Industrial Technology

College of Agricultural Sciences and Technology

Department of Industrial Technology

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B.S. in Industrial Technology

Programs of Study:

- CAD/CAM Systems Management
- Industrial Control Systems Management
- Quality Systems Management
- Transportation Systems Management
- Teacher Credential Program (Single Subject Waiver)

Bachelor of Vocational Education

M.S. in Industrial Technology

Minor in Industrial Technology

Teacher Credential Program

Certificate in Computer Process Control Network Administration

Industrial Technology

Industrial Technology (I T) at California State University, Fresno is preparing today's and tomorrow's leaders of industry. I T equips the graduate to use and manage 21st century technology. All of the courses in Industrial Technology's B.S. program cover state-of-the-art principles and use lab experiences to illustrate their applications. Computer software is used both as a tool and to stimulate processes. Four technical concentrations build on a common core of technology and management. Our faculty members are dedicated educators who have the industrial experience necessary to do an outstanding job in the classroom.

Enrichment opportunities abound for I T students. Professional societies active in the program include Epsilon Pi Tau (EPT), the National Association of Industrial Technology (NAIT), American Society of Quality (ASQ), American Production and Inventory Control Society (APICS), Automation Society of America (ISA), and American Society of Automotive Engineers (ASAE). Through participation in one or more of these groups, students learn more about their profession and interact with working professionals in their field. Internships are also available to provide on-the-job experience to interested students.

I T graduates get technically oriented jobs with an average starting salary of $35,000 in the San Joaquin Valley. A recent survey of alumni indicates that after eight years on the job, the typical graduate is making $55,000 and is in a technical management position.

The Fresno State Industrial Technology program is fully accredited by the National Association of Industrial Technology (NAIT).

The Master of Science in Industrial Technology program prepares graduates to assume positions of leadership and management. The program consists of a common core of 18 units of technical management courses and 12 units of elective courses, depending on the individual's educational and career objectives.

Instructional Facilities

The department's laboratory facilities are some of the most extensive and modern in the California State University system. The Industrial Technology Department continues to receive equipment and financial support from a number of California industries. Some facilities supported include the computer-aided design (CAD) lab, digital and analog electronics lab, hydraulics lab, process control/programmable logic controller lab, materials and fuels testing lab, robotics/computer numerical control (CNC)/computer integrated manufacturing (CIM) lab, motors and controls lab, and computer network lab.

Industrial and Technology Education Teachers. Teachers are in short supply. The need will become even greater as new curriculum programs emerge in industrial and technological education. This demand is attributed to emerging technologies and expanded applications for industrial and technological education.

Clinic Program

The Clinic Program is a hands-on program designed to answer research questions for business or industry and to expose students to the reality of professional practice. The program involves cooperative teams, comprised of three to five students, a faculty adviser, support staff, and a company liaison working on projects identified and funded by a business or industry. Some of the clinic projects which have been completed include the Hughes Aircraft Project, Grundfos Manufacturing Project, Duncan Enterprise Project, Raytheon Systems and Wawona Foods, and Raytheon Systems.

Faculty

Tony M. Au, *Chair*

Coordinators:
Norman A. Gullickson, *Teacher Education*
Matthew M. Yen, *Graduate*

Merle S. Adrian
Clift C. Cullen
Edward A. Gaiser
Gary E. Grannis
Norman A. Gullickson
Kenneth D. Moshier
Gary B. Paglierani
Gary H. Winegar

Bachelor of Science Degree Requirements

Industrial Technology Major

	Units
General Education	**51**
(Includes 12 upper-division units, to be taken no sooner than the term in which 60 units of coursework are completed.)	
Major	**71-72**
(including 18 upper-division units)	
Industrial Technology Core	(38-39)
I T 52, 74, 92, 102, 104, 107, 114, 115, 117, 118, 199 or S C 197; ACCT 4A or AG EC 31; MGT 106	
Technical Specialty	(33)
Select one:	
CAD/CAM Systems Management	
I T 53, 112, 116, 131, 134, 144, 147, 148, 156, 158, 177	

*See Advising Note 3

Industrial Control Systems Management
I T 53, 110, 112, 116, 131, 133, 148, 156, 158; plus 6 units approved by your adviser

Quality Systems Management
I T 112, 116, 137, 148, 177, 184, 194; MGT 126; plus 9 units approved by your adviser.

Transportation Systems Management
I T 12, 53, 110, 112, 116, 120, 121, 122, 127, 129, 131

Additional requirements 17-20
Upper-division writing skills: I T 198W (recommended); PHYS 2A; PHYS 2B; MATH 45 or DS 71; C SCI 1; I T 20 (*Note*: Courses required above satisfy four G.E. area requirements [A3, B1, B4, and D3.])

Electives 0-1

Total requirements 128
(including 40 upper-division units)

Advising Notes

1. All courses (except I T 194) required for the major must receive a letter grade, including additional major requirements in General Education.
2. Students must pass the upper-division writing exam or complete I T 198W with a grade of *C* or higher (to be taken no sooner than the term in which 60 units are completed).
3. I T 52 may be waived if equivalent work experience and/or training is demonstrated.
4. The General Education requirement of 51 units may be exceeded depending upon the selection of courses.
5. Students must take two science courses to meet the NAIT standards.

Bachelor of Vocational Education Degree Requirements

Units

General Education 51

Major 73
Swan Bill/Electives ..... (28-34) (upper division)
Required Courses ..... (39-45)
BVE 170, 172, 174, 175, 176, 178; H S 121; SPED 120; I T 92, 102, 117
Technical/Professional Electives (7-13 units). *To be approved by B.V.E. adviser.*

Additional requirements 0-4
upper-division writing skills

Total requirements 124-128
(including 40 upper-division units)

*According to California Legislature's Swan Bill, up to 40 upper-division units can be granted to vocational instructors toward a baccalaureate degree; however, generally between 28-34 units are earned.

Industrial Technology Minor

The Minor in Industrial Technology consists of 20 units of which 9 must be upper-division. At least 12 units must be taken in one of these specialized areas of study: CAD/CAM systems management, industrial control systems management, quality systems management, or transportation systems management.

Certificate in Computer Process Control Network Administration

The Certificate in Computer Process Control Network Administration consists of 15 units in industrial technology coursework. The student is required to take I T 112, 117, 133, and 158. In addition, 3 units must be selected from the following: I T 116, 134, 156, 177, 190, or 194.

Teacher Credential Program

The requirements for the Single Subject Waiver Program in Industrial and Technology Education include the following:

1. General Education courses required for the B.S. in Industrial Technology.
2. All I T Core courses required for the B.S. in Industrial Technology.
3. Education Core: I T 12, 41, 52, 60, 80.
4. 9 units each (in consultation with department adviser) in two different specializations, i.e.:
   - CAD/CAM Systems Management
   - Industrial Control Systems Management
   - Quality Systems Management
   - Transportation Systems Management

For additional requirements, see *Curriculum, Teaching, and Educational Technology — Single Subject Credential Program* requirements section in this catalog.

Master of Science Degree Requirements

The Master of Science in Industrial Technology is a 30-unit program which offers graduate study in both industrial and educational related professional and technical fields. Emphasis is directed toward the attainment of advanced competency in the areas of industrial and technology education as well as manufacturing technology. Through selected courses, within the department and other disciplines, knowledge and experience can be acquired in research and development, management and administration, technological studies, and educational studies that are related to all areas of the field.

Admission Requirements. The Master of Science degree program in Industrial Technology assumes preparation equivalent to a CSU undergraduate major in technology education (industrial arts), industrial technology, or a related field. Students who have not completed a degree in technology education or industrial technology are expected to have completed the following courses or their equivalents prior to enrollment in courses to be applied toward the master's program: I T 41, 52, 60, 74, 102, 114, 115; MATH 11 or DS 71; PHYS 2A; ERF 153 or DS 123.

Applicants whose preparatory education was principally in a language other than English must earn a minimum TOEFL score of 550.

Classified Standing. A baccalaureate degree is required and an undergraduate major in technology education, industrial technology, or a related field; a 3.0 GPA (last 60 semester units); a 450V/430Q GRE score; separate school application; three letters of reference from employers or faculty at the university attended most recently; a personal statement of 500 words or less indicating reasons for pursuing a master's degree; a preadmission consultation session with the department graduate program coordinator. Students lacking in any area with compensating strengths in other areas are encouraged to apply.

Conditional classified standing may be granted to petitioning applicants with a 2.5 to 2.99 GPA (last 60 semester units); GRE scores on file with the university; separate school application; three letters of reference; and a personal statement of 500

words or less. Students must request classified standing in the program by the semester in which a maximum of 10 units to be used toward the degree are completed.

Program Requirements. Under the direction of a graduate adviser, each student prepares and submits a coherent program individually designed within the following framework:

Specific Requirements	*Units*
Required courses	**15**
I T 223, 280, 282, 283, 285	
Electives in industrial technology or related field	**12**
(approved electives appropriate to individually designed program; a maximum of 9 units may be 100-level courses)	
Culminating Experience	**3**
I T 298 or 299	
Total minimum requirements	**30**

Graduate Advising Notes

1. Several of the 200-level and approved elective courses have prerequisites other than courses listed as admission requirements.
2. Students should request specific information concerning the Master of Science degree and the program advising sheet from the department office.
3. Upon admission, students should see the department graduate program coordinator for aid in program planning.
4. To progress through the graduate program, students must:
   a. Maintain a minimum 3.0 GPA
   b. Complete all prerequisite coursework
   c. Attain classified standing
   d. Meet the graduate writing skills requirement
   e. File for advancement to candidacy
   f. Complete the program requirements
   g. File a master's thesis or project committee assignment form
   h. Formally present and defend the thesis or project results
5. Classified standing must be achieved by the semester in which students take the 10th program unit. All admission requirements must be met. Students must maintain a 3.0 GPA.
6. Advancement to candidacy requires the completion of 9 program units at California State University, Fresno, a minimum GPA of 3.0, meeting the graduate writing skills requirement, and filing a Petition for Advancement to Candidacy a minimum of one semester prior to enrollment in thesis or project and by established deadline.
7. Students should demonstrate graduate writing proficiency by earning a *B* or better grade in the graduate course I T 280, Research Methodology. Students are also encouraged to publish their works in relevant journals or professional publications.
8. See *Division of Graduate Studies* section in this catalog for university requirements.

COURSES

Industrial Technology (I T)

10. Technology, Civilization, and Environment (3)
Insights of technology in key industries: telecommunication, agriculture, health care, and manufacturing automation. Contemporary issues including the Internet, genetic engineering, technology transfer, environmental impact, education, future trends, and social implications. Understanding and harnessing technology, career planning, and life adaptation with technological changes.

12. Basic Vehicle Systems (3)
Design, construction, and mechanical functions of vehicle engines, fuel systems, electrical systems, power transmission, brakes, and wheel suspension; proper use and safety of tools and equipment. (2 lecture, 3 lab hours)

15. Technological Opportunities for Humanity (3)
Opportunities for new technology in daily life. Role of technology in manufacturing, agriculture, medicine, communication, information systems, and transportation. Criteria for technological advances to be useful and wanted by individuals. Understanding and harnessing of technology. Career planning and life adaptation with technology and technological changes.

20. Technology and Society (3)
Critical relationship between society and technology. Technology, as it applies to contemporary issues such as technology and gender, the fate of skill and labor's power under changing conditions, technology and war, the problem of technocracy, technology and consumer culture, and technological relations to the natural environment. G.E. Breadth D3.

41. Industrial Design Graphics (3)
Application of the fundamentals of industrial design graphics. Sketching, lettering, orthographic projection, working drawings, auxiliary views, dimensioning, developments, pictorial drawings, duplication; interrelationship to the design process. Introduction to CAD. (6 lab hours)

45. Industrial Technology Exhibits and Competitions (3)
Provides a structure for students to be involved in various industrial technology exhibits and competitions, industrial technology research and development, project management, and team work. *CR/NC* grading only. (6 lab hours) (Formerly I T 145)

52. Basic Electricity (3)
(Same as ME AG 53.) Introduction to electricity including fundamentals of electrostatics, alternating and direct current electrical circuits, electrical calculations, magnetics, circuit applications, electrical measuring, and test equipment. (1 lecture, 4 lab hours) (Course fee, $5) (Formerly AET 53)

53. Electronic Devices and Circuits (3)
Fundamentals of direct and alternating current circuits, electric calculations, schematics, and wiring diagrams. Measuring and testing equipment, electromagnetism, principles of motors and generators, standards and codes, and concepts of analog and digital devices. (2 lecture, 2 lab hours) (Course fee, $5)

60. Basic Graphic Arts (3)
Introduction to the graphic arts; letterpress, photo offset lithography, screen printing; layout, composition, imposition, presswork, bindery. (6 lab hours; field trips) (Course fee, $6)

71. Metallurgical Processes (3)
(Same as ME AG 50.) Fundamentals of metallurgy; properties and characteristics of metals; survey of metal welding processes, equipment, and procedures; theory-discussion and laboratory experience in oxygen-fuel welding, cutting, brazing, and shielded metallic arc welding. (2 lecture, 3 lab hours) (Course fee, $7) (Formerly AET 50)

74. Manufacturing Processes (3)
Material removal by turning and milling operations on aluminum, brass, steel, plastic and wood. Material fusing and severing operations on metals and plastics. Nonferrous metal casting and thin gauge metal and plastic forming operations. (6 lab hours) (Course fee, $7)

80. Wood Processing Technology (3)
Wood properties, materials, finishing; hand, portable electric, and machine tool processing; design, production planning; safety, adhesives, and cutting principles; machine design and use. (6 lab hours) (Course fee, $10)

92. Industrial Safety Management (3)
Principles of safety management in an industrial environment; safety legislation and programs; management/supervisory and employee responsibilities and attitudes; physical hazards associated with chemicals, equipment, fire, compressed gases; other topics include eye, stress, drugs, lifting, office, and noise safety.

102. Industrial Computer Concepts and Applications (3)
Introduction to industrial computer systems. Comprehensive view of the components of a modern industrial information processing system and the parts each component plays in the processing of data. (2 lecture, 2 lab hours)

104. Product Design (3)
Prerequisite: I T 74 and 115 or permission of instructor. Elements, principles, and methods of design. Emphasis will be placed on the development of models and prototypes with attention to standard components, productivity, and packaging. (2 lecture, 2 lab hours)

106. Energy Conversion and Utilization (3)
Fundamental sources of energy, including the following energy conversion systems: direct mechanical, external combustion, internal combustion, solar power, wind power, electrical and atomic systems. Experiments and demonstrations. (2 lecture, 2 lab hours; field trips)

107. Facilities Planning (3)
Facility planning techniques as applied to facility location, zoning, building codes, line balancing, shipping-receiving, offices, material handling, storage, project scheduling, and computerized layout.

110. Fluid Power (3)
Prerequisite: I T 52. Selective study of fluid power principles and applications; hydraulics, pneumatics, and vacuum; includes pumps, controls, transmission systems, actuators, and fluidics. In-depth study of air conditioning-heating theory and applications. (6 lab hours; field trips) (Course fee, $5)

112. Industrial Process Control and Instrumentation (3)
Process control principles; components and principles; transducers, actuators, sensors, and instrumentation; computer interface software, terminologies, standards, and trends in control technnologies. Programmable logic controller principles, hardware, and software. (2 lecture, 2 lab hours)

114. Industrial Materials (3)
Chemical and physical properties of metals, polymers, ceramics, composites. Atomic structure and phases of matter emphasizing crystalline and amorphous solids. Mechanical properties, strength and testing of materials including impact, hardness, and tensile. Metallographic, microscopic inspection of electronic, and metallic specimens. (2 lecture, 2 lab hours)

115. CAD Principles and Methods (3)
Prerequisites: I T 102. Computer-aided design applications. Special emphasis in manufacturing, construction, and interior design applications. Exposure to CAD software packages. (2 lecture, 2 lab hours)

116. Applied Visual Programming (3)
Contemporary computer language used in office automation and manufacturing industry; basic concepts on structural programming, object-oriented language, programming mechanics, user interface development, and Internet applications. (2 lecture, 2 lab hours)

117. Quality Assurance (3)
Prerequisites: I T 102; MGT 106. Quality assurance principles and practices in industry: quality assurance systems, acceptance sampling, testing, source surveillance; probability and statistical concepts, process control techniques and measurement procedures as applied to quality.

118. Production Operations (3)
Prerequisites: I T 102, 104; MGT 106. A survey of production manufacturing operations: quality assurance, work sampling, testing, time and motion study; routing, scheduling, and inventory control; flow processes, material handling, and automation. (Field trips)

119. Computer-Integrated Manufacturing Concepts (3)
Prerequisites: a computer programming language; I T 118 or equivalent. Strategies on how to implement Computer-Integrated Manufacturing (CIM) for a complete manufacturing enterprise. Focuses on CIM systems, opportunities, concerns and solutions; design, development, implementation, and operations; and employees' educational programs. Team efforts and management are emphasized. (2 lecture, 3 lab hours)

120. Vehicle Engine Systems (3)
Prerequisites: I T 12, 53 or concurrently. Advanced study of vehicle engines and support systems. Includes engine theory, fuel and electrical systems, turbochargers, LPG, diesel, computerized emission and engine controls, and dynamometer testing analysis. (6 lab hours; field trips)

121. Automotive Engine Machining (3)
Prerequisites: I T 12, 74. Advanced study of automotive engine machining including precision measurements, principles of engine operation, machining of engine components, crack detection, assembly procedures, lubricating and cooling systems. (6 lab hours; field trips) (Course fee, $6)

122. Vehicle Chassis Analysis (3)
Prerequisite: I T 12. Advanced study of vehicle chassis components including power transmission, brake systems, wheel suspension, air conditioning, body repair and refinishing, computer controls and diagnostics. (6 lab hours; field trips)

127. Vehicle Design and Development (3)
Design and mechanical development of vehicles for intercollegiate competition events. Students will select one or more vehicle research projects: innovative future fuels, supermileage, mini baja, formula, aero design, walking robot. (6 lab hours)

129. Vehicle Diagnostic Procedures (3)
Prerequisites: I T 12, 53 or concurrently. Laboratory study and analysis of mechanical, electrical, and computer control problems. Technical reports. (6 lab hours) (Course fee, $5)

131. Digital Circuits and Systems (3)
Prerequisites: I T 52 and 53. Number systems, Boolean logic, and fundamentals of digital devices; basic applications of logic devices in computers and control systems. (1 lecture, 4 lab hours; field trips) (Course fee, $5)

133. Programmable Logic Controllers (3)
Prerequisites: I T 131; I T 112 recommended. Programmable logic controller principles and equipment; programming languages, procedures, and documentation; equipment and software selection and application. (2 lecture, 2 lab hours)

134. Industrial Robotics (3)
Prerequisite: a high-level programming language. Study, analysis, and evaluation of robotics systems. APT programming language for numerical control and application languages for robots. Use of robot vision and the geometry of computer vision applications. (2 lecture, 3 lab hours)

135. Computer-Aided Process Planning (3)
Prerequisites: I T 115, 177. Group technology, CAD/CAM integration, computer-aided methods for process planning, Flexible Manufacturing Systems. Production planning and control of cellular manufacturing. (2 lecture, 2 lab hours)

137. International Quality Standards (3)
Prerequisite: I T 117. ISO 9000 and related international quality systems. Implementation process. Conformance standards, quality system requirements, and the registration and audit processes.

144. Tool Design Graphics (3)
Application of graphics to industrial work holding devices; their application, drawing, and design. Construction of working drawings aided by standards, company catalogs, and handbooks. Final designs subjected to student presentation and evaluation. (6 lab hours; field trips)

146. Multimedia Development (3)
Integration of a variety of media types: graphics, animation, digital video, and sound. Emphasis placed on development and creation of multimedia as applied to various CAD/CAM projects, the process of bringing live interactivity to the Internet, Web page development, and desktop publishing. (Formerly I T 191T)

147. Advanced CAD Applications (3)
Prerequisites: I T 115. CAD as a tool to facilitate design activities. An overview of design processes and methods. Solid modeling techniques are introduced. A team approach in system design is emphasized. (2 lecture, 2 lab hours)

148. Manufacturing Systems Analysis and Development (3)
Prerequisite: I T 115. Computer-Integrated Manufacturing (CIM) systems utilized in manufacturing industries, systems development cycle, systems analysis, justification, benchmarking, personnel, and facilities planning.

156. Electric Motors and Controls (3)
Prerequisite: I T 52. Study and analysis of the characteristics and industrial applications of electric motors. Major emphasis is placed on programmable, solid state, and electromechanical motor controllers. (1 lecture, 4 lab hours; field trips) (Course fee, $4)

158. Applied Computer Networking (3)
Prerequisite: I T 102. Internet, intranet, local area network concepts, protocols, architectures, and implementation issues. Data communication in office technology and manufacturing automation. (2 lecture, 2 lab hours; field trips)

160. Graphic Communication Developments (3)
Prerequisite: I T 60. An investigation of the graphic reproduction processes including laboratory experiences, practical application, and frequent industrial trade tours. In-depth study of individually selected topics resulting in written and oral research reports. (6 lab hours; field trips) (Course fee, $10)

161. Photo Offset Lithography (3)
Prerequisite: I T 60. Photo offset lithography techniques and processes: design, layout, cold type composition, and paste-up, line, and half-tone copy, imposition, multicolor printing. (6 lab hours; field trips) (Course fee, $20)

177. Computer Numerical Control (3)
Prerequisite: I T 102. Computer numerically controlled hardware including milling and turning centers and flexible manufacturing systems. Programming in languages common to computer numerically controlled machine tools. Computer-controlled machining of industrial materials including aluminum, brass, steel, plastic, expanded foam, and wax. (2 lecture, 3 lab hours)

184. Advanced Manufacturing Technology (3)
Prerequisite: I T 74. Production processing, using metallic and nonmetallic materials, including product design, work cells, tooling, capacity planning, material handling, scheduling and flow chart. (6 lab hours; field trips) (Course fee, $10)

190. Independent Study (1-3; max total 6)
See *Academic Placement — Independent Study*. Approved for *SP* grading. (Course fee variable)

191T. Technical Topics in Industrial Technology (1-3; max total 6)
Prerequisite: permission of instructor. Investigation and analysis of selected subjects in industrial technology. (2-6 lab hours)

194. Cooperative Education in Industrial Technology (1-4; max total 12)
Prerequisites: courses appropriate to the work experience; permission of department cooperative education coordinator; junior standing. Integration of work experience with academic program, individually planned through program adviser. *CR/NC* grading only.

198W. Technical Writing (3)
Prerequisites: satisfactory completion (*C* or better) of the ENGL 1 graduation requirement; to be taken no sooner than the term in which 60 units are completed. Preparation of technical reports, research proposals, specifications, resumes, and correspondence using effective writing techniques, formats, and styles. Meets upper-division writing skills requirement for graduation.

199. Senior Problem in Industrial Technology (2)
Prerequisite: successful completion of Upper-Division Writing Exam or I T 198W. Approved problem or research project, with seminar, in the area of the student's option and emphasis. Approved for *SP* grading.

Bachelor of Vocational Education (BVE)

170. Technology and Society (3)
Historical development of technology and its impact on people and their institutions. Emphasis will be placed on people and their institutions, the consequences of rapid technological change as it relates to education and training, and work environment and environmental concerns.

172. Foundation for Occupational Education (3)
Presents concepts of vocational education and how they relate to other subject areas. Covers history, traditions, delivery systems, funding, practices, current issues, initiatives and policies. Looks at implications of the Swan Bill. (Career experience credit.)

174. Learning, Instruction, and Classroom Management in Vocational/Adult Education (3)
Exploration of individual traits and differences during stages of development that affect the way students learn. Covers instructional procedures and classroom organization and management. Looks at stoical development of technology and its impact on people and their institutions.

175. Student Diversity in Adult/ Vocational Education (3)
An overview of the diversity of student populations, the adult learning process, and interpersonal relations. Specifically addresses the identification of special needs populations and the application of learning strategies, activities, and materials with these students.

176. Curriculum Development and Evaluation in Vocational Education (3)
Preparation of unit plans that include goals, objectives, topical outlines, strategies, activities, safety considerations, and materials. Assessment of student skills and knowledge. Program evaluation including follow-up of students, employers, and advisory committees. Articulation agreements.

178. Leadership and Program Development (3)
Prerequisite: recommend completion of BVE 170. Introduction, definition, and discussion of leadership concepts. Importance of leadership as a quality characteristic for employability, success, and career advancement. Techniques for identifying, initiating, and implementing vocational education programs.

179. Supervisor's Role in the Administration of Vocational Education Programs (3)
Prerequisite: BVE 178. Covers responsibility and authority of supervisors in vocational education, including personnel procedures and laws concerning selection, training, development, and evaluation. Also covers employee morale and productivity using mission approach. Includes budgeting, funding, and legislative actions related to vocational programs.

GRADUATE COURSES

(See *Course Numbering System.*)

The following graduate courses are open only to students who have been accepted into a graduate program. Students who are not in graduate standing should contact the department graduate coordinator prior to enrolling.

Industrial Technology (I T)

223. Management of New Technology (3)
Study of new technology and its impact on people and their institutions. Topics focus on rapid technological changes as they relate to adoption, implementation, management strategies, and social issues.

280. Research Methodology (3)
Prerequisites: ERF 153. Seminar in research procedures in industrial education and technology; basic bibliography, research form and methods.

282. Advanced Communication Concepts and Visual Presentations (3)
Prerequisite: I T 115. Preparation and use of agendas, memoranda, business letters, electronic mail, fax communications. Video development and slide and transparency preparation and the incorporation of these media into presentations. Interview techniques, resume evaluations, dictation skills, professional relations with personnel, business etiquette.

283. Advanced Materials and Processes (3)
Prerequisite: I T 114. Chemical and physical properties of metals, polymers, ceramics and composites. The atomic structure and phases of matter emphasizing crystalline and amorphous solids. Materials technology of metallic, polymeric, ceramic, and advanced composites are stressed.

284T. Topics in Industrial Technology (2-3; max total 9 toward master's degree if no area repeated)
Advanced study in technical areas; current industrial practices, developments and trends related to design, materials, and processes.

285. Advanced Manufacturing Systems (3)
Prerequisites: I T 74, 115. A comprehensive study of modern manufacturing systems. Topics include plant layout, material control and transfer, operations measurement, transfer lines, CNC and DNC, machine tool network, computer-integrated manufacturing, flexible manufacturing systems, group technology, robotics, and manual assembly systems.

290. Independent Study (1-3; max total 6 if no area repeated; max combined total with I T 270 is 12)
See *Academic Placement — Independent Study*. Approved for *SP* grading.

298. Project (2-4; max total 4)
Prerequisites: I T 280; prior advancement to candidacy. See *Criteria for Thesis and Project*. Completion of an approved project appropriate to the candidate's area of specialization involving the development of a physical prototype or other similar professional problem-solving activity with extensive written documentation. Abstract required. Approved for *SP* grading.

299. Thesis (2-4; max total 4)
Prerequisites: I T 280; prior advancement to candidacy. See *Criteria for Thesis and Project*. Preparation, completion, and submission of an acceptable thesis for the master's degree. Approved for *SP* grading.

IN-SERVICE COURSE

(See *Course Numbering System.*)

Industrial Technology (I T)

341. Problems in Industrial Technology (2-3; max total 6 if no area repeated)
Prerequisite: permission of instructor. Intensive analysis of a selected area in industrial technology. Research paper, project, or reports.