

**Master of Arts in Industrial Technology**  
**Master of Arts in Technology Education**  
**Department of Technology**  
**The College of Fine and Applied Arts**

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The Department of Technology offers courses in a variety of technical areas, including appropriate technology, building science, industrial design, furniture studies, graphic arts and imaging technology, interior design, technical photography, technology education, and trade and industrial education. Students in the graduate program have the opportunity to develop prerequisite and advanced technical skills in relation to specific concentration areas. Emphasis at the graduate level includes leadership, research, and human relations skill development. A team-based, problem-solving approach to course work and research is stressed. Practical experiences from industry and/or education are integrated into the core courses. The program's aim is to foster philosophies for lifelong learning and skills for being effective in environments involving continual change. Graduates of the Department of Technology are prepared for careers in fields such as industrial training, building science management, technical sales, print production management, secondary school teaching, community college teaching, or for continuing education at the doctoral level.

The Technology Department offers the following graduate degree programs:

Master of Arts in Industrial Technology (Major Code: 532A/15.0612) Thesis Option.

Master of Arts in Industrial Technology (Major Code: 538\*/15.0612) with four concentrations:

Appropriate Technology (538C)

Building Science (538D)

Graphic Arts and Imaging Technology (538E)

Technical Communications (538H)

Master of Arts in Technology Education (Major Code: 546\*/13.1309) with two concentrations:

Community College Teaching (546B)

Secondary School Teaching (546S)[T]

Courses in the following disciplines are offered through the Department of Technology:

GRA: graphic arts and imaging technology courses

IND: industrial design courses

TEC: technology courses

In addition, the Technology programs include coursework offered by other departments as follows:

CI: curriculum and instruction courses (see the Curriculum Specialist program for course descriptions)

FDN: foundations of education courses (see the School Administration program for course descriptions)

HE: higher education courses (see the Higher Education program for course descriptions)

PSY: psychology courses (see the General Experimental Psychology program for course descriptions)

RES: educational research courses (see the School Administration program for course descriptions)

The Technology Education Master of Arts curriculum includes knowledge, concepts, and experiences that help the student interpret and manage the requirements of education in a technological society. Emphasis at the graduate level includes instructional leadership and human relations skill development. A team-based problem-solving approach to course work and research is stressed. Field-based experiences in education are integrated into required courses. The program's aim is to assist candidates in becoming teacher-leaders who can help bring about school improvement and increased student learning.

**NOTES FOR MA DEGREE STUDENTS**

- A. Requirements for admission to candidacy: Satisfactory completion of FDN 5000 or TEC 5000; Completion of 8 s.h. of graduate course work with at least a 3.0 GPA; Completion of an approved Program of Study, which is filed with the graduate coordinator; Students pursuing the Master of Arts in Technology Education with a concentration in Secondary School Teaching (546S)[T] must complete all requirements for licensure prior to completing the degree program.
- B. Independent study courses are not to be taken before admission to candidacy is completed.

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**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN INDUSTRIAL TECHNOLOGY (THESIS OPTION)**  
**(Major Code: 532A/15.0612)**

**Admission Requirements:** Baccalaureate degree from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

**Basic Criteria for Consideration:** (Undergraduate GPA from last 60 hours X 400) + GRE V + GRE Q = 2000  
 Applicants who have work experience but who do not meet the above criteria may be eligible for admission after an evaluation of the following: Interview; Work experience; Written statement of goals

**Hours:** 30 semester hours

**Location:** On Campus

**Required Courses:**

TEC	5000	Research in Technology .....	3
TEC	5119	Industrial Leadership, Organization, and Communication .....	3
TEC	5129	Project Management .....	3
TEC	5139	Technology and Culture.....	3
TEC	5670	Seminar .....	0
TEC	5809	Research and Development in Technical Areas .....	3
TEC	5909	Computer Uses for Industrial Research and Development.....	3
TEC	5999	Thesis.....	2-4
<b>REQUIRED HOURS .....</b>			<b>20-22</b>

**Approved Electives (5000 level or above):** (8-10 s.h.)

(To be selected in consultation with the student's graduate committee.)

**ELECTIVE HOURS .....** 8-10

**TOTAL HOURS FOR THE MA DEGREE .....** 30

**Thesis:** Required

**Proficiency:** None required

**Comprehensive:** Thesis Proposal (end of first year) and Thesis Defense. Students in this major will select their thesis committee and defend their thesis proposal in a scheduled meeting. During the last one-third of the program and at least 14 calendar days prior to the last day of classes for the semester, there will be an oral defense of the thesis. Students writing a thesis should follow the guidelines and deadlines developed by the Graduate School in the THESIS HANDBOOK, as well as departmental guidelines.

**Product of Learning:** None required

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**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN INDUSTRIAL TECHNOLOGY (NON-THESIS OPTION) (Major Code: 538\*/15.0612)**

**Admission Requirements:** Baccalaureate degree from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

**Basic Criteria for Consideration:** (Undergraduate GPA from last 60 hours X 400) + GRE V + GRE Q = 2000  
Applicants who have work experience but who do not meet the above criteria may be eligible for admission after an evaluation of the following: Interview; Work experience; Written statement of goals

**Hours:** 36 semester hours

**Location:** On Campus

**Required Courses:**

TEC	5000	Research in Technology.....	3
TEC	5119	Industrial Leadership, Organization, and Communication.....	3
TEC	5129	Project Management.....	3
TEC	5139	Technology and Culture.....	3
TEC	5670	Seminar.....	0
TEC	5809	Research and Development in Technical Areas.....	3
TEC	5909	Computer Uses for Industrial Research and Development.....	3
<b>REQUIRED HOURS .....</b>			<b>18</b>

**Concentration Course Requirements: (9-12 s.h.) .....** 9-12

Each program of study will include 9-12 s.h. of course work (5000 level or above) selected from the specified list of courses for each of the following concentrations:

- Appropriate Technology (538C),
- Building Science (538D),
- Graphic Arts and Imaging Technology (538E), and
- Technical Communications (538H).

(See the Graduate Coordinator in the Department of Technology for the specified lists.)

**Approved Electives:** (6-9 s.h. of 5000 level coursework chosen in consultation with an advisor)..... 6-9

**TOTAL HOURS FOR THE MA DEGREE .....** 36

**Thesis:** None required

**Proficiency:** None required

**Comprehensive:** Core exam (end of first year) and Oral Presentation for Technical Competencies - Students selecting the non-thesis option will have a written and oral exam covering information from the core classes. During the last one-third of the program and at least 14 calendar days prior to the date the candidate receives the degree, there will be an oral presentation of technical competencies to the program committee.

**Product of Learning:** None required

**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN TECHNOLOGY EDUCATION WITH A CONCENTRATION IN COMMUNITY COLLEGE TEACHING (Major Code: 546\*/13.1309; Concentration Code: 546B)**

**Admission Requirements:** Baccalaureate degree from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

**Basic Criteria for Consideration:** (Undergraduate GPA from last 60 hours X 400) + GRE V + GRE Q = 2000  
Applicants who have work experience but who do not meet the above criteria may be eligible for admission after an evaluation of the following: Interview; Work experience; Written statement of goals

**Hours:** 30 semester hours with thesis; 36 without thesis

**Location:** On Campus

**Required Courses:**

TEC	5119	Industrial Leadership, Organization, and Communication .....	3
TEC	5129	Project Management .....	3
TEC	5139	Technology and Culture.....	3
TEC	5670	Seminar .....	0
TEC	5809	Research and Development in Technical Areas .....	3
TEC	5909	Computer Uses for Industrial Research and Development.....	3
Choose one of the following courses.....			3
	RES 5000	Research Methods (3 s.h.)	
	TEC 5000	Research in Technology (3 s.h.)	
<b>REQUIRED HOURS</b> .....			<b>18</b>

**Professional Education Requirements:**

HE	5630	The Adult Learner.....	3
Choose at least one of the following courses.....			3-6
	HE 5440	Instruction in Postsecondary Institutions (3 s.h.)	
	HE 5420	The Community College (3 s.h.)	
	HE 5810	Planning Educational Programs (3 s.h.)	
	HE 6090	Seminar in Developmental Education (3 s.h.)	
<b>PROFESSIONAL EDUCATION HOURS</b> .....			<b>6-9</b>

**Thesis Options: (CHOOSE ONE)**

**WITH THESIS**

TEC	5999	Thesis.....	3
Approved Elective (5000 level or above) .....			0-3
(To be selected by the student in consultation with her/his graduate committee.)			

**WITHOUT THESIS**

Approved Electives (5000 level or above) .....			9-12
(To be selected by the student in consultation with her/his graduate committee.)			

**THESIS OPTION HOURS** ..... 3-12

**TOTAL HOURS FOR THE MA DEGREE** ..... **30 (with thesis)**  
**or 36 (without thesis)**

**Thesis:** Optional

**Proficiency:** None required

**Comprehensive**

- **Thesis Option:** Students selecting the thesis option will select their thesis committee and defend their thesis proposal in a scheduled meeting. During the last one-third of the program and at least 14 calendar days prior to the last day of classes for the semester, there will be an oral defense of the thesis.
- **Non-Thesis Option:** Students selecting the non-thesis option will have a written and oral exam covering information from the core classes. During the last one-third of the program and at least 14 calendar days prior to the date of graduation, there will be an oral presentation of technical competencies to the program committee.

**Product of Learning:** None required

**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN TECHNOLOGY EDUCATION WITH A CONCENTRATION IN SECONDARY SCHOOL TEACHING (Major Code: 546\*/13.1309; Concentration Code: 546S[T])+**

**+Advanced Licensure:** Requirements for this degree were designed, and have been approved by the appropriate bodies at the state level, to meet the advanced competencies as mandated in the North Carolina Excellent Schools Act for Master-level teacher education programs.

**Admission Requirements:** Baccalaureate degree from an accredited college or university; eligibility to hold NC "A" teacher licensure; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

**Basic Criteria for Consideration:** (Undergraduate GPA from last 60 hours X 400) + GRE V + GRE Q = 2000  
Applicants who have work experience but who do not meet the above criteria may be eligible for admission after an evaluation of the following: Interview; Work experience; Written statement of goals

**Hours:** 36 semester hours

**Location:** On Campus

**Research Requirements:**

TEC	5809	Research and Development in Technical Areas .....	3
Choose one of the following courses .....			3
	RES 5000	Research Methods (3 s.h.)	
	TEC 5000	Research in Technology (3 s.h.)	
<b>REQUIRED HOURS .....</b>			<b>6</b>

**Professional Education Requirements:**

CI/SPE	5045	Advanced Topics in Diversity.. .....	3
RES	5560	Classroom Assessment.....	3
PSY	5555	Advanced Educational Psychology.....	3
<b>PROFESSIONAL EDUCATION HOURS .....</b>			<b>9</b>

**Technology Requirements:**

TEC	5139	Technology and Culture .....	3
TEC	5670	Seminar .....	0
Choose one of the following courses .....			3
	TEC 5909	Computer Uses for Industrial Research and Development (3 s.h.)	
	CI 5630	Instructional Technology (3 s.h.)	
TEC or CI Electives.....			12
(Must be at the 5000 level or above and chosen with the graduate advisor's approval)			
<b>TECHNOLOGY HOURS .....</b>			<b>18</b>

**Thesis Options: (CHOOSE ONE)**

**WITH THESIS**

TEC	5999	Thesis (must meet Product of Learning requirements).....	3
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**WITHOUT THESIS**

TEC	5525	Product of Learning .....	3
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(To be selected by the student in consultation with her/his graduate committee.)

**THESIS OPTION HOURS .....** 3

**TOTAL HOURS FOR THE MA DEGREE .....** 36

**Thesis:** An optional part of the Product of Learning

**Proficiency:** None required

**Comprehensive:**

- **for the Thesis Option:** Students selecting the thesis option will select their thesis committee and defend their thesis proposal in a scheduled meeting. During the last one-third of the program and at least 14 calendar days prior to the last day of classes for the semester, there will be an oral defense of the thesis.
- **for the Non-Thesis Option:** Students selecting the non-thesis option will have a written exam covering information from the core classes. During the last one-third of the program and at least 14 calendar days prior to graduation, there will be an oral presentation of the product of learning to the program committee.

**Product of Learning:** Required (may include thesis)

**GRADUATE COURSES IN GRAPHIC ARTS AND IMAGING TECHNOLOGY (GRA)**

**GRA 5512. Advanced Electronic Imaging/Cross Media/(3).F;S.** This course addresses advanced concepts and practices pertaining to digital electronic imaging. To include: advanced techniques such as color management, image adjustment, scanning, color correction, masking, edge selection, and special effects, as well as an in-depth application of problem-solving analysis in creating effective image compositions. Lecture two hours, laboratory two hours. Prerequisite: GRA 3102 (Electronic Imaging). [Dual-listed with GRA 4512.]

**GRA 5522. Advanced 3D Imaging and Animation/(3).S.** This course focuses on using advanced texturing techniques, complex shading networks, inverse kinematics and forward kinematics to develop realistic 3D images and animation. Lecture two hours, laboratory two hours. Prerequisite: GRA 3312 (3D Imaging and Animation). [Dual-listed with GRA 4522.]

**GRA 5558. Digital Printing and Publishing/(3).F;S.** This course allows students the opportunity to explore digital printing applications such as short-run color and variable data printing. Students will study digital workflows, file preparation, data management, preflighting, digital front-end systems, press operation and routine maintenance, as well as an in-depth application of problem-solving analysis in managing variable data and multiple projects. Lecture two hours, laboratory two hours. Prerequisite: GRA 3102 (Electronic Imaging). [Dual-listed with GRA 4558.]

**GRA 5566. Advanced Flexographic Printing Methods/(3).S.** This course addresses advanced concepts and practices pertaining to the flexographic printing process. To include: advanced techniques such as multi-color spot and process color printing, quality control, corrugated board, image distortion, die calculations, and coatings. Lecture two hours, laboratory two hours. Prerequisites: GRA 1222 (Introduction to Flexography) and GRA 3102 (Electronic Imaging). [Dual-listed with GRA 4566.]

**GRA 5591. Advanced Offset Printing Methods/(3).F.** This course is designed to build on the basics covered in Graphic Communications I, Graphic Communications II, Electronic Prepress, and Electronic Imaging. Students will gain experience in advanced techniques in electronic prepress, halftones, duotones, process color, process stripping and process press work. Lecture two hours, laboratory two hours. Prerequisites: GRA 3012 (Graphic Communications II) and GRA 3102 (Electronic Imaging). [Dual-listed with GRA 4591.]

**GRA 5622. Current Trends in Graphic Communications Seminar/(1).F;S.** This course is designed to emphasize current trends, technical movements and problems as they relate to the future of the printing industry. Classes will focus on group discussions related to these and other current issues. Students will be required to refer to academic experiences, internship experiences and library skills to participate in discussions. Laboratory two hours. [Dual-listed with GRA 4622.]

**GRADUATE COURSES IN INDUSTRIAL DESIGN (IND)**

**IND 5557. Design for Manufacture/(3).F.** The design, development, and mass production of a manufactured product. To include market survey, design selection, prototype construction, development of jigs and fixtures, implementation of process planning and control systems, and the actual production of a product. Lecture two hours, laboratory two hours. [Dual-listed with IND 4557.]

**GRADUATE COURSES IN TECHNOLOGY (TEC)**

**TEC 5000. Research in Technology/(3).S.** A comprehensive study and practice of experimental research. The course covers the types, components, methods, and tools of research. The tools consist of statistical analysis, searching literature, data collection and publication of results. The student is required to perform and display a research project.

**TEC 5119. Industrial Leadership, Organization, and Communication/(3).F.** Current principles of leadership, organization, and communication as they relate to industrial settings. Emphasis will be placed on the driving forces of change, change agents, and how to be successful managing the necessary elements of change for effective utilization of human resources. Case studies will be provided to study how successful companies are responding to the new demands of leadership, organization, and communication.

**TEC 5129. Project Management/(3).S.** The study of management procedures, techniques, and practices in technical settings. A systems approach to managing processes and solving problems is emphasized. Topics include a variety of tools and techniques that project managers use to achieve success, including economic analysis, basic statistics, decision trees, personnel costing, critical path method, and scheduling software. Students will use spreadsheets to employ many of these techniques. In addition, the course investigates personnel relations, leadership techniques, facility layout and design, just-in-time inventory, planning for expansion, and other management issues.

**TEC 5139. Technology and Culture/(3).S.** A study of the complex relationships between culture, society, science and technology through selected readings, seminar discussion, written critiques and conferencing. Examples of these relationships will be taken from historical accounts and from analyses of contemporary societies, both industrial and non-industrial. Emphasis will be on the technical and sociocultural dimensions within the technical areas of energy and the environment, transportation, communication, and production systems.

**TEC 5309. Computer Networking/(3).S.Even-numbered years.** An introduction to computer networking technologies is presented. The representation of information by analog and digital electrical signals will be discussed. Methods of modulation, multiplexing, encoding, and the transmission of information along the media will be presented. Networking topologies, protocols, and in particular the OSI reference model will be presented. Software and hardware requirements for the implementation of Local Area Networks (LANs) will be emphasized. In particular, developing the skills needed for installation, troubleshooting, and optimization of networks will be the primary goal of the course.

**TEC 5409. Technical Presentations/(3).F.Odd-numbered years.** A study and development of technical reports and presentations. Emphasis is placed on presentation production methods and materials including computer applications.

**TEC 5500. Independent Study/(1-4).F;S.** Approved contract required.

**TEC 5509. Technical Competency Development/(3). F;S.** Individual study and research in the technologies and rationale for procedures used in industry. Emphasis placed on new technologies. Projects will be based upon the technical competencies as determined by the individual concentration areas. A written proposal for the study must be approved by the supervising faculty member and graduate advisor. The student's study is to include a project with a written report as well as an oral presentation. Course may be repeated once barring duplication.

**TEC 5525. Product of Learning/(1-3).On Demand.** Graded on an S/U basis.

**TEC 5530-5549. Selected Topics/(1-4).On Demand.**

**TEC 5550. Color Reproduction/(3).F;S.** This course is designed to further the student's understanding of color reproduction as it relates to printing. Emphasis is placed on digital image creation, editing, color theory, quality control, production variables, densitometry, tone reproduction, color correction, gray balance and proofing materials. Prerequisites: TEC 3002 and TEC 5591. [Dual-listed with TEC 4550.]

**TEC 5555. Contemporary Industrial Finishing/(2).On Demand.** Care and maintenance of finishing equipment; selection and use of spray equipment; preparation of the surface to be finished, staining and filling undercoating, top coating, oil finishes, application of simple and synthetic finishes. Lecture one hour, laboratory two hours. Prerequisite: TEC 2005. [Dual-listed with TEC 4555.]

**TEC 5560. Advanced Problems in Technical Areas/(1-2).On Demand.** Individual research. Areas to be determined by need, background, and interest. Prerequisite: must have been admitted to candidacy.

**TEC 5565. Applied Furniture Design and Construction/(4).S.** The study of traditional and contemporary furniture, and its importance, design, and construction procedures. The student may design and construct a piece of traditional or contemporary furniture. Lecture two hours, laboratory four hours. Prerequisite: TEC 3025. [Dual-listed with TEC 4565.]

**TEC 5573. Control System Technology/(3).S.** A detailed study of the architecture of modern programmable control systems. The course will include computation, machine representation of information, storage structures, buses, input/output interfacing, peripheral devices, and instruction codes. Theory to be reinforced by hands on experience. Some theory and practical experience in Programmable Logic Controllers (PLC) will be introduced. Lecture two hours, laboratory two hours. [Dual-listed with TEC 4573.]

**TEC 5592. Advanced Screen Process Printing/(3).On Demand.** Advanced laboratory practice in transfer and direct photographic screen printing with emphasis on multicolor printing, cylinder printing and finishing techniques. Lecture one hour, laboratory four hours. Prerequisite: TEC 3012. [Dual-listed with TEC 4592.]

**TEC 5604. Sustainable Transportation/(3).F;S.** This course will introduce students to contemporary trends and issues related to transportation technology. A major focus of the course will be the exploration of emerging new technologies and strategies for producing a sustainable transportation system. Specific topics addressed will include: public transportation strategies, bicycle technology, energy efficient transportation options, and alternative fuels such as biodiesel, alcohol, natural gas, hydrogen and electric vehicles. The environmental, social, and economic, as well as the technological aspects of all options will be explored. [Dual-listed with TEC 4604.]

**TEC 5605. Sustainable Resource Management/(3).S.** This course will introduce students to material efficiency issues, recycling, composting and the concept of life cycle design, which is a proactive approach for integrating pollution prevention and resource conservation strategies into the development of more ecologically and economically sustainable product systems. Lecture three hours. [Dual-listed with TEC 4605.]

**TEC 5606. Sustainable Water and Wastewater Technology/(3).F.** This course will introduce students to both contemporary and alternative water and wastewater technologies. Students will learn how to analyze the water cycle and be able to develop management concepts which are both economically and environmentally sustainable. Water issues facing the world, sources of water, water purification, water quality assessment, water pumping, efficiency, grey water, composting toilets and “living machines” will all be addressed in the course. [Dual-listed with TEC 4606.]

**TEC 5607. Wind and Hydro Power Technology/(3).F;S.** This course will introduce students to the basic concepts, tools, techniques and materials needed to design and construct systems that convert wind and hydro resources into electricity. Students will have the opportunity to learn how to measure these renewable resources and to estimate the power that could be produced from them. They will also have the opportunity to learn how to design and construct complete renewable electricity systems and become familiar with many contemporary products used in renewable electricity systems. The course will include classroom and “hands-on” design, construction and possibly some field trip experiences outside of class. Lecture two hours, laboratory two hours. Prerequisite: TEC 3601 or permission of the instructor. [Dual-listed with TEC 4607.]

**TEC 5608. Photovoltaic System Design and Construction/(3).F;S.** This course will introduce students to the basic concepts, tools, techniques and materials needed to design and construct systems that convert solar resources into electricity with photovoltaic (PV) technologies. Students will have the opportunity to learn how to assess the solar resources available at a particular site and how that information can be used to properly design PV systems. They will also have the opportunity to learn how to design and construct complete code compliant photovoltaic systems and become familiar with contemporary trends and products. The course will include classroom and “hands-on” design, construction and possibly some field trip experiences outside of class. Lecture two hours, laboratory two hours. Prerequisite: TEC 3601 or permission of the instructor. [Dual-listed with TEC 4608.]

**TEC 5609. Seminar in Career and Technology Education/(3).On Demand.** An overview of the historical development and current status of vocational education. Course content and assignments will focus on federal and state legislation; vocational funding; integrated learning; vocational student assessment; work-based learning; the current status and structure of vocational education; and other issues. Lecture three hours.

**TEC 5618. Sustainable Building Design and Construction/(3).F;S.** This course will introduce students to sustainability issues related to design energy and material efficient buildings that get the majority of their power from the sun. The course will explore a variety of alternative building materials and techniques such as straw bale, adobe, log post and beam, stress skin panel and geodesics. Other topics to be discussed will include site selection, sustainable community design, water conservation, and composting and recycling systems, waste reduction and indoor air quality problems and solutions. [Dual-listed with TEC 4618.]

**TEC 5619. Curriculum Development in Career and Technology Education/(3).SS.** Planning and development of teacher- and student- directed activities that align with state curriculum models. Students will create instructional videos and a variety of computer- generated instructional materials for use in technology education and other career and technical education programs. Emphasis is also placed on assessment strategies and on locating, evaluating, and revising existing instructional materials including computer-based materials. Lecture three hours. [Dual-listed with TEC 4619.]

**TEC 5628. Solar Thermal Energy Technology/(3).F;S.** This course will introduce students to the basic concepts, tools, materials and techniques needed to convert solar energy into heat. Specific technologies to be studied include solar cookers, solar dryers, solar water heaters, solar water pasteurization/distillation, solar greenhouses/coldframes, and some house heating systems. Students will develop skills in the use of tools, materials, and processes which effectively and efficiently capture and convert the sun's energy into thermal energy. The course will include traditional classroom and "hands on" design, construction and testing activities. Lecture two hours, laboratory two hours. [Dual-listed with TEC 4628.]

**TEC 5629. Organization and Management of Career and Technology Education/(3).S.** Instruction and laboratory experiences in the organization and management of technology education programs, including: selection and sources of equipment and supplies; facility planning; safety organization and management concerns; scheduling; student evaluation; and discipline. Computer applications incorporated throughout. Lecture three hours. [Dual-listed with TEC 4629.]

**TEC 5638. Contemporary Problems in Appropriate Technology/(3).S.** This course is designed to provide students with an overview of contemporary problems facing the Appropriate Technology movement such as affordable and efficient alternative energy systems, small scale production systems, waste management and recycling, bioregional development, community and shelter design and technology transfer methodology. Each student will have the opportunity to explore in-depth a problem of their choosing and will be given guidance in the identification, definition and analysis of their chosen problem. Both library research and prototype or model construction will be required. Lecture three hours. Prerequisite: TEC 4608 or permission of the instructor. [Dual-listed with TEC 4638.]

**TEC 5639. Career and Technical Student Organizations/(3).F;S.** An in-depth study of career and technical student organizations (CTSOs) and how to organize and manage a local chapter. Related activities such as service learning, establishing an advisory board, and career planning will also be covered. Lecture three hours. [Dual-listed with TEC 4639.]

**TEC 5660. Instructional Strategies in Career and Technology Education/(3).F.** The study of instructional strategies appropriate for use in trade and industry (grades 9-12) and technology education (grades K-12) classrooms. Class discussions will focus on learning theory, design-based instruction, and standards-based instructional planning. Students will prepare unit and lesson plans, prepare and deliver presentations and demonstrations, and engage in K-12 classroom-based observations. Lecture three hours. [Dual-listed with TEC 4660.]

**TEC 5670. Seminar/(0).F;S.** Required of all graduate students. Students will be required to attend all departmental seminars while enrolled as full-time students. Graded on an S/U basis.

**TEC 5708. Building Science/(3).F;S.** This course introduces students to the complex ways in which buildings actually interact with their environment. Particular issues include how moisture problems occur, how to protect building occupants from poor health due to indoor air quality, how to prevent building durability problems, and how to provide more energy

efficient and comfortable buildings for clients. The course shows students how to use diagnostic equipment, such as blower doors, duct leakage testing devices, indoor air quality measurement devices, and air flow detection equipment. The course also emphasizes translating technical materials into concise written reports, as well as comprehensive written reports.

Graduate students will be required to conduct additional research on their course project and have additional assignments of building science diagnostic testing. Prerequisites: TEC 2708, MAT 1020 or higher, or permission of the instructor. [Dual-listed with TEC 4708.]

**TEC 5709. Forecasting and Assessment of Technology/(3).On Demand.** This course examines three main subjects: 1) Methodologies developed to forecast technological growth, including economic analysis of emerging technologies. 2) Procedures and methods for assessing the impact of technologies on the economy, the environment, and society. 3) Societal issues regarding both technological growth and studying the future of technology.

**TEC 5711. Computer Modeling of Renewable Energy Systems/(3).F.** This course will be an in-depth investigation of a variety of software packages for modeling the performance of renewable energy systems. Software packages may include Excel, SAS, FChart, PVFChart, BLCC, HOMER, WindCAD, RETScreen, and ARCReader. Students will use these programs to predict the performance of a variety of solar heating technologies, photovoltaics, wind turbines, and solar house designs. The economics and environmental benefits of renewable energy systems will also be explored. File formats and memory allocation schemes, as they relate to understanding data storage, will be discussed. Effective problem solving skills will be emphasized throughout the course. [Dual-listed with TEC 4711.]

**TEC 5718. Construction Management/(3).F;S.** This course will introduce students to the mechanics of starting and managing a construction business. Organizational structures, required licenses, taxes, codes, permits, advertising, personnel management, customer relations, scheduling, accounting, insurance and financing will be addressed. Special attention will be given to the use of computer software, such as spreadsheets and scheduling programs, for construction management activities. Students will study construction management and personnel issues and will include budgeting and cash flow analysis using computer software for their final project. Prerequisites: TEC 2708, MAT 1020 or higher, or permission of the instructor, and basic knowledge of computer word processing, Internet procedures, and spreadsheets. [Dual-listed with TEC 4718.]

**TEC 5728. Commercial Building Design/(3).F;S.** This is an advanced level course exploring the broad field of architectural building design. It investigates the details of buildings, from structural elements to decorative components. Students have the opportunity to learn a variety of design development techniques, including manual drafting, sketching and rendering, computer-aided drafting and design (CADD), and model building. Required course projects include a full set of construction drawings for a commercial building using CADD software, as well as a rendering and model of the building. Students will also research and prepare a detailed report on a historical or current topic in architecture. Prerequisite: TEC 3028. [Dual-listed with TEC 4728.]

**TEC 5809. Research and Development in Technical Areas/(3).F.** Investigation and experimentation with contemporary processes, materials, and techniques to improve technical areas. Emphasis is on recent technological advances.

**TEC 5900. Internship/(3-6).On Demand.** A guided practical experience in an industrial or business setting. No more than three hours can be applied to a graduate program of study. Graded on an S/U basis.

**TEC 5909. Computer Uses for Industrial Research and Development/(3).F.** A seminar/laboratory course with a common core of technical experiences and topics related to computer applications. Designed to allow for research and development activities as well as individual experimentations within the specific needs of individual students. Seminar two hours, laboratory two hours. Prerequisites: TEC 1001 and TEC 2803 or equivalents.

**TEC 5989. Graduate Research/(1-9).On Demand.** This course is designed to provide access to University facilities for continuing graduate research at the master's and specialist's levels. Graded on an S/U basis. TEC 5989 does not count toward a degree.

**TEC 5999. Thesis/(2-4).On Demand.** Graded on an S/U basis.