the basics of C++ programming. Covers types, expressions, control structures, functions, and a brief introduction to classes and objects. This course will prepare students for further object-oriented courses. Prerequisite: a previous college-level course in problem solving and programming or instructor's permission. Cr 3.

COS 215 Introduction to C++ for C Programmers
The changes in the syntax and semantics of C that resulted in C++ are presented. C++ will be covered up to and including a brief introduction to classes and objects. This course will prepare students for further object-oriented courses. Prerequisite: a previous course in problem solving and programming in C (e.g., COS 211) or instructor's permission. Cr 1.

COS 230 Programming in COBOL
A study of the programming language used primarily in business. Prerequisite: COS 160 or analogous experience. Cr 3.

COS 241 Java Programming
Students will develop software using the Java programming language. Some work on connecting Java applets to Web pages using HTML will be included. Prerequisite: a previous course in problem solving and programming, or instructor's permission. Cr 3.

COS 246 Programming Topics
Topics to be covered may include programming languages not otherwise offered (e.g., Ada, Smalltalk), different programming methodologies (e.g., object-oriented programming), assembly languages, and other specific areas of programming. Prerequisite: COS 161 or permission of instructor. Cr 3.

COS 250 Computer Organization
The basic hardware, architecture, and software of computer systems are covered. Subjects include digital logic design, microprogramming, machine languages, assembly languages, and operating systems. Prerequisite: COS 161. This course must be taken concurrently with COS 255. Normally offered only in the spring semester. Cr 3.

COS 255 Computer Organization Laboratory
Students design, build, and test combinational and sequential logic circuits and write assembly language programs. This course must be taken concurrently with COS 250. Cr 1.

COS 280 Discrete Mathematics II
Concepts of modern algebra, set theory, Boolean algebra, elements of graph theory, and their application to computer science. Prerequisites: MAT 145 and COS 160. Cr 3.

COS 285 Data Structures
Basic abstract data types and their representations, fundamental algorithms, and algorithm analysis. Consideration is given to applications. Specific topics include linked structures, trees, searching and sorting, priority queues, graphs, and hashing. Course requirements include a substantial programming component. Prerequisites: COS 161, MAT 145, and calculus, or their equivalents. Cr 3.

COS 350 Systems Programming
A study of systems programming concepts and software, including the C programming language and the Unix programming environment and operating system interface. Students develop their abilities in these areas through programming exercises and projects. Prerequisites: COS 250, COS 285. Cr 3.

COS 360 Programming Languages
Examination of basic concepts and constructs of high-level languages via consideration of several representative languages. Topics include scope of declarations, binding time of constituents, type checking, and control organization. Study of implementation methods for various programming language features. Study of the methods of formal specifications of programming languages: regular, context-free, and attribute grammars and operational semantics. Exposure to programming in languages that deviate from the imperative style such as Lisp and Prolog. Prerequisites: COS 250, COS 285. Cr 3.

COS 368 Graphical User Interface Design
Principles of graphical user interface design are utilized to build working interfaces. The programming language used may vary from offering to offering. Possible languages include Java and C++. Students will work in an object-oriented, event-driven environment. Prerequisite: COS 285 or instructor's permission. Cr 3.

COS 374 Numerical Analysis
A study of the theory and application of computational algorithms for interpolation, equation solving, matrix methods, integration; error analysis. Prerequisites: MAT 252, MAT 295, COS 160, and permission of instructor. Cr 3.

COS 399 Programming Autonomous Robots
Introduction to the programming concepts involved with autonomous robotic systems. Using off-the-shelf "robot kits" students will design a simple robotic platform to meet specific goals. Then, using a common platform for the remainder of the course, students will develop their programming capabilities. Simple open-ended, feedback, and artificial intelligence systems will be explored throughout the course. Several benchmarks and robot competitions will be used to demonstrate the platform and programming learned in the course. Prerequisite: COS 285. Cr 3.

COS 400 Introduction to Simulation Modeling
Introduction to general principles of discrete event simulation modeling. Topics include design of simulation models, their implementation in a computer simulation language, and analysis of simulation data. Applications will emphasize computer and communication science. Requirements include a substantial programming component. Prerequisites: COS 285 and MAT 380 or equivalent. Cr 3.

COS 420 Object-Oriented Design
This course will focus on the construction of object-oriented software. Students will learn conceptual models for organizing objects and object hierarchies, an object-oriented design notation, the application of

design patterns, and the use of software development methodologies such as the Agile development process. The capabilities will be used to solve relatively complex problems in a group setting. Cr 3.

COS 430 Software Engineering
Study of methods applied to large-scale software development, including topics such as requirements analysis and specification, design, validation and verification, and project management, with emphasis on principles of design. Students use methods on a large programming project. Prerequisites: COS 250, COS 285. Cr 3.

COS 444 Software Project Management
The course covers project life cycle, including developing the charter, plans and justification, outsourcing and procurement decisions, scope management, time and cost estimation, quality control, personnel management, risk assessment, and the critical role of communication, both internal and external, to the project. Students will learn to lead and participate in significant software projects. Experts from industry will present case studies of success and failure. Prerequisite: COS 420 or COS 430. Cr 3.

COS 450 Operating Systems
Bottom up construction of a layered operating system beginning with the hardware interface and ending with the user interface. Specific topics covered include concurrent processes, process management, I/O, virtual memory, file management, resource scheduling, and performance measurement. Students are assumed to be familiar with general machine architecture, functions of system software (compilers, loaders, editors, etc.), data structures, and to have some experience with UNIX or another multiprogramming operating system. Prerequisites: COS 250, COS 350. Cr 3.

COS 452 Computer Graphics
A study of the techniques involved in computer graphics systems. Topics include: point-plotting and line drawing in two- and three-dimensional space; clipping and windowing; geometric modeling; algorithmic solutions to the hidden line and hidden surface problems. Prerequisite: COS 285. Cr 3.

COS 455 Computer Architecture
Fundamentals of the design and organization of digital computers. Topics include applications of Boolean algebra to logical design; machine algorithms used in addition, subtraction, multiplication, etc.; types of memory; synchronous and asynchronous operation; minimization of logic circuits. Also, concepts from microprocessors and large parallel computers. Prerequisite: COS 250. Cr 3.

COS 457 Database Systems
Study of the methods and principles of database management systems (DBMS). Topics addressed include DBMS objectives and architecture, data models, data definition and data manipulation languages, and providing Internet access to databases. The entity-relationship and relational models are emphasized and their use required in a design project. Prerequisites: COS 280, COS 285. Cr 3.

COS 460 Computer Networks
An introduction to computer networks. Computer network architecture is described. Other topics include digital data communication, local area networks, wide area networks, internetworks, and the Internet. Specific technologies, including Ethernet and ATM, and protocols, including TCP/IP, will be considered in detail. Prerequisite: COS 285. Cr 3.

COS 465 Distributed Systems
An introduction to the design and operation of distributed systems. Topics include client-server models, interprocess communications, RPC, replication and consistency, online transaction processing, error and fault recovery, encryption and security. Examples will be taken from extant distributed systems. Prerequisites: COS 450 and COS 460, or their equivalents, or permission of the instructor. Cr 3.

COS 467 Performance Analysis of Distributed Systems
The objective of the course is to learn techniques that enable assessing the performance of applications running on distributed systems. This is an important topic because software developers should have a good understanding regarding the performance of the distributed applications they develop. This course presents techniques such that the performance of distributed applications can be evaluated. Topics to be covered include queueing theory, simulation, availability, and performability modeling. Other techniques used to assess the performance of distributed systems will be introduced as needed. Prerequisites: COS 450 or COS 460, and MAT 281 or MAT 380. Cr 3.

COS 469 Compiler Construction
Definition of languages via context-free grammars. Organization of a compiler into phases of lexical analysis, parsing, code generation, and optimization. Students will implement a compiler for a Pascal-like language. Prerequisite: COS 360. Cr 3.

COS 470 Topics in Computer Science
Topics to be covered may include philosophy of computers, history of computers, computers and society, simulation, graphics, and other advanced topics. Prerequisite: COS 285 or permission of the instructor. Cr 3.

COS 471 Object-Oriented Databases
Object-oriented database technology integrates technologies from database systems and programming languages. The integrated technology provides significant advantages in nonstandard application areas, particularly in engineering. The course covers the object-oriented database system manifesto, limitations of the relational model, user-

defined types and complex objects, object-relational systems, persistent object systems, Java database technology, query languages, system architectures, and object-oriented database standards. The course includes hands-on experience with object-oriented database management systems and/or persistent object systems. Requirements include a substantial database development project, addressed by teams. Prerequisites: COS 457 and COS 478 or equivalent Java experience. Cr 3.

COS 472 Artificial Intelligence
An introduction to the underlying concepts and applications of intelligent systems. Topics include pattern matching, production systems, computer representations of knowledge, heuristic search techniques and computer problem solving, and automatic theorem proving. The programming language Lisp is introduced. Students will develop programs in Lisp applying the concepts and techniques introduced. Prerequisites: COS 280, COS 285. Cr 3.

COS 476 Advanced Object-Oriented Design
This course considers developing object-oriented, multi-tier, Web-based applications. Topics will include object-oriented design patterns in distributed environments, software components, and software frameworks. The course also has a significant hands-on implementation component, and after having completed this course, students will have practical experience with several leading distributed object technologies, including AJAX, Web Services, Enterprise JavaBeans, JDBC, and Servlets. The course is structured so that students will work in teams to develop a medium-sized, multi-tier application that incorporates several of the technologies mentioned above. Lectures will provide an introduction to the technologies and discuss principled ways to apply these technologies. Prerequisite: COS 420 or permission of instructor. Cr 3.

COS 478 Advanced Java Technology
The goal of this course is to provide an in-depth study of the most important and the more advanced components of the Java technology. The first part of the course covers topics such as concurrent object-oriented programming in Java and Java Core Reflection. The underlying technology (the Java Virtual Machine) is also covered in detail. The third segment of this course covers the extensions of the Java technology such as parametric polymorphism, orthogonal persistence, and assertions. Programming assignments include concurrent programming, programming with collection types, dynamic loading and compilation, usage of the Java reflective capabilities, and usage of persistent capabilities available in Java and its extensions. Prerequisite: COS 360 and Java experience. Cr 3.

COS 479 Object-Oriented Software Technology
The focus of this course is on object-oriented software systems that provide efficiency and reliability based on an advanced type system, and correctness and behavioral compatibility in software reuse via object-oriented assertions and programming by contract. Specific topics include object-oriented type systems (inheritance and subtype polymorphism, parametric polymorphism—bounded and F-bounded—self-typing and matching, type reflection) and semantics and correctness (object-oriented assertions, behavioral compatibility and behavioral subtyping, programming by contract, verification techniques and tools). Programming assignments are based on an object-oriented language with bounded parametric polymorphism, self-typing, and assertions. Prerequisites: COS 280 and COS 360. Cr 3.

COS 480 Theory of Computation
Study of the theoretical foundations of computer science, including elements of set theory and logic, the specification of formal languages via finite automata, regular expressions, push-down automata, context free grammars, and Turing machines. Also introduces the concepts of recursive and recursively enumerable sets. Prerequisite: COS 280. Cr 3.

COS 485 Design of Computing Algorithms
An introduction to the design and analysis of algorithms. Techniques for designing algorithms, such as divide-and-conquer, greedy method, dynamic programming, and backtracking are emphasized and illustrated. Many problems of practical importance are covered including: minimum spanning tree, single source shortest path, traveling salesperson, and graph search. The concepts of NP-completeness are also considered. Substantial programming in a high-level language. Prerequisite: COS 285. Cr 3.

COS 495 Advanced Web Architectures
The focus of communication over the Internet is shifting to computer-to-computer interaction. Standards for this interaction (ebXML, SOAP, WSFL) are now in place and maturing, and commercial use is exploding. We will survey these standards and evaluate their security, efficiency, and completeness. We will construct several case studies, including Web-based commerce. As a team, we will acquire and learn how to use available tooling, and we will put together working Web services and test their ability to interact with each other. Prerequisites: COS 285 and junior standing. Cr 3.

COS 497 Independent Study in Computer Science
An opportunity for juniors and seniors who have demonstrated critical and analytical capability to pursue a project independently, charting a course and exploring an area of interest within their major field. At most, three credits of COS 497 can be used to satisfy requirement C, as noted under Programs and Requirements. Prerequisites: junior or senior standing and permission of the Department chair and instructor. Cr 1-3.

COS 498 Computer Science Internship
An opportunity for students to gain practical experience in computer science-related employment. The

University internship program provides placement. This course is offered on a pass/fail basis only, does not fulfill any computer science requirement, and a maximum of 6 credits may be taken. Cr 3.

COS 499 Ethical Conduct and Social Responsibility
A study of ethical perspectives and social responsibilities of computer professionals. Assigned readings provide the basis for class discussions of such issues as social control and privacy, computer viruses, ACM code of professional conduct, hacking, limits of correctness in computer software, military influence on computer science research and education. Prerequisite: senior standing. Normally offered in spring semester only. Cr 1.

Department of Engineering

Chair of the Department: Julie Ellis
Professors: Guvench, Hodgkin; *Associate Professors:* Ellis, Jankowski, Lück, Smith; *Adjunct Professors:* Kurkjian, Masi, Most

Engineering is a challenging profession concerned with the design, development, fabrication, and control of physical devices and systems.

The mission of the Engineering Department is to provide a solid and complete engineering education built upon a foundation of mathematics, science, and liberal arts. Our undergraduate programs are broadly based, but there are opportunities to specialize. Computer usage is integrated throughout the curriculum. Internships and co-ops with our industrial partners are available to students at all levels.

The Department serves both traditional and nontraditional students who are diverse in academic background, age, and life experience. The Department also provides a technical resource to the community by linking the teaching, research, and public service capabilities of the Department with the needs of the industries, organizations, and institutions of southern Maine.

Graduates of the program are prepared to:

- function as engineers in technologically intensive firms;
- succeed in post-baccalaureate study;
- transfer their engineering skills to different environments; and
- contribute to society as broadly educated, articulate, and ethical professionals and citizens.

These objectives are complementary to and in addition to the general education objectives of the University.

Engineering programs include bachelor of science degree programs in electrical engineering and in mechanical engineering, a concentration in computer engineering, minors in electrical and mechanical engineering, and the first year or more for several other engineering specialties.

The Engineering Department is committed to maximizing the student's potential to achieve his or her academic goals. Upon admission, the student is assigned an academic advisor from the engineering faculty and staff. The student is then expected to meet with the advisor every semester before registering for classes. Regular contact with an academic advisor ensures that students receive adequate assistance in selecting courses, and that all students make satisfactory progress toward meeting their academic goals.

Please visit our Web site at www.usm.maine.edu/engineering for additional and more recent information about the Department and the programs.

Admission Requirements

Preparation for an undergraduate engineering program should include high school English, chemistry, physics, and mathematics including algebra and trigonometry.

Programs and Requirements

General Requirements for Bachelor of Science in Engineering Degrees (both electrical and mechanical)

Mathematics

MAT	152D	Calculus A
MAT	153	Calculus B
MAT	252	Calculus C
MAT	350	Differential Equations
MAT	380	Probability and Statistics

Computer Science
- COS 160, 170 Structured Problem Solving: Java, with Lab

Basic Science
- CHY 113K, 114K Principles of Chemistry I, with Lab
- PHY 121K, 114K General Physics I, with Lab
- PHY 123, 116 General Physics II, with Lab

Communication
- ENG 100C College Writing
- THE 170F Public Speaking

General Engineering
- EGN 100 Introduction to Engineering
- EGN 301 Design Project I: The Engineering Profession
- EGN 304 Engineering Economics

EGN 362 Materials Science
- EGN 402, 403 Design Project II and III

Electrical Engineering
- ELE 216 Circuits I: Steady-State Analysis
- ELE 217 Circuits II: System Dynamics
- ELE 323 Electromechanical Energy Conversion

Mechanical Engineering
- MEE 230 Thermodynamics I

Technical Electives

Four technical electives are required, with at least 2 in the major engineering discipline, and at least 3 in engineering disciplines. EGN electives are general engineering courses that contain both electrical and mechanical elements; they are applicable to both majors. The fourth required technical elective may be chosen from physics, chemistry, mathematics, computer science, electrical engineering, mechanical engineering or other technical disciplines as available and approved by the student's academic advisor.

For graduation, engineering majors must maintain an overall grade point average of 2.0 and a cumulative grade point average of 2.0 in engineering courses.

Certain engineering courses require junior standing. For the purposes of eligibility for engineering courses, junior standing is defined as having successfully completed a minimum of 6 credit hours in engineering courses at or above the 300-level.

University Core curriculum requirements are outlined elsewhere in this catalog. Some requirements of the engineering degrees also satisfy Core curriculum requirements.

I. Bachelor of Science in Electrical Engineering

The electrical engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Requirements for the degree include the following (italicized classes are general engineering requirements for both the electrical and mechanical engineering degrees):

General Engineering
- *EGN 100 Introduction to Engineering*
- *EGN 301 Design Project I: The Engineering Profession*
- *EGN 304 Engineering Economics*
- *EGN 362 Materials Science*
- *EGN 402, 403 Design Project II and III*

Electrical Engineering
- ELE 172 Digital Logic
- *ELE 216 Circuits I: Steady State Analysis*
- *ELE 217 Circuits II: System Dynamics*
- ELE 262 Physical Electronics
- ELE 271 Introduction to Microprocessors
- ELE 314 Linear Signals and Systems
- ELE 323 Electromechanical Energy Conversion
- ELE 342, 343 Electronics I and II
- ELE 351 Electromagnetic Fields

Mechanical Engineering
- *MEE 230 Thermodynamics I*

Technical Electives

Four technical electives are required, with at least two in electrical engineering and at least three in engineering disciplines. EGN electives are general engineering courses that contain both electrical and mechanical elements; they are applicable to both majors. As such, they may be counted as electrical engineering courses for the purpose of satisfying these requirements. The fourth required technical elective may be chosen from physics, chemistry, mathematics, computer science, electrical engineering, mechanical engineering or other technical disciplines as available and approved by the student's academic advisor.

Credits to graduate: 128

Computer Engineering Concentration

Students with a particular interest in the design and application of computer hardware and software systems may choose the computer engineering concentration. The requirements for the bachelor of science degree in electrical engineering with a concentration in computer engineering differ from the standard electrical engineering degree as follows:

Students in the concentration are not required to take ELE 323, ELE 343, ELE 351, EGN 362, or MEE 230. Instead, they are required to take COS 161, COS 285, COS 350, ELE 373 and a computer science elective, as approved by the student's academic advisor, for a program total of at least 126 credits.

For graduation, majors of the electrical engineering with a concentration in computer engineering must maintain an overall grade point average of 2.0 and a cumulative grade point average of 2.0 in engineering and computer science courses.

Minor in Electrical Engineering

A minor in electrical engineering may be obtained by successfully completing the following courses with a cumulative grade point average of 2.0: ELE 172, ELE 217, ELE 262, and two additional 3- or 4-credit electrical engineering courses at or above the 300-level, or as approved by the student's engineering advisor. Prerequisites for these courses must also be completed successfully.

II. Bachelor of Science in Mechanical Engineering

The mechanical engineering program officially began in the fall of 2006. Pursuant to ABET guidelines, accreditation is scheduled to follow after the first graduating class.

Requirements for the degree include the following (italicized classes are general engineering requirements for both the electrical and mechanical engineering degrees):

General Engineering

EGN	*100*	*Introduction to Engineering*
EGN	*301*	*Design Project I: The Engineering Profession*
EGN	*304*	*Engineering Economics*
EGN	*362*	*Materials Science*
EGN	*402, 403*	*Design Project II and III*

Mechanical Engineering

MEE	150	Applied Mechanics: Statics
MEE	*230*	*Thermodynamics I*
MEE	251	Strength of Materials
MEE	270	Applied Mechanics: Dynamics
MEE	332	Thermal Systems
MEE	341	Transport Phenomena Laboratory
MEE	360	Fluid Mechanics
MEE	372	Mechanisms
MEE	373	Controlled Mechanisms

Electrical Engineering

ELE	*216*	*Circuits I: Steady State Analysis*
ELE	*217*	*Circuits II: System Dynamics*
ELE	*323*	*Electromechanical Energy Conversion*

Technical Electives

Four technical electives are required, with at least two in mechanical engineering and at least three in engineering disciplines. EGN electives are general

engineering courses that contain both electrical and mechanical elements; they are applicable to both majors. As such, they may be counted as mechanical engineering courses for the purpose of satisfying these requirements. The fourth required technical elective may be chosen from physics, chemistry, mathematics, computer science, electrical engineering, mechanical engineering or other technical disciplines as available and approved by the student's academic advisor.

Credits to graduate: 126

Minor in Mechanical Engineering

A minor in mechanical engineering may be obtained by successfully completing the following courses with a cumulative grade point average of 2.0: MEE 150, MEE 230, MEE 251, MEE 270, and two additional 3- or 4-credit mechanical engineering courses at or above the 300-level, or as approved by the student's engineering advisor. Prerequisites for these courses must also be completed successfully.

III. Transfer Programs for Other Engineering Disciplines

The engineering transfer program prepares students to begin engineering studies at USM and then complete engineering degrees at the University of Maine or elsewhere. All University of Southern Maine students in this program are eligible to transfer to any accredited engineering program in the country for the completion of the program.

Course Fees

Course fees to cover the cost of materials and supplies are assessed in some engineering courses.

EGN 100 Introduction to Engineering
Engineers use mathematics and apply scientific principles to design, create, modify, and control physical systems. They communicate effectively in both written and oral forms, and work in teams as well as alone. This course introduces students to the tools, tasks, and culture of engineering. Students use spreadsheets to solve problems and graph the results. Through class work, laboratory exercises, and independent research, students learn fundamental concepts of devices such as batteries and motors. The course culminates with a project in which student teams design, build, test, demonstrate, and document a device, utilizing the knowledge and skills acquired in the early part of the course. Lecture 1 hr., Lab 3 hrs. Cr 3.

EGN 301 Design Project I: The Engineering Profession
The fundamental mission of engineering is design. Students, working in teams, learn the fundamentals of developing a specific problem statement, flowcharting, researching, project management, and design actualization. Professional issues such as ethics, intellectual property, interview skills, and resume preparation are explored. The student is challenged to consider the work of the engineer in the broader context of societal, personal, and professional responsibility. Prerequisite: junior standing. Lecture 3 hrs. Cr 2.

EGN 304 Engineering Economics
Economic analysis of engineering projects, cost concepts and design economics, cost estimation techniques, money-time relationships, comparing alternatives, depreciation and taxes, benefit-cost ratio, decision making under risk and uncertainty, capital investments and replacement. Prerequisite: junior standing. Lecture 3 hrs. Cr 3.

EGN 325 Control Systems
Introduction to feedback control systems. Modeling and analysis of control systems using frequency response, root locus, and state-space methods. Design and compensation of feedback control systems. Prerequisite: ELE 217. Lecture 3 hrs. Cr 3.

EGN 362 Materials Science
Concepts of relationships between structure, composition, and thermal, optical, magnetic, electrical and mechanical properties of metals, ceramics, glasses, and polymers. Prerequisites: PHY 123, MAT 153, CHY 113K. Lecture 3 hrs. Cr 3.

EGN 394 Engineering Internship
Work experience in engineering. An opportunity for students to obtain credit for a project or study sequence completed while employed. The activity must have both components of design and analysis and be pre-approved by the instructor. Prerequisites: junior standing, permission. Cr 1-3.

EGN 402 Design Project II
Proposal and measurable advances toward the design and implementation of a device or system to perform an engineering function. May be done individually or in small groups, but the contribution is evaluated on an individual basis. The student must secure a project advisor among the engineering faculty who agrees to supervise the proposed project. This is the first of a two-semester sequence, culminating with a progress report and to be followed by

EGN 403. Prerequisites: EGN 301 and project advisor permission. Cr 3.

EGN 403 Design Project III
Completion of the design and implementation of a device or system to perform an engineering function. May be done individually or in small groups, but the contribution is evaluated on an individual basis. This is the second of a two-semester sequence, culminating in an oral presentation, demonstration of the device or system, and delivery of the final report. Prerequisites: EGN 402 and project advisor permission. Cr 3.

EGN 417 Robot Modeling
Kinematics, statics, and dynamics of serial manipulators. Analysis and design of robotic structures. Examples of multiple platforms in the Robotics and Intelligence Systems Laboratory. Complements EGN 418. Prerequisites: ELE 217, COS 160. Lecture 3 hrs. Cr 3.

EGN 418 Robot Intelligence
Motion control, trajectory and path planning, actuators and sensors, artificial intelligence, and programming of robotic devices. Case study of multiple platforms in the Robotics and Intelligence Systems Laboratory. Complements EGN 417. Prerequisites: ELE 217, COS 160. Lecture 3 hrs., Lab. 1 hr. Cr 3.

EGN 446 Micro Electromechanical Systems
Topics include microfabrication, principles of electromechanical energy conversion and transduction, sensors and actuators, materials used for MEMS and their thermal, electrical, and mechanical properties, micro-electromechanical building structures and MEMS design. Prerequisites: ELE 323 or ELE 342, and permission. Lecture 3 hrs. Cr 3.

EGN 497 Independent Study
An opportunity for the student to explore topics not covered in available courses or to pursue a topic of interest in-depth. By prearrangement with a faculty member. Prerequisite: permission. Cr 1- 3.

EGN 498 Selected Topics in Engineering
Topics in engineering not regularly covered in other courses. The content can be varied to suit current needs. The course may, with permission of the Department, be taken more than once. Consult the Department for current offerings and prerequisites. Cr 1- 3.

ELE 172 Digital Logic
Introduction to the design of binary logic circuits. Combinatorial and sequential logic systems. Design with small and medium scale integrated circuits and programmable logic devices (PLDs). Registers, counters, and random access memories (RAMs). The algorithmic state machine (ASM). Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 216 Circuits I: Steady-State Analysis
An examination of fundamental circuit laws and theorems, network analysis, physical properties and modeling of resistors, inductors, and capacitors. Sinusoidal steady-state operation, phasors, impedance, power, three-phase systems, and the ideal transformer. The course also covers the operation of meters, oscilloscopes, power supplies, and signal generators. Prerequisites: MAT 153, PHY 123. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 217 Circuits II: System Dynamics
Time-domain analysis of first- and second-order systems, based on electric circuits, but drawing analogy to mechanical, fluid, and thermal systems. Study and application of the Laplace transform for the solution of differential equations governing dynamic systems. Frequency domain analysis, transfer functions, poles and zeros, frequency response, basic filtering, and resonance. Principles of control, feedback, and stability. Prerequisite: ELE 216. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 262 Physical Electronics
Basic characteristics and properties of materials of importance in solid-state engineering. Particular emphasis is placed on atoms, crystal structures, electronic conductivity, semiconductor theory and bipolar and field effect transistors. Prerequisites: CHY 113K, PHY 123. Lecture 3 hrs. Cr 3.

ELE 271 Introduction to Microprocessors
Introduction to microprocessors: architecture, operating principles, and programming. Binary representation and algebra. The microcomputer and its component parts: central processing unit, memory, input-output, and microcontrollers. Prerequisite: ELE 172. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 314 Linear Signals and Systems
Introduction to the theory of linear signals and systems. Linear time-invariant system properties and representations; differential and difference equations; convolution; Fourier analysis; Laplace and Z transforms. Selected topics in sampling, filter design, digital signal processing, and modulation. Prerequisite: ELE 217. Lecture 3 hrs., Lab 2 hrs. Cr 4.

ELE 323 Electromechanical Energy Conversion
Basic concepts of magnetic circuits and transformers. Three-phase system and power transmission. Conversion between electrical and mechanical energy through magnetic fields. Study of direct current motors and generators. Study of alternating current machines: induction motors, synchronous machines, and single-phase motors. Prerequisite: ELE 216. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 342 Electronics I
Fundamentals of electronic circuits with emphasis on the nonlinear nature of electronic devices, their modeling and applications in power conversion, waveshaping and small signal amplification.

Analysis, design, and SPICE simulation of such circuits. Prerequisites: ELE 262, ELE 217. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 343 Electronics II
Analysis and design of multistage amplifiers. Principles of operation of analog and digital integrated circuit building blocks. Applications in signal generation, amplification, and waveshaping. Topics include differential, multi-stage, and power amplifiers; frequency response of transistor amplifiers; feedback amplifiers and oscillators; operational amplifiers and applications; I.C. logic families. Prerequisite: ELE 342. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

ELE 351 Electromagnetic Fields
Static electric and magnetic fields; properties of dielectric and ferromagnetic materials; time varying fields, Faraday's law, Maxwell's equations; plane waves in dielectric and conducting media; calculation of the fields and other properties of common transmission lines and other devices. Prerequisites: MAT 252, PHY 123. Lecture 3 hrs. Cr 3.

ELE 363 Solid State Electronic Devices
The theory of selected solid state electronic devices and an introduction to device fabrication technology. Devices studied include bipolar junction-based structures, MOS, and optoelectronic devices. An occasional laboratory period may be substituted for equivalent class time. Prerequisite: ELE 262. Lecture 3 hrs. Cr 3.

ELE 371 Microprocessor Systems
The organization of microprocessor-based computers. Microprocessor architecture and operation; buses and system concepts; memory system organization and operation; software and programming: instruction formats and addressing modes. Input-output concepts: programmed I/O, interrupts. Microprocessor arithmetic. Prerequisites: ELE 271. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 373 Digital System Architecture and Design
Algorithmic approaches to digital system design. Methods of design and testing of multi-input, multi-output logic systems including arithmetic units, logic controllers, and microprocessors. Logic design with PLDs, FPGAs, and VHDL. Prerequisite: ELE 172. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 412 Power Electronics
Introduction to power electronics and power semiconductor devices. Analysis, performance characterization, and design of power electronics converters such as: rectifiers, DC choppers, AC voltage controllers, and single-phase inverters. Operation of DC motor drives. Prerequisites: ELE 342. Lecture 3 hrs. Cr 3.

ELE 442 Digital VLSI Circuits and Design
Principles of internal circuit and layout design of digital VLSI circuits. CMOS technology is emphasized. Topics include NMOS and CMOS processes, device physics and SPICE models, logic circuits, electrical and physical design of logic gates, dynamic CMOS circuits, memory, chip layout principles, parasitics, and performance estimation. Simulation, layout, and electronic design automation tools are demonstrated and used. Prerequisites: ELE 172, ELE 342. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 444 Analog Integrated Circuits and Design
Principles of internal circuit operation and design of analog integrated circuits with emphasis on CMOS technology. Topics include analog CMOS processes, devices and device models, bias and reference sources, differential and high gain amplifiers, OTAs and operational amplifiers, frequency response, feedback, stability and internal compensation with emphasis on the design of CMOS operational amplifiers, power stages and dc regulators. SPICE simulation, layout and electronic design automation tools are demonstrated and used in homework and design projects. Prerequisite: ELE 343. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 445 Special Topics in CMOS Integrated Circuit Design
Special topics such as high performance operational amplifiers, silicon integrated sensors and sensor interface circuits, switched capacitor circuits, oscillators and integrated waveform generators, phase-locked-loop circuits, memory, etc., are covered with emphasis on three chosen topics with instructor guided projects leading to chip level design of these circuits. SPICE simulation verifications, layout and electronic design automation tools are used extensively. Prerequisite: ELE 343. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 464 Microelectronic Fabrication
Principles of the processes used in the fabrication of integrated circuits in bipolar and CMOS technologies. Photolithography, crystal and epitaxial growth, oxidation, diffusion and ion implantation, chemical and physical film deposition and etching. Process and component design. Experiments on wafer processing and characterization. Prerequisite:, ELE 342. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 467 Optoelectronics
Properties and applications of optoelectronic devices and systems. Topics include radiation sources (LEDs and semiconductor lasers), photodetectors and detector circuits, solar cells, fiber optics, and electro-optical system components. Prerequisite:, ELE 342. Lecture 3 hrs., Lab. 1 hr. Cr 3.

ELE 468 Electronic Properties of Engineering Materials
Properties of conductive, dielectric, polar, magnetic, and other technologically important materials with a view toward understanding their behavior and application in electronic devices. Measurement techniques and production technology will be considered. Part of

the course will deal with reading and interpreting published articles in technical journals. Prerequisites: ELE 262, EGN 362. Lecture 3 hrs. Cr 3.

ELE 483 Communications Engineering
Basic principles of modern communication engineering. Analog and digital signals and systems; analysis methods. Modulation techniques: AM, FM, and carrier modulation of digital signals. Baseband signaling and coding. Noise in communication systems. Prerequisites: MAT 350, ELE 314. Lecture 3 hrs. Cr 3.

ELE 486 Digital Signal Processing
Basic principles of processing digital signals. Sampling and quantization. Time and frequency domain representation and analysis of discrete-time signals and systems. FIR and IIR systems. Digital filter design; review of classic analog filter design (Butterworth, Chebychev). Quantization and finite-precision effects. DSP hardware. Computers will be used to design and realize various signal processors. Prerequisites: ELE 314, COS 160. Lecture 3 hrs. Cr 3.

ELE 489 Digital Image Processing
The theory and practice of digital processing of images by computer. Introduction to two-dimensional signal processing theory: sampling, transforms, and filters. Image acquisition and representation; enhancement methods; image coding; image analysis; and image processing hardware. Prerequisites: ELE 314, COS 160. Lecture 3 hrs. Lab. 1 hr. Cr 3.

ELE 498 Selected Topics in Electrical Engineering
Topics in electrical engineering not regularly covered in other courses. The content can be varied to suit current needs. The course may, with permission of the department, be taken more than once. Consult the Department for current offerings and prerequisites. Cr 3.

MEE 150 Applied Mechanics: Statics
A study of force systems and equilibrium, structural models, friction, distributed forces. Designed to develop the ability to analyze and solve engineering problems. Prerequisites: MAT 152D, PHY 121K. Lecture 3 hrs. Cr 3.

MEE 230 Thermodynamics I
Energy and energy transformations, the First and Second Laws applied to systems and to control volumes, thermodynamic properties of systems, availability of energy. Prerequisites: MAT 153, PHY 121K. Lecture 3 hrs. Cr 3.

MEE 251 Strength of Materials
The principles of solid mechanics and their applications to practical problems, stresses and deflections in axial loading, torsion, beams, columns, combined stresses. Prerequisites: MEE 150, MAT 153. Lecture 3 hrs. Cr 3.

MEE 270 Applied Mechanics: Dynamics
Motion of particles and rigid bodies, impulse and momentum, work and energy and simple harmonic motion, force, mass, and acceleration. Prerequisites: MEE 150, MAT 252. Lecture 3 hrs. Cr 3.

MEE 332 Thermal Systems
The basic principles of thermodynamics, heat transfer, and fluid mechanics are used to develop analytic models of mass, momentum, and energy balance in systems of practical importance to all engineers. The following topics will be used to develop these models: properties of materials, the Bernoulli equation, the first and second law of thermodynamics, fluid mechanics of internal and external flow, and the principles of heat transfer. Prerequisite: MEE 230. Lecture 3 hrs. Cr 3.

MEE 341 Transport Phenomena Laboratory
Laboratory experiments designed to illustrate the concepts of heat, mass, and momentum transfer studied in MEE 332 and MEE 360. Corequisites: MEE 332 and MEE 360. Lab. 2 hrs. Cr 1.

MEE 360 Fluid Mechanics
Includes fluid statics, kinematics, Bernoulli equation, free-surface flow, viscosity, friction, dimensional analysis and similitude, and an introduction to compressible flow. Prerequisites: MEE 230, MEE 270, MAT 350. Lecture 3 hrs. Cr 3.

MEE 361 Physical Metallurgy
This course presents the basic science and engineering of steel and other technologically important metals to students. The course begins with a fundamental description of the phases and structure that are found in ferrous systems. Critical temperature and phase diagrams are covered in detail. The concept of transformation kinetics, important to all materials disciplines, is introduced. This leads to the study of heat treatment for ferrous and other materials. The physical metallurgy of welding is developed with particular reference to the phase transformation, both liquid-solid and solid-solid which occurs in the weld and the heat-affected zone. Prerequisite: EGN 362. Lecture 3 hrs. Cr 3.

MEE 372 Mechanisms
The design of mechanical components, including shafts, screws, fasteners, springs, bearings, and gears and gear trains. Use of computer analysis and design tools. This course also covers solid modeling of machine components, prototyping, creation of assemblies, and engineering drawings and materials selection. Lab: Introduction to hydraulic, pneumatic, and electrically driven systems. Introduction to programmable controllers. Student design project. Prerequisites: MEE 251, MEE 270. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

MEE 373 Controlled Mechanisms
Coupled systems, power transmission, and flexible mechanical elements are introduced. Welding,

bonding, and the design of permanent joints are presented. Design for reliability concepts are considered including statistical failure analysis techniques. Student design project. Prerequisite: MEE 372. Lecture 3 hrs., Lab. 2 hrs. Cr 4.

MEE 374 Fundamentals of Mechanical Vibrations
Concepts and techniques to develop and simplify a geometric model of a vibratory system, including model schematic, model parameters, degree of freedom, equivalent elements/systems and energy methods. Free-body diagrams and elemental equations of a vibratory system. Single degree-of-freedom vibrations, damping, harmonic and non-harmonic excitations. Multiple degree-of-freedom vibrations, free vibrations and multiple modes, the eigenvalue problem, forced vibrations. Vibration control in engineering design, vibration isolation and absorption. Prerequisite: ELE 217. Lecture 3 hrs. Cr 3.

MEE 432 Heat Transfer
The fundamental laws of heat transfer by conduction, convection, and radiation, applied to the study of engineering problems via analytical, numerical, and graphical techniques. Prerequisites: MEE 360, MAT 350 Cr 3.

MEE 435 Advanced Thermal Systems
Apply the principles of thermodynamics, fluid mechanics, and heat transfer to engineering systems. These systems include but are not limited to power generation, heating ventilating and air conditioning (HVAC), internal combustion engines, manufacturing processes. The concept of energy efficiency will be emphasized. Prerequisites: MEE 332, MAT 350. Lecture 3 hrs. Cr 3.

MEE 498 Selected Topics in Mechanical Engineering
Topics in mechanical engineering not regularly covered in other courses. The content can be varied to suit current needs. The course may, with permission of the department, be taken more than once. Consult the Department for current offerings and prerequisites. Cr 3.

Department of Environmental Science

Chair of the Department: Samantha Langley-Turnbaugh, 106 Bailey Hall, Gorham
Professors: Langley-Turnbaugh, Sanford; *Assistant Professor:* Wagner; *Research Professor:* Incze; *Assistant Research Professor:* Wilson; *Adjunct Professor:* Fitts; *Adjunct Assistant Professors:* Dodge, Martinez

The Department of Environmental Science offers three degrees: B.A. in environmental planning and policy, B.S. in environmental science, and a B.S. in environmental safety and health. Each of these prepares students for a variety of professional roles in the environmental and safety fields, and encourages students to pursue graduate academic and professional degrees and professional certifications. Our graduates find employment in many environmental settings, including federal, state, and local government; environmental and civil consulting and engineering, environmental education and teaching, private industry ranging from health care to semiconductor manufacturing, applied research, environmental advocacy, and community planning.

All students in the Department of Environmental Science complete a core set of courses and laboratory training in a broad range of perspectives and skills including environmental science, ecology, chemistry, communication, environmental regulations, impact assessment, and research methods. Additionally, the program requires students to specialize in an area of choice. Students choosing the environmental science option will study topics such as forest, wetland and plant ecology, and water quality. Students choosing the environmental planning and policy option will study topics such as policy analysis, environmental impact assessment, and risk assessment. Students opting for environmental safety and health will study the total work environment including air and water quality, ergonomic issues, and safety concerns. Near the end of their programs, all students apply their knowledge in a professional setting with a required internship.

A core interdisciplinary faculty representing all these areas is on hand to work with and guide students who are encouraged to participate in research with Departmental faculty. Faculty stress problem-based service learning by examining and solving local environmental problems.

Our location in greater Portland provides opportunities to examine a broad range of environmental and safety problems and issues both rural (agricultural or forested) and urban (industrial and commercial) settings.

Bachelor of Arts (Option 1: Environmental Planning and Policy), Bachelor of Science (Option 2: Environmental Science and Option 3: Environmental Safety and Health)

The minimum number of credits required for the major is 86 (depending on which of the degrees is selected) plus the 34 credits required of the University's Core curriculum. Note that these Departmental major requirements include 13 credits of Core curriculum. In order to graduate with a minimum of 120 credits, the student must not require any remedial work and all electives (taken here or transferred) must fit into the student's program of study, which is approved for each student by the Departmental faculty. A student must achieve at least a 2.0 grade point average and must earn at least a C- in each course applied toward completion of the major.

Required Courses

ESH	341	Environmental Regulations
ESP	101K	Fundamentals of Environmental Science
ESP	102K	Fundamentals of Environmental Science Lab
ESP	125K	Introduction to Environmental Ecology
ESP	126K	Introduction to Environmental Ecology Lab
ESP	150	Field Immersion
ESP	203W	Environmental Communication
ESP	280	Research and Analytical Methods
ESP	401W	Environmental Impact Assessment
ESP	400	Internship*
ESP	475	Senior Seminar
CHY	113K	Principles of Chemistry I
CHY	114K	Principles of Chemistry I Lab
		and
CHY	115	Principles of Chemistry II
CHY	116	Principles of Chemistry II Lab
		or
ESH	331	Applied Toxicology

Choose one tools course

Suggested tools courses: ECO 102, MAT 120D, MAT 220, GEO 108, GEO 205, GEO 308

*To be taken between junior and senior years

Majors must also complete one of the following three options:

Option 1: Environmental Planning/Policy

ESP	220J	Introduction to Environmental Policy
ESP	305	Community Planning Workshop
ESP	375	Environmental Risk Assessment and Management
ESP	417	Site Planning and Assessment
ESP	421W	Natural Resource Policy
GEO	209	Land Use Planning
		or
ESP	200	Environmental Planning

Electives:

Choose four environmental science classes 200-level or higher in accordance with program of study

Option 2: Environmental Science

CHY	231	Analytical Chemistry
CHY	232	Analytical Chemistry Lab
MAT	152D	Calculus A
PHY	111K	Elements of Physics and
PHY	114K	Physics Lab
		or
BIO	105K	Biological Principles I and
BIO	106K	Laboratory Biology
ESP	250	Soils and Land Use
ESP	360	Water Quality Assessment and Control
ESP	260	Soil and Water Conservation Engineering
		or
ESP	413	Forest Ecology

Electives:
Choose four environmental science classes 200-level or higher in accordance with program of study

Option 3: Environmental Safety and Health

ESH	221	Fire and Safety
ESH	332	Industrial Hygiene
ESH	342	Safety and Risk Management
ESH	350	Industrial Processes and Permitting
ITS	300	Ergonomics
ITS	320	Occupational Safety and Health

Electives:
Choose 37 additional credits from the recommended list below in accordance with program of study. Other courses may be suggested by the student for inclusion:

BIO	111/112	Anatomy and Physiology I
BIO	211/212	Anatomy and Physiology II
CHY	115/116	Principles of Chemistry II and Lab
CHY	231/232	Analytical Chemistry and Lab
PHY	111K/114K	Elements of Physics I and Lab
PHY	112/116	Elements of Physics II and Lab
ITS	321	Workplace Design Ergonomics
ESP	220J	Introduction to Environmental Policy (if another J was selected)
ESP	250	Soils and Land Use
ESP	260	Soil and Water Conservation Engineering
GEY	100K/101K	Volcanoes, Earthquakes, and Moving Plates and Lab
GEY	105K/106K	Ocean Planet and Lab
GEY	207	Atmosphere: Science, Climate, and Change
GEY	208	Environmental Geology
CON	216	Emergency Response
CON	252	Human Nutrition
CON	356	Concepts in Community Health
POS	363	Legal Process and the Environment

Check current catalog listing for prerequisites.

Program of Study

Before registering for the first semester of the junior year, all environmental science students must complete and submit a written program of study. Transfer students must complete a program of study upon admission to the program. The program of study is submitted to the environmental science faculty for approval. The program of study is intended to encourage students to tailor their academic studies based on their chosen concentration and personal interests. The program of study should be completed with the assistance of the advisor.

The program of study is a one-page document. The first section briefly describes the student's experience in the Department, including their concentration. The second section describes the student's interests (e.g., water resources, environmental compliance, natural resources management) and likely future goals (e.g., graduate school, law school, or professional employment). The third section describes the USM and Departmental courses (at least four of the courses must be environmental science courses at the 200 level or higher) that will support the student's current interests and future goals. A key component of this section is a brief description of a possible internship (job title and location), which is generally completed during the summer following the completion of the junior year. The final section is a timeline of the courses to be taken.

After approval, the program of study may be amended with the approval of the advisor. Any significant changes, such as course substitutions, may require Departmental approval.

Admission to the major is competitive, usually requiring grades equivalent to a B average or higher and completion of three high school laboratory science courses and advanced algebra. Transfer students and USM students wishing to change majors must meet the admission and coursework requirements for the major. The program committee may admit, on a conditional basis, students who do not meet the

general admission requirements, subject to specific agreement with the student to complete a series of prerequisite science and math courses with a grade of C (75) or better within a specified time period.

Certificate in Environmental Policy Analysis

The Department of Environmental Science offers a certificate in environmental policy analysis, designed for students and professionals in area industry, consulting, government, and non-governmental organizations. The certificate is designed to develop an individual's skills in identifying environmental policy problems, formulating policy solutions, and evaluating policies.

Candidates must apply to the chairperson of the Department of Environmental Science, be assigned an advisor, and have their course of study approved by the Department chairperson.

The certificate is awarded after the successful completion of 21 credit hours of study. The requirements for the certificate are successful completion of the following courses:

ESP	203W	Environmental Communication
ESP	220J	Environmental Policy: Pollution
ESP	375	Environmental Risk Assessment and Management
ESH	341	Environmental Regulations
ESP	421W	Natural Resource Policy

Students also must select two courses from the following:

ECO	326	Environmental Economics
ESP	475	Topics in Environmental Science/Senior Seminar
PHI	212	Environmental Ethics
POS	365	Environmental Politics and Policy
POS	375	International Environmental Politics and Policy
POS	453	Politics of American Policy Making

Soil and Wetland Certificate

This certificate program is designed to prepare individuals to be wetland delineators; site evaluators; to gain 15 credit hours in soils necessary to apply for an NRCS soil conservationist position; or to take the ARCPACS or soil certification exam.

The certificate is open to undergraduates and graduates in USM degree programs, and for environmental scientists, biologists, geologists, hydrologists, landscape architects, planners, plumbing and code enforcement officers, and engineers who would like to increase their knowledge of soils and jurisdictional wetlands.

The curriculum includes classes in soils, wetland ecology, erosion and sediment control, storm water management, and wetland delineation. A certificate will be presented to students completing the 18-hour program. Upon approval by the Department chair, up to 8 prior credits may be applied toward the certification program. A grade of C- or better is required for all courses applied toward the certification. For more information about the program please contact the chair of the Department of Environmental Science.

Course of Study

Required:

ESP	250	Soils and Land Use
ESP	255	Soil Morphology and Classification
ESP	260	Soil and Water Conservation Engineering
ESP	303	Wetland Ecology
ESP	350	Wetland Delineation

Electives:

ESP	341	Limnology
ESP	403	Bioremediation and Phytoremediation
ESP	417	Site Planning and Assessment

Certificate in Environmental Safety and Health

This certificate program is designed for supervisors responsible for environmental safety and health activities, persons having compliance responsibilities in their jobs, insurance company personnel, "jack-of-all-trades" employees in remote locations, technicians involved with these issues, and others who wish to enhance their work effectiveness and promotion options.

The certificate is awarded after the successful completion of eight courses (24 credit hours) selected from those listed below. Four of the courses should be primarily "environmental" and four should be primarily "health and safety" in nature.

ESH	331	Applied Toxicology
ESH	341	Environmental Regulations
ESH	342	Safety and Risk Management (formerly called Loss Control Management)
ESH	350	Industrial Processes and Permitting
ESP	101K	Fundamentals of Environmental Science
		or
ESP	125K	Introduction to Environmental Ecology
ESP	203W	Environmental Communication
ESP	250	Soils and Land Use
ESP	280	Research and Analytical Methods
ESP	360	Water Quality Assessment and Control
ESP	375	Environmental Risk Assessment
GEY	207	Atmospheric Science and Pollution
ITS	300	Ergonomics/Time Study
ITS	320	Occupational Safety and Health
PHI	212	Environmental Ethics

Up to four other environmental safety and health courses approved by the USM environmental science faculty may be earned at other institutions. For example, courses offered through other partners in the University of Maine System, courses offered through the Maine Community College System, or courses offered through another regionally accredited institution of higher learning.

For more information about the certificate program, contact the chair in the Department of Environmental Science.

Certificate in Environmental Education

This certificate is designed for teachers, scientists, public officials, consultants, field naturalists, environmental interpreters, and others having responsibility for educating or informing people about the environment. The certificate is awarded after the successful completion of 18 credit hours of study selected from the courses listed below. Candidates must apply to the chairperson of the Environmental Science Department, be assigned an advisor, and have their course of study approved by the Department chairperson. Up to 8 prior credits may be applied toward the certificate program.

Required:

ESP	445/	
EPB	545	Environmental Education and Interpretation
ESP	400	Internship (with an environmental education/interpretation host)

At least one of the following is required:

EPA	530	Science of Maine Forests
EPA	542	Environmental Science Concepts and Strategies for Middle School Teachers
EPB	525	Science Content for Elementary School Teachers
HRD	339	Adult Learning and Development

Choose from below to complete the credit requirements:

ESH	341	Environmental Regulations
ESP	101K	Fundamentals of Environmental Science
ESP	102K	Fundamentals of Environmental Science Laboratory
ESP	110	Introduction to Nature Tourism
ESP	125K	Introduction to Environmental Ecology
ESP	126K	Introduction to Environmental Ecology Laboratory
ESP	150	Environmental Science Field Immersion Session
ESP	203W	Environmental Communication
ESP	250	Soils and Land Use
ESP	280	Research and Analytical Methods
ESP	303	Wetlands Ecology
ESP	308	Global Environmental Problems and Sustainability
ESP	341	Limnology
ESP	411	Methods of Field Analysis
ESP	413	Forest Ecology

Minor in Environmental Science

Students who want to minor in environmental science and policy must complete 18 credits of environmental science courses with a grade of C- or higher. Students may transfer up to three (3) credits of comparable environmental science courses from other institutions. All students must complete ESP 101K, 102K, ESP 203, and collaborate with a Departmental faculty member to develop an individual course of study.

Minor in Environmental Sustainability

The Department of Environmental Science offers a 19-credit minor in environmental sustainability for students in any non-DES major. There is growing realization that the human population must strive to live in a sustainable relationship with Earth's finite resources. The goal of the minor is to provide broad, interdisciplinary training related to the problem of global environmental problems. Students in the environmental sustainability minor also examine the scientific, cultural, economic, and policy aspects of sustainability and are provided skills in how to recognize and overcome barriers to sustainability.

Required Courses

ESP 101K/ ESP 102K	Fundamentals of Environmental Science and Lab
ESP 200	Environmental Planning
ESP 308	Global Environmental Problems and Sustainability

Interdisciplinary Course (select one)

CRM 225	Crimes against the Environment
ESP/ECO 326	Environmental Economics
EYE 102	Sustainability, Culture, and the Environment
PHI 212	Environmental Ethics
POS 375	International Environmental Politics and Policies

Focused Study Courses

Select two 200-level (or above) ESP courses approved by your DES advisor (may include a research practicum, ESP 450)

All courses taken to satisfy the requirements for a minor in environmental sustainability must be completed with a cumulative GPA of at least 2.0.

Minor in Nature Tourism

The 18-credit nature tourism minor is jointly offered by the Department of Recreation and Leisure Studies, College of Nursing and Health Professions, and the Department of Environmental Science, School of Applied Science, Engineering, and Technology. For details about the minor, course requirements, and course descriptions visit the catalog section for Department of Recreation and Leisure Studies, College of Nursing and Health Professions.

ESH 221 Fire Safety

This course is an overview of fire system safety for the safety professional. Topics include the Life Safety Code, fundamentals of fire protection systems, chemical fire safety, requirements of the Occupational Safety and Health Administration concerning fire, and use of references and codes. Prerequisite: ITS or ITP 320 or permission of the instructor. Cr 3.

ESH 331 Applied Toxicology

This course introduces students pursuing careers in environmental science, engineering, and safety to the basics of organic chemistry and the basics of toxicology. Organic chemistry emphasis includes prevalence, identification, and nomenclature. Toxicology concepts include dose-response, target organs, and biological mechanisms. Principles of toxicology will be introduced using organic chemical examples as possible. Emphasis is on how to use, understand, and interpret readily available public information in the toxicology literature. Prerequisites: ESP 101K and 102K, ITP 320 or ITS 320, CHY 113K/114K or permission of the instructor. Cr 3.

ESH 332 Industrial Hygiene

This course will cover the general concepts and principles of industrial hygiene with direct application to workplace environments. Direct topic coverage will include: common health hazards, air contaminates, biological hazards, an introduction to air quality, noise, respiratory control, ventilation, hygiene sampling equipment/techniques, OSHA, and related standards. Prerequisites: Chemistry with lab (CHY 113K and 114K) or equivalent, and MAT 140D. Cr 3.

ESH 341 Environmental Regulations
This course is an intensive introduction to the federal and Maine environmental regulatory structure. This course is designed to provide basic competency in the knowledge and application in the environmental and health and safety fields. Topics include air, surface water, drinking water, worker protection, spill reporting, hazardous waste, and Superfund. Prerequisites: ESP 101K/102K and ESP 203W or permission. Cr 3.

ESH 342 Safety and Risk Management
This course is about the risk management process for industrial and commercial safety. Students will learn how to analyze the exposures to accidental losses facing individuals and organizations; describe, analyze, and apply alternative risk management techniques; and apply practical analysis of loss management. This class contains a unit on Process Safety Hazard Analysis. This course is equivalent to the prior offerings of ITS 342 Loss Control Management, and is required of environmental science students choosing the environmental safety and health option. Business majors should inquire of their advisors if this course can fulfill specific degree requirements. Prerequisites: ESP 101K/102K, CHY 113K/114K, ITP 320 or ITS 320 or instructor permission. Cr 3.

ESH 350 Industrial Processes and Permitting
This class addresses issues of industrial waste control, including manufacturing processes and resultant air pollutants, water pollutants, and hazardous waste generation. Emphasis is on environmental permitting. Prerequisites: ESP 101K/102K, CHY 113K/114K, ESH 341. Cr 3.

ESH 430 Environmental Practicum
The course places the senior-level student in the workplace for the purpose of completing his/her study of environmental principles. The opportunity to apply the materials covered in environmental policies, basic toxicology, industrial hygiene, and environmental air quality now can be put into practice. Students will be placed at various work site locations and will be assigned an environmental project within that site. To be included in the project are problem identification, hazard analysis, and problematic corrective actions. Each student practicum will be assigned a faculty advisor. Prerequisite: ES&H/advisor permission. Cr.3.

ESP 101K Fundamentals of Environmental Science
This course is an examination of the science of environmental problems, processes, and solutions. Students will explore the interrelationships of the natural world, the environment, and impacts from humans. Specific topics will include land, air, and water pollution; biodiversity; global climate change; energy; public health; and sustainability. Prerequisites: successful completion of the University's writing and mathematics proficiency requirements. Corequisite: ESP 102K. Cr 3.

ESP 102K Fundamentals of Environmental Science Laboratory
This laboratory course is designed to provide applied experience with some of the tools and techniques used in environmental science. Students will examine a variety of environmental issues using field kits, lab equipment, and computers. Prerequisites: successful completion of the University's writing and mathematics proficiency requirements. Corequisite: ESP 101K. Cr 1.

ESP 108/GEO 108 Introduction to ArcGIS
An introduction to Geographic Information Systems (GIS), stressing the practical applications of popular graphical user interface (GUI) software packages such as ArcView. Topics covered include displaying, downloading, editing, analyzing, and printing public domain and user-created geographical data sets. The main emphasis of the course is on the acquisition of system operations skills. Cr 3.

ESP 110 Introduction to Nature Tourism
This course covers the basics of nature tourism—a fast-growing, broad category that covers ecotourism and adventure tourism. An emphasis is placed on a variety of tourist activities and programs involving the outdoors in Maine and northern New England. ESP 110 is a required course for a minor in nature tourism. Cr 3.

ESP/FTY 111 Forest through Time
Basic concepts of science will be used to explain how forests have responded to natural and human influences over time. This foundation will be used to explore how a range of uses affect the future sustainability of forest systems and their ability to meet society's needs. This is a Web-based course. Cr 1.

ESP/FTY 112 Forest through Time: Discussions
Weekly discussions based on information presented in ESP/FTY 111 Forest through Time. (Course utilizes video conferencing). Prerequisite or co-requisite: ESP/FTY 111. Cr 2.

ESP 125K Introduction to Environmental Ecology
This is an introduction to the study of the interactions between organisms and their environments. Students will study the basic principles of ecology and systems and study specific ecosystems including forests, wildlife, freshwater, marine, urban, and humans. Prerequisites: successful completion of the University's writing and mathematics proficiency requirements. Prerequisites: ESP 101K/102K or BIO 105K/106K. Corequisite: ESP 126K. Cr 3.

ESP 126K Introduction to Environmental Ecology Laboratory
This laboratory course surveys the identification, measurement, and function of various ecosystems. A focus will be on the impact of human activity on ecosystems. Prerequisites: successful completion of the University's writing and mathematics proficien-

cy requirements. Prerequisites: ESP 101K/102K or BIO 105K/106K. Corequisite: ESP 125K. Cr 1.

ESP 150 Environmental Science Field Immersion Session
This field immersion session is designed to teach basic natural science field skills and build community in a long weekend format. The course includes components on forest, soil, aquatic, wildlife, and urban systems. Basic orienteering and map reading, topographical surveying, global positioning system operation, aerial photo interpretation, and dichotomous key use are emphasized. This required course is intended for students between the first and second year of the environmental science major. Students must be present for the entire immersion session. Cr 3.

ESP 200 Environmental Planning
This course introduces the central concepts of environmental planning theory and practice, including components of rural, regional, and community planning. Concepts and issues studied include planning history and regulations, natural resources inventory, spatial patterns and analysis, zoning techniques, growth management, and planning research. The course is a prerequisite for ESP 305 Community Planning Workshop. Prerequisite: ESP 101K/102K or permission. Cr 3.

ESP 203W Environmental Communication
Students study environmental communication to understand the influence of socio-economic, political, and scientific factors in the social construction of environmental problems. Topics include basic communication theory and its application to the perception and communication of risk, how communication is used to persuade/dissuade the public regarding environment problems, and how the environment is used to manipulate consumer behavior. Students also will explore the basics of social science research and its application to environmental communication. Prerequisites: ESP 101K and ESP 102K, sophomore standing, or permission. Cr 3.

ESP 220J Introduction to Environmental Policy
This course is an intensive introduction to the field of applied environmental policy. The course will focus on the policy process, including environmental problem identification, solution analysis, analysis and use of environmental policy tools, decision making, and policy implementation. Particular emphasis is given to air and water pollution and solid waste management. Prerequisites: ESP 101K and ESP 102K, sophomore standing, or permission of instructor. Cr 3.

ESP 250 Soils and Land Use
Study and description of soils as natural materials in the landscape. The course includes an examination of physical, chemical, and biological properties of soils as they affect soil-plant-water relations. Other topics include soil classification and suitability for agriculture, urban development, and contaminant remediation. Laboratory exercises include field examinations of soils and physical and chemical soil analyses. Prerequisites: ESP 101K, ESP 102K, and CHY 113K and 114K or permission. Cr 4.

ESP 260 Soil and Water Conservation Engineering
A study of the utilization, improvement, and protection of two essential resources—soil and water. Primary focus is on applying scientific and engineering principles to the problem areas of soil erosion and flood control. Students will design practical solutions to remediate these problems. Prerequisite: math proficiency. Cr 3.

ESP 280 Research and Analytical Methods
A focus on analytical and research techniques for environmental science and policy. The course is centered on the use of instrumentation and investigative research to address a thematic environmental issue. Topics include defining research problems, experiment design, measurement, sampling, and analysis. Students will complete group research projects. Prerequisites: ESP 203W and CHY 113K/114K. Cr 3.

ESP 303 Wetlands Ecology
This lecture course examines wetlands from the perspectives of science and policy. Topics will include wetland definitions, classification, and regional and national trends in habitat destruction and management. Prerequisites: ESP 101K/ESP 102K, CHY 113K/CHY 114K. Cr 3.

ESP 305 Community Planning Workshop
This course provides a practical approach to local community planning problems. Students will conduct field work to explore community decision-making processes regarding the use of natural, social and economic resources. Basic planning concepts are refined and applied to real-world problems in a collaborative manner. Prerequisites: ESP 101K, ESP 102K, and GEO 209 or ESP 200, or permission. Cr 3.

ESP 308 Global Environmental Problems and Sustainability
An examination of global environmental problems including climate change, ozone depletion, hydrologic changes, deforestation, and desertification. The latter half of the course will focus on the application of sustainability to solve these problems. Prerequisites: ESP 101K/ESP 102K, ESP 125K/ESP 126K, or permission of instructor. Cr 3.

ESP 341 Limnology
The study of inland waters with emphasis on the identification and ecology of aquatic organisms. This course meets on Fridays to allow time for extended field trips to local streams and lakes. Students will conduct independent research projects as part of the course. Prerequisites: BIO 107 or ESP 101K/ESP 102K or ESP 125K/ESP 126K, and CHY 115 or permission of instructor. Cr 5.

ESP 360 Water Quality Assessment and Control
A study of water-related legislation, methods for determining compliance with statutes, and control methods used for water quality attainment. Regional topics addressed include: waste-water treatment, drinking water standards, storm water runoff, lake eutrophication, best management practices, and biomonitoring for water quality assessment. Three hours of lecture and three hours of lab per week. Prerequisites: BIO 105K/106K and CHY 113K/114K and a statistics course or permission. Cr 4.

ESP 375 Environmental Risk Assessment and Management
The focus of this course is to provide students with an understanding of human health risk assessment as an organized, multidisciplinary approach to evaluating scientific data by studying basic toxicology and fate and transport of contaminants using generally accepted principles and terminology used in the field. Students will examine the limitations of current risk assessment methods and be introduced to the basics of public and community health. Finally, students will study the scientific, political, social, ethical, and economic dimensions of managing risks. Prerequisites: ESP 101K and 102K, ESP 203W, or permission of instructor. Cr 3.

ESP 380 Special Topics in Environmental Science
This course focuses on a topic of current interest in ecology and public policy that may vary from year to year. The goal of the course is to provide foundational knowledge as well as critical insights into a modern scientific and environmental issue of public interest. Examples include biodiversity, climate change, and ecosystem-based approaches to management. The course is based on readings of the primary scientific literature and roundtable class discussions. Prerequisite: ESP 101K or ESP 125K or BIO 105 or permission of the instructor. Cr 3.

ESP 400 Internship
The internship provides professional experience related to a student's chosen option within the major. The emphasis is on understanding the host organization's structure and function within the environmental area. In addition to satisfactory work experience, an oral presentation and written report are required. Offered as pass/fail only. Intended to be taken between the junior and senior year. Prerequisites: sophomore standing or higher, faculty approval of host organization, work plan, and completed "internship application" form. Cr 3.

ESP 401W Environmental Impact Assessment and Lab
An overview of methods used to analyze the environmental impact of human decisions. The course will emphasize U.S. requirements for impact assessment as outlined in NEPA. Federal documents (DEIS, EIA, EIS, FONSI, and ROD) filed for past and on-going projects are reviewed. A laboratory session is taken concurrently and is writing-intensive. Focus is on the application of assessment procedures to a thematic environmental issue. Prerequisite: ESP 280 or permission. Cr 4.

ESP 403 Bioremediation and Phytoremediation
A study of the interaction of soils and groundwater with organic and synthetic contaminants, and the role of soils in pollution control. Students investigate the physical, chemical, and microbiological properties of soil and water and compare conventional remediation with bioremediation techniques. Special emphasis is placed on regional pollution problems including agricultural runoff, landfill leachates, and leaking underground storage tanks. Prerequisites: ESP 101K,/ESP 102K, CHY 113K/114K, and ESP 250, or permission. Cr 3.

ESP 411 Methods of Field Analysis
This lecture/lab/field course investigates ecological issues using descriptive field techniques, hypothesis testing, computer analysis and journal article interpretation. This course is writing-intensive. Prerequisite: MAT 120D or ESP 290D. Cr 4.

ESP 412 Field Ecosystems Ecology
This course provides a fundamental understanding of ecosystem ecology, with an emphasis on forested and aquatic ecosystems and impacts of the physical and chemical environment on ecosystem functioning. The course is writing intensive and includes hypothesis generation, field research, computer analysis, and journal article interpretation and writing. The laboratory is field intensive and includes local field trips, team research exercises, and independent field research projects. Prerequisites: MAT 120D and ESP 125K/ESP 126K, or permission. Cr. 5.

ESP 413 Forest Ecology
This course provides students with an understanding of what constitutes a healthy forest ecosystem and a sustainable forest environment. Special emphasis is placed on the function, spatial variability, evolution of forest ecosystems, and the need for forest ecology as the foundation of forest management. The laboratory session is field intensive. Prerequisites: ESP 125K/126K or permission. Cr 4.

ESP 417 Site Planning and Assessment
An introduction to environmental planning and assessment concepts and skills associated with the development of sites for human use. Emphasis is given to the development of particular tracts or parcels of land in Maine. Prerequisites: ESP/GEO 108 or GEO 308 and GEO 209 or ESP 200, or permission of instructor. Cr 3.

ESP 421W Natural Resource Policy
Examination of natural resource policies and evaluation procedures used by natural resource decision makers. Case studies focus on topics such as forest health protection, the Endangered Species Act, the Maine Environmental Priorities Project, trans-

boundary ecosystems, and estuarine areas. Emphasis on natural resource policy processes, conflict resolution through consensus building, and stakeholder involvement. Prerequisites: ESP 101K/ESP 102K, ESP 220J, junior standing, or permission of instructor. Cr 3.

ESP 445 Environmental Education and Interpretation
Students explore the basics of classroom and nonformal environmental science education and interpretation using an inquiry-based approach. Topics include teaching ecosystem and environmental science principles, selecting and designing environmental curricula, and applying the Maine Learning Results to environmental education. Prerequisite: 12 credits of science or permission. Cr 3.

ESP 450 Research Practicum
Organized research experiences in ongoing faculty research projects or a mutually arranged special topic involving substantial skills development. Research will be conducted under the direct supervision of the faculty member. Permission of instructor required in semester prior to registration. May be repeated for a maximum of 6 credits. Cr 1-3.

ESP 475 Topics in Environmental Science/Senior Seminar
Topics in environmental science not regularly covered in other courses. The content will vary based on current local and regional environmental issues. The course also includes resume and cover letter writing and practice of interview skills. The course may, with permission of Department, be taken more than once. Prerequisite: ESP 401W or permission. Cr 3.

Department of Technology

Chair of the Department: William H. Moore, John Mitchell Center, Gorham
Professor: Anderson, Walker; *Associate Professors:* Marshall, Moore, Wilson, Zaner

Studies in technology focus on systems application wherein systems are composed of tools, equipment, machines and materials, methods/techniques, and people. Key to the successful implementation/application of systems are the many relationships and interactions among people, technology, and society. In these studies, technology and related concepts are presented in a manner that emphasizes a "hands on" or "applied" approach encompassing classroom interaction, laboratory activities, field experiences, engagement with local industry, and opportunities for internships/cooperative education.

Curriculum offered by the Department of Technology (DOT) provides a blend of academic, technical, and professional courses designed to prepare individuals for careers in leadership positions in business/industry. Several programs leading to a bachelor of science (B.S.) degree are offered:

B.S. Industrial Technology (INT) with concentrations in industrial management, precision manufacturing, information and communications technology, construction management, and electro-mechanical systems technology.

B.S. Applied Technical Leadership (ATL)

Each B.S. degree program is designed to meet the educational needs of students with a variety of academic backgrounds, employment experience, and career aspirations. Due to the similarities in curriculum and the rules for counting credit toward a degree program, students cannot complete both the applied technical leadership (ATL) and industrial technology (INT) degrees. Accordingly, there are two "paths of entry" into the B.S. in industrial technology program: 1) for traditional students, i.e., students who have no substantive "technically- related" college credit, or 2) for transfer students and nontraditional students, i.e., students who have completed college-level work that qualifies for transfer into USM. Nontraditional students are typically adult learners who seek some level of college credit based on a mix of prior college credit, work experience, and/or industrial training.

The B.S. in the applied technical leadership program is designed only for transfer and nontraditional students.

Industrial Technology

Industrial technologists are technically oriented management professionals who plan, direct, organize, and control industrial production and/or service delivery operations. Graduates of the degree program are prepared academically to assume leadership positions in a wide variety of organizations.

Industrial Management Concentration

This concentration is designed to prepare graduates for career leadership and management positions in a technical environment. Students in this concentration take courses intended to help students understand the many different organizational elements and functions composing industrial operations. Students completing this program will develop a broad-based, cross-sectional/functional understanding as a "generalist" management professional.

Precision Manufacturing Concentration

This concentration is designed to prepare graduates for career leadership and management positions in a computer-intensive/automated manufacturing environment. Students in this concentration take courses with specialized technical application in the area of computer-aided design/manufacturing, computer-numeric-control programming (CNC), industrial robotics, automated material handling, electronic control technology, computer-integrated manufacturing, rapid prototyping, and systems integration. This concentration is also available to nontraditional and transfer students with enough related technical experience or coursework to satisfy the technical competency requirements of the concentration or to students with an associate's degree in a metal working area. Students completing this program will develop a focused understanding of manufacturing operations as a "specialist" managerially oriented professional.

Information and Communications Technology Concentration

This concentration is designed to prepare graduates for career leadership and management positions in a computer applications-oriented environment integral to modern business and industry. Students in this concentration take courses that emphasize theory and application relating to the management and operation of computer and technical systems used for communications, information management, control technology, and publishing. Students completing this program will develop a focused understanding of computer applications-based and data/information-intensive operations. Students completing this program may elect also to complete minors in computer science or business administration.

Construction Management Concentration

This concentration is designed to prepare graduates for advancement opportunities in construction-related industries primarily as site managers, superintendents, project managers, directors of operations, and construction managers. Students in this concentration take courses that emphasize theories and applications of planning, managing, directing, organizing, and controlling construction operations. This concentration is available only to nontraditional and transfer students with enough related technical experience or coursework to satisfy the technical competency requirements of the concentration. To satisfy the technical competency requirements, nontraditional students must complete a portfolio assessment based on the state of Maine standards for secondary vocational education (construction-related trades). To satisfy the technical competency requirements, transfer students must complete a construction-related associate's degree program from a regionally accredited community or technical college (2+2 articulation agreements are currently in place with Central and Southern Maine Community Colleges).

Electro-Mechanical Systems Technology Concentration

This concentration is designed to prepare graduates for career leadership and management positions in computer-controlled/automated, equipment-intensive environments. Students in this concentration take courses that emphasize theory and application relating to the design, control, and integration of electrical, mechanical, hydraulic, and pneumatic components and assemblies. This concentration is available only to nontraditional and transfer students with enough related technical experience or coursework to satisfy the technical competency requirements of the concentration or to students with an associate's degree in an electricity/electronic related area. Students completing this program will develop a focused understanding of power and control systems utilized in industrial, environmental, construction, transportation, and military sectors.

Applied Technical Leadership (ATL)

This degree program is designed to provide career advancement opportunities for personnel employed in a variety of technically oriented career fields such as fire science, law enforcement, medical technology, business process operations, and service industries. Students eligible to enter this program are expected to have gained selected technical and managerial competencies via the completion of an associate of science degree in an appropriate field, industrial/military training, occupational experience, or through a combination of the above. Prior learning assessment and/or review of college transcripts will be the primary means for verification of competency attainment. Students in this degree program will develop the knowledge, skills, and abilities needed to advance into managerially oriented positions.

Areas of Minor Study

Three areas of study in the Department of Technology are available as minors: computer applications, industrial management, and manufacturing technology. Each minor consists of a minimum of 18 credit hours approved and monitored by a faculty advisor in the Department. The student must declare the minor. The courses used for each minor will be selected from those approved and/or required for that minor by the Department faculty. Admission to the minor will require the completion of at least 24 credits with a grade point average of 2.0. Successful completion of the minor will require a grade point average of 2.0 in the courses making up the minor.

Admission Requirements (All Programs)

Students must meet all University of Southern Maine admission requirements.

The Department of Technology has approved transfer pathways from many of Maine's community colleges. The purpose of these pathways is to allow individuals with specific associate degrees to complete a bachelor of science degree with a focus in areas such as: electro-mechanical technology, integrated manufacturing technology, machine tool technology, and metal manufacturing technology.

Programs and Requirements

All students must meet University Core curriculum requirements and additional Departmental requirements. Specific requirements for bachelor of science degree programs offered through the Department of Technology are indicated in the following tables. A minimum of 15 credit hours or 5 courses must be taken in the Department.

Industrial Technology

Bachelor of science in industrial technology (INT)

Concentrations:

- Industrial Management – 127 credits
- Precision Manufacturing – 127 credits
- Information and Communications Technology – 127 credits
- Construction Management – 130 credits
- Electro-Mechanical Systems Technology – 131 credits

Applied Technical Leadership

Bachelor of science in applied technical leadership – 121 credits

Internship

The Department of Technology, recognizing the value of integrating theory and practice through application in actual work environments, encourages internships for qualified majors. An internship provides a wide range of opportunities for applying knowledge and skills obtained in a classroom or laboratory to actual work situations.

An internship is an option that qualified students may pursue as an integral component of their degree program. It provides an opportunity to participate in a supervised program relevant to the student's major.

Permission of the instructor is needed to register for an internship.

Laboratory Fees

Laboratory fees to cover the cost of materials and supplies are assessed to ITT courses and selected ITS courses.

Bachelor of Science in Industrial Technology
with a concentration in Industrial Management
(for traditional students)
The minimum number of credits required for the degree: 127

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements – 18 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
EGN 100 Intro to Engineering
ITT 181 Intro to Computers
Physics OR Chemistry
ITT 460 Capstone
General Elective - 6 Credits
(Academic, Professional or Technical)

Professional - 36 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., and Supr.
ITP 310 Plant Layout & Material Hand.
ITP 330 Production Control
ITP 340 Fundamentals of Quality
ITP 350 Teambuilding and Facilitation
ITP 381 Human Resource Dev./Ind.
ITP 410 Technical Ops. and Strategies
ITP 490 Cost Analysis & Control
ITS 300 Ergonomics/Time Study
ITS 320 Occupational Safety and Health
ACC 110 Financial Accounting Information for Decision Making

Technical - 33 Credits
Required - 30 Credits
ITT 103 Materials Property and Testing
ITT 221 Power and Energy Processing
ITT 231 Technical Graphics
ITT 241 Graphic Communications
ITT 252 Material Processing
ITT 282 Computer Aided Design
ITT 323 Fluid Power
ITT 353 Automated Mat. Processing
ITT 425 Applied Process Control Engineering
ITT 440 Internship
Technical Electives - 3 Credits
ITT Designated Courses

Bachelor of Science in Industrial Technology
with a concentration in Industrial Management
(for nontraditional/transfer students)
The minimum number of credits required for the degree: 127

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 15 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
ITT 181 Intro to Computers
Physics OR Chemistry
ITT 460 Capstone
General Elective - 6 Credits
(Academic, Professional or Technical)

Professional - 36 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., & Supr.
ITP 310 Plant Layout & Material Hand.
ITP 330 Production Control
ITP 340 Fundamentals of Quality
ITP 350 Teambuilding and Facilitation
ITP 381 Human Resource Dev./Ind.
ITP 410 Technical Ops. and Strategies
ITP 490 Cost Analysis & Control
ITS 300 Ergonomics/Time Study
ITS 320 Occupational Safety & Health
ACC 110 Financial Accounting Information for Decision Making

Technical Required - 36 Credits
Technical Communications (9 Credits)
Technical Graphics
Graphic Communications
Computer Aided Design

Materials and Processes (9 Credits)
Materials Properties and Testing
Material Processes
Automated Material Processing

Electro-Mechanical (9 Credits)
Power and Energy Processing
Fluid Power
Applied Process Control Engineering

Advanced Automation (9 Credits)
Applied Automation Engineering
Advanced Computer Aided Design (CAM/RP)
Computer Integrated Manufacturing Systems

ITT 400 Occupational Competency
an associate's degree from an accredited institution with Department approval.

Bachelor of Science in Industrial Technology
with a concentration in Information and Communications Technology
The minimum number of credits required for the degree: 127

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics or Chemistry

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 18 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
Computer Programming
BUS 345 Information Technology/MIS Science
ITT 460 Capstone
General Elective - 6 Credits
(Academic, Professional or Technical)

Professional - 27 Credits
Required - 15 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., & Supr.
ITP 350 Teambuilding and Facilitation
ITP 381 Human Resource Dev./Ind.
ITS 300 Ergonomics/Time Study

Professional Electives - 12 credits from approved ITP courses or students completing an approved minor may use courses in their minor as professional electives if they are not required courses in the INT program or otherwise used to fulfill INT degree requirements. Courses may not be used to fulfill more than one requirement on the degree worksheet. You may satisfy the minimum number of credits by taking one of the approved minors listed below:
Computer Science
Economics
Business Administration
Information Management

Technical - 42 Credits
Required - 24 Credits
EGN 100 Intro to Engineering
ITT 181 Introduction to Computers
ITT 241 Graphic Communications
ITT 272 Intro to Computer Networking
ITT 281 Internet Web Site Dev.
ITT 282 Computer Aided Design
ITT 311 Telecommunications
ITT 343 Desktop Pub. & Design
Technical Electives - 18 Credits
ITT Designated Courses

Bachelor of Science in Industrial Technology
with a concentration in Precision Manufacturing
The minimum number of credits required for the degree: 127

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 15 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
ITT 181 Intro to Computers
Physics OR Chemistry
ITT 460 Capstone
General Elective - 9 Credits
(Academic, Professional or Technical)

Professional - 30 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., & Supr.
ITP 310 Plant Layout & Material Hand.
ITP 330 Production Control
ITP 340 Fundamentals of Quality
ITP 410 Technical Ops. and Strategies
ITP 490 Cost Analysis and Control
ITS 300 Ergonomics/Time Study
ITS 320 Occupational Safety & Health
ACC 110 Financial Accounting Information for Decision Making

Technical - 39 Credits
EGN 100 Intro to Engineering
ITT 103 Materials Property & Testing
ITT 221 Power & Energy Processing
ITT 231 Technical Graphics
ITT 252 Material Processing
ITT 282 Computer Aided Design
ITT 311 Telecommunications
ITT 323 Fluid Power
ITT 353 Automated Mat. Processing
ITT 384 Advanced CAD
ITT 425 Applied Process Control Engineering
ITT 427 Applied Automation Engineering
ITT 440 Internship

Note: This concentration is also available to nontraditional and transfer students with enough related technical experience or coursework to satisfy the technical competency requirements of the concentration or to students with an associate's degree in a metal working related area.

Bachelor of Science in Industrial Technology
with a concentration in Construction Management
(for nontraditional/transfer students)
The minimum number of credits required for the degree: 130

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 12 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
ITT 181 Intro to Computers
ACC 110 Financial Accounting
General Elective - 6-7 Credits
(Academic, Professional or Technical)

Professional - 30 Credits
ITC 100 Intro. Construction Management
ITC 341 Construction Docs I
ITC 351 Cost Estimating
ITC 432 Project Management II
ITC 442 Construction Docs II
ITP 230 Project Management I
ITP 280 Industrial Org. Mgt. & Supervision
ITS 300 Ergonomics/Time Study
ITS 320 Occupational Safety & Health
BUS 280 Legal Environment Business
ESP 260 Soil and Water Conservation Engineering

Professional ITP Electives - 3-9 Credits

Technical Electives - 35-42 Credits

Note: Completion of the construction management (CM) concentration requires a minimum of 130 credits satisfying the University, department, professional, and technical requirements. Academic course equivalency or transfer from regionally accredited construction-related associate's degree programs can only be applied to the University, department, and/or technical requirements via portfolio assessment or transfer. Students interested in the CM concentration must meet with an academic advisor regarding the suitability of credit for portfolio assessment or articulation as applied to the 130-credit requirement for graduation.

Bachelor of Science in Industrial Technology
with a concentration in Electro-Mechanical Systems Technology
The minimum number of credits required for the degree: 131

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K - Physics

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 15 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
ITT 181 Intro to Computers
ACC 110 Financial Accounting
ITT 460 Capstone
General Elective - 6 Credits
(Academic, Professional or Technical)

Professional - 18 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., & Supr.
ITP 310 Plant Layout & Material Hand.
ITP 330 Production Control
ITP 340 Fundamentals of Quality
ITS 300 Ergonomics/Time Study **or**
ITS 320 Occupational Safety & Health

Technical - 58 Credits
Required - 15 Credits
ITT 221 Power & Energy Processing
ITT 323 Fluid Power
ITT 425 Applied Process Control Engineering
ITT 427 Applied Automation Engineering
ITT 440 Internship
Technical Electives - 43 Credits
From a completed electronics related associate's degree

Bachelor of Science in Applied Technical Leadership
The minimum number of credits required for the degree: 121

University Requirements
A - Writing Proficiency
B - Math Proficiency
W - Writing-Intensive

Core Curriculum - 31 Credits
C - ENG 100C English Competency
D - MAT 140D Pre-Calculus (or above)
E - Reasoning

Fine Arts - 6 Credits (Different Depts.)
F - Performance Centered
G - History Centered

Humanities - 6 Credits (Different Prefixes)
H - Literature
I - Times Culture

Social Sciences - 6 Credits (Different Depts.)
J - Economics
J -

Natural Sciences - 4 Credits (With Lab)
K -

Writing Intensive - 3 Credits
W - ITP 210 Technical Writing

Departmental Requirements - 12 Credits
MAT 148D Applied Calculus
ITP 240 Industrial Statistics
Computer Science
General Elective - 9 Credits
(Academic, Professional or Technical)

Professional - 27 Credits
ITP 230 Project Management
ITP 280 Industrial Org., Mgt., & Supr.
ITP 340 Fundamentals of Quality
ITP 350 Teambuilding and Facilitation
ITP 381 Human Resource Dev./Ind.
ITS 300 Ergonomics/Time Study
ITS 320 Occupational Safety & Health
ACC 110 Financial Accounting Information for Decision Making
_____ Professional Elective

Tech./Occupational Specialization - 39 Credits
Occupational Assessment/Elective Courses
ITT 400 Occupational Competency (Portfolio Assessment)
ITT 440 Related Occupational Experiences/ Internships

EDU 324 Student Teaching
Full-time student teaching during the senior year is provided for one semester under direct supervision in off-campus situations for all who meet requirements. Prerequisites: successful completion of EDU 100, TCE 380, TCE 381, and HRD 200J. Cr 12.

ATE 280 Facility Organization and Management
A course in which the student will develop an understanding of the administrative principles and practices which provide for highly effective instruction in industrial, vocational, and technical classrooms and laboratories. Students will organize systems for personnel supervision and accountability; organize personnel and maintenance systems; develop and employ a safety education program in compliance with state of Maine and OSHA regulations; develop and employ an organized budget/procurement schedule; and design and implement a contemporary laboratory/workplace environment. Cr 3.

ATE 300 Occupational and Trade Analysis
Identification of occupational or trade fields, units, operations, and items of related information. Cr 3.

ATE 312 Teaching Students with Special Needs
A foundational requirement providing technical managers, career and technical education instructors, and technology educators with a fundamental understanding of the federal legislation regarding special needs, its implementation in the workplace and learning environment. Students will be aware of federal legislation and its implications in the related environment; identify and diagnose exceptional individuals; provide appropriate materials for exceptional individuals; modify working and learning environments; and monitor, assess, and advise exceptional individuals in the working and learning environment. Cr 3.

ATE 320 Coordination of Cooperative Education
The role of the coordinator in organizing and conducting a program of work-study experience in high school. Introduction to cooperative half-time training, community survey, advisory committees, laws and regulations; and examination of the responsibilities and activities of the coordinator. Cr 3.

ATE 350 Philosophy of Career and Technical Education
A survey of the history and philosophy of vocational education in the United States with emphasis upon recent developments. Cr 3.

ATE 380 Curriculum Development
A course in the identification and development of curriculum materials focusing on the techniques needed to develop units and courses of study. Students will analyze the instructional situation; develop educational goals and objectives; identify educational activities to achieve those objectives; identify evaluation activities related to the objectives; specify subject content for the course; schedule unit and course activities; and locate resources to support the instruction. Prerequisite: ATE 300. Cr 3.

ATE 381 Methods and Materials of Instruction
A course of study in which the students are introduced to the various teaching methods and techniques of professional and effective practitioners. Students will develop their own learning and teaching styles. Included in this course are the procurement/creation and utilization of contemporary instructional equipment and teaching materials. Students will evaluate, prepare, and utilize appropriate, relevant instructional materials; plan, prepare, and present lessons; promote effective student use of the learning environment; and organize objectives, develop teaching plans, and evaluate measures of learning. Cr 3.

ATE 402 Student Teaching
Full-time student teaching during the senior year is provided for one semester under direct supervision in off-campus situations for all who meet requirements. Prerequisite: satisfactory completion of professional requirements and advisor's permission. Cr 6.

ATE 411 Measurement and Evaluation
A course in educational measurement and evaluation, focusing on teacher made achievement and performance tests, and grading. Students will examine the characteristics of effective evaluation instruments and grading systems; evaluate various types of measurement instruments; develop and effectively use evaluation instruments; and create and use effective competency-based and norm-referenced grading systems. Cr 3.

ATE 420 Trends in Contemporary Career and Technical Education
Identification, analysis, and discussion of major problems and trends in vocational education. Cr 3.

ATE 450 Local Administration and Supervision of Career and Technical Education
Procedures and practices utilized in establishing, promoting, coordinating, supervising, controlling vocational programs on the local level. Cr 3.

ATE 460 Independent Study in Career and Technical Education
An opportunity to pursue independently a topic, project, or experiment of interest. Students will prepare a contract or proposal for study to be conducted and, upon completion, submit findings in a scholarly report or other evidence of completeness. Permission of advisor. Cr 3.

EGN 100 Introduction to Engineering
Engineers use mathematics and apply scientific principles to design, create, modify, and control physical systems. They communicate effectively in both written and oral forms, and work in teams as well as alone. This course introduces students to the tools, tasks, and culture of engineering. Students use spreadsheets to

solve problems and graph the results. Through class work, laboratory exercises, and independent research, students learn fundamental concepts of devices such as batteries and motors. The course culminates with a project in which student teams design, build, test, demonstrate, and document a device, utilizing the knowledge and skills acquired in the early part of the course. Lecture 1 hr., Lab 3 hrs. Cr 3.

ITC 100 Introduction to Construction Management
This course is the first course in the construction management program and will introduce students to construction management. Topics include: the scope of the construction industry, the scope of management activities, the bidding process, contracts, project stages, cost estimating, administration, operations and site management, project planning and scheduling, project monitoring, construction safety and health, and personal and company equipment. Cr 3.

ITC 341 Construction Documents I
This course will present the value and importance of how construction documents define the rights of, responsibilities of, and relationships among all the parties that are necessary for the successful completion of any project. The architect/engineer (A/E), the contractor(s), and all other project participants must work within guidelines for a successful project conception through design and construction to facility management. Investigation into various documents, agreements, and conditions of contracts will be addressed. The importance of standardized document format will be emphasized. Prerequisite: ITC 100 or instructor permission. Cr 3.

ITC 351 Cost Estimating
This course will train students to estimate the costs of various construction activities. Emphasis will be placed on the theory and application of the primary concepts used in the analysis and control of costs pertaining to planning, development, and managing construction operations. The major themes of the budget estimating process; the bid contract estimating process; the negotiated contract estimating process; and advanced estimating techniques will be covered in the course. Spreadsheets and commercial estimating applications will be used. Prerequisite: ITC 100 or instructor permission. Cr 3.

ITC 432 Project Management II
This course focuses on construction project scheduling and control using contemporary computer applications. Topics covered include: activity and resource scheduling, schedule updating and control, project resource management, contract management, cost management, contractor integration, and change management. Prerequisites: ITC 100 and ITP 230. Cr 3.

ITC 442 Construction Documents II
This course will consist of a continuation of the Construction Documents I course with emphasis on standards developed by professional associations, such as American Institute of Architects (AIA), Engineers Joint Contract Documents Committee (EJCDC), and the Design-Build Institute of America (DBIA) which have developed standardized documents detailing the necessary information for the completion of a project. The major portion of this course will consist of investigation of, discussion of importance of, and sample project development using: procurement requirements, contracting requirements, specifications, contract drawings, and resource. Actual construction examples will be used. Prerequisites: ITC 100 and ITC 341. Cr 3.

ITP 210 Technical Writing
A basic study of techniques used in technical fields to communicate in writing. Study includes document purpose, situation analysis, style, format and production of reports, proposals, procedure sheets, technical descriptions, forms, letters, memos, and visual aids. Prerequisite: USM English and writing proficiency requirements must have been met. Prerequisite: ENG 100C English Composition or equivalent. Cr 3.

ITP 230 Project Management
This course will present a structured analysis of planning, organizing, directing, controlling, and monitoring resources related to completing a set of well-defined tasks. In this course, significant effort will be devoted to understanding the relationship between technology and human resources, and the demands placed on both as they interact. Also covered will be use of computer-based tools in the management of projects. Cr 3.

ITP 240 Industrial Statistics
This course will cover the theory and application of basic descriptive and inferential statistics used in industrial environments. Course topics include various distributions, probability, measure of location and dispersion, point estimates and confidence intervals, hypothesis testing, simple linear and multiple regression, and correlation analyses. Prerequisites: MAT 108 and computer spreadsheet proficiency. Cr 3.

ITP 280 Industrial Organization, Management, and Supervision
An introduction to industrial organization and management. A study of the common elements of industry as it relates to the areas of research and development; industrial relations; production; financial control; marketing; and labor. Management and supervisory theory and practices will be highlighted. Emphasis will also be placed upon contemporary issues/problems/trends associated with a global economy. Cr 3.

ITP 310 Plant Layout and Material Handling
A study of facility and workplace design. Emphasis will be on efficient layout and material flow through manufacturing, warehousing, and service facilities with attention given to the resulting impacts on product and process quality and environmental factors. Cr 3.

ITP 330 Production Control
Lectures, discussions, and problems dealing with the principles and practices of production and inventory control. Study includes information flow, forecasting, scheduling, capacity planning, material requirements planning, shop floor control, economic order quantities, order point analysis, ABC analysis, line balancing, project scheduling and just-in-time techniques. Prerequisite: basic math competency. Cr 3.

ITP 340 Fundamentals of Quality
An overview addressing fundamental concepts and principles of quality control applied to manufacturing and service sector industries. Major topics include theory and application of qualitative and quantitative tools and techniques as well as quality awards and standards. Specific topics include foundations of quality, planning tools, traditional tools, variability, process set-up verification, pre-control, SPC process capability analysis, acceptance sampling, and quality awards. The methodology, materials, and processes associated with solving problems, and working in teams to improve quality will be the primary focus of the course. Prerequisite: math proficiency or instructor permission. Cr 3.

ITP 350 Teambuilding and Facilitation
This course will expose students to a variety of topics related to teambuilding, conflict resolution, and the facilitation of meetings. Teambuilding topics include team types and functions, roles, and responsibilities of team members, stages of team development, and common team dynamics. Conflict resolution topics include acknowledging that conflicts will arise in personal and professional settings, understanding the positive and negative roles and manifestations of conflict, techniques for embracing conflict, establishing boundaries for conflict in professional settings and meetings, and setting standards for professional and ethical responsibility when conflicts arise. Meeting facilitation topics include understanding the role of a meeting facilitator, identifying and understanding behavior and participation during meetings, meeting preparation, and meeting documentation. Cr 3.

ITP 381 Human Resource Development in Industry
An introduction to the development of human resources in industrial settings. Students are introduced to the organizational environment and the various functions of human resource management. Topics covered include human resource developments and requirements, training and development, compensation management, job analysis and classification, employee management relations, and other pertinent functions. Students become involved in career development for possible preparation of a portfolio of their prior learning and work experience. Cr 3.

ITP 410 Technical Operations and Strategies
This course will focus on the theory and application of concepts utilized to maintain global manufacturing competitiveness. Major topics include lean manufacturing, kanban, autonomation, visual signaling, pokayoke, takt time, and kaizan techniques. Waste elimination, set-up time reduction, and continuous improvement theory and practices will be highlighted. Prerequisite: ITP 310 or instructor permission. Cr 3.

ITP 441 Statistical Quality Control
This course will focus on statistical applications in quality. Major topics include distributions of data, probability and reliability, process set-up verification, pre-control, statistical process control for variables and attributes, process capability analysis, measurement systems analysis, acceptance sampling for variables and attributes, and common applications of statistically based experiment designs. Software will be used to help students understand underlying theory, develop a sound methodology, and collect and analyze data. Prerequisites: ITP 240, ITP 340, computer spreadsheet proficiency, or instructor permission. Cr 3.

ITP 490 Cost Analysis and Control
This course will cover the theory and application of concepts used in analysis and control of costs pertaining to planning, developing, and managing industrial operations. Concepts include financial/cost accounting, time value of money, methods of evaluating competing alternatives, economic value-added analysis, and capital equipment cost justification. Prerequisite: ACC 110 and MAT 108 or instructor permission. Cr 3.

ITS 300 Ergonomics/Time Study
A study of the bio-mechanics of the human body and how it interacts with a workplace while performing human activity. Surface electromyography measurements techniques are employed along with lifting analysis software, to measure stress on the body, with the effort to eliminate cumulative trauma disorders. Time study measurement techniques are employed in the development of time standard so one will be able to predict productivity. Prerequisite: basic math concepts or instructor permission. Cr 3.

ITS 320 Occupational Safety and Health
This introductory course provides input into the importance of safety and health in the workplace. Emphasis will be placed on the worker, his or her work environment including such special emphasis as OSHA and other regulatory agencies, hygiene, hazard identification, machine safeguarding, hazardous waste, loss control, and other major concern areas. The course includes the necessary topic areas required by OSHA's 30 hour card program. Upon satisfactory completion of this course, the student will receive the OSHA 30 hour card which is directly issued through OSHA's training unit. Cr 3.

ITS 321 Workplace Design Ergonomics
This course has been developed to educate the student in the use of ergonomic principles as they apply to the design/redesign of workstations as they exist

in all types of working environments. Work analysis in the field, reporting, and presentation of redesigned ergonomic changes are a major requirement. State-of-the-art surface electromyography techniques and lifting analysis equipment will be used in both laboratory and field applications. Prerequisite: ITP 300 or ITS 300, or instructor permission. Cr 3.

ITS 420 Ergonomic Practicum
This course places the senior level student in the workplace for the purpose of completing his/her study of ergonomic principles. The opportunity to apply the materials covered in ergonomics/time study and workplace design ergonomics now can be put into practice. Students will be placed at various work site locations and will be assigned an ergonomic project within each site. To be included in the project are problem identification, hazard analysis, and problematic corrective actions. Each student practicum will be assigned a faculty advisor. Prerequisite: ES&H/advisor permission. Cr 3.

ITT 103 Materials Properties and Testing
A study of the basic properties of industrial materials, their structures, and testing procedures used to determine those properties. Studies include physical, mechanical, optical, chemical, thermal, and electrical properties. Testing, associated literature research, reporting procedures, calculation, and measurement are also included. Cr 3.

ITT 181 Introduction to Computers
An introduction to current and emerging computer applications. The course includes an overview of basic computer hardware and operating system, file management, and general application software. Emphasis is on computer terms, concepts, and the integration of activities, including operating system functions, word processing, spreadsheets, databases, graphics, and communication. Lecture and lab. Cr 3.

ITT 221 Power and Energy Processing
A technical investigation into energy converters and transactional power systems. Course emphasis is on mechanical and electrical power transmission systems and their applications to modern technology and industrial equipment. Cr 3.

ITT 231 Technical Graphics
A basic course in technical graphics focusing on technical sketching and mechanical drawing. Content includes basic skill development using contemporary industrial standards, technical sketching, orthographic projection, detail and assembly working drawings, and pictorial projections. This course is normally taken before ITT 282 Computer Aided Design. Cr 3.

ITT 241 Graphic Communications
This course is a comprehensive survey of common reproduction systems having significance in graphic communications industries. It emphasizes overall workflow and the use of contemporary processes, equipment, and materials as they apply to graphic reproduction planning and design; preparation assembly; conversion; reproduction; distribution, transmission, and transfer; and storage and retrieval, including computer-based tools. Lecture and lab. Prerequisite: ITT 181, computer proficiency, or instructor permission. Cr 3.

ITT 252 Material Processing
A laboratory course consisting of the study of materials processing using non-automated hand and machine tools. Multiple materials will be incorporated into the production of selected products. The course will focus on tool use and safety. Prerequisite: ITT 103 or instructor permission. Cr 3.

ITT 270 Introduction to Computer Hardware
The goal of this course is to introduce the hardware components, and their respective functions, of microcomputer systems. Activities address the specification, assembly, upgrading, and maintenance of microcomputers. Assignments may include readings of articles and Web-based documents, discussions, tours, and hands-on activities dealing with microcomputer hardware. A basic proficiency with personal computers is assumed. Cr 3.

ITT 272 Introduction to Computer Networking
The goal of this course is to develop an understanding of computer networks and provide basic background necessary for their construction and maintenance. It consists of readings, discussions, tours, and hands-on activities dealing with the structure, hardware, software, and protocols that make up computer networks. Prerequisite: ITT 181 or instructor permission. Cr 3.

ITT 281 Internet Web Site Development
This course develops a basic understanding of and skill in the design, development, and maintenance of Web sites. Topics include Internet fundamentals, Web site design methods, HTML, cascading style sheets, HTML editors, FTP, site maintenance, intellectual property issues, and working with clients. Students will develop sample Web and associated design documents, and maintain a Web site on a server. It is assumed that students will have a working knowledge of personal computers. Cr 3.

ITT 282 Computer-Aided Design
An introduction to computer-aided design systems and their relationship to design, drafting, production, and documentation processes. Emphasis is on understanding and utilizing computer-aided design (CAD) hardware and software. The course focuses on basic 2D and 3D functions as they generally apply to computer-aided design applications. Lecture and lab. Prerequisites: computer proficiency and interpretation of technical drawings. Prerequisite: ITT 181 or instructor permission. Cr 3.

ITT 311 Telecommunications
An introduction to contemporary telecommunications hardware and applications. Emphasis includes

state-of-the-art transmission media such as copper, fiber-optic, and wireless technologies including microwave, radio frequency, and infrared. Additional topics may include: classification of data networks; communications systems parameters such as bandwidth, serial parallel, analog and digital; modulation and multiplexing schemes; and the convergence of data, video, and voice networks. Prerequisite: ITT 181 or instructor permission. Cr 3.

ITT 323 Fluid Power
A study of fluids at work. Investigation of the theory and application of hydraulics and pneumatics in technology and industry. Design, purpose, construction, and maintenance of fluid power devices and systems included. Cr 3.

ITT 342 Graphic Communications and Publishing
A study of publishing technologies with an emphasis on print production workflow. Laboratory experiences include design, copy preparation, photographic and electronic conversion, assembly and imposition, image carrier preparation, and production processes. Emphasis is on digital workflow in copy preparation; line and halftone conversion; and spot and process color separation. Lecture and lab. Prerequisite: ITT 241 or instructor permission. Cr 3.

ITT 343 Desktop Publishing and Design
An introduction to the principles of copy preparation and development for image display and reproduction using multiple media. Emphasis is on computer-based desktop publishing hardware and software. Activities include scanning, digital photography, illustration, and preparation of production specifications. Prerequisite: ITT 241 or instructor permission. Cr 3.

ITT 344 Digital Audio and Video Technology
An introduction to audio and video digital technology. This hands-on course looks at the basic concepts involved in acquisition, editing, and distribution of digital content. Emphasis is on understanding the basic concepts using available camcorders and non-linear editing software. Students will be assigned outside-the-classroom video projects. Prerequisite: ITT 181, equivalent, or instructor permission. Cr 3.

ITT 353 Automated Material Processing
This course is designed to provide students with basic understanding of how the computer is employed in the control of machine tools used in today's modern industry to automatically process materials. Emphasis will be placed on the basics of computer numerical control machining (CNC), practical approaches to industrial material selection, machining speeds and feeds as they pertain to different industrial materials, and programming of machine tools and their respective communication control languages. In addition, computer-aided design software will be used to generate programming codes to DNC to the machining centers to produce parts. Prerequisite: ITT 252, ITT 282, or instructor permission. Cr 3.

ITT 362 Construction/Transportation Technology
This course will concentrate on construction and transportation systems and technology in an historical, present-day, and futuristic context. Emphasis will be placed on the study of construction projects in a residential, commercial, and super structure setting; and, on transportation devices and systems in a land, air, water, and space environment. This will be a laboratory-based course. Cr 3.

ITT 373 Intermediate Computer Networking
The goal of this course is to build upon and further the understanding of computer networks. Activities address the detailed construction, upgrade designs, and maintenance of both large and small networks. Assignments may include readings of articles and Web-based documents, discussions, tours, and hands-on activities dealing with structure, hardware, software, security, and protocols that make up modern computer networks. Prerequisite: ITT 272 (or ITT/TCE 370) or instructor permission. Cr 3.

ITT 376 Network Security and Ethics
This course examines the issues of network security from the perspective of both liabilities and the policies that face network administrators and network security officers. Interrelated with the issues of network security are the ethical responsibilities of those who manage computer networks. Topics addressed in this course will include practical approaches to securing networks using risk analysis, cost effective counter measures, layered defenses, policy development, and implementation procedures. Prerequisite: ITT 272 or instructor permission. Cr 3.

ITT 382 Advanced Web Site Development
This course develops an understanding of techniques that go beyond basic HTML to develop dynamic Web sites. Topics include a review of xhtml and cascading style sheets, server-side programming, writing to and reading from files and databases, site design, and coding standards. Students are expected to be proficient with HTML, HTML editors, JPEG and GIF image manipulation, FTP, and basic Web site maintenance. Some programming experience is desirable. Prerequisite: ITT 281, equivalent, or instructor permission. Cr 3.

ITT 384 Advanced Computer-Aided Design
An advanced computer-aided design course focusing on three-dimensional modeling, image rendering, and animation. Emphasis is on understanding and utilizing current and emerging computer-aided and design hardware and software to present designs, products, and processes effectively. The course emphasizes basic concepts of three-dimensional model creation and use. Prerequisite: ITT 282 or instructor permission. Cr 3.

ITT 400 Occupational Competency

This course is designed to allow credit for technical expertise learned on the job or through attendance at appropriate/related schools, workshops, and/or seminars. The student's technical knowledge and skill must be documented through the University's portfolio assessment procedures. Program Option II majors only. See advisor for further information. Cr 1-39.

ITT 425 Applied Process Control Engineering
A study of the fundamental concepts, devices, and applications of electronic components and controllers utilized in industrial process control. Laboratory sessions focus on instrumentation, programming, downloading, and wiring discrete input/output devices to programmable logic controllers. Prerequisites: ITT 181, ITT 221, ITT 323 or instructor permission. Cr 3.

ITT 427 Applied Automation Engineering
An investigation into the technology, nomenclature, and applications of robotic and automated material handling systems. Emphasis includes system components, communications integration, programming, and feedback devices. Prerequisites: ITT 221, ITT 252, ITT 323, ITT 425 or instructor permission. Cr 3.

ITT 440 Related Occupational Experiences/Internships
This experience is designed to advance technical and supervisory skills during employment with a business or industry. Interested students must meet with the internship coordinator prior to the job search process, and the hosting firm must be approved by the coordinator prior to course registration. Securing suitable employment is the student's responsibility. Formal assignments will be discussed during weekly seminars. Contact the internship coordinator for additional information. Health insurance is required of students in this course. Prerequisite: instructor permission. Cr 1-3.

ITT 441 Advanced Occupational Experiences/Internships
This second-level course is a continuation of the occupational/internship experience in ITT 440. It is designed to further advance technical and supervisory skills during employment with a business or industry. Interested students must meet with the internship coordinator prior to the job search process, and the hosting firm must be approved by the coordinator prior to course registration. Securing suitable employment is the student's responsibility. Formal assignments will be discussed during weekly seminars. Contact the internship coordinator for additional information. Health insurance is required of students in this course. Prerequisites: ITT 440 and instructor permission. Cr 1-3.

ITT 452 Metallurgy and Metrology
A study of the properties of metals and how they are altered to meet industrial requirements. Measurements and testing of these properties along with inspection techniques and heat treatment activities will be performed. Individual and group activities will be conducted. Prerequisite: ITT 103, ITT 252, or instructor permission. Cr 3.

ITT 460 Capstone
This course integrates curriculum content from several upper-division courses to create a capstone experience involving the management of technical systems. Students will develop an understanding of the issues related to integrating components and equipment into an operational system. Major areas of the course include linkages among system components. An additional component of the course will be a problem-solving activity employing many of the technologies available in the Department's laboratories. Lecture and lab. Prerequisite: senior-level course and instructor permission. Cr 3.

ITT 490 Special Problems in Technology
Provides upper-level students an opportunity to pursue independently a topic, project, or experiment of interest. Students will prepare a contract or proposal for study to be conducted and, upon completion, submit findings in a scholarly report or other evidence of merit. Prerequisite: instructor permission. Cr variable.

TCE 383 Technology Education Practicum I
This is the initial practicum for students preparing to be technology teachers. In this course, students develop and participate in units of study similar to those they will be expected to teach in junior/middle and senior high schools. Units in this practicum are in the areas of construction, production, and transportation technologies. Prerequisite: advisor and instructor permission. Cr 3.

TCE 483 Technology Education Practicum II
This is the second practicum for students preparing to be technology teachers. In this course, students develop and participate in units of study similar to those they will be expected to teach in junior/middle and senior high schools. Units in this practicum are in the areas of information/communications systems, energy/power systems, agriculture and related biotechnologies, and medical technologies. Prerequisite: advisor and instructor permission. Cr 3.