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PURDUE UNIVERSITY

BULLETIN

School of ENGINEERING AND TECHNOLOGY

Indiana University–Purdue University
Indianapolis

93/95

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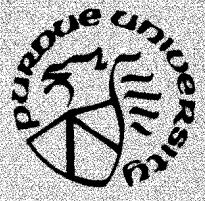

93/95

Indiana University–Purdue University Indianapolis (IUPUI)
799 W. Michigan Street
Indianapolis, IN 46202-5160

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IUPUI Calendar 1993-95

First Semester 1993-94		
Classes begin	W	August 25
Labor Day (no classes)	M	September 6
Thanksgiving recess begins	W	November 24
Classes resume	M	November 29
Classes end	M	December 13
Final exams	T-M	December 14-20
Second Semester 1993-94		
Classes begin	M	January 10
Spring recess begins	M	March 14
Classes resume	M	March 21
Classes end	N	May 1
Final exams	M-N	May 2-8
Commencement	N	May 15
Summer I 1994		
Classes begin	W	May 11
Memorial Day recess	M	May 30
Classes end	W	June 22
Summer II 1994		
Classes begin	M	June 27
Independence Day recess	M	July 4
Classes end	M	August 8

First Semester 1994-95		
Classes begin	W	August 24
Labor Day (no classes)	M	September 5
Thanksgiving recess begins	W	November 23
Classes resume	M	November 28
Classes end	M	December 12
Final exams	T-M	December 13-19
Second Semester 1994-95		
Classes begin	M	January 9
Spring recess begins	M	March 13
Classes resume	M	March 20
Classes end	N	April 30
Final exams	M-N	May 1-7
Commencement	N	May 14
Summer I 1995		
Classes begin	W	May 10
Memorial Day recess	M	May 29
Classes end	W	June 21
Summer II 1995		
Classes begin	M	June 26
Independence Day recess	T	July 4
Classes end	M	August 7

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Indiana University–Purdue University Indianapolis (IUPUI)

Indiana University–Purdue University Indianapolis is an innovative, urban university campus with a student body of more than 28,000, a faculty of 1,500, and a support staff of 6,800. Through its parent universities, it offers 166 degree programs in more than 200 fields of study.

With programs in the arts, sciences, and professions, IUPUI is one of the most comprehensive public institutions of higher learning in Indiana. This broad spectrum of educational opportunities enables its students to prepare for a wide range of careers. Programs range from two-year associate degree programs to doctoral degree programs. Both the graduate and undergraduate divisions of IUPUI are fully accredited by the North Central Association of Colleges and Secondary Schools.

IUPUI was formed in 1969 when Purdue University and Indiana University merged their Indianapolis operations. Indiana University had established its first extension center in Indianapolis in 1916; it made the center a regional campus in the 1960s and created Indiana University at Indianapolis in 1968. Purdue University began programs in Indianapolis during World War II and established a regional campus in 1946. The combined resources of the two statewide university systems in the state's capital city make IUPUI an excellent place for education and research.

IUPUI's urban location enables its students and faculty to work closely with public and private agencies, government, business, and industry. Its urban orientation enables the campus to be directly involved in metropolitan concerns and aspirations.

IUPUI's main campus is located just west of downtown Indianapolis and contains nationally recognized sports facilities. Another location is the Herron School of Art, located at 1701 Pennsylvania Street. A third location, in Columbus, Indiana, serves approximately 1,300 students.

Lectures, theater presentations, and other special events are presented on campus, and the city provides many locations for sports, entertainment, and the arts. Men's and women's varsity teams participate in a number of sports, and an intramural sports program offers recreation for all students.

Indiana University

Indiana University, founded in 1820, is one of the oldest and largest state-assisted universities in the country. IU remains dedicated to its original commitment to provide a wide range of educational services and a statewide system of public higher education. Eight campuses—the two largest in Bloomington and Indianapolis, and other campuses in Gary, Fort Wayne, Kokomo, New Albany, Richmond, and South Bend—serve more than 96,000 students.

Purdue University

Purdue University was established at West Lafayette in 1869 under the Morrill Act to promote the agriculture and industry of the state. The university was named for civic leader John Purdue, who donated funds to help establish it. Purdue enjoys an international reputation for work in the physical sciences, agriculture, engineering, and technology. It serves more than 35,000 students through its residential campus in West Lafayette; its additional campuses in Indianapolis, Fort Wayne, Hammond, and Westville; and Statewide Technology programs in several locations.

University Policies

Equal Opportunity/Affirmative Action Policy
Indiana University–Purdue University Indianapolis (IUPUI) pledges itself to continue its commitment to the achievement of equal opportunity within the university community and throughout American society as a whole. In this regard, IUPUI will recruit, hire, promote, educate, and provide services to persons based upon their individual qualifications. IUPUI prohibits discrimination based on arbitrary considerations of such characteristics as age, color, disability, ethnicity, gender, marital status, national origin, race, religion, sexual orientation, or veteran status.

IUPUI shall take affirmative action, positive and extraordinary, to overcome the discriminatory effects of traditional policies and procedures with regard to the disabled, minorities, women, and Vietnam-era veterans.

The campus Affirmative Action office monitors university policies and assists individuals who have questions or problems related to discrimination.

Student Responsibility
Students are responsible for understanding all requirements for graduation and for completing them by the time they expect to graduate. Advisers, directors, and deans will help students understand and meet the requirements established by the school for graduation; the student alone is responsible for fulfilling these requirements. Since the faculty and trustees vote to confer the degree at the end of the student's course of study and may withhold the degree if requirements are not met, it is important for students to acquaint themselves with all regulations and to remain informed throughout their college careers. **Note:** Students who must interrupt their course of study for more than one calendar year may be required to meet all curriculum requirements for the program offered at the time of their return. At the time of initial matriculation, transfer students should carefully verify the status of transferable credit and special residency requirements to be fulfilled in order to earn a degree from the School of Engineering and Technology.

Code of Student Ethics
All students at IUPUI are governed by the Indiana University Code of Student Ethics as approved by the Trustees of Indiana University on May 4, 1990. The code is designed to assure due process for all students in matters requiring disciplinary action. Under the code, authority over student conduct in academic matters has been lodged with the dean of each academic division. Authority in other matters belongs to the dean for student affairs. Further information, including information on due process hearings in the event of disciplinary action, can be found in the booklet, *Code of Student Ethics*. This booklet can be obtained from any departmental office in the School of Engineering and Technology as well as the Office of the Dean, Engineering and Technology 1211, 799 W. Michigan Street, or the Office of the Dean for Student Affairs, IUPUI, 355 N. Lansing Street, Indianapolis, IN 46202-2896; telephone (317) 274-2546.

Release of Public Information
Certain information maintained in the IUPUI Office of the Registrar is considered public and will be released on request. As stated in the IUPUI Policy on Student Records, the following is public information: name, address, phone number, major field of study, dates of attendance, admission or enrollment status, campus, school, college or division, class standing, degrees and awards, activities, sports, and athletic information. Records of arrest and/or conviction and traffic accident information are public information and may also be released to anyone making inquiry.

If students wish to restrict the release of public information except name, enrollment status, degrees, and dates of attendance, they must file the appropriate form in the Office of the Registrar, Cavanaugh Hall 133, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140.

School of Engineering and Technology

The School of Engineering and Technology offers undergraduate and graduate programs that prepare students for careers in industry. It is one of the largest schools at IUPUI, with an enrollment of approximately 2,400 students. All degrees are awarded by Purdue University.

The School of Engineering and Technology was formed in 1972 and is the successor to Purdue University programs that began in Indianapolis in 1940. The first Purdue University courses in the city were defense training courses sponsored by the U.S. Office of Education. After World War II, the curriculum was changed from a certificate to a diploma program. Three technical institute programs were established: drafting and mechanical technology, electrical technology, and supervision and production technology. Ten students graduated at the first commencement in 1947. Freshman engineering courses were added in 1948; the Bachelor of Science in Engineering was first offered in 1969.

The School of Engineering and Technology offers degree programs in the areas listed below. In addition to North Central Association of Colleges and Secondary Schools accreditation by the campus, several individual programs have professional accreditation by either the Engineering Accreditation Commission or the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). Where appropriate, program accreditation is identified on the page describing the individual plan of study.

Engineering Degree Programs

Bachelor of Science in Electrical Engineering (B.S.E.E.)
Bachelor of Science in Engineering (B.S.E.)
Bachelor of Science in Mechanical Engineering (B.S.M.E.)

Master of Science (M.S.)
Master of Science in Engineering (M.S.E.)
Master of Science in Electrical Engineering (M.S.E.E.)
Master of Science in Mechanical Engineering (M.S.M.E.)

Technology Degree Programs

Associate in Applied Science (A.A.S.) with a major field of study in the following:

Architectural Technology
Biomedical Electronics Technology
Civil Engineering Technology
Computer Integrated Manufacturing Technology
Computer Technology (Commercial Option)
Computer Technology (Technical Option)
Electrical Engineering Technology
Mechanical Drafting–Design Technology
Mechanical Engineering Technology
Supervision

Bachelor of Science (B.S.) with a major field of study in the following:

Computer Integrated Manufacturing Technology
Computer Technology
Construction Technology
Electrical Engineering Technology
Mechanical Engineering Technology
Supervision

For more information, please contact the following offices:

Admissions
IUPUI Office of Admissions
Cavanaugh Hall 129
425 University Boulevard
IUPUI
Indianapolis, IN 46202-5140
Telephone: (317) 274-4591

Programs
Office for Student Affairs
Purdue University School of Engineering and Technology
799 W. Michigan Street
IUPUI
Indianapolis, IN 46202-5160
Telephone: (317) 274-2533

Admission

Undergraduate Admission

The School of Engineering and Technology offers admission opportunities to all students qualified to complete any of its programs, as long as space for effective instruction is available. The school reserves the right, however, to give admission preference to those students whose legal residence is within the state of Indiana. Inquiries about admission as well as requests for admission applications should be addressed to the Office of Admissions, Cavanaugh Hall 129, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140.

Specific admission requirements to the programs in the School of Engineering and Technology are discussed elsewhere in this bulletin. Refer to the sections entitled "Undergraduate Engineering Programs," "Graduate Engineering Programs," and "Technology Programs" for specific information about admission.

Admission with Advanced Standing

Many prospective students may be eligible to begin their program of study in the School of Engineering and Technology at an advanced level. Eligibility for advanced standing will be established most frequently by transfer of credit from another college or university, by formal advanced placement courses in high school, by participation in the College Level Examination Program (CLEP), or by achievement of credit by examination.

Qualified applicants who have not previously attended another college or university may obtain specific information by writing the Office for Student Affairs, School of Engineering and Technology, 799 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5160.

Transfers

From IUPUI Schools, Indiana University Campuses, or Purdue University Campuses

Students desiring to transfer from these schools should have a minimum cumulative grade point average of 2.0 on a 4.0 scale and be in good disciplinary standing. (For direct admission to engineering programs, students must meet certain other requirements detailed in "Admission Requirements" in the undergraduate engineering section of this bulletin.) Students must follow the procedures listed below. After reviewing the transfer request and supporting materials, the school will inform students in writing of the acceptance or rejection of the application.

1. An IUPUI student must file a Student Record Change Form with the engineering and technology recorder of the School of Engineering and Technology or with the recorder of the student's current school. Filing the Student Record Change Form constitutes a request, not approval, for admission to a particular program.
2. A student at another Indiana University campus must file an Intercampus Transfer Form, which may be obtained from the office of the dean of the school and campus where the student is enrolled.
3. A Purdue University student from another campus must complete an official undergraduate application through the IUPUI Office of Admissions.
4. Students seeking admission who previously have been dismissed for academic reasons must petition the Faculty Committee on Readmission.
5. Students who transfer from another campus of Indiana University or Purdue University must complete a program of study that includes at least 32 credit hours for a baccalaureate and at least 15 credit hours for an associate degree at IUPUI. For the associate degree, at least 4 out of 15 credits are expected to be in the major. For the baccalaureate degree, at least 9 out of 32 credits are expected to be in the major at the junior level or higher.

From Other Colleges and Universities

Applicants transferring from colleges and universities other than Indiana University or Purdue University must fulfill the following requirements:

1. An application for undergraduate admission on the prescribed form, including a copy of high school records, must be submitted.
2. An official transcript of work done in all institutions previously attended must be forwarded. Failure to report enrollment at another institution on the admission application is basis for immediate termination from the School of Engineering and Technology.
3. For admission to an engineering or technology program, Indiana applicants must have a cumulative grade point average of at least 2.0 on a 4.0 scale and out-of-state applicants must have an average of at least 2.5 for all courses previously taken at a recognized college or university. Transfer credits are evaluated and distributed by the department in which the student enrolls.

4. Students must complete at least 32 credit hours in residence for a baccalaureate degree or at least 15 credit hours for an associate degree. For the associate degree, at least 4 out of 15 credits are expected to be in the major. For the baccalaureate degree, at least 9 out of 32 credits are expected to be in the major at the junior level or higher.
5. Individual academic programs may require transfer students to complete specific courses prior to admission with advanced standing, as well as meeting the additional departmental residency requirement.
6. Transfer students must be in good academic and disciplinary standing at the college (or colleges) previously attended. Students who have been dismissed for academic reasons by another college or university, or who have less than a 2.0 grade point average, may petition the Faculty Committee on Readmission for admission.

Prospective transfer students are encouraged to write or visit the School of Engineering and Technology. Credit for courses in the School of Engineering and Technology is usually given for work of equivalent character and amount successfully completed at another accredited college. Transfer credit is not granted for work done at those institutions not fully approved by a regional accrediting association of secondary schools and colleges. In addition to having regional association approval, certain programs may require accreditation by professional organizations and/or societies before credit will be considered for transfer. Credit will not be transferred from any institution whose regional accreditation designation is A/V (Associate/Vocational-Technical). The only exception to the above policy is when agreements exist that specify courses or blocks of credit that will transfer into specific Purdue University degree programs. Academic departments within a campus or individual campuses within the Purdue University system may elect to establish special agreements with another institution to accept credit for courses that otherwise might not be considered for transfer.

Graduates of unaccredited institutions, proprietary institutions, or institutions accredited only as occupational training institutions are encouraged to review their academic plans carefully before seeking advanced credit. If the student should change curricula in the process of transferring from another college or university, credits for certain courses may not be applicable toward requirements in the new curriculum.

To Other Indiana University Campuses
Indiana University credits transferred from one campus of Indiana University to another will be evaluated and accepted in terms at least as favorable as credits transferred from other accredited institutions in the United States. No review of the credits will be undertaken except in good faith terms with the same criteria used in evaluating external credits.

Second Degrees or Additional Major Fields

Requirements for a Second Degree
Holders of baccalaureate degrees who have additional academic objectives are generally encouraged to pursue appropriate graduate degree programs. Baccalaureate degree holders may, however, obtain special permission to enroll in programs at either the associate or baccalaureate degree level in the School of Engineering and Technology. Candidates must fulfill all academic requirements for the additional major field of study. Applicants for a second associate degree must complete at least 15 credit hours after admission to the second associate degree program; applicants for a second baccalaureate program must complete at least 32 credit hours after admission. For the associate degree, at least 4 out of 15 credits are expected to be in the major. For the baccalaureate degree, at least 9 out of 32 credits are expected to be in the major at the junior level or higher.

Students seeking an additional undergraduate degree must submit all college transcripts and a special application that is available from the engineering and technology recorder. The application must be approved before the student begins the degree program. If the student's first degree is from an institution other than IUPUI or another IU campus, the student must also file an undergraduate application for admission with the Office of Admissions, Cavanaugh Hall 129, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140.

Graduates from the School of Engineering and Technology may receive a second baccalaureate degree in any of the engineering or technology programs, as long as the second degree program does not result in the same diploma as the first degree. For this reason, technology graduates may not pursue additional degrees in any of the school's technology programs. They may, however, complete the equivalent of an additional major field as discussed below.

Requirements for an Additional Major Field (Technology Programs Only)
Graduates of any of the school's technology programs may desire to broaden their academic preparation to include courses typically taken by students completing degrees in a different major field. Although they may not earn an additional degree in any of the school's technology programs, a special notation can be added to the student's academic transcript indicating that an additional program of study, equivalent to an additional degree in another major field, has been completed.

To accomplish this, the student must obtain approval in advance from the School of Engineering and Technology and complete all of the same courses in a plan of study as do students who will earn the appropriate degree in that major field. The student may be required to complete a minimum number of credit hours that have not been used to fulfill requirements for any other major field of study or degree program. Approval is obtained in the manner noted above for students seeking to earn a second undergraduate degree.

Special Credit

Special credit by examination, by credentials, and/or by experience may be awarded in order to expedite the education of qualified students. Toward this end, each instructional department or division determines which of its courses are available for special credit by examination, by credentials, and/or by experience and establishes procedures to determine the eligibility of students, to administer the granting of special credit requests, and to grade the evaluation of these requests. The evaluations are as comprehensive as those given in the course and are graded as satisfactory (performance comparable to that expected of students who receive A through C– in the course) or unsatisfactory. Newly admitted students or currently enrolled students who have not received a grade or directed grade other than W (Withdrawal) in the course may request an examination for credit.

Responsibility for initiating a request for special credit in a specific course normally rests with the individual student. The student should confer in advance with the department chair, adviser, or course instructor to determine if consideration for special credit is warranted.

Admission of International Students

Applicants from foreign countries are considered for admission on the basis of credentials certifying the completion of secondary school. They are not required to take the Scholastic Assessment Tests (SAT) or the American College Test (ACT). Official translations must accompany transcripts and other credentials not written in English. The applicant must demonstrate adequate English proficiency for admission by submitting Test of English as a Foreign Language (TOEFL) results. A TOEFL score of at least 550 is required for regular admission to all programs offered by the School of Engineering and Technology. All international undergraduate students must take the IUPUI English as a Second Language (ESL) placement test before they can register for classes. They will be placed in language classes based on their performance on this examination. International student applicants must also furnish sufficient evidence of adequate financial support for the entire period of their schooling. International applicants should submit all credentials at least six months prior to the semester in which they seek to enroll.

Admission as a Nondegree Student

Adults who wish to study in any of the departments of the university without undertaking a regular plan of study and without becoming candidates for degrees may be admitted as nondegree students. Applicants must give evidence of prerequisite background for the course or courses in which they plan to enroll. Applicants who do not have baccalaureate degrees should apply to the Office of Admissions, Cavanaugh Hall 129, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140. Regardless of whether they plan to take undergraduate or graduate courses, applicants who have baccalaureate degrees should apply to the IUPUI Graduate Office, Union Building A203, 620 Union Drive, IUPUI, Indianapolis, IN 46202-5167; telephone (317) 274-4023.

Auditing Courses

Auditors are students who wish to take classes without receiving either credits or grades for these classes. Auditors may attend lecture classes when they have paid the appropriate fees and identified themselves as auditors to the instructor. Auditors are not admitted in courses with a laboratory component.

Graduate Admission

For information about admission to graduate programs offered by the School of Engineering and Technology, refer to the section entitled "Graduate Engineering Programs" in this bulletin.

Academic Advising and Counseling

Faculty, department chairs, and the Office for Student Affairs are available to provide information about programs of study and career opportunities in engineering and technology.

Students who are admitted to the School of Engineering and Technology are assigned an academic adviser in their major department. Before they meet with their adviser for initial counseling and registration, beginning and transfer students are required to participate in IUPUI's placement testing program. Faculty academic advisers are available in each department to assist students in planning their academic programs to meet graduation requirements. It is the student's responsibility to meet periodically with this adviser in order to ensure satisfactory progress toward an academic objective. Students may be required by many departments to confer with an adviser each semester to plan their course schedules.

Academic Regulations

Grades and Grade Reports

Students are responsible for the completion of all required work in each course in which they are enrolled by the last scheduled class meeting, unless course assignments have been properly cancelled. Students receive a grade in each course in which they are enrolled at the close of the session. Grades indicate student achievement with respect to the objectives of the course, and instructors are required, by action of the Faculty Senate, to record the grade a student has earned in a course. Grades that have been officially recorded will be changed only in cases of instructor error or subsequent finding of student academic dishonesty.

Basis of Grades

The School of Engineering and Technology uses a grading system that may include plus and minus grades as well as straight letter grades for all undergraduate and graduate courses. These grades and their grade point values are indicated below.

1. For credit courses:

A	4.0	C	2.0
A–	3.7	C–	1.7
B+	3.3	D+	1.3
B	3.0	D	1.0
B–	2.7	D–	0.7
C+	2.3	F	0.0 (no credit)

2. For credit courses taken under the Pass/Fail option:
   P: Pass; equivalent to grade A through D– (no grade point value assigned).
   F: Failure; failure to achieve minimal objectives of the course. The student must repeat the course satisfactorily in order to obtain credit for it.
3. For noncredit courses including thesis research but not including laboratory portions of courses in which, for purposes of scheduling, separate course designations are used for the laboratory sections:
   S: Satisfactory; meets course objectives (no grade point value assigned).
   F: Unsatisfactory; does not meet course objectives.
4. Incomplete, Deferred, or Withdrawal grades for credit or noncredit courses (no grade point value assigned):
   I: Incomplete, no grade; a temporary record indicating that the work is satisfactory as of the end of the semester but has not been completed. The grade of Incomplete may be assigned only when a student has successfully completed at least three-fourths of the work in a course and unusual circumstances prevent the student from completing the work within the time limits previously set. An instructor may require the student to secure the recommendation of the dean that the circumstances warrant a grade of Incomplete. When an Incomplete is given, the instructor will specify the academic work to be completed and may establish a deadline of up to one year. If the student has not completed the required work by the end of the following year, the registrar will automatically change the I to an F.
   R: Deferred; a grade given for those courses that normally require more than one academic session to complete, such as project, thesis, and research courses. The grade indicates that work is in progress and that the final report has not been submitted for evaluation.
   W: Withdrawal; a grade of W shall be recorded on the final grade report.

Withdrawing from Classes

During the first half of a semester or session, students may officially withdraw from classes without penalty if they obtain the approval of their adviser. During the third quarter of a semester or session, students may withdraw from classes if they obtain the approval of their adviser and the appropriate instructors; during the last quarter of the semester, students will be allowed to withdraw from classes only under extenuating circumstances. At that time they must obtain the approval of the appropriate instructors, their adviser, and the dean, and must also present a written justification from a doctor, member of the clergy, adviser, etc. The fact that a student merely stops attending a class will not entitle the student to a grade of W.

Pass/Fail Option

To provide students with the opportunity to broaden their education with minimal concern for grades earned, an alternate grading system, the Pass/Fail option, is permitted for a limited portion of the required credit hours. The following general rules are currently applicable; individual departments may impose further restrictions. For example, courses taken under Pass/Fail option and courses taken by correspondence may not be used to fulfill graduation requirements for engineering students.

1. Subject to the regulations of divisions or departments, students may elect this option in any course that does not already appear on their academic record and in which they are otherwise eligible to enroll for credit with a letter grade. Students may elect this option for not more than 20 percent of the total credit hours required for graduation.
2. Students who are enrolled in a course under this option have the same obligations as those who are enrolled in the course for credit with a letter grade. When instructors report final grades in the course, any student who would have earned a grade of A through D– will receive a P, and any student who has not passed will receive an F. The registrar will make an appropriate notation on the student's academic records in place of a letter grade, but will not use the course in computing the grade point average unless the student receives a failing grade.
3. This option is not available to students on probation.
4. This option is available for a maximum of two courses in any one semester and one course during a summer session.
5. Consistent with the policy of the School of Engineering and Technology, students receiving the grade of Pass in a course taken under the Pass/Fail option may not retake the same course for a letter grade.

These rules are general or minimum guidelines for those electing this option. There are certain specific limitations on registration for the Pass/Fail option. This option may be elected only during continuing student registration, late registration, and the drop/add period at the beginning of a semester or session. Changes from letter grade to Pass/Fail and vice versa may not be made after the second week of classes during the regular semester or after the first week of classes during the summer sessions.

Good Standing

For purposes of reports and communications to other institutions and agencies and in the absence of any further qualification of the term, students are considered in good standing unless they have been dismissed, suspended, or dropped from the university and have not been readmitted.

Scholastic Indexes

The scholarship standing of all regular students enrolled in programs leading to an undergraduate degree is determined by two scholastic indexes: the semester index and the graduation index.

Semester Index

The semester index (semester grade point average) is an average determined by weighting each grade received (4.0 for an A, 3.7 for an A–, etc.) during a given semester and multiplying it by the number of credit hours in the course, adding up all the figures, and then dividing the sum by the total number of course credit hours obtained during that semester. Grades of P and S are not included in the computation; grades of F are included. The cumulative semester index is the weighted average of all courses taken by a student, except those to which the FX policy is applied. See "Repeated Courses (FX Policy)" in this bulletin.

Graduation Index
The graduation index (degree grade point average) is the weighted average of grades in only those courses that are used to meet the graduation requirements for the program in which the student is enrolled. When a student retakes a course with the adviser's approval or later substitutes a substantially equivalent course for one previously taken, only the most recent course grade is used by the school in calculating the graduation index. Since certain courses previously completed by the student may on occasion be omitted from a program of study, the graduation index and the cumulative semester index may differ.

Graduation Index Requirements

For all baccalaureate degrees in the School of Engineering and Technology, a minimum graduation index of 2.0 is required for graduation. Candidates for graduation from engineering programs must also have an index of 2.0 for all required engineering courses.

For the Associate in Applied Science degree, a minimum graduation index of 1.9 is required for graduation.

Academic Probation and Academic Dismissal

Academic standards for retention and dismissal are established by the faculty for each specific academic program. Therefore, a student is subject to the regulations applicable to all students enrolled in a particular program at the time of registration. If students are experiencing academic difficulty, they are encouraged to consult their academic adviser.

Students will be notified by letter from the Office of the Dean, School of Engineering and Technology, when they are placed on academic probation. The letter will also inform the student of the conditions that must be met for removal from academic probation. Students who are dismissed for academic reasons will also be notified by a letter from the Office of the Dean.

The following standards are currently applicable for students enrolled in the School of Engineering and Technology.

Academic Probation
Full-time students are automatically on academic probation when either the cumulative semester index or the semester index is below 2.0 (C). Part-time students are automatically on academic probation when either the cumulative semester index or the grade point average for the last 12 credit hours of consecutive enrollment is below 2.0 (C).

Students who, in subsequent enrollments, do not improve significantly may receive a letter stating that they will be subject to dismissal if an index of 2.0 (C) or higher is not earned in the current enrollment period. Such students may be placed on the academic checklist and may not be permitted to register in advance for a subsequent semester. This determination is made by the faculty after a review of the individual student's academic record. These students may register during final registration after grades are posted and a checklist clearance has been obtained from the assistant dean for student affairs.

Removal from Probation
Students are removed from academic probation when they complete 12 credit hours of consecutive enrollment with a minimum grade point average of 2.0, provided their overall grade point average is also above 2.0.

Academic Dismissal
Full-time students are subject to dismissal when they fail to attain a 2.0 semester grade point average in any two consecutive semesters or when their cumulative semester index has remained below 2.0 (C) for any two consecutive semesters. Part-time students are subject to dismissal when their cumulative semester index or grade point average for the last 18 credit hours of consecutive enrollment is below 2.0 (C).

Readmission

A student who has been dropped for scholastic deficiency may petition the Faculty Committee on Readmission for readmission. If readmitted, the student will be placed on probation. Students may contact the particular department for specific rules and regulations.

Repeated Courses (FX Policy)

An undergraduate student who retakes and passes a course previously failed may elect to have only the final passing grade counted in computing the cumulative semester index, in accordance with the limitations listed below. In retaking the course, students must receive a grade of A through D– or a grade of S to remove the original F grade. After retaking the course, the original

grade of F will be replaced by the grade FX on the transcript. The student's transcript, however, will continue to show the original enrollment in the course and all grades earned for each subsequent enrollment. This policy is subject to the following limitations:

1. Students may exercise the FX option for no more than three courses, totaling no more than 10 credit hours.
2. Students may use the FX option only once in a given course.
3. Students who plan to use the FX option must inform the engineering and technology recorder when they have satisfactorily retaken the course.

Under this policy, only the grade of F can be replaced in the cumulative semester index with a subsequent passing grade. All passing grades (D– through A) are included in the cumulative semester index, even if a student retakes a course. However, in computing the graduation index, the grade point average of courses required by a program of study for graduation, the school includes only the most recent grade earned when the course has been attempted more than one time.

Scholarships and Awards

The faculty cooperate in nominating students for a variety of annual awards offered by departments in the School of Engineering and Technology and by other organizations.

Dean's Freshman Scholarships
These $500 scholarships are awarded each fall to entering freshmen in each of the departments of the School of Engineering and Technology. Selection criteria vary from department to department. Students interested in applying for these scholarships should contact the Office for Student Affairs, School of Engineering and Technology, 799 W. Michigan Street, Indianapolis, IN 46202-5160.

Minority Engineering Advancement Program (MEAP) Scholarships
Awards are available to full-time and part-time students who are African American, Hispanic, or American Indian and who are enrolled in appropriate engineering or engineering technology programs in the school. These are renewable awards that range from $200 to $400 or more per semester. Students interested in applying for a MEAP scholarship should contact the director of the Minority Engineering Advancement Program, Office for Student Affairs, 799 W. Michigan Street, Indianapolis, IN 46202-5160.

Outstanding Woman Scholar Award
This $500 scholarship recognizes superior achievement by a woman enrolled in the School of Engineering and Technology. Students are nominated for this award by their departments.

Departmental Awards
A number of scholarships and awards are available each year through the departments in the School of Engineering and Technology. These include awards for outstanding associate and baccalaureate degree recipients, as well as memorial, endowed, and externally funded scholarships. Students should contact their departments for information about these awards.

The School of Engineering and Technology also recognizes faculty, staff, and alumni for their outstanding accomplishments. The special awards established for this purpose are as follows:

Frank E. Burley Distinguished Professorship Award
This annual award was established in 1985, in honor of Professor Emeritus Frank E. Burley. Professor Burley joined the School of Engineering and Technology in 1968 after a career spanning 29 years as an engineer and, later, as manager of product engineering at Western Electric Company, Indianapolis. A faculty member in the Department of Electrical Engineering Technology, Professor Emeritus Burley has continued to serve his department long after his retirement in 1978. The recipient is selected to receive this award by a committee of full professors.

The Wisner-Stoelk Outstanding Faculty Award
In the academic year 1974-75, the School of Engineering and Technology initiated an annual award for the outstanding faculty member. This award was designated the Wisner-Stoelk Outstanding Faculty Award the following academic year in honor of Professors Howard L. Wisner and Herman C. Stoelk, who retired in 1976 after many years of dedicated service to the school. Selection is based on a secret ballot taken among the student body in the school each year. The formal announcement is made each year at the Honors Convocation.

The Abraham M. Max Distinguished Professorship Award
This award was established in 1991 to honor Professor Emeritus Abraham M. Max, who was the first chair of the Division of Engineering. Every year a professor is recognized for outstanding achievements in research. The recipient is selected to receive this award by a committee of full professors.

The Distinguished Staff Award
This award was established in 1991 in honor of its first recipient, Lucille Payton, administrative assistant to the dean. The award recognizes and rewards staff members for their dedication and exceptional service to the students, faculty, and staff of the School of Engineering and Technology.

Distinguished Alumni Award
The Distinguished Alumni Award was established in 1983. This award is presented by the school to a graduate of the School of Engineering and Technology in recognition of outstanding achievement in the field of engineering or technology, in the practice of the profession, or in service to the community.

Scholastic Recognition

Dean's List

At the conclusion of each semester, the recorder of the School of Engineering and Technology indicates which undergraduate students were distinguished in their scholastic work as indicated by the grades they received at the close of the semester. The names of these students are suitably publicized. In order to be recognized on the School of Engineering and Technology Dean's List for a given semester, students must meet all the following requirements:

1. Earn a semester grade index of 3.5 or higher;
2. Complete successfully all courses in which they were enrolled with a grade of P, C, or better in each course;
3. Complete at least 6 credit hours for a letter grade;
4. Complete a minimum of 15 credit hours while registered as a student in the School of Engineering and Technology, including the credit hours earned in the semester under consideration;
5. Earn a semester grade point average that places the student in the top 10 percent of all students in their department or division who have completed at least 6 credit hours for a letter grade that semester.

The School of Engineering and Technology Dean's List is not compiled for summer sessions.

Graduation with Distinction

By awarding degrees "With Distinction" or "With Highest Distinction," the School of Engineering and Technology recognizes the outstanding scholastic achievement of selected associate and baccalaureate degree candidates.

Distinction at graduation is awarded on the basis of all course work taken for letter grades. Individuals must complete all the requirements for their field of study and meet the following requirements:

1. A candidate for the baccalaureate degree with distinction must have earned at least 65 hours of credit at Purdue University or Indiana University. A candidate for an associate degree with distinction must have earned at least 35 hours of credit at Purdue University or Indiana University.
2. Honors are awarded according to the following cumulative semester grade point averages:
   3.500-3.849—With Distinction
   3.850-4.000—With Highest Distinction.

Students who are awarded their degrees with distinction receive corresponding diplomas and are given special recognition during the annual commencement exercise.

Graduation Requirements

Graduation requirements vary according to degree program. See the sections entitled "Undergraduate Engineering Programs," "Graduate Engineering Programs," and "Technology Programs" in this bulletin for specific information about graduation requirements.

Expenses and Financial Aid

University Fees

All fees are due and payable by the due date on the student's schedule confirmation and are subject to change without notice by action of the Trustees of Indiana University. A complete listing of all fees is published for each term in the class schedule.

The following table shows the fee structure for courses in this school at the time of publication of this bulletin.

Rates per Credit Hour	Indiana Residents	Out-of-State Students
Undergraduate	$80.50	$242.60
Graduate	$107.85	$311.05

Extra laboratory fees may be charged when laboratory instruction is required.

A resident undergraduate student would typically pay approximately $1,600 in tuition fees, books, and supply costs for an average full-time semester.

Late Enrollment and Late Program Change Fees

All classes are considered closed following final registration for a specific term. Schedule changes after that date are considered a special privilege and require special authorization and an additional fee. The student should refer to the appropriate class schedule for a listing of these charges.

The School of Engineering and Technology will not allow any student to register after expiration of the 100 percent refund period. (See "Refunds" in this section of the bulletin.)

Residency Status

The criteria for establishing in-state residency and thus qualifying for in-state fee rates are very strict. Inquiry about establishing resident status for fee purposes should be made to the registrar, who is the proper source of information. Contact the Office of the Registrar, Cavanaugh Hall 133, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140; telephone (317) 274-1501.

Special Examination Fees

The Trustees of Indiana University have approved the following fee structure for special credit.

1. If the credit is awarded as a result of an examination within the first three semesters following matriculation, there is no charge.
2. If the credit is awarded as a result of an examination and the student is a first-semester transfer student, there is a $12.00 charge per credit hour.
3. If the credit is awarded as a result of an examination and the student does not meet any of the above conditions, the charge per credit hour is at the regular resident or nonresident rate.
4. If the credit is awarded as a result of experience or credentials, the student will be charged $12.00 per credit hour with a maximum charge of $60.00.

Auditing Fees

Students who desire an official record of auditing a particular course will be charged full tuition. Written permission from the instructor must be obtained before a student may register to audit. Courses that consist of both lecture and laboratory or laboratory only may not be audited.

Other Fees

Students may also be required to pay a technology fee, an activity fee, and special fees for the following services: housing, locker rental, parking, recreation, and student identification card, depending on enrollment status and anticipated use. A complete listing of special fees is provided each term in the IUPUI *Schedule of Classes*.

Payment Procedures

Payments must be made in cash or by bank draft, express order, postal money order, traveler's check, personal check, MasterCard®, Visa®, or Discover® for the exact amount of fees due at the time of registration. No check for a greater amount will be accepted. All payments must be made to the bursar at the registration site. Students who register before or during final registration may be able to pay fees using the two-installment option. For information about this option, refer to the IUPUI *Schedule of Classes*.

Credit Cards

Students may use MasterCard®, Visa®, or Discover® for payment of university fees and housing. Both Visa® and MasterCard® are accepted by the IUPUI bookstores. In the event that a student under age 21 wishes to use one of the above credit cards belonging to a parent, bank regulations require prior authorization by the parent.

Refunds

Refunds for fall and spring semesters are based on the date of the official withdrawal application as follows.

1. For withdrawal during the first week of classes or through the drop/add period—100 percent refund.
2. For withdrawal during the second week of classes—75 percent refund.
3. For withdrawal during the third week of classes—50 percent refund.
4. For withdrawal during the fourth week of classes—25 percent refund.
5. For withdrawal during the fifth week and thereafter—NO REFUND.

To be eligible for a refund, the student must officially notify the Office of the Registrar at the time of withdrawal. Refund information for summer sessions is published in the IUPUI *Schedule of Classes*.

Financial Aid

It is the philosophy of IUPUI to encourage students in their educational goals and to reduce financial barriers. IUPUI recognizes that many students and their parents cannot afford to finance a college education entirely from their own income and assets. For this reason, a program of financial assistance is available to admitted and enrolled students who have a demonstrated financial need. Aid is available in the form of scholarships, grants, and loans.

Students desiring further information about any of the following financial aid programs should write to this address:

Office of Scholarships and Financial Aid
Cavanaugh Hall 103
425 University Boulevard
IUPUI
Indianapolis, IN 46202-5140
Telephone: (317) 274-4162

Application Procedures

Potential financial aid recipients must complete the IUPUI Application for Scholarships and the Financial Aid Form (FAF), both of which are available from the Office of Scholarships and Financial Aid. The application deadline for any summer session and the next academic year is March 1, although applications will be processed as long as funds are available. Students who apply late should anticipate finding other funds with which to pay for tuition and books until their financial aid applications are processed.

Eligibility

Financial aid awards are given on the basis of need as determined by the information supplied on the FAF. IUPUI students enrolled for 6 or more credit hours are eligible if need is demonstrated. The amount of the award will be less for part-time students than for full-time students; full-time student status is considered to be 12 or more credit hours. Only regularly admitted students and transient students from Purdue University are eligible.

Types of Aid

Financial aid is generally offered as a package consisting of a combination of scholarships, grants, loans, and/or work-study awards, although awards may vary with individual students. All awards are subject to the availability of funds.

Scholarships
Scholarships are awarded on the basis of academic achievement. Sources of scholarships may be both inside and outside IUPUI. Scholarship awards are generally not based on need and are not subject to repayment by the student.

Merit Scholarships
Each year IUPUI awards a number of merit scholarships to individuals who maintain an academic grade point average of 3.5 or above. Both full- and part-time students are eligible. In order to obtain a merit scholarship, students must submit an application to the IUPUI Office of Scholarships and Financial Aid by March 1.

Grants
Grants are awarded on the basis of need only and are not subject to repayment by the student.

Student Loans
Several different student loan programs are available at IUPUI. Some are based on financial need; some are not. Interest rates and maximum awards vary by program. Contact the Office of Scholarships and Financial Aid for details.

Part-Time and Summer Employment

Many students who attend IUPUI are able to earn part of their expenses through part-time and summer employment. The IUPUI Office of Career and Employment Services, Business/SPEA Building 2010, 801 W. Michigan Street, (317) 274-2554, offers assistance in locating part-time jobs and maintains current information regarding part-time employment opportunities. Students should contact this office for further information concerning employment assistance.

Work-Study Program

The Federal College Work-Study Program available at IUPUI was established by the Higher Education Act of 1965. The primary purpose of the program is to provide eligible students with work opportunities that will complement their academic programs and career aspirations. Students who have been admitted to IUPUI may apply through the Office of Scholarships and Financial Aid.

Veterans Benefits

Students eligible for education benefits from the Veterans Administration enroll according to the following benefits scale:

Undergraduate Benefits	**Fall & Spring Semesters**	**Summer I & II[1]**
Full time	12 cr. or more	6 cr.
Three-quarters time	9-11 cr.	5, 4 cr.
One-half time	6-8 cr.	3 cr.
Tuition only	Fewer than 6 cr.	1 cr.

Graduate Benefits	**Fall & Spring Semesters**	**Summer I & II[1]**
Full time	8 cr. or more	4 cr.
Three-quarters time	5-7 cr.	3 cr.
One-half time	4 cr	2 cr.
Tuition only	Fewer than 4 cr.	1 cr.

Further information on benefits, including Veterans Administration paid tutorial assistance and work-study opportunities, is available from the veterans affairs representative at the Office of the Registrar, Cavanaugh Hall 133, 425 University Blvd., IUPUI, Indianapolis, IN 46202-5144 [(317) 274-1521 or (317) 274-1522].

[1]See the veterans affairs representative at the Office of the Registrar to discuss benefits for summer sessions.

Campus Resources and Student Services

Adaptive Educational Services (Formerly Disabled Student Services)

IUPUI recognizes the needs of students with disabilities. Support services, such as note takers, tutors, or readers, are available for those students determined eligible.

For further information about support services or the preadmission orientation for students with disabilities, contact the Office of Adaptive Educational Services, Cavanaugh Hall 001C; telephone (317) 274-3241. Office hours are 8 a.m. to 5 p.m., Monday through Friday. If necessary, special arrangements can be made for evening appointments.

Audiovisual Facilities

Media equipment for classroom and laboratory use is available in the Instructional Technology Service Center, located in Education/Social Work Building 2130. Faculty members may order, deliver, and pick up equipment, videotapes and films, supplies, and materials from this location. The equipment service is available to students who have a signed approval form from the Office of Student Activities. Students needing audiovisual equipment should contact the Office of Student Activities, telephone (317) 274-3931.

Individual Learning Centers, with study carrels equipped with video, audio, and slide-viewing equipment, are available in Cavanaugh Hall 421. This center is open for student, faculty, and staff use.

For further information about media facilities and production services, as well as campus broadband and electronic classrooms, call the Office of Learning Technologies at (317) 274-8964.

Campus Housing

Residential housing for IUPUI is located on the main campus and is managed by the Department of Campus Housing, Ball Residence 107, 1226 W. Michigan Street, Indianapolis, IN 46202-5179. Admission to the university does not guarantee campus housing accommodations at IUPUI. Students must file separate applications for housing in order to reserve spaces and should apply as soon as they decide to attend school at this campus; housing applications can be submitted even though the student has not yet been admitted. Assignments are made based on the date of receipt of the application and the $15 application fee. Waiting lists may exist for certain types of accommodations. Students interested in living on campus may apply to live in Ball Residence, the International House, Warthin Apartments, or the Graduate Townhouse Apartments. Accommodations for students with disabilities are available. The Campus Housing office also functions as a resource for off-campus accommodations. For additional information, contact the Department of Campus Housing at the above address or telephone the office at (317) 274-7200.

Career and Employment Services

Departmental chairs and academic advisers can provide information about career opportunities in specific fields.

The IUPUI Office of Career and Employment Services, located in Business/SPEA Building 2010, 801 W. Michigan Street, (317) 274-2554, assists students and alumni in obtaining employment. The office maintains a library of company information, employment trends, and occupational information and counsels students about career planning and placement. The office also maintains lists of summer and part-time employment opportunities.

Companies interested in employing college graduates interview students on campus September through November and January through March. A list of firms and institutions that will visit the campus is published and circulated early in the fall semester. Students interested in interviewing with a company should register with the Office of Career and Employment Services. The office also serves as a referral agent to many companies and organizations.

Students enrolled in the School of Engineering and Technology can receive additional placement assistance and enroll in the Co-op Program through the school's Office for Student Affairs. The Office for Student Affairs, located in Engineering and Technology Building 1211, 799 W. Michigan Street, (317) 274-2533, assists students with career-related decisions, including cooperative education, student employment, and placement. Students undecided on a career can obtain information about salaries, future outlook, and the job market for graduates in the fields of engineering and technology. Seniors in the School of Engineering and Technology may register with the Purdue University Placement Office in West Lafayette through the Office for Student Affairs.

Child Care

The IUPUI Child Care Center is located at 525 N. Blackford Street. The center is open from 6:30 a.m. to 6:00 p.m., Monday through Friday, and operates by reservation only. For further information call (317) 274-3508. The center operates year-round.

Counseling and Psychological Services

Counseling and Psychological Services offers individual counseling, psychological testing, and group counseling services for students, faculty, and staff. All counseling, interviews, and records are confidential. The staff includes counseling psychologists, professionally trained counselors, and interns. For further information or to make an appointment, call (317) 274-2548 or visit the office in Union Building 330, 620 Union Drive.

Health Care and Insurance

All IUPUI students may receive medical care in Student Employee Health Service on a fee-for-service basis. All labs, X rays, and referrals will be the responsibility of the student. Student Employee Health Service is located on the first floor of Coleman Hall; telephone (317) 274-8214 or 274-1015. The hours are 8:30 a.m. to 5:00 p.m., Monday through Friday. Applications for health insurance are also available from this office.

Honors Programs

The IUPUI Honors Program provides the opportunity for eligible students to enrich their undergraduate education by challenging their scholastic abilities and realizing their scholastic potential. Entering students who graduated in the top 10 percent of their high school class and who have a combined SAT score of 1200 or better, and IUPUI or transfer students who have completed 12 credit hours and have earned a 3.3 or higher grade point average on a 4.0 scale, are eligible for honors work. A student with a grade point average of less than 3.3 may be permitted to take honors courses with the consent of the director of the Honors Program. For further information, contact the IUPUI Honors Program, Education/Social Work Building 2126B, 902 W. New York Street, IUPUI, Indianapolis, IN 46202-5154; telephone (317) 274-2660.

Office of Integrated Technologies

A *Student Guide to Integrated Technologies* details useful information for students regarding services available on the campus through the Office of Integrated Technologies. This guide is available in Engineering and Technology 1021, and contains information about the following services.

Public technology clusters contain both IBM and Macintosh computers and give students access to mainframe computers as well as to microcomputer word processing, spreadsheet, and data base programs. Consultants are available in the clusters for help in using the systems, resolving problems, and using the cluster software.

The **Integrated Technology Center,** located in Cavanaugh Hall 421, contains media-equipped study carrels for students, faculty, and staff. The equipment includes audio, video, synchronous sound-slide, and related items. The center houses lecture and language tapes for use on the premises. The center is open during working hours on weekdays with evening hours Monday through Thursday as well as Saturday hours.

Students may apply for their own user ID that will allow them to use **electronic mail** for as long as they are at IUPUI. Request forms are available in Engineering and Technology 1023 and 1030.

Free technology classes offered under the TIPS program ("today's information processing skills") help students learn the basics of using DOS, word processing on the Macintosh or IBM, electronic mail, and data base or spreadsheet programs, as well as the library and student services systems. Students may enroll in TIPS classes in Engineering and Technology 1023 from 8 a.m. to 5 p.m., Monday through Friday.

Quick Docs, free handouts on the basics of technology, are available at the general consulting office in Engineering and Technology 1030. A list of available Quick Docs is posted in each cluster.

Access Point is a membership organization available to all students, faculty, and staff. Access Point functions as a microcomputer resource center and provides members with a variety of services: laser printing, graphics and text scanning, public domain software libraries, evaluation copies of commercial software packages, demonstration computers, purchasing plans, and assistance with computer system selection. Students are welcome to join for a nominal fee of $15 per year. Access Point is located in Engineering and Technology 1030D.

The **Instructional Technology Services Center**, Cavanaugh Hall 421, telephone (317) 274-4510, serves as the coordination center for audiovisual services for faculty and students. Students may purchase a course audio for a nominal fee. They may also arrange to use audiovisual equipment for a course presentation with an instructor's approval. The center has both daytime and evening hours.

Production services, including video and audio production, photography services, photo lab processing, and preparation of graphics, are also available. These services are available only to individual students or student groups when prior approval has been obtained from the Office of Student Activities, telephone (317) 274-3931.

Office of International Affairs

The Office of International Affairs, located in the south wing of the Union Building in Room 207, provides the following services to IUPUI students:

- admissions processing for all international applicants and for permanent resident applicants with less than two years of study in a U.S. high school (a special international application is required for undergraduate students);
- nonimmigrant documentation for international students;
- orientation activities for all incoming international students and interested permanent residents;
- advising for international students on nonimmigrant regulations, employment authorization, university procedures, housing, and adjustment to life in Indiana; and
- advising about study abroad opportunities for domestic students.

To obtain information about international admissions to IUPUI or other services provided by the Office of International Affairs, call (317) 274-7294 or visit the office in Union Building 207, 620 Union Drive, IUPUI, Indianapolis, IN 46202-5167.

Libraries

The IUPUI library system is composed of five separate libraries open to all students enrolled at the university and to all Indiana residents. These libraries are located at the dental school, the Herron School of Art, the Michigan Street campus, the law school, and the medical school. The School of Education also maintains a curriculum resource center. The dental, Herron, law, and medical libraries contain specialized collections reflecting their respective curricula. The University Library on Michigan Street covers the liberal arts, social sciences, business, education, journalism, physical education, the sciences, engineering, and technology and is the general undergraduate library at IUPUI. Online and CD-ROM data bases are available for searching. Specialized microfiche collections are available in artificial intelligence, robotics, and CAD/CAM. Since procedures among the different libraries vary slightly, students should consult with personnel at the library's main desk before checking out books and other materials.

Military Officer Training

The U.S. Army Reserve Officers' Training Corps (ROTC) program is available for all students. Two-, three-, and four-year scholarships are awarded on a competitive basis. Army ROTC scholarships will pay most tuition and on-campus educational expenses as well as a flat rate for textbooks, classroom supplies, and equipment. In addition, an allowance of up to $1,000 each school year is given. Army scholarships are targeted toward engineering students. Students may enroll in the ROTC program on a voluntary or exploratory basis during the first two years. Books and supplies are provided; tuition is free; and elective credit hours are awarded for the freshman and sophomore military science classes. Students do not incur any military commitment until enrollment in the third-year course or upon acceptance of an ROTC scholarship. Advanced placement in military science is available for veterans, members of the Army Reserve or National Guard, and students with three to four years of high school ROTC. ROTC Advanced Course students receive a tax-free living allowance of $2,000. Students who are members of the Army Reserve or National Guard can become ROTC cadets and receive the benefits from the two programs. Completion of the program leads to a commission as a second lieutenant in either the Active Army, Army Reserve, or National Guard. For further information contact the ROTC office at 630 W. New York Street, Indianapolis, IN 46202-2887; telephone (317) 274-2691.

Office of Multicultural Student Affairs

The Office of Multicultural Student Affairs seeks to reflect and/or complement IUPUI's goal of equal access to all students. A major goal of the office is to promote ethnic and cultural harmony within the university community and to ensure that there is open communication, a solid foundation for cultural understanding, and an appreciation of individual differences.

The mission of the Office of Multicultural Affairs is to maximize the educational and cultural experiences of all students and to ensure that students from underrepresented groups within the student population are fully integrated into the fabric of the university.

Minority students enrolled in the School of Engineering and Technology may receive additional services through the school's Minority Engineering Advancement Program (MEAP), described in the section entitled "Special Resources of the School of Engineering and Technology" in this bulletin.

Parking Facilities and Privileges

IUPUI recognizes that students in the city use cars. It therefore issues permits for parking, indicating by letter the privileges to which an individual is entitled. All parking areas and facilities on campus are classified by letter codes, and letter signs are located at the entrance to each area. Students are required to prominently display as directed an appropriate permit at all times when parked on university property. Individuals who park in spaces designated for the physically impaired or in reserved parking areas will be towed. Parking regulations are enforced at all times.

Parking registration forms are available at Parking and Transportation Services, 1004 W. Vermont Street, and at regular student registration locations. In accordance with the university's policy on refunding academic fees upon withdrawal from school, a student may receive a parking permit refund upon return of an unexpired permit.

Parking fees for students are as follows and may be paid at the time of registration:

Fall and spring semesters (flat fee)	$23.50 per semester
Summer sessions	$9.00 per session
Garage parking	$68.60 per semester

Fees are reviewed on an annual basis. Changes in student fees take effect with the fall term. Please check the IUPUI *Schedule of Classes* for current rates.

Parking for People with Disabilities
A person who has a physical disability may be eligible for a special parking permit during the period of the disability. Students may request these permits at Parking and Transportation Services. The fees are the same as for regular surface parking fees.

Placement Testing Program

The IUPUI Testing Center provides placement testing for all new beginning students and transfer students. Prior to course counseling and registration, students are required to complete English, mathematics, and reading tests to facilitate academic advising and selection of courses. The IUPUI Testing Center is located in Union Building 129, 620 Union Drive; telephone (317) 274-2620.

The English test consists of an essay. The mathematics test includes whole number operations, fractions, decimals, exponents, algebraic expressions, equation simplification, factoring, geometry, trigonometry, and progression. The reading test is divided into two sections: vocabulary and comprehension of a written passage. Engineering students should inquire about additional mathematics testing.

Participation in this placement testing program is mandatory for all students in the School of Engineering and Technology.

University Writing Center

The University Writing Center provides tutoring for all kinds of writing needs, a workshop series on subjects ranging from sentence construction to organization of a paper, and a hotline service for telephone inquiries. Its staff consists of faculty and English majors who serve as tutors. Students are encouraged to use the center's services in Cavanaugh Hall 427, 425 University Boulevard, (317) 274-2049.

Special Resources of the School of Engineering and Technology

Computer Network Center (CNC)

R. Bruce Renda *(Director)*

The Computer Network Center was established in 1983 as the CAD/CAM Center to serve the computing needs of approximately 100 faculty and staff and 3,700 students in the School of Engineering and Technology.

The current network of computers consists of approximately 300 DOS-based machines and 100 SUN workstations on 15 distinct networks (seven departmental and eight student labs) in two separate buildings. DOS machines available in student labs include IBM X86 machines. Some of the SUN workstations are used as X-terminals, allowing them to utilize the power of the central server (described below) and providing students and faculty with a UNIX environment for higher powered applications than can be accommodated in the DOS world. The DOS-based machines run a network package using the NFS network protocol, which allows them, in turn, to share files with the UNIX-based server.

Each of these networks is tied to the school backbone (the central conduit for data) by an Intel X86 class machine serving as a network bridge. The network bridge isolates a machine from the global traffic on the backbone, yet allows the flow of packets when connection outside the local network is requested. The segments of the backbone all lead to the one central server, a SUN 4/670 MP 4 processor machine configured to handle this type of load. This machine currently has about 3 GB (gigabytes) of storage on line, and two network coprocessors that help handle the network load. The backbone supports the TCP/IP and NFS/UDP/IP along with all of their upper-level applications.

This system, sometimes referred to as client-server, combines the power of distributed computing with the benefits of centralized storage. Expanded capabilities have permitted the creation of accounts for students that remain theirs as long as they are enrolled in school. Students and faculty are no longer limited to working in one lab or office, since they can access their files from any office, lab, or even at home or other locations if they have dial-up capabilities.

Computational Biomechanics Laboratory

The Computational Biomechanics Laboratory was established in 1990 within the Department of Mechanical Engineering to conduct research in biomechanics jointly with the Indiana University Schools of Medicine and Dentistry at IUPUI. The laboratory is equipped with SUN Sparc/1+ and Sparc 2 workstations, a Macintosh II microcomputer, a Macintosh Laser Writer II laser printer, and Hewlett Packard PaintJet XL color printers. PATRAN geometric modeling and finite element mesh generation, and ABAQUS finite element analysis programs, are used at the laboratory for modeling of biological systems. Current research topics include mechanics of temporomandibular joint, bone fatigue and fracture, and modeling and remodeling of bones.

Computational Fluid Dynamics Laboratory

Akin Ecer *(Director)*

The Computational Fluid Dynamics Laboratory was established in 1986 within the Department of Mechanical Engineering to conduct research in the area of computational fluid dynamics and heat transfer. The laboratory is supported through research grants. Current research projects include the finite element solution of three-dimensional flow problems, high speed compressible flow calculations for internal and external flows, unsteady flows computations, and the application of parallel computers in computational fluid dynamics.

The laboratory is equipped with an Intel Computer (iPSC1), IBM and SUN workstations, and computer terminals to provide access to the IBM and VAX computers of the Indiana University computing network. Access is also available to the NASA computers at Ames and Lewis Research Centers, the IBM Research Center at Kingston, NY, and the iPSC/860 parallel computers at Intel, Portland.

Electronics Manufacturing Productivity Facility (EMPF)

Gary L. Burkart *(Executive Director)*

The Electronics Manufacturing Productivity Facility (EMPF) was established in 1984 under the sponsorship of the Naval Material Command to perform applied research and development in manufacturing processes. In 1990 it relocated to Indianapolis, expanded to include the

sponsorship of IUPUI, and was designated a National Center for Excellence. The EMPF operates under a cooperative research and development agreement with IUPUI; the Naval Air Warfare Center, Aircraft Division, in Indianapolis, IN; the Naval Surface Warfare Center, Crane Division, in Crane, IN; and private industry via its advisory boards. The EMPF works to bring manufacturing technology into the engineering environment. It does this by identifying, developing, transferring, and implementing innovative electronics manufacturing technologies, processes, and practices jointly with academic, industrial, and government organizations.

Collaboration between EMPF staff and the faculty of the School of Engineering and Technology can result in a variety of hands-on and applied research opportunities for students, as well as continuing education for practitioners. Written inquiries should be directed to Communications Group, EMPF, 714 N. Senate Avenue, Indianapolis, IN 46202-3112; telephone (317) 226-5607.

Cooperative Education Program
Cooperative education is based on the idea that both academic learning and practical experience are important to a well-rounded education in engineering and technology. The Cooperative Education (Co-op) Program offers students the opportunity to acquire work experience related to their academic field of study.

Students enrolled in the co-op program attend classes full time and work full time in alternating semesters. During periods of employment, co-op students earn salaries that are competitive and related to the starting salaries of college graduates in their fields. For each semester of employment, students must register in an industrial practice class and pay appropriate fees. Students may earn academic credit toward the baccalaureate degree by participating in the co-op program. The amount and distribution of credit is determined by the departments. Departments require students to complete at least three co-op work sessions successfully to receive academic credit.

Students who successfully complete four or more work sessions are eligible for a Purdue University Cooperative Education Certificate when they receive their bachelor's degree.

Eligibility Requirements for acceptance in the Cooperative Education Program include the following:

1. The student must be admitted to the School of Engineering and Technology and be enrolled in one of the following academic programs:
   Computer Integrated Manufacturing Technology
   Computer Technology
   Construction Technology
   Electrical Engineering
   Electrical Engineering Technology
   Interdisciplinary Engineering
   Mechanical Engineering
   Mechanical Engineering Technology
   Supervision
2. The student must have satisfactorily completed the first two semesters of the academic program and must meet the minimum grade point average requirements established by the academic department.

For further information about the co-op program, call or write the Office for Student Affairs, School of Engineering and Technology, 799 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5160; telephone (317) 274-2533.

Minority Engineering Advancement Program (MEAP)

The Minority Engineering Advancement Program (MEAP) was established in 1974 to encourage minority students to pursue studies in engineering or engineering technology. Through the annual MEAP summer workshops, the school identifies and recruits talented secondary school students and provides them with information about engineering careers and college requirements. Since 1976, more than 1,300 students have participated in these workshops.

MEAP also provides counseling and tutor referral service to minority undergraduates enrolled in the School of Engineering and Technology. In addition, scholarships and grants are available to American Indian, black, or Hispanic students—groups that have been historically underrepresented in engineering. For more information, students should contact the Office for Student Affairs, School of Engineering and Technology, 799 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5160; telephone (317) 274-2943.

Summer Internships in the Federal Republic of Germany

The School of Engineering and Technology offers internship opportunities in the state of Baden-Württemberg in southwestern Germany. The internships are noncredit, full-time positions in a German industrial complex. Work assignments last from the middle of May until the middle of July. These internships allow students to gain technical experience in German companies, knowledge of a foreign culture, improved German language skills, and other benefits of an intercultural experience. Juniors or seniors with grade point averages of 3.0 or better and prior German language skills are eligible to apply. Participants receive a stipend to cover a major part of their expenses. Living accommodations are arranged, usually with a German host family. Free time for travel, study, and recreation is available at the end of the program. For more information, contact the Office for Student Affairs, School of Engineering and Technology, 799 W. Michigan Street, Indianapolis, IN 46202-5160; telephone (317) 274-2533.

Undergraduate Engineering Programs

Programs for full-time students pursuing baccalaureate degrees in engineering are presented in this section. The admission requirements, curricula, graduation requirements, and course descriptions of each program listed are those that were in effect at the time of printing and may subsequently change. Students are encouraged to obtain the latest course and curriculum information from their academic advisers.

The following undergraduate engineering degree programs are available in the School of Engineering and Technology:

Degree Program	Administered by
Bachelor of Science in Electrical Engineering (B.S.E.E.)	Department of Electrical Engineering
Bachelor of Science in Engineering (B.S.E.) (Interdisciplinary Engineering)	Department of Electrical Engineering
Bachelor of Science in Mechanical Engineering (B.S.M.E.)	Department of Mechanical Engineering
Bachelor of Science in Engineering (B.S.E.) (Interdisciplinary Engineering—Engineering Management)	Department of Mechanical Engineering

Admission Requirements

Admission is based on evidence presented by individual applicants to show that they are capable of profiting from and contributing to one of the academic programs of the school. Inquiries about admission to engineering programs as well as requests for admission applications should be addressed to the Office of Admissions, Cavanaugh Hall 129, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140.

In determining the qualifications of an applicant, the Office of Admissions uses the following criteria:

1. Graduation from a high school accredited by a state Department of Public Instruction.
2. The extent to which the student meets or exceeds the minimum subject matter requirements specified for a particular program.
   a. For admission to any of the engineering programs, the applicant's record must include the following:

Subjects	Semesters
English	6
History or social studies	2
Algebra	2
Plane geometry	2
Advanced algebra	1
Trigonometry	1
Chemistry	2
Laboratory science	2

   b. **Class Rankings**
   For admission to an engineering program, Indiana residents must rank in the upper half of their high school graduating class. Out-of-state applicants who rank in the upper half of their high school graduating class will be considered on an individual basis for admission to an engineering program.
   c. **Required Tests**
   All applicants who have not completed a full year of college work are required to take the College Entrance Examination Board (CEEB) Scholastic Assessment Test (SAT) or the American College Test (ACT). For admission to the engineering programs, minimum SAT scores of 400 verbal and 500 mathematics or minimum ACT scores of 21 English and 23 mathematics are required.
   d. **Admissions Limitations**
   Because of a limitation on the total number of students that may be accepted as beginners, out-of-state admissions may close at any time. When it becomes necessary to limit the number of Indiana residents accepted for a specific program, students will be offered admission to an alternate program or admission to the desired program for a subsequent semester.

Undergraduate Engineering Curriculum

All the undergraduate engineering curricula in this bulletin are presented as four-year programs. Well-qualified students with excellent high school preparation should be able to complete all requirements in the four-year period or less. Students with deficiencies in their high school preparation or those who participate in the Cooperative Education Program may require more time to complete their degrees. Other students may adjust their semester credit loads in order to maintain employment or for other reasons. Programs can be tailored for part-time and evening students since courses are scheduled in both day and evening classes. Part-time and evening students are urged to consult their advisers so that future scheduling problems are avoided.

It is important for students to recognize that some flexibility is provided in each of the curricula in order to allow for individual differences in backgrounds and academic goals. It is the student's responsibility to consult with an academic adviser to design a program to fit personal needs.

Creative accomplishment in an engineer's career often derives from an education that stresses major ideas and fundamental concepts of engineering rather than specific technologies. The engineering curricula provide wide experience in the mathematical, physical, and engineering sciences as well as in the social sciences and the humanities. In this way the student obtains both thorough training in engineering and a well-rounded education. Such an approach provides the best preparation for the engineer, who must envision and develop the technologies of the future and deal with scientific advances.

Engineers are responsible for translating the ever-expanding reservoir of scientific knowledge into systems, devices, and products and for engaging in the further expansion of knowledge. To meet these responsibilities, those who are learning to be engineers must not only master the ideas of others but must also originate new ideas. Although engineers deal extensively with facts and scientific fundamentals as a matter of course, they cannot rely on these alone. Engineers inevitably face decisions that cannot be made on the basis of technical skill, but that require a broad understanding of human values and behavior as developed by studies in the social sciences and humanities. They must also be able to accommodate situations where judgment and wisdom, combined with scientific knowledge or technical skill, can provide a solution.

General Education Program

A total of 27 credit hours of general education courses is required in the engineering curricula. Eight credit hours are required in communications courses: **ENG W131, COMM C110,** and **TCM 360.** A 1 credit hour course in engineering ethics, **EE 401** or **ME 401,** is required of all students. Eighteen credit hours in humanities and social sciences must be selected from a list of approved courses. One social science course, **ECON E201,** is required of all students. The remaining 15 credit hours are to be selected by the student in accordance with the following rules:

1. The student should explore different areas of the humanities and the social sciences.
2. Each general education program should have a unifying framework.
3. Courses such as accounting, industrial management, personal finance, ROTC, and personnel administration do not fulfill the purpose of the general education program, regardless of their general value in total engineering education.
4. General education electives may be found in such subjects as philosophy, religion, history, literature, fine arts, sociology, psychology, anthropology, economics, and modern languages. A list of currently approved courses is posted in engineering offices.
5. At least 6 credit hours must be taken in humanities and 3 in social sciences.
6. A minimum of 6 credit hours must be selected in the same department. If an approved economics course is chosen for a social science elective, this requirement will be automatically satisfied.
7. No more than 6 credit hours may be used at the introductory level. These courses are preceded by an asterisk (*) on the approved list.
8. Modern language courses, when used as an elective, must include at least 6 credit hours of a single language.
9. Courses in a student's native language may not count as general education electives.
10. Geography courses are not acceptable as general education electives.
11. The Pass/Fail option may not be used to satisfy general education requirements.
12. No more than 6 credit hours of approved general education electives may be scheduled in any one semester.
13. If credit by examination in a course is used to satisfy part of the general education requirements, an additional 3 credit hours must be satisfactorily completed in the same

department (except in the case of foreign languages, where an additional course must be in the same language).

14. The approved list of courses may vary from semester to semester. Courses on the approved list during the semester the student takes the course will be accepted even if they are subsequently removed from the list.
15. Students may petition their academic adviser and department chair for approval of courses not listed.

Graduation Requirements

To earn a Bachelor of Science in Engineering (B.S.E.), Bachelor of Science in Electrical Engineering (B.S.E.E.), or Bachelor of Science in Mechanical Engineering (B.S.M.E.) degree, engineering students must satisfy the following requirements. Requirements for graduation include receiving credit in all required courses—at least 129 credit hours in the electrical engineering program, 131 credit hours in the engineering management program, 130 credit hours in the interdisciplinary engineering program, or 129 credit hours in the mechanical engineering program.

Each student must have an approved plan of study that lists all courses for the specific degree program. Students should prepare their plans of study for approval during the junior year. If a student wants to deviate from the published curricula, written permission of the administrator of the program is required.

Additional requirements include the following:

1. Completion of the program of study for the degree by resident course work, by examination, or by credit accepted from another institution. The dean may refuse to accept as credit toward graduation any course that was completed 10 or more years previously, and former students will be notified of all such decisions upon reentering. Substitution of courses required for graduation may be made by the dean of the school.
2. Resident study at IUPUI for at least two semesters and the completion during this period of at least 32 credit hours of work in courses regularly open to third- or fourth-year students. In addition, students are expected to complete at least 9 credit hours of courses in their major. Students are also expected to complete the senior year in residence; however, with the approval of the dean, students who have had at least four semesters of resident study may complete a maximum of 20 credit hours of the senior year in another approved college or university. For the purpose of this rule, two summer sessions are considered equivalent to one semester.
3. Registration for CAND 991 either during the semester before or at the beginning of the semester of anticipated graduation as indicated by the student's academic program.
4. Registration in the School of Engineering and Technology, either in residence or in absentia, during the semester or summer session immediately preceding the awarding of the degree.
5. A graduation index of 2.0 in required engineering courses in addition to an overall graduation index of 2.0 for all courses on the approved plan of study. Students who have completed all other requirements for a bachelor's degree but have failed to meet the minimum graduation index may register for additional courses, with the approval of an authorized representative of the dean, after a review of their record. The additional courses may not exceed 20 credit hours. Students may take a maximum of 9 of the 20 credit hours in another approved college or university, provided the courses are approved in advance and in writing by an authorized representative of the dean of the School of Engineering and Technology. A copy of the approval must be filed in the office of the engineering and technology recorder. Credit in these additional courses must be established within five years of the date on which all other degree requirements were met. Students will have fulfilled the requirements for graduation if graduation indexes, including extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.
6. Applicants for a second baccalaureate degree must complete at least 32 credit hours after they are admitted to the second baccalaureate degree program, out of which 9 credit hours are expected to be in their major.

Department of Electrical Engineering

Professors Dunipace, Potvin, Renda, Sinha, Yokomoto, Yurtseven
Associate Professors Abel *(Adjunct)*, Chen, Dines *(Chair)*, El-Sharkawy, Rizkalla
Assistant Professors Buckwalter *(Adjunct)*, Chien, Madhavan
Lecturer O'Loughlin

The Department of Electrical Engineering offers programs at the bachelor's, master's, and doctoral levels. At the baccalaureate level, the department offers programs leading to the Bachelor of Science in Engineering degree (B.S.E.) and the Bachelor of Science in Electrical Engineering (B.S.E.E.). The B.S.E. degree program is designed for students who desire broad flexibility and the opportunity for interdisciplinary study. The program does not have a designated professional curriculum. Additional information about the program can be obtained from the faculty in the Department of Electrical Engineering. The program leading to the B.S.E.E. is described in this section. Graduate programs in electrical engineering are described in the section entitled "Graduate Engineering Programs" in this bulletin.

Electrical engineering programs are designed to prepare students for careers in the commercial, government, and academic sectors where electrical engineering expertise is needed in computers, information processing, circuit and electronic design, control and robotics, communications, energy systems, and manufacturing. Programs in the Department of Electrical Engineering are enhanced by the department's interaction with local industry and with the Indiana University School of Medicine. Students have direct and routine access to full-time faculty, which further enhances and accelerates the learning process. These advantages and the overall metropolitan environment lead to an application-oriented, practical education that prepares students for success.

The Department of Electrical Engineering regards research as an important catalyst for stimulating excellence in engineering education. Graduate research and undergraduate design projects in the areas of signal processing, image processing, artificial intelligence, control, robotics, manufacturing, and electronics offer opportunities for application and enhancement of expertise.

An undergraduate education in electrical engineering provides a strong foundation in mathematical, physical, and engineering sciences. In the course of acquiring this knowledge, students must also develop problem-solving skills. In addition, the general education courses in the program provide the communication skills and appreciation of human and social issues necessary to translate engineering achievements into advancements for society.

Bachelor of Science in Electrical Engineering

Accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

The B.S.E.E. degree prepares students for career opportunities in the hardware and software aspects of design, development, and operation of electronic systems and components. Challenging positions are available in government, commercial, and education sectors in the areas of electronics, communication systems, signal and information processing, power, automation, robotics and manufacturing, control, and computers. Within these areas, career opportunities include design, development, research, manufacturing, marketing, operation, field testing, maintenance, and engineering management.

Four specialized tracks are available in the B.S.E.E. program: circuits and electronics; communication and signal processing; computer engineering; and robotics, control, and manufacturing. Within each of these tracks a total of 129 credit hours is required for graduation. These include the general education requirements for engineering, completion of the freshman engineering program, the sophomore electrical engineering program that follows, and the requirements for each track that follow.

Freshman Year

First Semester

ENGR 196 Engineering Problem Solving 3
CHEM C111 Chemical Science I.....4
COMM C110 Fundamentals of Speech Communication.....3
MATH 163 Integrated Calculus and Analytic Geometry I 5
15

Second Semester

EE 195 Introduction to Computing in Electrical Engineering.....3
CHEM C112 Chemical Science II.....3
ENG W131 Elementary Composition I.....3
MATH 164 Integrated Calculus and Analytic Geometry II.....5
PHYS 152 Mechanics.....4
18

Sophomore Year

Third Semester

EE 201 Linear Circuit Analysis I 3
EE 207 Electronic Measurement Techniques 1
MATH 261 Multivariate Calculus.....4
PHYS 251 Heat, Electricity, and Optics 5
Humanities or Social Science Elective.....3
16

Fourth Semester

EE 202 Linear Circuit Analysis II.....3
EE 208 Electronic Devices and Design Lab 1
EE 255 Introduction to Electronics Analysis and Design 3
ECON E201 Introduction to Microeconomics 3
MATH 262 Linear Algebra and Differential Equations.....4
Humanities or Social Science Elective.....3
17

CIRCUITS AND ELECTRONICS

Students selecting the circuits and electronics track have the opportunity to study circuits for specific applications, as well as computational methods and computer simulations applicable to all circuits. The operational principles of discrete devices (e.g., a transistor) and the design of discrete electronic circuits are studied, along with the design of thin-film integrated circuits such as logic gates, operational amplifiers, and memory and microprocessor chips.

Junior Year

Fifth Semester

EE 266 Digital Logic Design 3
EE 267 Digital Logic Design Lab.....1
EE 301 Signals and Systems.....3
EE 311 Electric and Magnetic Fields.....3
ME 200 Thermodynamics I.....3
Humanities or Social Science Elective.....3
16

Sixth Semester

EE 302 Probabilistic Methods in Electrical Engineering.....3
EE 340 Simulation, Modeling, and Identification.....3
EE 362 Microprocessor Systems and Interfacing 4
Humanities or Social Science Elective.....3
Track Elective.....3
16

Senior Year

Seventh Semester

EE 305 Semiconductor Devices 3
EE 382 Feedback System Analysis and Design 3
EE 400 Undergraduate Seminar.....1
EE 444 Introduction to Communication Systems Analysis.....3
EE 455 Integrated Circuit Engineering 3
Humanities or Social Science Elective.....3
16

Eighth Semester

EE 401 Engineering Ethics and Professionalism 1
EE 492 Senior Design 3
TCM 360 Communication in Engineering Practice.....2
Technical Elective.....3
Track Elective.....3
12

Circuits and Electronics Track Electives (Choose 2)

EE 446 Digital Computational Techniques for Electronic Circuits 3
EE 449 Design of Analog and Digital Filters 3
EE 456 Advanced Integrated Circuit Engineering 3
EE 466 Introduction to the Design of Digital Computers 3
EE 495 Topics: Electronic Manufacturing 3
EE 554 Electronic Instrumentation and Control Circuits 3
EE 558 Integrated Circuit Layout and Design 3
EE 559 MOS VLSI Design 3

Electrical Engineering Electives (Choose 1)

Any track elective from any track 3
Graduate EE course (if prerequisites are met) 3
EE 321 Principles of Electromechanical Energy Conversion 3
EE 359 Data Structures 3
EE 410 Introduction to Digital Signal Processing 3
EE 483 Sampled Data Control System Analysis and Design 3
EE 495 Topics: Biomedical Signals and Systems 3
EE 495 Selected Topics in Electrical Engineering 3
EE 496 Electrical Engineering Projects 3

Technical Electives (Choose 1)

Any track elective from any track 3
Any **EE** elective of this track 3
CSCI 300 Systems Programming 3
CSCI 414 Numerical Methods 3
CSCI 340 Discrete Computational Structures 3
CSCI 355 Introduction to Programming Languages 3
MATH 510 Vector Calculus 3
MATH 511 Linear Algebra with Applications 3
MATH 520 Boundary Value Problems of Differential Equations 3
MATH 522 Qualitative Theory of Differential Equations 3
MATH 525 Introduction to Complex Analysis 3
ME 302 Thermodynamics II 3
PHYS 520 Mathematical Physics 3
PHYS 530 Electricity and Magnetism 3
PHYS 545 Solid-State Physics 3
PHYS 550 Introduction to Quantum Mechanics 3

COMMUNICATION AND SIGNAL PROCESSING

The communication and signal processing track prepares students for career opportunities in the areas of communication systems, signal processing and analysis, image processing, and artificial intelligence. Applications include medical imaging, system design, medical signal analysis, medical image processing and display, transmission and processing of satellite communication data, earth resources monitoring and analysis, geophysical exploration, digital audio and video information processing, and design of artificially intelligent machines.

Junior Year

Fifth Semester

EE 266 Digital Logic Design 3
EE 267 Digital Logic Design Lab 1
EE 301 Signals and Systems 3
EE 311 Electric and Magnetic Fields 3
ME 200 Thermodynamics I 3
Humanities or Social Science Elective 3
16

Sixth Semester

EE 302 Probabilistic Methods in Electrical Engineering 3
EE 340 Simulation, Modeling, and Identification 3
EE 362 Microprocessor Systems and Interfacing 4
Humanities or Social Science Elective 3
Technical Elective 3
16

Senior Year

Seventh Semester

EE 305 Semiconductor Devices 3
EE 382 Feedback System Analysis and Design 3
EE 400 Undergraduate Seminar 1
EE 410 Introduction to Digital Signal Processing 3
EE 444 Introduction to Communication System Analysis 3
Humanities or Social Science Elective 3
16

Eighth Semester

EE 401 Engineering Ethics and Professionalism 1
EE 411 Advanced Techniques in Digital Signal Processing 3
EE 492 Senior Design 3
EE Elective 3
TCM 360 Communication in Engineering Practice 2
Track Elective 3
15

Communication and Signal Processing Track Electives (Choose 1)

EE 449 Design of Analog and Digital Filters 3
EE 495 Topics: Biomedical Signals and Systems 3
EE 495 Topics: Data Communications 3
EE 495 Topics: Pattern Recognition 3
EE 495 Topics: Digital Image Processing 3

Electrical Engineering Electives (Choose 1)

Any required **EE** course from any track (300 level or higher) 3
Any track elective from any track, excluding **PHYS 342** 3
Graduate **EE** course (if prerequisites are met) 3
EE 359 Data Structures 3
EE 495 Selected Topics in Electrical Engineering 3
EE 496 Electrical Engineering Projects 3

Technical Electives (Choose 1)

Any required **EE** course from any track (300 level or higher) 3
Graduate **EE** course (if prerequisites are met) 3
Any track elective of any track 3
EE 359 Data Structures 3
EE 495 Selected Topics in Electrical Engineering 3
EE 496 Electrical Engineering Projects 3
CSCI 300 Systems Programming 3
CSCI 403 Introduction to Operating Systems 3
CSCI 414 Numerical Methods 3
CSCI 437 Introduction to Computer Graphics 3
CSCI 443 Data Base Systems 3
CSCI 450 Principles of Software Engineering 3
CSCI 463 Analysis of Algorithms 3
CSCI 485 Expert System Design 3
CSCI 487 Artificial Intelligence 3
CSCI 502 Compiling and Programming Systems 3
CSCI 503 Operating Systems 3
MATH 511 Linear Algebra with Applications 3
MATH 520 Boundary Value Problems of Differential Equations 3
MATH 523 Introduction to Partial Differential Equations 3
MATH 525 Introduction to Complex Analysis 3
MATH 526 Principles of Mathematical Modeling 3
MATH 530 Functions of a Complex Variable I 3
MATH 531 Functions of a Complex Variable II 3
MATH 544 Real Analysis and Measure Theory 3
PHYS 520 Mathematical Physics 3

COMPUTER ENGINEERING

The computer engineering track teaches design concepts and implementation techniques in the areas of digital hardware, software, and computer architecture. The courses associated with this track emphasize the understanding of system programming, computer applications, and the internal operation and external interface of computers. These courses encourage students to use the concepts learned in other engineering courses in the design and development of computer application projects.

Junior Year

Fifth Semester

EE 266 Digital Logic Design	3
EE 267 Digital Logic Design Lab	1
EE 301 Signals and Systems	3
EE 359 Data Structures	3
ME 200 Thermodynamics I	3
Humanities or Social Science Elective	3
	16

Sixth Semester

EE 302 Probabilistic Methods in Electrical Engineering	3
EE 311 Electric and Magnetic Fields	3
EE 340 Simulation, Modeling, and Identification	3
EE 362 Microprocessor Systems and Interfacing	4
Humanities or Social Science Elective	3
	16

Senior Year

Seventh Semester

EE 305 Semiconductor Device	3
EE 365 Introduction to the Design of Digital Computers	3
EE 382 Feedback System Analysis and Design	3
EE 400 Undergraduate Seminars	1
Humanities or Social Science Elective	3
Track Elective	3
	16

Eighth Semester

EE 401 Engineering Ethics and Professionalism	1
EE 492 Senior Design	3
EE Elective	3
TCM 360 Communication in Engineering Practice	2
Track Electives	6
	15

Computer Engineering Track Electives (Choose 3)

EE 456 Advanced Integrated Circuit Engineering	3
EE 468 Introduction to Compilers and Translation Engineering	3
EE 469 Operating Systems Engineering	3
EE 495 Topics: Digital Image Processing in Medicine	3
EE 495 Topics: MOS VLSI Design	3
EE 562 Introduction to Data Management and AI	3
EE 565 Computer Architecture	3
CSCI 300 Systems Programming	3
CSCI 403 Introduction to Operating Systems	3
CSCI 414 (MATH 414) Numerical Methods[1]	3
CSCI 437 Introduction to Computer Graphics[1]	3
CSCI 443 Data Base Systems	3
CSCI 450 Principles of Software Engineering	3
CSCI 463 Analysis of Algorithms	3
CSCI 485 Expert System Design	3
CSCI 487 Artificial Intelligence	3
CSCI 502 Compiling and Programming Systems	3
CSCI 503 Operating Systems	3

Electrical Engineering Electives (Choose 1)

Any required **EE** course from any track (300 level or higher)	3
Any track elective from any track	3
Graduate **EE** course (if prerequisites are met)	3
EE 410 Introduction to Digital Signal Processing	3
EE 495 Selected Topics in Electrical Engineering	3
EE 496 Electrical Engineering Projects	3

[1]Not counted as an engineering design course.

ROBOTICS, MANUFACTURING, AND CONTROL

The robotics, manufacturing, and control track teaches fundamentals underlying the application of control theory and robotics in contemporary industrial settings. The courses and electives associated with this track provide the tools to analyze, interpret, and modify the dynamic behavior of a wide variety of systems including robots, electronic devices, and manufacturing processes. Courses encourage students to develop a close link between theoretical and empirical performance by working with analog and digital simulations and with laboratory hardware.

Junior Year

Fifth Semester

EE 266 Digital Logic Design 3
EE 267 Digital Logic Design Lab 1
EE 301 Signals and Systems 3
EE 311 Electric and Magnetic Fields 3
ME 200 Thermodynamics I 3
Humanities or Social Science Elective 3
16

Sixth Semester

EE 302 Probabilistic Methods in Electrical Engineering 3
EE 340 Simulation, Modeling, and Identification 3
EE 362 Microprocessor Systems and Interfacing 4
Humanities or Social Science Elective 3
Track Elective 3
16

Senior Year

Seventh Semester

EE 382 Feedback System Analysis and Design 3
EE 400 Undergraduate Seminar 1
EE 489 Introduction to Robotics 3
EE Elective 3
Humanities or Social Science Elective 3
Track Elective 3
16

Eighth Semester

EE 401 Engineering Ethics and Professionalism 1
EE 483 Sampled Data Control System Analysis and Design 3
EE 492 Senior Design 3
TCM 360 Communication in Engineering Practice 2
Technical Elective 3
Track Elective 3
15

Robotics, Manufacturing, and Control Track Electives (Choose 3)

EE 444 Introduction to Communication System Analysis 3
EE 495 Topics: Control Theory II 3
EE 495 Topics: Digital Image Processing 3
EE 495 Topics: Electronics Instrumentation and Control 3
EE 580 Optimization Methods for Systems 3

Electrical Engineering Electives (Choose 1)

Any required **EE** course from any track (300 level or higher) 3
Any track elective from any track, excluding **PHYS 342** 3

Technical Electives (Choose 1)

Any required **EE** course from any track (300 level or higher) 3
Graduate **EE** course (if prerequisites are met) 3
Any track elective of any track 3
EE 359 Data Structures 3
EE 495 Selected Topics in Electrical Engineering 3
EE 496 Electrical Engineering Projects 3
CSCI 240 Computing II 4
CSCI 300 Systems Programming 3
CSCI 340 Discrete Computational Structures 3
CSCI 414 Numerical Methods 3
MATH 511 Linear Algebra with Applications 3
MATH 520 Boundary Value Problems of Differential Equations 3
MATH 523 Introduction to Partial Differential Equations 3
MATH 525 Introduction to Complex Analysis 3
MATH 526 Principles of Mathematical Modeling 3
MATH 530 Functions of a Complex Variable I 3
MATH 531 Functions of a Complex Variable II 3
PHYS 520 Mathematical Physics 3
PHYS 530 Electricity and Magnetism 3

Department of Mechanical Engineering

Professors Akay, Ecer, Herman *(Adjunct)*, Naghdi, O'Loughlin, Renda, Roberts *(Adjunct)*
Associate Professors Afolabi, Oshida *(Adjunct)*, Paydar *(Chair)*, Pidaparti, Ungan
Assistant Professors Chen, Chittajallu, Katona, Turner
Lecturer Lamm

The Department of Mechanical Engineering offers programs at the bachelor's, master's, and doctoral levels. At the baccalaureate level, programs described here lead to the Bachelor of Science in Mechanical Engineering (B.S.M.E.) and the Bachelor of Science in Engineering (B.S.E.), an interdisciplinary degree. Students enrolled in the department study under full-time faculty actively engaged in research in a variety of areas: biomechanics, combustion, composites, computational fluid dynamics, computer-aided design, control, elasticity, experimental mechanics, fluid mechanics, finite element methods, fracture, heat transfer, manufacturing, robotics, solid and structural mechanics, stress analysis, turbomachinery, and vibration. Part-time employment is available to students in the research laboratories of the department. Such experience enhances course work and is particularly valuable to those who later undertake graduate study.

Bachelor of Science in Mechanical Engineering

Accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

Mechanical engineering has its foundation in the basic sciences, including mathematics, physics, and chemistry, and requires an understanding of such areas as solid and fluid mechanics, materials, thermodynamics, heat and mass transfer, manufacturing processes, instrumentation, and control. Mechanical engineers are engaged in a variety of activities including design, manufacturing, research, development, testing, construction, operations, sales management, consulting, and teaching.

The mechanical engineering curriculum provides a broad base on which to build an engineering career. Traditional subjects in mechanical engineering are complemented with extensive computer experience such as computer-aided design and numerical problem solving. The program's flexibility allows students to specialize in the areas of their choosing through the choice of electives.

The number of credit hours required for graduation is 129, distributed as follows:

1. Mathematics and Physical Sciences
   a. Calculus: **MATH 163, 164, 261,** and **262** 18
   b. Chemistry: **CHEM C111** and **C112** 7
   c. Physics: **PHYS 152** and **251** 9
2. Communications
   a. Speech: **COMM C110** 3
   b. Writing: **ENG W131** 3
   c. Communication in Engineering Practice: **TCM 360** 2
   d. Engineering Ethics and Professionalism: **ME 401** 1
3. Humanities and Social Sciences
   a. Economics: **ECON E201** 3
   b. Electives[1] 15
4. Freshman Engineering Courses
   a. Introduction to Computer Applications in Engineering: **ME196** 2
   b. Computer Programming: **ME 197** 3
5. Mechanics and Materials
   a. Mechanics: **ME 270** and **274** 6
   b. Materials: **ME 272** and **MSE 345** 7

   79
6. Design
   a. Mechanical Design: **ME 262** and **372** 7
   b. Engineering Design: **ME 462** 4
7. Thermal Sciences
   a. Thermodynamics: **ME 200** and **ME 302** 6
   b. Fluid Mechanics: **ME 310** 4
   c. Heat Transfer: **ME 315** 4
8. Electrical Engineering, Instrumentation, and Control
   a. Electrical Engineering: **EE 201** and **EE 207** 4
   b. Systems, Instrumentation, and Control: **ME 330, 340,** and **ME 482** 9
9. Technical Electives
   a. Mechanical Engineering Electives 9
   b. Elective[1] 3

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[1]The 27 credit hours of electives must be chosen in accordance with the departmental guidelines and from the approved list of electives, available in the department.

Freshman Year

First Semester

ME 196 Introduction to Computer Applications in Engineering 2
CHEM C111 Chemical Science I 4
COMM C110 Fundamentals of Speech Communication 3
MATH 163 Integrated Calculus and Analytic Geometry I 5
14

Second Semester

CHEM C112 Chemical Science II 3
ENG W131 Elementary Composition I 3
MATH 164 Integrated Calculus and Analytic Geometry II 5
ME 197 Introduction to Computer Programming 3
PHYS 152 Mechanics 4
18

Sophomore Year

Third Semester

ME 200 Thermodynamics I 3
ME 270 Basic Mechanics I 3
ECON E201 Introduction to Microeconomics 3
MATH 261 Multivariate Calculus 4
PHYS 251 Heat, Electricity, and Optics 5
18

Fourth Semester

ME 262 Mechanical Design I 3
ME 274 Basic Mechanics II 3
EE 201 Linear Circuit Analysis I 3
EE 207 Electronic Measurement Techniques Laboratory 1
MATH 262 Linear Algebra and Differential Equations 4
Humanities or Social Science Elective[1] 3
17

Junior Year

Fifth Semester

ME 272 Mechanics of Materials 4
ME 310 Fluid Mechanics 4
ME 330 Modeling and Analysis of Dynamic Systems 3
MSE 345 Introduction to Engineering Materials 3
Humanities or Social Science Elective[1] 3
17

Sixth Semester

ME 302 Thermodynamics II 3
ME 315 Heat and Mass Transfer 4
ME 340 Dynamic Systems and Measurement 3
ME 372 Mechanical Design II 4
Humanities or Social Science Elective[1] 3
17

Senior Year

Seventh Semester

ME 482 Control Systems Analysis and Design 3
ME Elective[1] 3
TCM 360 Communication in Engineering Practice 2
Technical Elective[1] 3
Humanities or Social Science Elective[1] 3
14

Eighth Semester

ME 401 Engineering Ethics and Professionalism 1
ME 462 Engineering Design 4
ME Electives[1] 6
Humanities or Social Science Elective[1] 3
14

Mechanical Engineering Electives

ME 402 Biomechanics of the Musculoskeletal System 3
ME 403 Thermal Science Application 3
ME 418 Heating and Air-Conditioning Analysis and Design 3
ME 430 Power Engineering 3
ME 433 Principles of Turbomachinery 3
ME 450 Introduction to Computer-Aided Engineering 3
ME 451 Computational Methods in Thermal Sciences 3
ME 472 Advanced Mechanics of Materials 3
ME 474 Vibration Analysis 3
ME 491 Engineering Design Projects 1-2
ME 497 Selected Topics in Mechanical Engineering 3

[1]The 27 credit hours of electives must be chosen in accordance with the departmental guidelines and from the approved list of electives, available in the department.

Approved Technical Electives

ME 402 Biomechanics of the Musculoskeletal System....3
ME 403 Thermal Science Application....3
ME 418 Heating and Air-Conditioning Analysis and Design....3
ME 430 Power Engineering....3
ME 433 Principles of Turbomachinery....3
ME 450 Introduction to Computer-Aided Engineering....3
ME 451 Computational Methods in Thermal Sciences....3
ME 472 Advanced Mechanics of Materials....3
ME 474 Vibration Analysis....3
ME 491 Engineering Design Projects....1-2
ME 497 Selected Topics in Mechanical Engineering....3
ME 500 Thermodynamics....3
ME 505 Heat and Mass Transfer....3
ME 509 Intermediate Fluid Mechanics....3
ME 510 Gas Dynamics....2
ME 513 Engineering Acoustics....3
ME 525 Combustion....3
ME 551 Finite Element Analysis....3
ME 552 Advanced Applications of Finite Element Techniques....3
ME 569 Mechanical Behavior of Materials....3
ME 581 Numerical Methods in Mechanical Engineering....3
ME 597 Selected Topics in Mechanical Engineering....3
CSCI 240 Computing II....4
CSCI 300 Systems Programming....3
CSCI 414 Numerical Methods....3
EE 208 Electronic Devices and Design Laboratory....1
EE 255 Introduction to Electronic Analysis and Design....3
EE 266 Digital Logic Design....3
EE 267 Digital Logic Design Lab....1
EE 302 Probabilistic Methods in Electrical Engineering....3
EE 362 Microcomputer Systems and Interfacing....4
EE 489 Introduction to Robotics....3
MATH 510 Vector Calculus....3
MATH 511 Linear Algebra with Applications....3
MATH 520 Boundary Value Problems of Differential Equations....3
MATH 522 Qualitative Theory of Differential Equations....3
MATH 523 Introduction to Partial Differential Equations....3
MATH 525 Introduction to Complex Analysis....3
MATH 526 Principles of Mathematical Modeling....3
PHYS 342 Modern Physics....3
PHYS 480 Solar Energy Usage....3
PHYS 545 Solid-State Physics....3
STAT 311 Introductory Probability....3
STAT 511 Statistical Methods I....3

Bachelor of Science in Engineering—Interdisciplinary Engineering

Interdisciplinary engineering provides an opportunity for students whose interests and talents, while oriented toward engineering and science, do not coincide with the plans of study previously outlined in this section. Interdisciplinary engineering does not have a designated professional curriculum, but it is constituted to accommodate a degree objective with broad flexibility and opportunity for interdisciplinary studies.

Students cooperate with their faculty advisers in the development of a personalized plan of study leading to the Bachelor of Science in Engineering (B.S.E.) degree with interdisciplinary engineering identified as the major field of study. The Department of Mechanical Engineering has prepared plans of study with such major program areas as bioengineering and engineering management. A description of the engineering management program follows. For information about other available options, please consult faculty in the Department of Mechanical Engineering.

Bachelor of Science in Engineering—Interdisciplinary Engineering (Engineering Management)

The School of Engineering and Technology and the Indiana University School of Business offer a joint program in engineering management. This program prepares students to begin careers that may lead to administrative or management positions in technological, engineering, or manufacturing operations. The program also prepares students for careers in large nontechnological organizations such as financial institutions, which may require skills generally associated with both engineering and business. The engineering management program provides both a solid engineering and a solid management background. To complete the graduation requirements, students take courses in electrical, industrial, and mechanical engineering, as well as accounting, business law, economics, finance, marketing, and management.

Students who finish this four-year degree have several options for continuing their education. With approximately three additional semesters of study, they can also complete an undergraduate program in industrial, electrical, or mechanical engineering. With the added completion of approximately six undergraduate courses they can enroll in a master's degree

program in industrial, electrical, or mechanical engineering. With approximately five additional undergraduate courses they can apply for admission to dental or medical school. They may also apply for direct admission to law school. Students interested in any of these options for continued education should consult their advisers when determining their plans of study.

The number of credit hours required for graduation is 131, distributed as follows:

1. Mathematics and Physical Sciences
   a. Calculus: **MATH 163, 164, 261,** and **262**.....18
   b. Chemistry: **CHEM C111**.....4
   c. Physics: **PHYS 152** and **251**.....9
2. Communications and Ethics
   a. Speech: **COMM C110**.....3
   b. Writing: **ENG W131**.....3
   c. Communication in Engineering Practice: **TCM 360**.....2
   d. Engineering Ethics and Professionalism: **ME 401**.....1
3. Humanities and Social Sciences
   a. Sociology: **SOC R100**.....3
   b. Psychology: **PSY B104**.....3
   c. Electives.....6
4. Freshman Engineering Courses
   a. Introduction to Computer Applications in Engineering: **ME 196**.....2
   b. Computer Programming: **ME 197**.....3

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5. Engineering Courses
   a. Electrical Engineering: **EE 201, 207,** and **266**.....7
   b. General Engineering.....12
   c. Mechanical Engineering: **ME 200, 270, 272, 274,** and **330**.....16
   d. Materials: **MSE 345**.....3
6. Economics: **ECON E201, E202,** and **E270**...9
7. Business
   a. Accounting: **BUS A201** and **A202**.....6
   b. Business Law: **BUS L203**.....3
   c. Finance: **BUS F301**.....3
   d. Management: **BUS Z302**.....3
   e. Marketing: **BUS M301**.....3
   f. Operations and System Management: **BUS P301** and **BUS** Elective.....6
8. Business or Engineering Elective.....3

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Freshman Year

First Semester

CHEM C111 Chemical Science I.....4
COMM C110 Fundamentals of Speech Communication.....3
MATH 163 Integrated Calculus and Analytical Geometry I.....5
ME 196 Introduction to Computer Applications in Engineering.....2

14

Second Semester

ENG W131 Elementary Composition I.....3
MATH 164 Integrated Calculus and Analytical Geometry II.....5
ME 197 Introduction to Computer Programming.....3
PHYS 152 Mechanics.....4
PSY B104 Psychology as a Social Science.....3

18

Sophomore Year

Third Semester

ECON E201 Introduction to Microeconomics.....3
EE 201 Linear Circuit Analysis I.....3
MATH 261 Multivariate Calculus.....4
PHYS 251 Heat, Electricity, and Optics.....5
SOC R100 Introduction to Sociology.....3

18

Fourth Semester

BUS A201 Introduction to Accounting I.....3
BUS L203 Commercial Law I.....3
ECON E202 Introduction to Macroeconomics.....3
EE 207 Electronic Measurement Techniques...1
MATH 262 Linear Algebra and Differential Equations.....4
ME 270 Basic Mechanics I.....3

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Junior Year

Fifth Semester

BUS A202 Introduction to Accounting II	3
ECON E270 Introduction to Statistical Theory in Economics	3
EE 266 Digital Logic Design	3
ENGR Elective[1]	3
ME 200 Thermodynamics I	3
ME 274 Basic Mechanics II	3
	18

Sixth Semester

BUS F301 Financial Management	3
BUS M301 Introduction to Marketing	3
BUS P301 Operations Management	3
ENGR Elective[1]	3
ME 272 Mechanics of Materials	4
	16

Senior Year

Seventh Semester

ME 330 Modeling and Analysis of Dynamic Systems	3
TCM 360 Communications in Engineering Practice	2
ENGR Electives[1]	6
Humanities or Social Science Electives	6
	17

Eighth Semester

BUS Z302 Managing and Behavior in Organizations	3
ME 401 Engineering Ethics and Professionalism	1
MSE 345 Engineering Materials	3
BUS Elective[2]	3
Business or Engineering Elective	3
	13

[1]Engineering (ENGR) electives are in the areas of statics and dynamics, probability and statistics, quality control and reliability, industrial automation, industrial system operations, and materials and mechanics.
[2]The business (BUS) elective should be in the management of technology.

Graduate Engineering Programs

Professors Akay, Dunipace, Ecer, Naghdi, O'Loughlin, Potvin, Renda, Sinha, Yokomoto, Yurtseven
Associate Professors Afolabi, Y. Chen, Dines, El-Sharkawy, Paydar, Pidaparti, Rizkalla, Ungan
Assistant Professors J. Chen, Chien, Chittajallu, Katona, Madhavan, Turner

Graduate faculty in the Purdue University School of Engineering and Technology have research interests in the areas of biomechanics, CAD/CAM, communications and information processing, control and systems science, robotics, automation and manufacturing, machine intelligence, microelectronics, solid mechanics, structural mechanics, composites, vibration, finite element analysis, computational fluid dynamics and heat transfer, and computer-aided testing. Interdisciplinary research with the IU Schools of Medicine and Dentistry, as well as with the Department of Computer and Information Science in the Purdue School of Science at IUPUI, provides students with opportunities to explore areas such as biomechanics; biosignal processing; neural networks and their applications in signal processing, control, and robotics; medical imaging; modeling and control of biosystems; robot optimal path/trajectory planning; mechanics of temporomandibular joint, bone fatigue, and fracture; and modeling and remodeling of bones.

The school offers four graduate degrees, the Master of Science in Electrical Engineering (M.S.E.E.), the Master of Science in Mechanical Engineering (M.S.M.E.), the Master of Science in Engineering (M.S.E.), and the Master of Science (M.S.). Another degree program, leading to the Master of Science in Industrial Engineering (M.S.I.E.), is administered with approval of the School of Industrial Engineering at Purdue University, West Lafayette.

Students completing a master's degree in engineering will be prepared to enter the work force at a high level of responsibility and expertise. Knowledge of the expansion of new technologies and the strategic importance of high productivity and better efficiency helps students with master's degrees to advance rapidly in today's business and industries.

Qualified students may be authorized to pursue the Ph.D. degree in electrical engineering or mechanical engineering at IUPUI. Programs leading to the Ph.D. in electrical engineering and in mechanical engineering are administered with the respective approval of the School of Electrical Engineering and the School of Mechanical Engineering at Purdue University, West Lafayette. Students are usually expected to complete the M.S.E.E. or M.S.M.E. before pursuing the Ph.D. degree.

Students seeking more information about Ph.D. degree programs should contact the Department of Electrical Engineering, (317) 274-9726, or the Department of Mechanical Engineering, (317) 274-9717, or write to the Purdue University School of Engineering and Technology at Indianapolis, 723 W. Michigan Street, Indianapolis, IN 46202-5132.

Graduate courses are usually offered on the IUPUI evening schedule. The programs are designed to meet the needs of part-time students employed in the Indianapolis area, as well as traditional students who are preparing for careers in research-directed areas.

Admission Policies and Procedures

To be considered as a candidate for Master of Science degrees in engineering, electrical engineering, industrial engineering, and mechanical engineering, an applicant ideally should have graduated from an engineering program accredited by ABET, the Accreditation Board for Engineering and Technology, Inc., with an undergraduate graduation grade point average of at least 3.0 (out of 4.0) or equivalent as shown on the official transcript. All applicants are encouraged to take the General Aptitude Test of the Graduate Record Examination (GRE). Students whose native language is not English are required to have a score of 550 or higher in the TOEFL (Test of English as a Foreign Language). Information on testing dates and locations can be obtained from the IUPUI Graduate Office, Union Building A203, 620 Union Drive, IUPUI, Indianapolis, IN 46202-5167; telephone (317) 274-4023.

Graduates from non–ABET-accredited programs and others who do not meet the above requirements (including graduates of technology programs) will be considered for admission to the Master of Science degree program or may apply for admission to the Master of Science in Engineering degree program (electrical engineering option only) upon completion of the following requirements:

1. Graduating grade point average (GPA) of at least 3.00 (on a scale of 4.00) or equivalent from a baccalaureate degree program with a strong emphasis in engineering, mathematics, or the physical sciences.
2. Completion of the engineering calculus sequence:
   MATH 163 and **MATH 164** Integrated Calculus and Analytic Geometry I and II (10 cr.)
   MATH 261 Multivariate Calculus (4 cr.)
   MATH 262 Linear Algebra and Differential Equations (4 cr.)
3. Completion of the following undergraduate EE courses (total of 25 semester credit hours) or equivalent (course numbers are for courses offered at IUPUI). Equivalence of courses is to be determined by the Graduate Committee of the Department of Electrical Engineering.
   EE 201 Linear Circuit Analysis I (3 cr.) *or* **EE 202** Linear Circuit Analysis II (3 cr.)
   EE 301 Signals and Systems (3 cr.)
   EE 302 Probabilistic Methods in Electrical Engineering (3 cr.)
   EE 305 Semiconductor Devices (3 cr.)
   EE 311 Electric and Magnetic Fields (3 cr.)
   EE 359 Data Structures (3 cr.)
   EE 382 Feedback System Analysis and Design (3 cr.)
   One undergraduate **EE** laboratory course

Plus one of the following:
   EE 255 Introduction to Electronics Analysis and Design (3 cr.)
   EE 266 Digital Logic Design (3 cr.)
   EE 340 Simulation, Modeling, and Identification (3 cr.)
   EE 362 Microprocessors Systems and Interfacing (4 cr.)

4. The student must maintain a cumulative grade point average of 3.00 (on a 4.00 scale) or above in the courses listed in items 2 and 3 above.

Graduates from non–ABET-accredited programs or graduates of programs other than engineering may apply for admission to the M.S. degree program (mechanical engineering concentration) upon completion of the following undergraduate courses:
   MATH 163 and **MATH 164** Integrated Calculus and Analytic Geometry I and II (10 cr.)
   MATH 261 Multivariate Calculus (4 cr.)
   MATH 262 Linear Algebra and Differential Equations (4 cr.)
   ME 272 Mechanics of Material (4 cr.)
   ME 274 Basic Mechanics II (3 cr.)
   ME 302 Thermodynamics II (3 cr.)
   ME 310 Fluid Mechanics (4 cr.)
   ME 315 Heat and Mass Transfer (4 cr.)
   ME 330 Modeling and Analysis of Dynamic Systems (3 cr.)
   ME 372 Mechanical Design II (4 cr.)
   ME 462 Engineering Design (4 cr.)
   ME 482 Control System Analysis and Design (3 cr.)

Admission as a Regular Graduate Student

Applications for admission may be obtained by writing to either the Department of Electrical Engineering or the Department of Mechanical Engineering at the Purdue University School of Engineering and Technology, 723 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5132; telephone (317) 274-9726 or (317) 274-9717.

International students should allow six months for the processing of their applications. Students residing in the United States should apply at least three months before the beginning of the semester in which they wish to enroll. Applicants will be formally advised of the final admission decision by the dean of the Graduate School, Purdue University, West Lafayette.

Admission as a Temporary Graduate Student

(Postbaccalaureate Registrant)

This classification is intended for those who want to pursue study beyond the baccalaureate degree, but who do not have specific degree objectives. It is not intended to be a form of probationary admission to a regular degree program.

It is possible for those registered in this classification to apply for admission to the Graduate School as regular graduate students; *however, no more than 12 hours of credit earned under the temporary graduate student classification may be applied to an advanced degree program* if an individual is later admitted as a regular graduate student. Students who have already earned 12 credit hours under the temporary classification will not be able to count toward their degree programs the

credit earned during the semester in which acceptance as a regular graduate student is pending, unless admission is approved before the end of that semester. Furthermore, credit earned in courses taken while admission is pending may be applied to the advanced degree only if those courses are appropriate to the degree program and acceptable to both the School of Engineering and Technology and the Graduate School. No course in which a grade of less than B has been received will be accepted as part of a plan of study if the course was taken under enrollment as a temporary graduate student. Please note that the 12 credit hour limitation taken at temporary graduate student status that can be used on a plan of study will be modified if excess undergraduate credit is also to be applied to the plan of study.

Students interested in the temporary graduate student classification, also referred to as postbaccalaureate nondegree enrollment, should contact the IUPUI Graduate Office, Union Building A203, 620 Union Drive, IUPUI, Indianapolis, IN 46202-5167; telephone (317) 274-4023.

Undergraduate and Transfer Credit

Course credits earned while an undergraduate at IUPUI or other accredited institutions of higher learning may be applied toward an advanced degree if these credits are in excess of any requirements for the baccalaureate degree. Such credits must be certified as available for graduate credit by the institution from which the student received the baccalaureate degree, but will be accepted only if all of the following conditions are met: (1) the student had senior standing when taking the course, (2) the student received a grade of B or better, (3) the course was designated as a graduate course, and (4) the course was taken at the graduate level. No more than 12 hours of credit resulting from a combination of excess undergraduate credit and credit earned in postbaccalaureate status may be applied toward an advanced degree. Any additional conditions under which excess undergraduate credit may be used for graduate credit will be determined by the School of Engineering and Technology.

Subject to the restrictions stated below, credits earned for graduate study at other universities may be applied toward an advanced degree as transfer credit. Only credit hours associated with graduate courses for which grades of B or better were obtained will be eligible for transfer. In addition, course work used to satisfy the requirements of one master's degree may not be used on the plan of study for another master's degree, and course work from just one (and only one) master's degree may be used on the plan of study for a doctoral degree. Any additional conditions under which credit transfers may be made will be determined by the School of Engineering and Technology.

General Degree Requirements

To earn a master's degree, students must satisfy the following requirements:

1. Students must maintain regular graduate student standing.
2. All regular students are required to demonstrate acceptable proficiency in English composition before a plan of study may be filed or an advanced degree obtained. If the necessary substantiation of English proficiency as outlined below is contained in the application, English clearance will be given automatically upon acceptance into a degree program. If substantiation is lacking on the application, the student is expected to satisfy this requirement during the first term of enrollment.

   A student whose first language is English may meet the English requirement in any of three ways:
   a. By receiving a grade of B or better in all undergraduate courses in English composition;
   b. By submitting an official record from the Educational Testing Service, showing a scaled score of 600 or higher on the verbal portion of the GRE aptitude test;
   c. By passing the English proficiency examination administered by the English department at IUPUI.

   A student whose first language is not English—and who has scored higher than 550 on the TOEFL—may meet the English proficiency requirement in any of the following ways:
   a. By submitting a score of 5 or higher on the Test of Written English (TWE);
   b. By satisfactorily completing ENG G013 or ENG W131 or the equivalent;
   c. By submitting an official record from the Educational Testing Service, showing a scaled score of 600 or higher on the verbal portion of the GRE aptitude test.

   Nonnative speakers of English who are U.S. citizens or who hold permanent visas may satisfy the written English proficiency requirement by any of the methods described in item 2.
3. Students must file a plan of study appropriate to meet their needs in their chosen field of study. A tentative plan should be drawn up by the student and the graduate adviser in

advance of registration for the first semester of graduate work. The formal plan of study must be filed as soon as possible thereafter, but before the completion of 15 credit hours toward graduation. Students who have not filed a plan of study before the completion of 15 credit hours may not be allowed to register for the following term. The plan of study must be approved by the advisory committee and the Graduate School. The English requirement must be fulfilled before the plan of study can be filed.

4. Students must meet credit, grade, and index requirements. The number of required credit hours varies between 30 and 33 among the master's degree programs offered at IUPUI. Only grades of A, B, or C are acceptable in fulfilling Graduate School requirements for any plan of study. An advisory committee may require a grade of B or better in certain courses. Pass/Fail grades are not acceptable in fulfilling degree requirements. Incomplete course grades must be cleared by the twelfth week of the second semester after the session in which the Incomplete was awarded. All graduate students are expected to maintain a cumulative grade point average of 3.0 out of a possible 4.0.
5. Students must pass the required oral and written examinations. A final examining committee, usually the advisory committee, is appointed for each master's degree candidate. The committee must certify to the Graduate School either that the student has passed the required examination or that the committee is satisfied with the accomplishment of the student as based on a committee conference.

Master of Science in Electrical Engineering

Faculty in the Department of Electrical Engineering have research interests in the areas of communications and information processing, control and systems science, robotics and automation, machine intelligence, and microelectronics. The focus in the department is on interdisciplinary research jointly with the Indiana University School of Medicine and the Department of Computer and Information Science, both at IUPUI. Interdisciplinary research areas include biosignal processing, neural networks and their applications in control and robotics, medical imaging, modeling and control of biosystems, and robot optimal path/trajectory planning in both structured and unstructured environments. Students are encouraged to conduct their thesis research in these areas.

The graduate program leading to the M.S.E.E. degree is organized into two areas of study: control and automation, and signal processing. The control and automation track is for students who are interested in the fields of modeling, controls design, and software development of intelligent robot manipulators and modern control theory. A thorough understanding of these problems will ultimately lead to advances in production technologies such as flexible manufacturing cells in automated factories.

The signal processing track offers opportunities for research in linear and nonlinear filtering, spectral estimation, and algorithm development, and for applying these techniques to problems in medical fields drawn from the departments of neurology, radiology, physiology and biophysics, and anatomy within the Indiana University School of Medicine.

For both tracks the thesis option requires 30 credit hours of course work: 9 credit hours of thesis, 6 credit hours of core courses, 6 credit hours of primary area courses, 6 credit hours of either primary areas or related area courses, and 3 credit hours of mathematics. The nonthesis option also requires 30 credit hours of course work: 6 credit hours of core courses, 9 credit hours of primary area courses, 9 credit hours of related area courses, and 6 credit hours of mathematics.

Core courses for both thesis and nonthesis tracks include **EE 600** Random Variables and Signals, **EE 602** Lumped System Theory, and **EE 608** Computational Models and Methods.

Mathematics courses include **MATH 511** Linear Algebra with Applications or a higher-level course appropriate for science or engineering students.

Primary area courses for the control and automation track include the following:
EE 569 Introduction to Robotic Systems
EE 580 Optimization Methods for Systems and Control
EE 675 Introduction to the Analysis of Nonlinear Systems
EE 680 Introduction to Modern Control Theory

Primary area courses for the signal processing track are as follows:
EE 544 Digital Communications
EE 629 Introduction to Neural Networks
EE 637 Digital Image Processing I
EE 638 Digital Signal Processing

Related area courses for both tracks in the nonthesis option are as follows:
Primary area course for any track
EE 554 Electronic Instrumentation and Control Circuits
EE 559 MOS VLSI Design
EE 595 Selected Topics in Electrical Engineering
EE 696 Advanced Electrical Engineering Projects (nonthesis option only)
CSCI 512 Numerical Methods for Engineers and Scientists
CSCI 515 Numerical Analysis of Linear Systems
CSCI 520 Computational Methods in Analysis
CSCI 614 Numerical Solution of Ordinary Differential Equations
ME 551 Finite Element Analysis
ME 552 Advanced Applications of Finite Element Methods
PHYS 520 Mathematical Physics
PHYS 530 Electricity and Magnetism
PHYS 545 Solid-State Physics
STAT 512 Applied Regression Analysis
STAT 520 Time Series and Applications
STAT 524 Applied Multivariate Analysis

Students may select one of the primary areas and choose related area courses from the other primary area courses or related area courses or both.

Master of Science in Mechanical Engineering

Research interests of the faculty in the Department of Mechanical Engineering include biomechanics, CAD/CAM, combustion, composites, computational fluid dynamics and heat transfer, dynamics and control, finite element methods, manufacturing, solid mechanics, stress analysis, structural and computational mechanics, and vibration. The Computational Biomechanics Laboratory and the Computational Fluid Dynamics Laboratory facilitate much of this research. These laboratories are described in the section entitled "Special Resources of the School of Engineering and Technology" in this bulletin.

The graduate program leading to the M.S.M.E. degree is organized into two areas of study: solid mechanics and thermal sciences. The solid mechanics track is for students who are interested in the study of solids, stress analysis, kinetics, biomechanics, vibration, and structural mechanics. The thermal sciences track is for students who are interested in heat transfer, fluid mechanics, thermodynamics, and computational fluid dynamics.

For both tracks, the thesis option requires 30 credit hours of course work: 9 credit hours of thesis, 9 credit hours of primary area courses, 6 credit hours of related area courses, and 6 credit hours of mathematics. The nonthesis option also requires 30 credit hours of course work: 12 credit hours of primary area courses, 12 credit hours of related area courses, and 6 credit hours of mathematics.

Primary area courses for the solid mechanics track are as follows:
ME 507 Continuum Mechanics I
ME 550 Advanced Stress Analysis
ME 551 Finite Element Analysis
ME 560 Kinematics
ME 562 Advanced Dynamics
ME 563 Mechanical Vibrations
ME 575 Theory and Design of Control Systems
AAE 553 Elasticity in Aerospace Engineering
CE 577 Analysis of Plates and Shells

Primary area courses for the thermal sciences track include the following
ME 500 Thermodynamics
ME 505 Heat and Mass Transfer
ME 506 Two-Phase Flow and Heat Transfer
ME 509 Intermediate Fluid Mechanics
ME 510 Gas Dynamics
ME 525 Combustion
ME 551 Finite Element Analysis
ME 614 Computational Fluid Dynamics

Related area courses for both tracks include the following:

1. Engineering courses: a minimum of two courses from the following for the nonthesis option. Thesis option students should take two of these.
   Any two closely related mechanical engineering courses
   Any two closely related electrical engineering courses
   ME 552 Advanced Applications of Finite Element Methods
   ME 573 Interactive Computer Graphics
   ME 581 Numerical Methods in Mechanical Engineering
   ME 697 Mechanical Engineering Projects (nonthesis option only)
2. Other related area electives for the nonthesis option only (maximum of two)
   CSCI 520 Computational Methods in Analysis
   CSCI 614 Numerical Solution of Ordinary Differential Equations
   CSCI 615 Numerical Solution of Partial Differential Equations
   PHYS 520 Mathematical Physics
   PHYS 545 Solid-State Physics
   PHYS 550 Introduction to Quantum Mechanics
   PHYS 556 Introductory Nuclear Physics

Mathematics courses include **MATH 510** Vector Calculus or higher-level courses appropriate for science and engineering students.

Master of Science in Engineering

The M.S. in Engineering program is an interdisciplinary engineering program with an emphasis on the basic engineering sciences. It is designed to meet the specific needs of engineers employed in industry. The program has enough flexibility that the student may elect courses in several engineering disciplines or may elect strong options in fewer disciplines. The recommended maximum load for any student who is fully employed is two courses per semester.

Both thesis and nonthesis programs can be arranged. The nonthesis program requires a minimum of 30 credit hours of course work, and the thesis program requires a minimum of 21 credit hours of course work in addition to an acceptable project or thesis.

In either the thesis or a nonthesis program, a plan of study consists of a group of courses in the student's primary area and other courses in a related area or areas. The courses in the primary area should form a coherent group, with all courses showing a close relationship. Courses in the related area or areas are less closely related to the primary area but still contribute to the program. Generally, courses in mathematics will be included in the plan of study.

Master of Science

This program is designed for students who are graduates of nonaccredited engineering programs and for students who have a bachelor's degree in science, engineering technology, or related areas.

Students typically choose the industrial engineering option within this degree program. However, students may concentrate in electrical or mechanical engineering if they meet undergraduate prerequisite requirements. For the industrial engineering option, a typical plan of study may include six industrial engineering core courses, two courses from a selected minor, and two more courses from a second minor area. Minor areas often chosen include statistics, industrial psychology, and business administration.

Master of Science in Industrial Engineering

The M.S. in Industrial Engineering program is subject to approval by the graduate committee of the School of Industrial Engineering, Purdue University, West Lafayette. Arrangements can be made through the graduate adviser in the Department of Mechanical Engineering, 723 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5132; telephone (317) 274-9717.

This program provides an opportunity for engineers engaged in manufacturing or production operations to obtain an advanced degree. Entrance requirements are similar to those for the other engineering programs. Thirty-three credit hours of course work are required in the nonthesis option, of which 21 hours must be in industrial engineering.

Engineering Course Descriptions

Key to Course Descriptions

The courses listed in this section will, for the most part, be offered during the 1993-95 academic years. Additional information about course schedules may be obtained from the specific departments in the school. Courses are grouped under their program subject abbreviation. Course descriptions may contain the following information, in order: course number, course title, number of credit hours (in parentheses), number of hours of lecture per week, number of laboratory hours per week, number of recitation hours per week (group discussion and problem solving), and prerequisites (P) and/or corequisites (C), followed by the course description. For example, under Electrical Engineering (EE), a course description reads:

EE 202 Linear Circuit Analysis II (3 cr.) Class 3. P: EE 201. P or C: MATH 262. Continuation of **EE 201.** Use of computer-aided design programs. Complex frequency plane, resonance, scaling, and coupled circuits. Two-port network parameters. Laplace transform methods. Use of trees, general loop and nodal equations, matrix formulations.

This listing indicates that the course number is **EE 202** with the title "Linear Circuit Analysis II" (a continuation of **EE 201**). It's worth 3 credit hours. The class meets 3 hours a week for lectures. A required prerequisite is **EE 201.** Another prerequisite or corequisite is **MATH 262.** A brief course description then follows.

Please refer to the bulletin of the Purdue University Graduate School for descriptions of graduate courses not appearing in the following lists.

Candidacy for Degree (CAND)

CAND 991 Candidate for Degree
In order to be included in all appropriate graduation processes, a student who completes the requirements for a degree at the end of a semester or session must be registered for that session in CAND 991. Certain programs require that this be done the session prior to anticipated graduation. Students should verify this requirement in advance with their adviser or department head.

Electrical Engineering (EE)

EE 195 Introduction to C for Electrical Engineering (3 cr.) Class 2, Recitation 1-2. P: ENGR 196. C: MATH 163. An introductory course in computer programming, with emphasis on problem decomposition and program structure. The objective of the course is to introduce students to solving problems using high-level programming languages. The students are also introduced to a number of concepts fundamental to electrical engineering. Programming will be in C in order to develop a structured approach to problem solving. Problems drawn from the field of electrical engineering will be simple and will require no prior engineering knowledge.

EE 199 Engineering Industrial Practice I (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

EE 201 Linear Circuit Analysis I (3 cr.) Class 3. P or C: MATH 261 and PHYS 251. Recommended C: EE 207. Volt-ampere characteristics for circuit elements; independent and dependent sources; Kirchhoff's laws and circuit equations. Source transformations; Thevenin's and Norton's theorems; superposition. Transient response of resistor capacitor (RC), resistor inductor (RL), and resistor inductor capacitor (RLC) circuits; sinusiodal steady-state and impedance. Instantaneous and average power.

EE 202 Linear Circuit Analysis II (3 cr.) Class 3. P: EE 201. P or C: MATH 262. Continuation of EE 201. Use of computer-aided design programs. Complex frequency plane, resonance, scaling, and coupled circuits. Two-port network parameters. Laplace transform methods. Use of trees, general loop and nodal equations, matrix formulations.

EE 207 Electronic Measurement Techniques (1 cr.) Lab 3. P or C: EE 201. Experimental exercises in the use of laboratory instruments. Voltage, current, impedance, frequency, and waveform measurements. Frequency and transient response. Use of operational amplifiers in instrumentation systems.

EE 208 Electronic Devices and Design Laboratory (1 cr.) Lab 3. P: EE 207. C: EE 255. Laboratory experiments in design and measurement with analog devices. Applications include single-stage and multistage bipolar and FET amplifiers, operational amplifier applications, differential amplifiers, and active filters.

EE 255 Introduction to Electronics Analysis and Design (3 cr.) Class 3. P: EE 201. Recommended C: EE 208. Diode, bipolar transistor, and field effect transistor (FET) circuit models for the design and analysis of electronic circuits. Single-stage and multistage analysis and design. Computer-aided design calculations, amplifier operating point design and frequency response of single and multistage amplifiers. High frequency and low frequency designs are emphasized.

EE 266 Digital Logic Design (3 cr.) Class 3. P or C: EE 201. An introduction to logic design, with an emphasis on practical design techniques and circuit implementation. Topics include Boolean algebra; theory of logic functions; mapping techniques and function minimization; logic equivalent circuits and symbol transformations; transistor-transistor-logic (TTL)/metal oxide semi-conductor (MOS) logic into gate implementations; electrical characteristics; propagation delays; signed number notations and arithmetic; binary and decimal arithmetic logic circuits; theory of sequential circuits; timing diagrams; analysis and synthesis of SR-, D-, T-, and JK-based sequential circuits; clock generation circuits; algorithmic state machine method of designing sequential circuits.

EE 267 Digital Logic Design Laboratory (1 cr.) Lab 3. P: EE 207. C: EE 266. A series of logic circuit experiments using TTL integrated circuits. Designed to reinforce material presented in EE 266 lecture.

EE 299 Engineering Industrial Practice II (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

EE 301 Signals and Systems (3 cr.) Class 3. P: EE 202 and MATH 262. Signal and system representation. Fourier series and transforms, sampling and discrete Fourier transform. Discrete time system, difference equation, Z-transforms. State equations, stability, characteristic values and vectors. Continuous time systems, time and frequency domain analysis. Continuous systems with sampled inputs.

EE 302 Probabilistic Methods in Electrical Engineering (3 cr.) Class 3. P or C: EE 301. An introductory treatment of probability theory including distribution and density functions, moments, and random variables. Applications of normal and exponential distributions. Estimation of means and variances. Hypothesis testing and linear regression. Introduction to random processes, correlation functions, spectral density functions, and response of linear systems to random inputs.

EE 305 Semiconductor Devices (3 cr.) Class 3. P: EE 255, MATH 261, and PHYS 251. Materials- and phenomena-based examination of devices emphasizing the how and why of solid-state device operation.

EE 311 Electric and Magnetic Fields (3 cr.) Class 3. P: MATH 262 and PHYS 251. Continued study of vector calculus, electrostatics, and magnetostatics. Maxwell's equations, introduction to electromagnetic waves, transmission lines, and radiation from antennas. Students may not receive credit for both EE 311 and PHYS 330.

EE 321 Principles of Electromechanical Energy Conversion (3 cr.) Class 3. P: EE 202. C: EE 311. The general theory of electromechanical motion devices relating to electric variables and electromagnetic forces. The basic concepts and operational behavior of DC, induction, brushless DC, and stepper motors used in control applications are presented.

EE 340 Simulation, Modeling, and Identification (3 cr.) Class 2, Lab 3. P: EE 207 and EE 301. Investigation and evaluation of design problems through simulation of systems described by ordinary differential and difference equations. Development of simulation models from physical parameters and from experimental data. Topics include continuous, discrete, and hybrid models of electrical, mechanical, and biological systems. Laboratory experiences demonstrate concepts studied in text and lecture.

EE 359 Data Structures (3 cr.) Class 3. P: EE 195. An introductory course in computer engineering with emphasis on data structure and program design. The language used in the course is C. The classical concepts of structured programming such as stack, queue, linked list, tree, recursion, sorting and searching are presented. The applications of structured programming in engineering are discussed.

EE 362 Microprocessor Systems and Interfacing (4 cr.) Class 3, Lab 3. P: EE 195, EE 266, and EE 267. An introduction to basic computer organizations, microprocessor instruction sets, assembly language programming, the design of various types of digital as well as analog interfaces, and microprocessor system design considerations. The accompanying laboratory is designed to provide practical hands-on experience with microprocessor software application and interfacing techniques. Topics include design and implementation of a simple three-bus computer; a detailed study of a particular microcomputer architecture and instruction set (Motorola 6809); assembly language programming techniques; system control signals and I/O port design and handshaking protocols; interrupt control systems; LSI parallel and serial interfaces; analog data and control interfaces.

EE 365 Introduction to the Design of Digital Computers (3 cr.) Class 3. P: EE 362. The hardware organization of computer systems including the following topics: instruction set selection, arithmetic/logic unit design, hard wired and microprogrammed control schemes, memory organization, I/O interface design. The course will involve computer simulation of digital systems.

EE 382 Feedback System Analysis and Design (3 cr.) Class 3. P: EE 301 or ME 330 or equivalent. In this course classical concepts of feedback system analysis and associated compensation techniques are presented. In particular, the root locus, Bode diagram, and Nyquist criterion are used as determinants of stability.

EE 399 Engineering Industrial Practice III (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

EE 400 Electrical Engineering Undergraduate Seminar (1 cr.) Class 2. P: Senior standing in electrical engineering. A lecture-demonstration series on electrical and electronic devices, procedures, systems, and career topics.

EE 401 Engineering Ethics and Professionalism (1 cr.) Class 1. P: Senior standing. Topics to be considered include some of the ethical, social, political, legal, and ecological issues that practicing engineers may encounter. (EE 401 and ME 401 are cross-listed courses; students may not get credit for both EE 401 and ME 401.)

EE 410 Introduction to Digital Signal Processing (3 cr.) Class 2, Lab 3. P: EE 301. P or C: EE 362. An introductory treatment of digital signal processing algorithms and implementation using high speed digital signal processors. Detailed discussion of sampling, architecture, addressing modes and instruction set of digital signal processors, discrete Fourier transform, fast Fourier transform, and digital filtering.

EE 411 Advanced Techniques in Digital Signal Processing (3 cr.) Class 2, Recitation 2. P: EE 302. P or C: EE 410. Theory and algorithms for processing stochastic signals. Review of discrete-time transforms and stochastic process. Introduction to optimum and adaptive filtering. Introduction to classical and modern spectral analysis.

EE 427 Semiconductor Power Electronics (3 cr.) Class 2, Lab 3. P: EE 255 and EE 301. Introduction to power semiconductor devices, characteristics, and ratings. Analysis and design of circuits with power semiconductors and associated devices are emphasized. Topics include power rectification, inversion, AC-to-AC power control, firing circuits, and microcomputer control of power circuits.

EE 444 Introduction to Communication Systems Analysis (3 cr.) Class 3. P: EE 301 and EE 302. Applications of the principles of signal analysis of amplitude, phase, and frequency modulator systems. Behavior of receivers in the presence of noise. Pulse code modulation and multiplex systems. Emphasis on applications of theory to communication system design.

EE 446 Digital Computational Techniques for Electronic Circuits (3 cr.) Class 3. P: EE 195, EE 202, and EE 301. Algorithmic and computational aspects of electronic circuit analysis, both linear and nonlinear. Numerical methods such as Newton-Raphson and various integration formulas. Sparse matrices and implicit integration techniques. Worst case and tolerance analysis.

EE 449 Design of Analog and Digital Filters (3 cr.) Class 3. P: EE 195, EE 255, and EE 301. Approximation of filter transfer characteristics, scaling, and transformations in digital filter design; active filter design using op-amps; sensitivity calculations and minimization; computer-aided methods.

EE 455 Integrated Circuit Engineering (3 cr.) Class 3. P: EE 202 and EE 255. Recommended P or C: EE 305. Analysis, design, and fabrication of silicon, thin-film, and thick-film integrated circuits. Consideration of circuit design, layout, and fabrication techniques for integrated circuits. Circuit simulation studies are aided with SPICE II software system. Integrated operational amplifiers and logic gates (T2L, I2L, MOS, and CMOS) are treated.

EE 456 Advanced Integrated Circuit Engineering (3 cr.) Class 3. P: EE 455. A continuation of EE 455 with a similar array of topics being treated in greater depth. Additional material on epitaxy, sputtering, diffusion schedules, DMOS, VMOS, SOS, FET op-amps, Gummel-Poon models, threshold logic, flip-flops, and semiconductor memories is included. SPICE II simulations using macro models.

EE 466 Introduction to the Design of Digital Computers (3 cr.) Class 3. P: EE 362. The hardware organization of computer systems including the following topics: instruction set selection, arithmetic/logic unit design, hard-wired and microprogrammed control systems, memory organization, I/O interface design, parallel processing, and computer communication.

EE 468 Introduction to Compilers and Translation Engineering (3 cr.) Class 3. P: EE 359, EE 362, and EE 466. The design and construction of compilers and other translators. Topics include compilation goals, organization of a translator, grammars and languages, symbol tables, lexical analysis, syntax analysis (parsing), error handling, intermediate and final code generation, assemblers, interpreters, and an introduction to optimization/parallelization. Emphasis is on engineering, from scratch, a compiler or interpreter for a small programming language—typically a C or Pascal subset. Projects involve the implementation (and documentation) of such a system using C on ECN UNIX.

EE 469 Operating Systems Engineering (3 cr.) Class 3. P: EE 359, EE 362, and EE 365. The design and construction of modern operating systems. Basic process concepts in multiprogrammed computer systems including concurrency, scheduling, resource sharing, synchronization, deadlock, mutual exclusion, and protection. The engineering of operating systems involving detailed examination and modification of an existing operating system, UNIX. Presentation of analytic modeling and performance evaluation techniques. Case studies of existing operating systems. A substantial part of the course will involve projects centered on modification of UNIX. The projects will support concepts of OS design and construction including primary and secondary storage management, file systems, I/O subsystems, CPU scheduling, and disk scheduling.

EE 483 Sampled Data Control System Analysis and Design (3 cr.) Class 3. P: EE 382. An introduction to computer-controlled systems from both the state variable and Z-transform points of view along with sampling theory and its effect on digital control design. Design of digital controllers from the state space and frequency domain points of view.

EE 489 Introduction to Robotics (3 cr.) Class 3. P or C: EE 382 or equivalent. Homogeneous transformations; kinematics of manipulator arm; dynamic equations using Newton-Euler and Euler-Lagrange formulations; inverse kinematics; trajectory generation; task planning; manipulator control; robot languages and industrial applications of robots.

EE 491 Engineering Design Project (1-2 cr.) P: Senior standing and consent of a faculty sponsor. The student selects an engineering design project and works under the direction of the faculty sponsor. Suitable projects may be from the local industrial, municipal, state, and educational communities. May be repeated for a maximum of 4 credit hours.

EE 492 Senior Design (3 cr.) Class 1, Lab 5. P: Senior standing and consent of department chair. General design methodology, consideration of alternative solutions, and project planning in design. The influence of safety, reliability, economics, and aesthetics on design of engineering systems. The interpretation of specifications and requests for proposals. Early in the course, teams of students will be assigned a major design problem that will be the focus throughout the course. Oral presentation and report writing are required.

EE 495 Selected Topics in Electrical Engineering (1-4 cr.)

EE 496 Electrical Engineering Projects P: Consent of instructor. Hours and credits to be arranged.

EE 499 Engineering Industrial Practice IV (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

EE 544 Digital Communications (3 cr.) Class 3. P: EE 444 or graduate standing. Introduction to digital communication systems and spread spectrum communications. Topics include analog message digitization, signal space representation of digital signals, binary and M-ary signalling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal band width requirements. The principal types of spread spectrum systems are analyzed and compared. Application of spread spectrum to multiple access systems and to secure communication systems is discussed.

EE 547 Introduction to Computer Communication Networks (3 cr.) Class 3. P: EE 302 or equivalent. A qualitative and quantitative study of the issues in design, analysis, and operation of computer communication and telecommunication networks as they evolve toward the integrated networks of the future employing both packet and circuit switching technology. The course covers packet and circuit switching, the OSI standards architecture and protocols, elementary queuing theory for performance evaluation, random access techniques, local area networks, reliability and error recovery, and integrated networks.

EE 554 Electronic Instrumentation and Control Circuits (3 cr.) Class 3. P: EE 255 and EE 301. Analysis and design of special amplifiers, pulse circuits, operational circuits, DC amplifiers, and transducers used in instrumentation, control, and computation.

EE 559 MOS VLSI Design (3 cr.) Class 3. P: EE 305 and 466. An introduction to most aspects of large-scale MOS integrated circuit design including: device fabrication and modeling; useful circuit building blocks; system considerations; and algorithms to accomplish common tasks. Most circuits discussed are treated in detail with particular attention given those circuits, whose regular and/or expandable structures, are primary candidates for integration. All circuits will be digital and will be considered in the context of the Silicongate MOS enhancement-depletion technology. Homework will require the use of existing IC mask layout software, and term projects will be assigned.

EE 565 Computer Architecture (3 cr.) Class 3. P: EE 466 or graduate standing. An introduction to the problems involved in

designing and analyzing current machine architectures. Included are stack, SIMD, and MIMD machines, and the use of overlap, pipeline, parallel, and associative processing. Advanced I/O systems and memory organizations are examined. Evaluation methods for the performance of computer systems to enable the architect to determine the relation between a computer design and the design goals are explored. Some programming experience is assumed.

EE 569 Introduction to Robotic Systems (3 cr.) Class 3. P: EE 382 or graduate standing. Analysis of methods of the design and operation of robotic systems. Identification of three-dimensional objects using digitized images. Arm control: coordinate transformations, feedback control systems, hardware components. Applications of distributed microcomputer systems to robotic control. Discussion of command languages and planning of job assignments.

EE 580 Optimization Methods for Systems and Control (3 cr.) Class 3. P: EE 382, EE 483, or graduate standing. Introduction to various methods of obtaining the extremum of a nondynamic or dynamic system and their uses in control system design. Linear programming, various search methods, nonlinear programming, and dynamic programming are presented for discrete-time as well as continuous-time systems. Various real-life applications are discussed, and appropriate case studies are investigated.

EE 595 Selected Topics in Electrical Engineering Hours and credits to be arranged.

EE 600 Random Variables and Signals (3 cr.) Class 3. P: EE 444 or EE 483 or graduate standing. Engineering applications of probability theory. Problems of events, independence, random variables, distribution and density functions, expectations, and characteristic functions. Dependence, correlation, and regression; multivariate Gaussian distribution. Stochastic processes, stationarity, ergodicity, correlation functions, spectral densities, random inputs to linear systems, Gaussian processes.

EE 602 Lumped System Theory (3 cr.) Class 3. P: EE 301. P or C: MATH 511 or consent of instructor. An investigation of the basic theory and techniques of modern system theory, emphasizing linear state model formulations of continuous- and discrete-time systems in the time and frequency domains. Includes linearity, time invariance, discrete- and continuous-time state models, canonical forms, associated transfer functions and impulse response models, the state transition matrix, the Jordan form, controllability, observability, and stability.

EE 604 Electromagnetic Field Theory (3 cr.) Class 3. P: EE 311 or graduate standing. Review of general concepts (Maxwell's equations, materials interaction, boundary conditions, energy flow); statics (Laplace's equation, Poisson's equation); distributed parameter systems (classification of solutions, transmission lines, and waveguides); radiation and antennas (arrays, reciprocity, Huygen's principle); a selected special topic (e.g., magnetostatics, waves in anisotropic media, and optical fibers).

EE 606 Solid-State Devices (3 cr.) Class 3. P: Graduate standing or consent of instructor. A relatively broad, moderate-depth coverage of semiconductor devices and related topics. The first portion of the course presents and examines semiconductor fundamentals required in the operational analysis of solid-state devices. This is followed by a detailed examination of the positive-negative (PN) junction diode and PN junction devices. The final portion of the course treats heterojunction surface devices including Schottky diode, the MOS capacitor, and the MOSFET.

EE 608 Computational Models and Methods (3 cr.) Class 3. P: EE 368 and EE 369, or consent of instructor. Computation models and techniques for the analysis of algorithm complexity. The design and complexity analysis of recursive and nonrecursive algorithms for searching, sorting, and set operations; graph algorithms; matrix multiplication; polynomial evaluation; FFT calculations; and NP-complete problems.

EE 629 Introduction to Neural Networks (3 cr.) Class 3. P: EE 600. An introduction to basic concepts in the design, analysis, and application for computational neural networks. Topics include highly parallel fine grain architectural models such as the Boltzman machine, Rosenblatt's Perception, Hopfields' neural nets, backpropogation, and their associated learning algorithms. Proposed architectures and related simulation techniques are discussed. Applications to signal/image processing and recognition, optimization, and controls are examined.

EE 637 Digital Image Processing I (3 cr.) Class 3. P: EE 302 and EE 648, or equivalent. Introduction to digital image processing techniques for enhancement, compression, restoration, reconstruction, and analysis. 2-D signals and systems; sampling and scanning; random fields; discrete cosine transform; discrete Karhunen-Loeve transform; grayscale transformations; linear, ranked order, and morphological filters; human vision, printing, and display of images; entropy-based compression; vector quantization; block truncation coding; transform coding; predictive coding; image degradation models; Wiener filter; constrained deconvolution;

computed tomography; edge detection; shape representation; and segmentation.

EE 638 Digital Signal Processing I (3 cr.) Class 3. P: EE 302 or equivalent. The course consists of the following: (a) fast transforms, algorithms with special emphasis on multidimensional signals. Discussion of new transforms and algorithms such as number-theoretic and polynomial transforms, prime-factor and Winograd's FFT algorithms, rectangular transforms, fast algorithms for convolution, multidimensional transforms, convolutions, and Toeplitz systems; (b) multidimensional digital signal processing: new algorithms and structures such as McClellan transformations in multidimensional filter design and implementation, multidimensional transform techniques in analysis and implantation, hexagonal sampling lattices, multidimensional spectral estimation, adaptive filtering, beam-forming, inverse problems, multidimensional signal restoration, nonlinear filtering techniques such as median-filtering; (c) multirate digital signal processing: basic principles of sampling rate conversion (decimation and interpolation), multirate techniques in filter banks, spectrum analyzers and synthesizers.

EE 641 Digital Image Processing II (3 cr.) Class 3. P: EE 600 and 637. An advanced treatment of selected topics in digital image processing. Image models, color, digital video, synthetic aperture radar, magnetic resonance imaging, stack filters, morphological filters, inverse problems in computational vision, multiscale techniques.

EE 675 Introduction to the Analysis of Nonlinear Systems (3 cr.) Class 3. P or C: EE 602. Applications of phase plane methods and classification of singular points. Iteration and perturbation techniques. Jump resonance. Limit cycles. Relaxation oscillations. Introduction to Liapunov and asymptotic stability. Control area staff.

EE 680 Introduction to Modern Control Theory (3 cr.) Class 3. P: EE 580 or EE 602. Theoretical methods in optimal control theory. Topics include the calculus of variations and the Pontryagin minimum principle with applications to minimum energy problems. Geometric methods will be applied to the solution of minimum time problems. Computational methods, singular problems, observer theory, and sufficient conditions for existence of solutions are also discussed.

EE 685 Digital Process Control and Mathematical Modeling of Industrial Systems (3 cr.) Class 3. P: EE 483 or equivalent. This course describes the recent status of automatic control in industry with emphasis on the application of digital control. Problems involved in the use of both supervisory and direct digital control systems will be presented. The development of process mathematical models will also be covered.

EE 696 Advanced Electrical Engineering Projects Hours and credits to be arranged.

EE 698 Research M.S. Thesis.

General Engineering (ENGR)

ENGR 195 Selected Topics in Engineering I (0-3 cr.) Selected topics in general or interdisciplinary engineering (freshman level).

ENGR 196 Engineering Problem Solving (3 cr.) Class 3. C: MATH 163. Introduction to engineering and to the use of mathematics and computers in engineering problem solving. Topics covered illustrate the application of vector and linear algebra and graphical solutions in subject areas common to most engineering disciplines.

ENGR 295 Selected Topics in Engineering II (0-3 cr.) Selected topics in general or interdisciplinary engineering (sophomore level).

ENGR 395 Selected Topics in Engineering III (0-3 cr.) Selected topics in general or interdisciplinary engineering (junior level).

ENGR 495 Selected Topics in Engineering IV (0-3 cr.) Selected topics in general or interdisciplinary engineering (senior level).

Industrial Engineering (IE)

IE 501 Introduction to Operations Research (3 cr.) Class 3. P: MATH 262 and STAT 311. Fundamentals of operations research. Mathematical programming, decision theory, stochastic processes, and their applications. Emphasis on problem formulation, solution strategies, and computer software packages.

IE 530 Quality Control (3 cr.) Class 3. P: STAT 511 or equivalent. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production.

IE 532 Reliability (3 cr.) Class 3. P: STAT 511 or equivalent. Reliability of components and multicomponent systems. Application of quantitative methods to the design and evaluation of engineering and industrial systems and of processes for assuring reliability of performance. Economic and manufacturing control activities related to product engineering aspects of reliability. Principles of maintainability. Product failure and legal liability.

IE 533 Industrial Applications of Statistics (3 cr.) Class 3. P: IE 330 or STAT 511 or equivalent. The application of statistics to the effective design and analysis of industrial studies relating to manufacturing and human

factors engineering in order to optimize the utilization of equipment and resources. Emphasis on conducting these studies at the least cost.

IE 535 Linear Programming (3 cr.) Class 3. P: IE 501 or equivalent. Optimization of linear objective functions subject to linear constraints. Development of theory, algorithms, and applications of linear programming.

IE 536 Stochastic Models in Operations Research (3 cr.) Class 3. P: IE 336 or IE 561 or equivalent. An introduction to techniques for modeling random processes used in operations research. Markov chains, continuous time Markov processes, Markovian queues, and reliability and inventory models.

IE 545 Engineering Economic Analysis (3 cr.) Class 3. P: Senior standing and IE 355. Analysis of engineering costs and capital investments. Applications of classical optimization, mathematical programming, the theory of the firm, and the theory of production to the analysis of investment proposals. Evaluation and selection of individual projects and formulation of capital investment programs.

IE 546 Economic Decisions in Engineering (3 cr.) Class 3. P: STAT 511 and IE 501, or equivalent, or consent of instructor. Topics in decision making and rationality including decision analysis, decision making under uncertainty, and various descriptive and prescriptive models from operations research, economics, psychology, and business. Applications are drawn from engineering decision making, public policy, and personal decision making. Attention is also paid to designing aids to improve decision making.

IE 558 Safety Engineering (3 cr.) Class 3. P: IE 386. Application of human factors and engineering practice in accident prevention and the reduction of health hazards are presented. The objective of this course is to provide an understanding of the safety and health practices that fall within the responsibilities of the engineer in industry. Special attention is devoted to the detection and correction of hazards and to contemporary occupational safety and health laws and their enforcement.

IE 566 Production Management Control (3 cr.) Class 3. Background and development of production management, plus current concepts and controls applicable to production management functions.

IE 577 Human Factors in Engineering (3 cr.) Class 3. Survey of human factors in engineering with particular reference to human functions in human/machine systems and consideration of human abilities and limitations in relation to design of equipment and work environments.

IE 579 Advanced Production Control (3 cr.) Class 3. P: IE 383, IE 478, or consent of instructor. Modern, quantitative, computer-oriented techniques of production planning and control for discrete part manufacturing environments. Emphasis on design for data-driven systems and relationships with computer-aided manufacturing (CAM). Data base and analytic planning and control models.

IE 590 Topics in Industrial Engineering Credit and hours to be arranged. Selected topics in industrial engineering for seniors and graduate students.

IE 690 Advanced Topics in Industrial Engineering Credit hours to be arranged. Advanced study in various fields of industrial engineering for graduate students.

Materials Engineering (MSE)

MSE 345 Introduction to Engineering Materials (3 cr.) Class 3. P: Junior standing in engineering. Introduction to the structure and properties of engineering materials including metals, alloys, ceramics, plastics, and composites. Characteristics and processing affecting behavior of materials in service.

MSE 523 Physical Ceramics (3 cr.) Class 3. P: Graduate standing. Physical and chemical processes responsible for microstructure development in modern ceramic materials, and the relationship between microstructures and physical properties. The material covered is divided into three parts: solid-state processes including structural defects, diffusion, sintering and grain growth, reaction rates, nucleation and growth, and microstucture development; mechanical and thermal behavior including deformation, strength, thermal properties, and thermal and compositional stresses; and electrical and magnetic behavior including electrical conductivity, dielectric properties, and magnetic properties.

MSE 540 High Temperature Alloys (3 cr.) Class 3. P: Consent of instructor. Theory of alloying and relationship among temperature, structure, and mechanical properties in nickel, cobalt, and iron base alloys are presented. Effects of thermomechanical processing are shown. Analysis of microstructures by transmission electron microscopy, scanning electron microscopy, X-ray diffraction, and X-ray microprobe are discussed.

MSE 575 Transport Phenomena in Solids (3 cr.) Class 3. P: Senior standing in engineering or science. Energetics and kinetics of phase change in metals and alloys. Nucleation and growth models, with special emphasis on role of crystal defects. Selected topics in multicomponent diffusion.

MSE 576 Corrosion (3 cr.) Class 3. P or C: CHEM 373 or MSE 345. Rate-controlling steps in electrode processes; activation, ohmic, and concentration polarization; passivation; potentio-static studies and alloy design; applications to engineering systems.

MSE 597 Selected Topic in Materials Science and Materials Engineering Hours and credits to be arranged.

Mechanical Engineering (ME)

ME 184 Engineering Industrial Practice I (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

ME 196 Introduction to Computer Applications in Engineering (2 cr.) Class 2. C: MATH 163. Introduction to the engineering profession, graphs, and units. Introduction to computers, computer-aided drafting, and engineering calculations with mathematical software packages.

ME 197 Introduction to Computer Programming (3 cr.) Class 2, Recitation 1. P: ME 196. An introduction to FORTRAN programming for engineering freshman, with emphasis on solutions to engineering problems.

ME 200 Thermodynamics I (3 cr.) Class 3. P or C: MATH 261. First and second laws, entropy, reversible and irreversible processes, properties of pure substances. Application to engineering problems.

ME 262 Mechanical Design I (3 cr.) Class 2, Lab 2. P: ME 197, MATH 164, and ME 270. C: ME 274. The basic concepts of mechanical design are introduced with emphasis on use of computer-aided design techniques. Applications are chosen from the area of linkage and mechanism design. Laboratory hours are devoted to the implementation of computer techniques in solving mechanical design problems.

ME 270 Basic Mechanics I (3 cr.) Class 3. P: PHYS 152. P or C: MATH 261. Fundamental concepts of mechanics, force systems and couples, free body diagrams, and equilibrium of particles and rigid bodies. Distributed forces; centroids and centers of gravity of lines, areas, and volumes. Second moment of area, volumes, and masses. Principal axes and principal moments of inertia. Friction and the laws of dry friction. Introduction to kinematics of particles. Application to structures and machine elements, such as bars, beams, trusses, and friction devices.

ME 272 Mechanics of Materials (4 cr.) Class 3, Lab 2. P: ME 270 or equivalent. Analysis of stress and strain; equations of equilibrium and compatibility; stress/strain laws; extension, torsion, and bending of bars; membrane theory of pressure vessels; elastic stability; selected topics. Laboratory experiments include testing of mechanical properties and failure analysis.

ME 274 Basic Mechanics II (3 cr.) Class 3. P: ME 270. P or C: MATH 262. Kinematics of particles in rectilinear and curvilinear motion. Kinetics of particles, Newton's second law, energy, and momentum methods. Systems of particles, kinematics and plane motion of rigid bodies, forces and accelerations, energy and momentum methods. Kinetics, equations of motions, energy and momentum methods for rigid bodies in three-dimensional motion. Application to projectiles, gyroscopes, machine elements, and other engineering systems.

ME 284 Engineering Industrial Practice II (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

ME 302 Thermodynamics II (3 cr.) Class 3. P: ME 200. Properties of gas mixtures, air-vapor mixtures, applications. Thermodynamics of combustion processes, equilibrium, energy conversion, power, and refrigeration systems.

ME 310 Fluid Mechanics (4 cr.) Class 3, Lab 2. P: ME 200 and ME 274. Continua, velocity fields, fluid statics, basic conservation laws for systems and control volumes, dimensional analysis. Euler and Bernoulli equations, viscous flows, boundary layers, flows in channels and around submerged bodies, and one-dimensional gas dynamics.

ME 315 Heat and Mass Transfer (4 cr.) Class 3, Lab 2. P: ME 310. Fundamental principles of heat transfer by conduction, convection, and radiation; mass transfer by diffusion and convection. Application to engineering situations.

ME 330 Modeling and Analysis of Dynamic Systems (3 cr.) Class 3. P: EE 201, and MATH 262. Introduction to dynamic engineering systems; electrical, mechanical, fluid, and thermal components; linear system response; Fourier series and Laplace transform.

ME 340 Dynamic Systems and Measurements (3 cr.) Class 2, Lab 2. P: ME 330. Modeling and formulation of differential equations for dynamic systems, including mechanical vibratory systems, thermal systems, fluid systems, electrical systems, and instrumentation systems. Analysis of dynamic systems and measuring devices including transient response and frequency response techniques, mechanical systems, transducers, and operational amplifiers. Consideration of readout devices and their responses to constant, transient, and steady-state sinusoidal phenomena. Calibration and data analysis techniques are introduced. Both analog and digital computation are included.

ME 372 Mechanical Design II (4 cr.) Class 3, Lab 2. P: ME 262, ME 272, and ME 274. Type

and dimensional synthesis of mechanisms. Vector loop approach. Numerical methods and graphical techniques. Computer-aided design techniques. Cams and gears. Static and dynamic balancing. Strength design for mechanisms and robotics. Reliability principles.

ME 384 Engineering Industrial Practice III (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

ME 401 Engineering Ethics and Professionalism (1 cr.) Class 1. P: Senior standing. Topics to be considered include some of the ethical, social, political, legal, and ecological issues that a practicing engineer may encounter. EE 401 and ME 401 are cross-listed courses; students may not receive credit for both EE 401 and ME 401.

ME 402 Biomechanics of the Musculoskeletal System (3 cr.) Class 3. P: ME 272. The majority of the discussion will be directed toward mechanical design of organisms with emphasis on the mechanics of the musculoskeletal system. Selected topics in prosthesis design and biomaterials will be discussed to emphasize the unique biological criteria that must be considered in biomechanical engineering design.

ME 403 Thermal Science Applications (3 cr.) Class 3. P: ME 310 and ME 315. Applications of thermal science theory to such topics as heating, ventilating, and air conditioning; real cycles of combustion engines; turbomachinery; power plants and combustion.

ME 418 Heating and Air-Conditioning Analysis and Design (3 cr.) Class 3. P: ME 315. Psychometrics, air-conditioning systems, equipment selection, duct design, and piping design. Heating and cooling loads, solar radiation and heat transmission in buildings. Heat pumps. Application of air-conditioning to residences, computer rooms, light commercial and high-rise buildings.

ME 430 Power Engineering (3 cr.) Class 3. P: ME 200. Energy, combustion, energy cycles, steam power plants, fuel bed and suspension firing, steam generators, heat exchangers, draft, prime movers, pumps and piping, water supply and conditioning, the variable load problem, station performance, and energy rates.

ME 433 Principles of Turbomachinery (3 cr.) Class 3. P: ME 200 and ME 310. Unified treatment of principles underlying fluid mechanic design of hydraulic pumps, turbines, and gas compressors. Similarity and scaling laws. Cavitation. Analysis of radial and axial flow machines. Blade element performance. Radial equilibrium theory. Centrifugal pump design. Axial compressor design.

ME 450 Introduction to Computer-Aided Engineering (3 cr.) Class 3. P: ME 262 and ME 272. Advanced applications of interactive computer graphics; geometric modeling techniques; introduction to the use of finite element method; applications of finite element method in stress analysis and heat transfer areas; use of existing hardware and software systems.

ME 451 Computational Methods in Thermal Sciences (3 cr.) Class 3. P: ME 315 and ME 330. Mathematical description of heat transfer and fluid flow problems, discretization methods, heat convection, convection and diffusion, incompressible flows, high speed flow.

ME 462 Engineering Design (4 cr.) Class 3, Recitation 2. P: MSE 345 and ME 372. C: ME 315. Application of the design is emphasized. Design problems from all areas of mechanical engineering are considered.

ME 472 Advanced Mechanics of Materials (3 cr.) Class 3. P: ME 272 and MATH 262. Studies of stresses and strains in three-dimensional elastic problems. Failure theories and yield criteria. Bending of curved beams. Torsion of bars with noncircular cross sections. Beams on elastic foundation. Energy methods. Selected topics. Students may not receive credit for both ME 472 and ME 550.

ME 474 Vibration Analysis (3 cr.) Class 3. P: ME 272, ME 274, and ME 330. Introduction to simple vibratory motions, such as undamped and damped free and forced vibrations, vibratory systems with more than one degree of freedom, Coulomb damping, transverse vibration of beams, torsional vibration, critical speed of shafts, and applications.

ME 482 Control System Analysis and Design (3 cr.) Class 3. P: ME 330 or equivalent. Classical feedback concepts, root locus, Bode and Nyquist techniques, state-space formulation, stability, design applications. Students may not receive credit for both EE 382 and ME 482.

ME 484 Engineering Industrial Practice IV (1-5 cr.) P: Consent of the co-op adviser. For engineering students on cooperative assignment only.

ME 491 Engineering Design Project (1-2 cr.) P: Senior standing and consent of a faculty sponsor. The student selects an engineering design project and works under the direction of the faculty sponsor. Suitable projects may be from the local industrial, municipal, state, and educational communities. May be repeated for up to 4 credit hours.

ME 497 Selected Topics in Mechanical Engineering Hours and credits to be arranged.

ME 500 Thermodynamics (3 cr.) Class 3. P: ME 302. The empirical, physical basis of the laws of thermodynamics. Availability concepts and

applications. Properties and relations between properties in homogeneous and heterogeneous systems. The criteria of equilibrium. Application to a variety of systems and problems including phase and reaction equilibrium.

ME 505 Heat and Mass Transfer (3 cr.) Class 3. P: ME 315. Heat and mass transfer by diffusion in one-dimensional, two-dimensional, transient, periodic, and phase change systems. Convective heat transfer for external and internal flows. Similarity and integral solution methods. Heat, mass, and momentum analogies. Turbulence. Buoyancy driven flows. Convection with phase change. Radiation exchange between surfaces and radiation transfer in absorbing-emitting media. Multimode heat transfer problems.

ME 507 Continuum Mechanics I (3 cr.) Class 3. P: ME 272. Introduction to Cartesian tensor. Basic principles of continuum mechanics; concepts of deformation, motion, stress, and strain; conservation of mass, balance of momenta, continuum thermodynamics, and constitutive equations. Illustrative applications in elasticity, fluid dynamics, and viscoelasticity.

ME 509 Intermediate Fluid Mechanics (3 cr.) Class 3. P: ME 310 or equivalent. Fluid properties, basic laws for a control volume, kinematics of fluid flow, dynamics of frictionless incompressible flow, basic hydrodynamics, equations of motion of viscous flow, viscous flow applications, boundary layer theory, wall turbulence, and lift and drag of immersed bodies.

ME 510 Gas Dynamics (3 cr.) Class 3. P: ME 310. Flow of compressible fluids. One-dimensional flows including basic concepts, isentropic flow, normal and oblique shock waves, Rayleigh line, Fanno line, and simple waves. Multidimensional flows including general concepts, small perturbation theory for linearized flows, and method of characteristics for nonlinear flows.

ME 525 Combustion (3 cr.) Class 3. Physical and chemical aspects of basic combustion phenomena. Classification of flames. Measurement of laminar flame speeds. Factors influencing burning velocity. Theory of flame propagation. Flammability, chemical aspects, chemical equilibrium. Chain reactions. Calculation and measurement of flame temperature. Diffusion flames. Fuels. Atomization and evaporation of liquid fuels. Theories of ignition, stability, and combustion efficiency.

ME 550 Advanced Stress Analysis (3 cr.) Class 3. P: ME 272 and MATH 262. Studies of stresses and strains in three-dimensional problems. Failure theories and yield criteria. Stress function approach to two-dimensional problems. Bending of nonhomogeneous asymmetric curved beams. Torsion of bars with noncircular cross sections. Energy methods. Elastic stability. Introduction to plates. Students may not receive credit for both ME 472 and ME 550.

ME 551 Finite Element Analysis (3 cr.) Class 3. P: Graduate standing or consent of instructor. After the concepts of finite elements methods are presented, formulation for different engineering problems and their applications are studied. Topics include variational methods, the finite element concept, and applications in stress analysis, dynamics, fluid mechanics, and heat transfer.

ME 552 Advanced Applications of Finite Element Methods (3 cr.) Class 3. P: ME 551 or equivalent. Various algorithms for nonlinear and time-dependent problems in two and three dimensions are studied. The emphasis is on advanced applications with problems chosen from fluid dynamics, heat transfer, and solid mechanics areas. Each student is required to complete an independent project.

ME 560 Kinematics (3 cr.) Class 3. P: ME 372. Geometry of constrained plane motion with application to linkage design. Type and number synthesis, size synthesis. Path curvature, inflection circle, cubic of stationary curvature. Finite displacements, three- and four-separated positions. Graphical, analytical, and computer techniques.

ME 562 Advanced Dynamics (3 cr.) Class 3. P: ME 372 or consent of instructor. Dynamics of multiple degrees of freedom mechanical systems. Holonomic and nonholonomic constraints. Lagrange's equations of motion. Hamilton's principle for holonomic systems. Kinematics and kinetics of rigid body motion including momentum and energy methods, linearized equations of motion. Classification of vibratory systems—gyroscopic, circulatory forces. Stability of linear systems—divergence and flutter. Applications to gyroscopes, satellite dynamics, etc.

ME 569 Mechanical Behavior of Materials (3 cr.) Class 3. P: MSE 345 or MSE 411. A study of how loading and environmental conditions can influence the behavior of materials in service. Elastic and plastic behavior, fracture, fatigue, low and high temperature behavior. Introduction to fracture mechanics. Emphasis is on methods of treating these conditions in design.

ME 572 Analysis and Design of Robotic Manipulators (3 cr.) Class 3. P: ME 372. Introduction to the analysis and design of robotic manipulators. Topics include kinematic configurations, forward and inverse position solutions, velocity and acceleration, path planning, off-line programming, force and torque solutions, rigid body dynamics, motors

and actuators, robot design, sensors and controls, computer simulation, and graphical animation.

ME 573 Interactive Computer Graphics (3 cr.) Class 3. P: ME 197. The principles of computer graphics and interactive graphical methods for problem solving. Emphasis is placed on development and use of graphical tools for various display devices. Topics include pen plotting, storage tube, three dimensions, color, modeling of geometry, and hidden surface removal.

ME 581 Numerical Methods in Mechanical Engineering (3 cr.) Class 3. P: ME 315, ME 197 or its equivalent, and ME 372. The solution to problems arising in mechanical engineering using numerical methods. Topics include nonlinear algebraic equations, sets of linear algebraic equations, eigenvalue problems, interpolation, curve fitting, ordinary differential equations, and partial differential equations. Applications include fluid mechanics, gas dynamics, heat and mass transfer, thermodynamics, vibrations, automatic control systems, kinematics, and design.

ME 597 Selected Topics in Mechanical Engineering (1-6 cr.) Available by arrangement with individual faculty members.

ME 614 Computational Fluid Dynamics (3 cr.) Class 3. P: ME 581 or AAE 516 or equivalent; ME 509 or ME 510 or equivalent; or consent of instructor. Application of finite difference methods, finite element methods, and the method of characteristics for the numerical solution of fluid dynamics problems. Incompressible viscous flows: vorticity transport equation, stream function equation, and boundary conditions. Compressible flows: treatment of shocks, implicit and explicit artificial viscosity techniques, and boundary conditions. Computational grids.

ME 697 Mechanical Engineering Projects (3 cr.) Individual advanced study in various fields of mechanical engineering. May be repeated for up to 6 credit hours.

ME 698 Research M.S. Thesis.

Technology Programs

The School of Engineering and Technology offers a variety of technology programs at the associate and baccalaureate degree level. Although specific lengths of time are established for each university degree program, the required time may vary for individual students. Well-qualified students with excellent high school preparation may, for example, complete a program in less than the length of time indicated. Other students who elect to combine cooperative education with their course work may take more time to complete all degree requirements. Students may adjust their semester credit loads for employment or personal reasons, and plans of study can be tailored to meet the needs of part-time and evening students. Extended time has not been detrimental to the successful completion of a program.

Programs for full-time students pursuing Associate in Applied Science degrees or Bachelor of Science degrees within the technology departments are presented in this section.

The admission requirements, curricula, graduation requirements, and course descriptions of each program listed are those that were in effect at the time of printing. Course content and curricula may be changed to reflect the needs of business, industry, and government. Students are therefore encouraged to obtain the latest course and curriculum information from academic advisers.

Admission Requirements

Admission is based on evidence presented by individual applicants to show that they are capable of profiting from and contributing to one of the academic programs of the school. Inquiries about admission to technology programs as well as requests for admission applications should be addressed to the Office of Admissions, Cavanaugh Hall 129, 425 University Boulevard, IUPUI, Indianapolis, IN 46202-5140.

In determining the qualifications of an applicant, the Office of Admissions uses the following criteria:

1. Graduation from a high school accredited by a state Department of Public Instruction.
2. The extent to which the student meets or exceeds the minimum subject matter requirements specified for a particular program.
   a. For admission to computer technology programs, the applicant's record must include the following:

Subjects	Semesters
English	6
History or social studies	2
Algebra	3
Geometry	2
Laboratory science	2

   b. For admission to all other technology programs, the applicant's record must include the following:

Subjects	Semesters
English	6
History or social studies	2
Algebra	2
Geometry	2
Laboratory science	2

   c. **Class rankings**
   For admission to all technology programs, Indiana residents must rank in the upper half of their high school graduating class, and out-of-state residents must rank in the upper third of their high school graduating class.
   d. **Required tests**
   All applicants who have not completed a full year of college work are required to take the College Entrance Examination Board (CEEB) Scholastic Assessment Test (SAT) or the American College Test (ACT). For admission to technology programs, a combined SAT total of 750 or above or a combined ACT total of 16 or above is required. Applicants who have graduated from high school two or more years previous to applying for admission may be considered without completion of the ACT or SAT.

e. **Admissions limitations**
Because of a limitation on the total number of students that may be accepted as beginners, out-of-state admissions may close at any time. When it becomes necessary to limit the number of Indiana residents accepted for a specific program, students will be offered admission to an alternate program or admission to the desired program for a subsequent semester.

Associate in Applied Science

Science and technology activities range from the applied and practical to the highly theoretical and abstract. At one extreme are the mechanics, draftspersons, and service personnel; at the other are the theoretical scientists. Within this spectrum, educational backgrounds include doctoral degrees, master's degrees, bachelor's degrees, and associate degrees at the university level, as well as certificates and diplomas from other postsecondary educational and training institutions.

Frequently the degree level is indicative of the job level. For example, the medical profession includes physicians with doctoral degrees, medical technologists with bachelor's degrees, and nurses with associate and bachelor's degrees at the university level, as well as practical nurses, hospital technicians, and operating room technicians with diplomas from other postsecondary educational institutions.

The Associate in Applied Science degree offered in the School of Engineering and Technology at IUPUI is awarded upon successful completion of two years of university-level study in applied science. Graduates of these programs are called technicians.

Technicians' jobs require the application of technical knowledge and skills; job requirements normally include manipulative skills necessary to perform technical tasks. Technicians have considerable knowledge of the materials and processes involved and know how to apply the principles of physical and biological sciences, generally using instruments rather than tools. Their contribution is mainly through mental activity in conjunction with the application of skills. In many organizations the technician is permitted to move vertically in the organization to higher levels of responsibility, depending on capability and willingness to pursue further education.

Program	**Administered by**
Architectural Technology	Department of Construction Technology
Biomedical Electronics Technology	Department of Electrical Engineering Technology
Civil Engineering Technology	Department of Construction Technology
Computer Integrated Manufacturing Technology	Department of Manufacturing Technology
Computer Technology (Commercial Option)	Department of Computer Technology
Computer Technology (Technical Option)	Department of Computer Technology
Electrical Engineering Technology	Department of Electrical Engineering Technology
Mechanical Drafting–Design Technology	Department of Manufacturing Technology
Mechanical Engineering Technology	Department of Manufacturing Technology
Supervision	Department of Supervision

Bachelor of Science

The Bachelor of Science degree is awarded under the "two-plus-two" education plan. A student following this plan first earns an associate degree in two years and then may complete a baccalaureate degree after two more years. In the case of transfer students, all departmental requirements must be met.

A student is awarded an Associate in Applied Science degree upon successful completion of the two-year program. The associate degree signifies that the recipient is educated at the technician level and is ready to seek full-time employment. Thus individuals may go directly into the work force, or they may elect to continue their studies.

Students who desire to continue their formal education may be admitted for an additional two years of study to earn a Bachelor of Science degree in the various technology programs. Students who successfully complete this program are awarded a Bachelor of Science degree, which provides the background for increased job responsibility.

The following programs are available to qualified students:

Program	Administered by
Computer Integrated Manufacturing Technology	Department of Manufacturing Technology
Computer Technology	Department of Computer Technology
Construction Technology	Department of Construction Technology
Electrical Engineering Technology	Department of Electrical Engineering Technology
Mechanical Engineering Technology	Department of Manufacturing Technology
Supervision	Department of Supervision

For more specific information, see the advisers in the respective departments.

Graduation Requirements

Associate Degree

To earn an Associate in Applied Science (A.A.S.) degree, students must satisfy the following requirements:

1. Completion of the plan of study for the degree by resident course work, by examination, or by credit accepted from another institution. The dean of the school may refuse to accept as credit toward graduation any course that was completed 10 or more years previously, and former students will be notified of all such decisions upon reentering. Substitutions of courses required for graduation may be made by the dean of the School of Engineering and Technology.
2. Resident study at IUPUI for at least two semesters and the completion during this period of at least 15 credit hours of work in courses regularly open to first- or second-year students. At least 4 credit hours of course work is expected to be completed in residence in the student's major. Students are generally expected to complete the entire second year in residence; however, with the approval of the dean of the school, students who have at least three semesters of resident study may complete a maximum of 16 credit hours of the second year in another approved college or university. For the purpose of this rule, two summer sessions are considered equivalent to one semester.
3. Registration for CAND 991 either during the semester before or at the beginning of the semester of anticipated graduation as indicated by student's academic program.
4. Registration in the School of Engineering and Technology, either in residence or in absentia, during the semester or summer session immediately preceding the award of the degree.
5. A graduation index of 1.9. Students who have completed all other requirements for an A.A.S. degree but have failed to meet the minimum graduation index may register for additional courses, with the approval of an authorized representative of the dean of the school, after a review of their record. These additional courses may not exceed 10 credit hours, and credit in these courses must be established within three years of the date on which all other degree requirements were met. Students will have fulfilled the requirements for graduation if their graduation indexes, including the extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.
6. Applicants for a second A.A.S. degree must complete at least 15 credit hours at IUPUI after admission to the second associate degree program. A second associate degree may not be earned in the same program.

Baccalaureate Degree

To earn a Bachelor of Science (B.S.) degree, students must satisfy the following requirements. Engineering students must satisfy additional requirements as described in the section entitled "General Degree Requirements" in this bulletin.

1. Completion of the program of study for the degree by resident course work, by examination, or by credit accepted from another institution. The dean may refuse to accept as credit toward graduation any course that was completed 10 or more years previously, and former students will be notified of all such decisions upon reentering. Substitution of courses required for graduation may be made by the dean of the school.
2. Resident study at IUPUI for at least two semesters and the completion during this period of at least 32 credit hours of work in courses regularly open to third- or fourth-year students. At least 9 credit hours of work is expected to be completed in residence in the student's major at the junior level or higher. Students are generally expected to complete the senior year in residence; however, with the approval of the dean, students who have had at least four semesters of resident study may complete a maximum of 20 credit hours of the senior year in

another approved college or university. For the purpose of this rule, two summer sessions are considered equivalent to one semester.

3. Registration for CAND 991 either during the semester before or at the beginning of the semester of anticipated graduation as indicated by student's academic program.
4. Registration in the School of Engineering and Technology, either in residence or in absentia, during the semester or summer session immediately preceding the awarding of the degree.
5. A graduation index of 2.0. Students who have completed all other requirements for a bachelor's degree but have failed to meet the minimum graduation index may register for additional courses, with the approval of an authorized representative of the dean, after a review of their record. The additional courses may not exceed 20 credit hours. Students may take a maximum of 9 of the 20 credit hours in another approved college or university, provided the courses are approved in advance and in writing by an authorized representative of the dean of the School of Engineering and Technology. A copy of the approval must be filed in the office of the recorder. Credit in these additional courses must be established within five years of the date on which all other degree requirements were met. Students will have fulfilled the requirements for graduation if graduation indexes, including extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.
6. Applicants for a second baccalaureate degree must complete at least 32 credit hours at IUPUI after they are admitted to the second baccalaureate degree program.

Technology Plans of Study

Semester-by-semester plans of study follow for the technology programs available in the school. These plans generally reflect the sequence in which courses are offered. In each plan, departmental courses are listed first, followed by those courses outside the department or school that are required or recommended. Technology courses are described in the section "Technology Course Descriptions" in this bulletin. Many of the recommended or required courses offered by other schools at IUPUI are described in the section "Other Courses."

In some technology plans of study, the word "selective" is used. This term refers to any of a number of courses recommended by the departments in a given area or subject. Students should consult their faculty advisers for information about permissible electives or selectives.

Department of Computer Technology

Professors Crozier, Orr (*Chair*)
Associate Professor Solinski
Assistant Professors Hanson, Silence
Lecturer Williamson

The Department of Computer Technology offers programs at both the associate and bachelor's degree levels. These programs are designed to provide an applications-oriented, practical education that prepares students for careers as systems analysts (people who design, install, and evaluate information systems); commercial and technical programmer/analysts (people who design, write, and maintain programs for a variety of applications, including manufacturing); and network systems specialists (people who select, specify, maintain, augment, and administer the network and networking needs of a company). Typical jobs for graduates can encompass such diverse areas as cost control, sales analysis, and communication networking.

Students may earn a Purdue University Associate in Applied Science degree in computer technology and a Purdue University Bachelor of Science degree in computer technology at IUPUI. The associate degree features two four-semester options designed to prepare graduates to work in either commercial or technical areas. A business option is available for those pursuing the bachelor's degree.

Associate in Applied Science—Computer Technology (Commercial Option)

The commercial option of the A.A.S. degree program features a business-oriented approach to computer information systems. Students take a full year of COBOL along with data communications, operating systems, and data base concepts. Students who graduate with an A.A.S. in CPT under the commercial option can apply their credits toward the B.S. degree or can enter the work force directly.

Freshman Year

First Semester		Second Semester	
CPT 115 Introduction to Data Processing	3	**CPT 122** Computer Applications in Finite Mathematics	3
CPT 140 Introduction to Computer Lab	1	**CPT 224** Microcomputer Tools and Applications	3
ENG W131 Elementary Composition I	3	**CPT 265** COBOL Programming	3
IET 104 Industrial Organization	3	**PSY B104** Psychology as a Social Science	3
MATH 151 Algebra and Trigonometry[1]	5	**TCM 220** Technical Report Writing	3
	15		15

[1]May be replaced by MATH 153 *and* MATH 154

Sophomore Year

Third Semester		Fourth Semester	
CPT 232 Assembly Language Programming	3	**CPT 225** Statistical Methods	3
CPT 254 Information Systems Concepts	3	**CPT 240** Introduction to Data Communications and Networks	3
CPT 288 Data Storage and Data Base Concepts	3	**CPT 286** Computer Operating Systems I	3
CPT 365 Topics in COBOL	3	**BUS A202** Introduction to Accounting II	3
BUS A201 Introduction to Accounting I	3	**ECON E201** Introduction to Microeconomics	3
COMM C110 Fundamentals of Speech Communication	3	Elective	2
CAND 991 Candidate for Degree	0		17
	18		

Associate in Applied Science—Computer Technology (Technical Option)

The technical option of the A.A.S. degree program provides students with a rigorous and analytical approach to problem solving. This option provides a basic foundation in applied mathematics and general physics as well as in FORTRAN and Pascal. The option is designed to enhance employment potential for students who seek jobs in the areas of manufacturing, communication networking, or research and development. The technical option also provides a foundation for upper-level study, should students choose to pursue the B.S. degree.

Freshman Year

First Semester		Second Semester	
CPT 115 Introduction to Data Processing	3	**CPT 224** Microcomputer Tools and Applications	3
CPT 140 Introduction to Computer Lab	1	**CPT 264** FORTRAN Programming	3
ENG W131 Elementary Composition I	3	**COMM C110** Fundamentals of Speech Communication	3
IET 104 Industrial Organization	3	**MATH 164** Integrated Calculus and Analytic Geometry II	5
MATH 163 Integrated Calculus and Analytic Geometry I	5	**TCM 220** Technical Report Writing	3
	15		17

Sophomore Year

Third Semester		Fourth Semester	
CPT 225 Statistical Methods	3	**CPT 220** Numerical Methods I	3
CPT 233 Assembly Language for the Microcomputer	3	**CPT 286** Computer Operating Systems I	3
CPT 366 Pascal Programming	3	**CPT 240** Introduction to Data Communications and Networks	3
PHYS 218 General Physics I[1]	4	**ECON E201** Introduction to Microeconomics	3
CAND 991 Candidate for Degree	0	**PHYS 219** General Physics II[1]	4
Elective[2]	3		17
	16		

Bachelor of Science—Computer Technology

General Requirements

1. Completion of the Associate in Applied Science degree in computer technology or an equivalent degree.
2. Completion of the core requirements, plus additional courses required to complete a minimum of 130 credit hours, which includes credits earned toward the associate degree. The additional courses are free electives, except that no more than 9 credit hours may be taken in the Department of Computer Technology (CPT).
3. A minimum of 42 credit hours must be earned in courses at the 300 level or higher. Some 300- and 400-level non-CPT course work is not acceptable for upper-level credit. Students must verify upper-level credit with a CPT adviser.

[1]Students with the appropriate background are encouraged to take PHYS 152 and PHYS 251.
[2]MATH 261 is suggested for students intending to pursue a Bachelor of Science degree.

Core Requirements (130 credit hours)

1. **General Education** (61 credit hours)
   Communications (composition, speech, and report writing) 12
   Social Sciences (economics, political science, psychology, and sociology) 9
   Humanities (creative arts, history, literature, religion, folklore, art appreciation, theatre, music, anthropology, philosophy, and languages) 6
   Business (accounting, supervision) 9
   Mathematics (must include a calculus course) 17
   Physical Sciences (biology, chemistry, geology, and physics; laboratories required) 8
2. **Computing Principles** (34 credit hours)
   CPT 115, 140, 220 or 254, 224, 232 or 233, 240, 264, 265, 286, 288, 362, and either 365 or 366
3. **Computing Concentration** (24 credit hours)
   It is recommended that students concentrate their efforts for the 24 hours in one of these three areas: Information Systems, Network Systems, or Software Systems. A course cannot count both as a computing principles course and a concentration course.
4. **Electives** (11 credit hours)

Upper-Level Courses

CPT 301 Queueing Theory and Traffic Analysis 3
CPT 302 Microcomputer Organization 3
CPT 303 Communications Security and Network Controls 3
CPT 324 Information Center Function 3
CPT 340 Data Communications 3
CPT 345 Computer Graphics 3
CPT 351 Expert Systems 3
CPT 352 Decision Support and Information Systems 3
CPT 362 C Language Programming 3
CPT 365 Topics in COBOL 3
CPT 366 Pascal Programming 3
CPT 374 Systems Analysis 3
CPT 384 Systems Design 3
CPT 386 Computer Operating Systems II 3
CPT 387 Evaluation and Selection of Small Computing Systems 3
CPT 388 Topics in Programming Languages ..3
CPT 389 Using a Data Base Management System 3
CPT 396 Computer Laboratory 1-2
CPT 402 Design and Implementation of Local Area Networks 3
CPT 440 Communication Network Design 3
CPT 442 Fiber Optics 3
CPT 470 Software Design and Implementation 3
CPT 471 Software Conversion and Maintenance 3
CPT 484 Systems Analysis and Design Project 3
CPT 486 Systems Programming 3
CPT 489 Data Base Analysis and Design 3
CPT 490 Senior Project 1-4
CPT 491 Senior Design Project, Phase I 1
CPT 492 Senior Design Project, Phase II 2
CPT 499 Computer Technology 1-4

Bachelor of Science—Computer Technology (Business Option)

This option is designed for students who wish to combine computing skills with a knowledge of business fundamentals. It incorporates business courses from the Indiana University School of Business, allowing computer technology students to minor in business. Positions for which graduates are qualified include business programmer/analyst and business systems analyst.

General Requirements

Students must complete the Associate in Applied Science degree in computer technology (commercial option) or an equivalent degree.

Junior Year

Fifth Semester

CPT 340 Data Communications....3
CPT 374 Systems Analysis....3
CPT 389 Using a Data Base Management System....3
MATH M119 Brief Survey of Calculus I....3
TCM 350 Visual Elements of Technical Documents....3
15

Sixth Semester

CPT 352 Decision Support and Information Systems....3
CPT 384 Systems Design....3
CPT 300-level Programming Language....3
BUS L203 Commercial Law....3
ECON E202 Introduction to Macroeconomics....3
SPV Selective (SPV 374, 376, 401, 410)....3
18

Senior Year

Seventh Semester

CPT 484 Systems Analysis and Design Project....3
BUS F301 Financial Management....3
BUS M301 Introduction to Marketing Management....3
BUS P301 Operations Management....3
CAND 991 Candidate for Degree....0
Computer Concentration Elective....3
15

Eighth Semester

CPT 324 Information Center Functions....3
CPT 351 Expert Systems....3
BUS J401 Administrative Policy....3
BUS Z302 Managing and Behavior in Organizations....3
Humanities Elective....3
Elective....2
17

Business courses must be taken in the order listed above. At the time a student is ready to begin BUS F301, the student's grade point average must be 2.3 or above in the following group of courses: MATH M118 or CPT 122, MATH M119 or MATH 221, PSY B104, BUS A201, BUS A202, BUS L203, CPT 115/140, CPT 224, CPT 265, ECON E201, ECON E202, ECON E270 or CPT 225.

Department of Construction Technology

Professor Fleenor (*Chair*)
Associate Professors Maxwell, Sener
Assistant Professors Kinsey, Patton

The Department of Construction Technology offers two Associate in Applied Science degree programs, one in architectural technology and the other in civil engineering technology. Upon satisfactory completion of either of these programs, students may continue with the third and fourth years to obtain the degree of Bachelor of Science with a major in construction technology. These majors may apply to enter the co-op work program following their freshman year.

Associate in Applied Science—Architectural Technology

The architectural technology curriculum is a two-year associate degree program designed to provide students with the skills to work in the areas of architectural drafting and detailing, simple structural design, planning, estimating, inspection, and sales. The curriculum is not intended to prepare students for registration as professional architects.

Graduates typically find employment with architectural firms, construction firms, building material suppliers, and various governmental agencies. Graduates are also eligible to pursue a Bachelor of Science degree in construction technology.

Freshman Year

First Semester

ART 116 Construction Graphics 3
ART 162 Building Materials and Methods 2
ART 172 Systems of Construction 2
CPT 180 Spreadsheets 1
CPT 181 QuickBASIC 1
CPT 183 Problem Solving Using FORTRAN 1
ENG W131 Elementary Composition I 3
MATH 153 Algebra and Trigonometry I 3
16

Second Semester

ART 120 Architectural Presentation 3
ART 155 Residential Construction 3
ART 285 Electrical Systems for Buildings 2
COMM C110 Fundamentals of Speech Communication 3
MATH 154 Algebra and Trigonometry II 3
TCM 220 Technical Report Writing 3
17

Sophomore Year

Third Semester

ART 222 Commercial Construction 3
ART 284 Mechanical Systems for Buildings 3
CET 160 Statics 3
MATH 221 Calculus for Technology I 3
PHYS 218 General Physics I 4
16

Fourth Semester

ART 210 History of Architecture 3
CET 104 Fundamentals of Surveying 3
CET 260 Strength of Materials 3
CET 267 Materials Testing 2
CNT 280 Quantity Survey 3
PHYS 219 General Physics II 4
CAND 991 Candidate for Degree 0
18

Associate in Applied Science—Civil Engineering Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board of Engineering and Technology, Inc. (ABET)

This program prepares students for employment in civil engineering firms, construction firms, surveying firms, testing laboratories, material supply companies, city engineering offices, and highway departments. Graduates of the two-year program are prepared for office positions; laboratory work; or on-site positions in surveying, field engineering, and inspection.

Emphasis is on basic engineering principles of mechanics, soils, hydraulics and drainage, surveying, and materials testing. Also included are courses in mathematics, physical sciences, social sciences, communications, computer programming fundamentals, and the humanities.

Graduates may also continue their education by pursuing a Bachelor of Science degree with a major in construction technology.

Freshman Year

First Semester

ART 116 Construction Graphics.....3
ART 162 Building Materials and Methods 2
ART 172 Systems of Construction.....2
CPT 180 Spreadsheets 1
CPT 181 QuickBASIC.....1
CPT 183 Problem Solving Using FORTRAN...1
ENG W131 Elementary Composition I.....3
MATH 153 Algebra and Trigonometry I 3
16

Second Semester

CET 275 Applied Civil Engineering Drafting 3
ART 285 Electrical Systems for Buildings.....2
COMM C110 Fundamentals of Speech Communication.....3
MATH 154 Algebra and Trigonometry II.....3
TCM 220 Technical Report Writing 3
Humanities or Social Science Elective[1] 3
17

Sophomore Year

Third Semester

CET 104 Fundamentals of Surveying 3
CET 160 Statics 3
ART 284 Mechanical Systems for Buildings....3
MATH 221 Calculus for Technology I.....3
PHYS 218 General Physics I.....4
16

Fourth Semester

CET 231 Soils Testing 3
CET 260 Strength of Materials 3
CET 267 Materials Testing.....2
CNT 280 Quantity Survey 3
PHYS 219 General Physics II.....4
CAND 991 Candidate for Degree.....0
Construction Elective 3
18

Bachelor of Science—Construction Technology

The baccalaureate program is open to students with an A.A.S. in architectural technology or civil engineering technology or with an equivalent degree. The curriculum is intended to further students' knowledge in areas of structural and civil engineering design as well as in construction management. Students in this program develop their knowledge of the principles and practice of construction through further technical course work. Additional course work in business and management and training in written and oral communication are also included. Many students complete the course work on a part-time basis by taking a reduced course load during the semesters they are engaged in construction-related employment.

Graduates of the program are prepared for employment with architects, contractors, building product companies, consulting engineering firms, and state and government organizations. Occupations such as detailing, drafting, inspecting, estimating, merchandising, supervising, and testing may also be filled by experienced graduates of this program.

Junior Year

Fifth Semester

CNT 330 Construction Field Operations.....3
CET 312 Construction Surveying 2
CET 382 Steel Structures Design.....3
ECON E201 Introduction to Microeconomics 3
TCM 340 Correspondence in Business and Industry 3
Mathematics Selective[1].....3
17

Sixth Semester

BUS L203 Business Law.....3
CET 231 Soils Testing (ART majors) *or* Construction Elective (CET majors)[1].....3
CET 387 Reinforced Concrete Design.....3
SPV 252 Human Relations in Supervision.....3
Science Selective with Lab 4
16

Summer Session

CNT 390 Construction Work Experience.....1

[1]All electives and selectives must be approved by the student's adviser.

Senior Year

Seventh Semester

CNT 340 Construction Scheduling.....2
CNT 445 Construction Management.....3
CET 452 Hydraulics and Drainage.....3
CET 484 Wood, Timber, and Formwork Design.....3
CAND 991 Candidate for Degree.....0
Construction Elective[1].....3
Humanities or Social Science Elective[1].....3
17

Eighth Semester

CNT 442 Construction Cost and Bidding.....3
CNT 470 Site Development.....3
CNT 494 Engineering Economics for Construction.....3
CET 430 Foundation Systems.....3
Humanities or Social Science Elective[1].....3
15

[1]All electives must be approved by the student's adviser.

Department of Electrical Engineering Technology

Professors Needler, Sharp, Willison
Associate Professors Conrad, Pfile *(Chair)*
Assistant Professors Buchanan, Cooney

Associate in Applied Science—Biomedical Electronics Technology

This two-year program consists of a combination of courses in basic electrical circuits, analog and digital electronics, microprocessor fundamentals, mathematics, physics, medical instrumentation, human anatomy, and human physiology. The program is enhanced by the department's interaction with the Indiana University School of Medicine on the IUPUI campus and with local hospitals.

The curriculum enables graduates to find employment as biomedical equipment technicians, medical equipment sales personnel, medical equipment servicing/maintenance technicians, or research technicians.

The curriculum satisfies the educational requirements of the Association for the Advancement of Medical Instrumentation (AAMI) and the Certified Biomedical Equipment Technician License.

Graduates of this program are eligible for admission to the Bachelor of Science degree program in electrical engineering technology. Approximately two additional years of study are necessary to complete the requirements for the B.S. in electrical engineering technology.

Freshman Year

First Semester		Second Semester	
EET 102 Electrical Circuits I	4	**EET 152** Electrical Circuits II	4
EET 105 Digital Fundamentals I	3	**EET 154** Analog Electronics I	4
CPT 180 Spreadsheets	1	**BMET 240** Introduction to Medical Electronics	3
CPT 181 QuickBASIC	1	**ENG W131** Elementary Composition I	3
CPT 182 Problem Solving Using C	1	**PHYS 218** General Physics	4
MATH 151 Algebra and Trigonometry	5		
	15		18

Sophomore Year

Third Semester		Fourth Semester	
EET 155 Digital Fundamentals II	3	**EET 205** Introduction to Microprocessors	4
EET 204 Analog Electronics II	4	**BIOL N214** Human Biology[1]	2
BIOL N212 Human Biology[1]	2	**BMET 360** Biomedical Electronic Systems II	4
BMET 320 Biomedical Electronic Systems I	4	**COMM C110** Fundamentals of Speech Communication	3
MATH 221 Calculus for Technology I	3	**PSY B104** Psychology as a Social Science	3
CAND 991 Candidate for Degree	0		
	16		16

Associate in Applied Science—Electrical Engineering Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

This program provides a combination of courses in electricity, electronics, mathematics, science, and general academic areas that leads, after two years of full-time course work, to the degree of Associate in Applied Science. The program prepares students for careers as technicians in a wide variety of electronics, electrical, and related fields. Students find employment in automation, computer electronics, telecommunications, power, testing, quality assurance, field service, prototype fabrication, process management, cost estimating, and customer service. Courses in this program are offered in both the daytime and the evening.

Graduates of this program are eligible for admission to the Bachelor of Science degree program. Approximately two additional years of study are necessary to complete the requirements for the B.S. in electrical engineering technology.

[1]Evening students take ANAT K295 and PHSL K295.

Freshman Year

First Semester
EET 102 Electrical Circuits I 4
EET 105 Digital Fundamentals I 3
CPT 180 Spreadsheets 1
CPT 181 QuickBASIC 1
CPT 182 Problem Solving Using C 1
MATH 151 Algebra and Trigonometry 5
15

Second Semester
EET 152 Electrical Circuits II 4
EET 154 Analog Electronics I 4
ENG W131 Elementary Composition I 3
MATH 221 Calculus for Technology I 3
PHYS 218 General Physics 4
18

Sophomore Year

Third Semester
EET 155 Digital Fundamentals II 3
EET 204 Analog Electronics II 4
COMM C110 Fundamentals of Speech Communication 3
PHYS 219 General Physics 4
CAND 991 Candidate for Degree 0
Humanities or Social Science Elective 3
17

Fourth Semester
EET 205 Introduction to Microprocessors 4
EET 212 Electrical Power and Machinery 4
EET 302 Introduction to Control Systems 4
MET 157 Electrical and Electronic Drafting 3
15

Bachelor of Science—Electrical Engineering Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET)

Students who receive the Associate in Applied Science degree in electrical engineering technology or biomedical electronics technology are eligible to enter this Bachelor of Science degree program. All transfer students should meet IUPUI requirements for the Associate in Applied Science degree. The program provides additional study in electrical engineering technology as well as in related technical and nontechnical areas essential in modern industry. Graduates of this program are qualified for high-level positions as technologists in diverse industries such as automotive electronics, computer electronics, defense, factory automation, broadcasting, electronics manufacturing, telecommunications, energy and power, consumer electronics, robotics, and instrumentation.

Courses in this program are offered in both the daytime and the evening. The department has six recommended options: power, control systems, communications, digital/microprocessor systems, linear electronics, and electronics manufacturing. Please see the department-approved course list for these options.

Junior Year

Fifth Semester
EET Electives 8
MATH 222 Calculus for Technology II 3
STAT 301 Elementary Statistical Methods I 3
TCM 220 Technical Report Writing 3
17

Sixth Semester
EET 383 Advanced Electrical Networks 3
EET Elective 4
MET Elective 3
TCM 370 Oral Practicum for Technical Managers 3
Humanities or Social Science Elective 3
16

Senior Year

Seventh Semester
EET 490 Senior Design Project Phase I 1
EET Elective 4
Non-**EET** Technical Elective 6
CAND 991 Candidate for Degree 0
Humanities or Social Science Elective 3
Science or Mathematics Elective 3
17

Eighth Semester
EET 491 Senior Design Project Phase II 2
EET Elective 4
MET Elective 3
Communications, Humanities, or Social Science Elective 3
Free Elective 3
15

Minor in Electrical Engineering Technology

The minor in electrical engineering technology (EET) requires completion of a minimum of 23 credit hours of EET courses. Required courses are EET 102, EET 105, EET 152, and EET 154. In addition, two courses from the following list must be completed: EET 204, EET 205, EET 212, and EET 302. At least 12 hours of the minor must be taken at IUPUI. Students with credit for EET 116 should consult the EET department.

Students who wish to complete a minor in electrical engineering technology should consult with a department adviser regarding prerequisite courses or credit for courses taken at other universities.

Practical Industrial Electronics (PIE) Program

This program is offered by the Department of Electrical Engineering Technology through the Division of Continuing Studies. Each program requires two years of study (360 classroom hours). The plans of study are shown in the following table.

Semester	Program		
	Communications	**Industrial**	**Microprocessor**
1	Basic Electronics	Basic Electronics	Basic Electronics
2	Active Device Fundamentals	Active Device Fundamentals	Active Device Fundamentals
3	Electronic Circuits	Electronic Circuits	Electronic Circuits
4	Communication Electronics	Industrial Control Circuits	Microprocessor Workshop for Technicians

For more details about this program, contact:

Program Coordinator
PIE Program
620 Union Drive
IUPUI
Indianapolis, IN 46202-5171
Telephone: (317) 274-5051

Department of Manufacturing Technology

Professor Peale
Associate Professors Bowman, Frank, Moll, Rennels, Tharp, Westcott, Zecher
Assistant Professor Bluestein (*Chair*)
Lecturer Feldmann (IUPUI Columbus)

Associate in Applied Science—Computer Integrated Manufacturing Technology

Computer integrated manufacturing integrates all functions of the manufacturing process by using computers as tools to increase efficiency of design and production operations.

This program prepares students for a high-tech manufacturing environment. Graduates will be ready for positions in numerical control programming, process planning, and quality control inspection. Successful completion of the program qualifies students for acceptance into the Bachelor of Science program in computer integrated manufacturing technology. Co-op work programs with industry may be available to students.

Freshman Year

First Semester

CPT 179 Data Base Management	1
CPT 180 Spreadsheets	1
CPT 184 Word Processing	1
EG 110 Drafting Fundamentals	3
IET 104 Industrial Organization	3
MATH 151 Algebra and Trigonometry	5
MET 135 Basic Machining	3
	17

Second Semester

CIMT 102 Introduction to Computer Integrated Manufacturing	3
ENG W131 Elementary Composition I	3
MET 105 Introduction to Engineering Technology	2
MET 180 Materials and Processes	3
MET 204 Production Drawing	3
MET 212 Applications of Engineering Mechanics	3
	17

Sophomore Year

Third Semester

CIMT Selective[1]	3
COMM C110 Fundamentals of Speech Communication	3
IET 204 Maintaining Quality	3
MET 222 Computer Graphics	3
PHYS 218 General Physics I	4
CAND 991 Candidate for Degree	0
Humanities Selectives[1]	3
	19

Fourth Semester

CIMT 260 Robotics and Automated Material Handling	3
EET 116 Electrical Circuits	4
IET 250 Fundamentals of Production Cost Analysis	3
PHYS 219 General Physics II	4
STAT 301 Elementary Statistical Methods I	3
	17

Bachelor of Science—Computer Integrated Manufacturing Technology

This program prepares graduates to take their new skills in computer integrated manufacturing into traditional manufacturing situations. Typical areas of employment are advance manufacturing planning, robotics, processing, production control, statistical process planning, and CAD/CAM management.

Graduates of the IUPUI computer integrated manufacturing technology associate degree program are eligible for admission to this two-year add-on curriculum leading to a Bachelor of Science degree.

[1] A list of selectives can be obtained from the academic adviser.

Junior Year

Fifth Semester

CIMT 224 Production Control and MRP 3
CPT 182 Problem Solving Using C.....1
CPT 183 Problem Solving Using FORTRAN...1
CPT 185 Advanced Problem Solving Using FORTRAN 1
EET 216 Electrical Machines and Controls.....3
MATH 221 Calculus for Technology I.....3
MET 235 Production Machining.....3
TCM 220 Technical Report Writing 3
18

Sixth Semester

IET 301 Cost Evaluation and Control 3
IET 354 Attribute and Variable Sampling.....3
MATH 222 Calculus for Technology II 3
MET 271 Programming for Numerical Control.....3
SPV 252 Human Relations in Supervision.....3
Interdisciplinary Elective 3
18

Senior Year

Seventh Semester

CIMT 310 Plant Layout and Material Handling.....3
CIMT Technical Selective 3
MET 245 Tool and Die Design 3
MET 491 Applied Metallurgy 3
SPV 374 Industrial Supervision.....3
TCM 370 Oral Practicum for Technical Managers 3
CAND 991 Candidate for Degree.....0
18

Eighth Semester

CIMT 460 Motion and Time Study 3
CIMT Capstone Elective.....3
CIMT Technical Selective 3
TCM 340 Correspondence in Business and Industry 3
Humanities Elective.....3
Mathematics or Science Elective 3
18

Associate in Applied Science—Mechanical Engineering Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

Mechanical engineering technology concerns the generation, transmission, and utilization of mechanical and fluid energy, and the design and production of tools, machines, and their products. This program prepares specialists in the development of machines and products, in production processes, in the installation and maintenance of machines, and in solving repetitive engineering problems.

Graduates of this program are prepared to work as laboratory technicians, engineering aides, plant maintenance supervisors, layout designers, production assistants, and technical personnel. With additional experience, graduates may be promoted to such positions as industrial supervisor, machine and tool designer, technical buyer, production expeditor, and cost estimator.

Graduates of the associate degree program in mechanical engineering technology are eligible for certification as associate engineering technologists. In addition, successful completion of this program automatically qualifies a student for acceptance into the Bachelor of Science program in mechanical engineering technology. Co-op work programs with industry may be available to students.

Freshman Year

First Semester

MET 105 Introduction to Engineering Technology.....2
MET 180 Materials and Processes 3
EG 110 Drafting Fundamentals 3
ENG W131 Elementary Composition I.....3
MATH 151 Algebra and Trigonometry.....5
16

Second Semester

MET 111 Applied Statics 3
MET 135 Basic Machining 3
MET 200 Power Systems 3
MET 204 Production Drawing.....3
CPT 179 Data Base Management.....1
CPT 180 Spreadsheets 1
CPT 184 Word Processing 1
TCM 220 Technical Report Writing 3
18

Sophomore Year

Third Semester		Fourth Semester	
MET 112 Applied Mechanisms	3	**MET 214** Machine Elements	3
MET 219 Applied Strength of Materials	3	**MET 330** Introduction to Fluid Power	3
IET 104 Introduction to Industrial Organization	3	**MET** Elective	3
MATH 221 Calculus for Technology I	3	**COMM C110** Fundamentals of Speech Communication	3
PHYS 218 General Physics	4	**PHYS 219** General Physics	4
CAND 991 Candidate for Degree	0	**SPV 252** Human Relations in Supervision	3
	16		19

Bachelor of Science—Mechanical Engineering Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

This program is designed to satisfy a specific need of industry. Practical and applied courses are selected to give students additional communicative and supervisory skills, interdisciplinary technical understanding, and greater expertise in their major area.

Graduates of the two-year associate degree program are eligible for admission to this two-year add-on curriculum leading to a Bachelor of Science degree.

Junior Year

Fifth Semester		Sixth Semester	
MET 300 Applied Thermodynamics	3	**MET 232** Dynamics	3
CPT 182 Problem Solving Using C	1	**MET 350** Applied Fluid Mechanics	3
CPT 183 Problem Solving Using FORTRAN	1	**CHEM C101** Elementary Chemistry	5
CPT 185 Advanced Problem Solving Using FORTRAN	1	**EET 216** Electrical Machines and Control	3
EET 116 Electrical Circuits	4	Humanities or Social Sciences Elective	3
MATH 222 Calculus for Technology II	3		17
SPV 374 Industrial Supervision	3		
	16		

Senior Year

Seventh Semester		Eighth Semester	
MET Elective	3	**MET 414** Projects in Mechanical Design	3
STAT 301 Elementary Statistical Methods I	3	**MET** Elective	3
TCM 340 Correspondence in Business and Industry	3	**ECON E201** Introduction to Microeconomics	3
CIMT, IET, or **SPV** Elective	3	**IET 250** Fundamentals of Production Cost Analysis	3
CAND 991 Candidate for Degree	0	**TCM 370** Oral Practicum for Technical Managers	3
Interdisciplinary Elective	3	Humanities or Social Science Elective	3
	15		18

Associate in Applied Science—Mechanical Drafting–Design Technology

Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET)

Mechanical drafting–design technology teaches students to prepare sketches and drawings for design proposals, experimental models, prototype configurations, and production parts and assemblies using both conventional drafting techniques and computer graphics.

This program prepares senior draftspersons and junior design draftspersons for employment in manufacturing and construction industries, government, utilities, and other service firms. In addition, graduates are prepared to make industrial illustrations for parts manuals, brochures, proposals, and assembly instructions. Increasingly, emphasis is placed on computer graphics and computer-aided design.

Graduates of this program perform drafting and design functions such as developing the design of a subassembly or major component under the direction of an engineer or an engineering technologist. With additional experience, graduates may be promoted to checker, designer, or drafting supervisor. This program provides students with sufficiently broad training to facilitate progression into a variety of other technical and supervisory positions.

Students who complete the associate degree should contact an adviser concerning eligibility to continue their education toward a Bachelor of Science degree in other IUPUI programs.

Freshman Year

First Semester
EG 110 Drafting Fundamentals 3
MET 105 Introduction to Engineering Technology 2
MET 180 Materials and Processes 3
COMM C110 Fundamentals of Speech Communication 3
ENG W131 Elementary Composition I 3
MATH 153 Algebra and Trigonometry I 3
17

Second Semester
IET 204 Techniques of Maintaining Quality 3
MET 135 Basic Machining 3
MET 156 Graphical Computations 3
MET 204 Production Drawing 3
MATH 154 Algebra and Trigonometry II 3
Humanities or Social Science Elective 3
18

Sophomore Year

Third Semester
MET 111 Applied Statics 3
MET 112 Applied Mechanisms 3
MET 206 Production Illustration and Sketching 3
MET 222 Computer Graphics 3
MET 245 Tool and Die Design 3
PHYS 218 General Physics 4
CAND 991 Candidate for Degree 0
19

Fourth Semester
MET 219 Applied Strength of Materials 3
MET 328 CAD/CAM in Mechanical Design ...3
MET 330 Introduction to Fluid Power[1] 3
MATH 119 or **MATH 221** 3
PHYS 219 General Physics 4
16

Technical Drafting Certificate Program

This is an intensive 32 credit hour technical program for the part-time student who wants to learn the fundamentals of industrial drafting plus the basics of tool and die design. A certificate will be presented to those who successfully complete all course work. Upon the successful completion of the program, the student may continue working toward the Associate in Applied Science degree in mechanical drafting–design technology.

First Semester
EG 110 Drafting Fundamentals 3
MATH 153 Algebra and Trigonometry I 3
MET 105 Introduction to Engineering Technology 2
8

Second Semester
MET 180 Material Processes 3
MET 204 Production Drawing 3
MET 206 Production Illustration and Sketching 3
MET 222 Computer Graphics 3
12

Third Semester
MET 156 Graphical Computations 3
MET 245 Tool and Die Design 3
MET 328 CAD/CAM in Mechanical Design 3
MET Elective 3
12

[1] A selective that has been approved by an adviser may be substituted for MET 330.

Quality Control Certificate Program

Developed in conjunction with the Northeast Indiana Section of the American Society for Quality Control, this certificate program provides training and instruction in the use of measuring instruments and techniques of statistical quality control. The course work provides a basis for practical implementation of these techniques in the quality control system of an industrial organization. Integral parts of the program include an investigation of quality control and the role of quality costs, determination of customer needs, and follow-up on field performance and feedback to further improve the quality system. A certificate will be presented to those who successfully complete all course work.

Curriculum

The courses are listed in the order in which they should be taken.

MATH 151 Algebra and Trigonometry
(or MATH 153 and 154).....5
IET 204 Techniques of Maintaining Quality....3
STAT 301 Elementary Statistical Methods.....3
IET 354 Attribute and Variable Sampling.....3
IET 364 Total Quality Control.....3
IET 374 Nondestructive Testing *or*
IET 499 Designing for Quality in
Manufacturing.....3
20

CAD/CAM Certificate Program

This certificate program provides a quick overview of modern manufacturing, with special emphasis on CAD/CAM.

A total of 20 semester credit hours with a cumulative grade point average of 2.0 on a 4.0 scale are required to receive the certificate.

All students must complete the following courses:

EG 110 Drafting Fundamentals 3
MATH 151 Algebra and Trigonometry[1] 5
MET 135 Basic Machining 3
MET 271 Programming for
Numerical Control 3
MET 328 CAD/CAM for Mechanical
Design and Drafting *or*
MET 204 Production Drawing.....3

Students must then choose one of the following electives, depending on the prerequisite requirements that they meet.

MET 222 Computer Graphics 3
MET 235 Production Mechanics.....3
MET 245 Tool and Die Design 3

[1]The sequence of MATH 153 and MATH 154 may be substituted for MATH 151.

Manufacturing Systems Certificate Program

This certificate program provides an overview of the manufacturing system and the control of the various components of the system. Individuals without a technical background will benefit from the program extensively in adjusting to the manufacturing environment.

A total of 20 semester credit hours with a cumulative grade point average of 2.0 on a 4.0 scale are required to receive the certificate.

All students must complete the following courses:

CIMT 102 Introduction to Computer Integrated Manufacturing.....3
CIMT 224 Production Control and MRP 3
IET 104 Industrial Organization.....3
IET 250 Fundamentals of Production Cost Analysis.....3
MATH 151 Algebra and Trigonometry[1].....5

Students must then choose one of the following electives, provided that they meet the prerequisite requirements.

CIMT 260 Robotics and Automated Material Handling.....3
CIMT 310 Plant Layout and Material Handling.....3
IET 364 Total Quality Control.....3

[1]The sequence of MATH 153 and MATH 154 may be substituted for MATH 151.

Department of Supervision

Professors Arffa, Bostwick
Associate Professors Ansty (*Chair*), Wilkins
Assistant Professors Goodwin, Held
Lecturers Fitzpatrick, Fox

The Department of Supervision offers degrees that provide a broad-based education for those who desire leadership roles in business, government, or industry. A guiding vision of the department is to close the gap between theory and practice—the difference between what one thinks and teaches and what one does.

Associate in Applied Science (A.A.S.) and Bachelor of Science (B.S.) degrees are available. There is also a 21 credit hour certificate program in human resource management.

The degree programs are flexible and well rounded. A key aspect of both degree programs is the related technology area, comprising 15 credit hours for the A.A.S. degree and 27 credit hours for the B.S. degree. The technology courses provide specific training in the technology of the workplace. The department may, in some cases, approve appropriate courses in other schools. The remainder of courses—especially those in supervision—help develop the student's skills in effectively handling the complex issues facing today's business leaders.

Course work for the A.A.S. degree provides a solid foundation for students who wish to enhance their employment opportunities or pursue more advanced degrees. The work is sufficiently balanced to include the study of mathematics and science, technology related to the student's intended career, general education, and supervision. Students develop abilities that help them become effective contributors early in their employment in both technical and managerial roles.

The B.S. degree increases the range and depth of the student's education in technical and leadership areas. Graduates are prepared to assume leadership positions in a variety of organizational functions as well as pursue graduate degrees. The degree requirements are arranged in seven areas of study: mathematics and science, communication, behavioral science, social science and humanities, related technology, supervision, and electives. After completing required courses, students are free to choose the remainder of their courses.

Credit hour requirements for each area in the A.A.S. and B.S. degree programs are listed below. Requirements for the certificate program are listed as well.

Associate in Applied Science—Supervision

The Associate in Applied Science degree in supervision requires a total of 63 credit hours. Of the 18 hours required in supervision, 9 must result from taking **SPV 252, 374,** and **378**. The balance of the requirements for graduation are as follows:

1. 12 credit hours in mathematics and physical or biological science, including **MATH 153-154** or **MATH 118-119** or higher. One lab science course is recommended.
2. 9 credit hours in communication, which includes **ENG W131, COMM C110,** and **TCM 220**.
3. 3 credit hours in behavioral science, selected from anthropology, psychology, or sociology.
4. 15 credit hours in related technology. Related technology is defined as course work in technology, excluding supervision and technical communication. Also accepted are courses in allied health, nursing, business, engineering and science—excluding psychology. (Other courses may be used with the consent of the department adviser.) One computer course is recommended.
5. 6 credit hours of electives.

Freshman Year

First Semester		**Second Semester**	
SPV 252 Human Relations in Supervision	3	**SPV 374** Supervisory Management	3
ENG W131 Elementary Composition I	3	**COMM C110** Fundamentals of Speech Communication	3
Behavioral Science Selective	3	Laboratory Science Selective	3
Mathematics Selective	3	Mathematics Selective	3
Related Technology Selective	3	Related Technology Selective	3
	15		15

Sophomore Year

Third Semester	
SPV 378 Labor Relations	3
SPV Selective	3
TCM 220 Technical Report Writing	3
CAND 991 Candidate for Degree	0
Related Technology Selectives	6
Free Elective	3
	18

Fourth Semester	
SPV Selective	3
Mathematics or Science Selective	3
Related Technology Selectives	6
Free Elective	3
	15

Bachelor of Science—Supervision

The Bachelor of Science degree in supervision requires a total of 128 credit hours. Of the 30 credit hours required in supervision, 15 must result from taking SPV 252, 331, 374, 378, and 490. The balance of the requirements for graduation are as follows:

1. 17 credit hours in mathematics and physical or biological science, including **MATH 153-154** or **MATH 118-119** or higher. One lab science course is required.
2. 18 credit hours in communication, including **ENG W131** and **COMM C110**; the balance must be composed of speaking and writing courses. At least two additional writing courses must be taken.
3. 12 credit hours in behavioral science, selected from anthropology, psychology, and sociology; at least three hours must be at the 300 level or higher.
4. 6 credit hours in social science and the humanities, which includes history, language, art, music, philosophy, folklore, literature, comparative literature, classics, and religion.
5. 27 credit hours in related technology, including at least two computer courses. Related technology is defined as course work in technology, excluding supervision and technical communication. Also accepted are courses in allied health, nursing, business, engineering and science—excluding psychology. (Other courses may be used with the consent of the department adviser.) Rather than taking a random assortment of courses, students should fulfill this requirement by taking at least one sequence of not fewer than 9 credit hours in any of the above accepted disciplines.
6. 18 credit hours of electives.

Junior Year

Fifth Semester	
SPV Selective	3
Behavioral Science Selectives.	3
Communications Selective	3
Mathematics or Laboratory Science Selective	2
Social Science or Humanities Selective	3
Free Elective	3
	17

Sixth Semester	
SPV Selective	3
Behavioral Science Selective	3
Communication Selective	3
Mathematics or Laboratory Science Selective	3
Related Technology Selective	3
	15

Senior Year

Seventh Semester	
SPV 331 Occupational Safety and Health	3
SPV 490 Senior Research Project *or* **SPV** Selective	3
CAND 991 Candidate for Degree	0
Behavioral Science Selective	3
Communication Selective	3
Related Technology Selective	3
Free Elective	3
	18

Eighth Semester	
SPV 490 Senior Research Project *or* **SPV** Selective	3
Related Technology Selective	3
Social Science or Humanities Selective	3
Free Electives	6
	15

Human Resource Management Certificate Program

This certificate program is cosponsored by the Department of Supervision and the Central Indiana Personnel Association. The Human Resource Management Certificate Program provides a thorough explanation of the personnel department's role in dealing with human resources. The focus of the courses will be practical. Each course emphasizes the application of vital concepts so that students will acquire a comprehensive understanding of the subject matter.

Students are required to successfully complete 21 credit hours (seven courses) to earn the certificate. Five courses are core requirements and two courses are selectives.

Required Core Courses Students must successfully complete all five of the following courses (15 credit hours).

SPV 368 Personnel Law 3
SPV 383 Human Resources Management.....3
SPV 385 Leadership Strategies for Quality and Productivity.....3
SPV 476 Compensation Planning and Management 3
SPV 479 Staffing Organizations.....3

Selective Courses Students must successfully complete two of the following three courses (6 credit hours).

SPV 331 Occupational Safety and Health 3
SPV 375 Training Methods.....3
SPV 378 Labor Relations.....3

To enroll in this program students must be formally admitted by the Office of Admissions on the IUPUI campus. Credit will be given for applicable courses taken at other colleges or universities. Students may apply these courses toward degree programs in the Department of Supervision. Additional information may be obtained from the Department of Supervision, 799 W. Michigan Street, IUPUI, Indianapolis, IN 46202; telephone (317) 274-2413.

Technology Course Descriptions

Key to Course Descriptions

The courses listed in this section will, for the most part, be offered during the 1993-95 academic years. Additional information about course schedules may be obtained from the specific departments in the school. Courses are grouped under their program subject abbreviation. Course descriptions may contain the following information, in order: course number; course title; number of credit hours (in parentheses); number of hours of lecture per week; number of laboratory hours per week; number of recitation hours per week (group discussion and problem solving); and prerequisites (P) and/or corequisites (C), followed by a course description. For example, under Civil Engineering Technology (CET), a course description reads:

CET 104 Fundamentals of Surveying (3 cr.) Class 2, Lab 3. P: MATH 154 or equivalent. Measurement of vertical and horizontal distances and angles using the tape, level, transit, theodolite, and EDMI. Computations of grades, traverses, areas, and curves.

This listing indicates that the course number is CET 104 with the title "Fundamentals of Surveying." It's worth 3 credit hours. The class meets 2 hours a week for the lecture and 3 hours a week for the laboratory. The required prerequisite is **MATH 154** or an equivalent course. A brief course description then follows.

The numbering system for courses reflects the following levels:

1-49	Precollege and deficiency courses
50-99	Nondegree courses
100-299	Courses normally scheduled for freshmen and sophomores
300-499	Courses normally scheduled for juniors and seniors
500-599	Dual-level courses that may be scheduled for seniors and for graduate students for graduate credits
600-699	Graduate courses

Architectural Technology (ART)

Students registering for ART courses must have received a grade of C– or above for all prerequisite courses.

ART 116 Construction Graphics (3 cr.) Class 1, Lab 6. P: High school geometry or equivalent. Introduction to drafting fundamentals, with emphasis on architectural and civil engineering topics. Use of instruments, lettering, orthographic projections, auxiliary views, intersections, and perspectives. Students may not receive credit for both ART 116 and ART 117.

ART 117 Construction Drafting and CAD (3 cr.) Class 1, Lab 5. P: High school geometry or equivalent. Introduction to drafting fundamentals with emphasis on architectural and civil engineering topics. Develop basic drafting skills, using orthographic projections, auxiliary views, and perspectives. Students will be introduced to the fundamentals of CAD.

ART 120 Architectural Presentation (3 cr.) Class 1, Lab 6. C: ART 116. Development of architectural presentations using pencil, ink, and color techniques as a means of communication.

ART 155 Residential Construction (3 cr.) Class 2, Lab 3. P: ART 116 and ART 162. A study of wood frame construction through a semester project requiring planning, preliminary, and working drawings. Outside lab assignment is required.

ART 162 Building Materials and Methods (2 cr.) Class 1, Lab 3. The study of properties and use of various building materials in modern construction.

ART 172 Systems of Construction (2 cr.) Class 2. A survey of the organization of the construction industry and introduction to various building components and systems, with an emphasis on the study of structural systems.

ART 200 Fundamentals of CAD for Construction (3 cr.) Class 2, Lab 3. P: ART 116 or ART 117. An introduction to computer-aided design (CAD) hardware and software with an emphasis on two-dimensional drawings and design. Assignments will focus upon practical architectural and civil engineering applications for construction.

ART 210 History of Architecture I (3 cr.) Class 3. A survey of Western architecture from ancient times to the present day. Social, technological, and cultural influences on architectural styles are emphasized.

ART 220 Advanced Architectural Presentation (3 cr.) Class 1, Lab 6. P: ART 120 or consent of instructor. Advanced subjects in architectural presentation.

ART 222 Commercial Construction (3 cr.) Class 2, Lab 3. P: ART 155. Preparation of preliminary and working drawings for an intermediate-sized commercial building. At the instructor's option, the work may be done in groups.

ART 224 Advanced Commercial Construction (3 cr.) Class 2, Lab 3. P: ART 222. Preparation of preliminary and working drawings for a multistory building. At the instructor's option, students will accomplish work as a part of an assigned group.

ART 267 Specifications and Contract Documents (2 cr.) Class 2. The study of general conditions and building construction specifications, agreements, contracts, liens, and bonds.

ART 284 Mechanical Systems for Buildings (3 cr.) Class 3. P: MATH 153 or equivalent and sophomore standing. The study of plumbing, heating, ventilation, air conditioning, and other mechanical systems for buildings.

ART 285 Electrical Systems for Buildings (2 cr.) Class 2. P: MATH 153 or equivalent. A survey of electrical and lighting system requirements for residential and commercial buildings. Lighting fundamentals and design, electric circuits, power requirements, and wiring layout used for building construction systems.

ART 299 Architectural Technology (1-4 cr.) Hours and subject matter to be arranged with staff. Course may be repeated for up to 9 credit hours.

ART 310 History of Architecture II (3 cr.) Class 3. The study of Western architecture, structure, and building technology of the eighteenth, nineteenth, and twentieth centuries.

ART 350 Energy Conservation in Buildings (3 cr.) Class 3. P: ART 284. Heat loss and heat gain in buildings; impact of governmental laws and incentives; effects of insulation and efficient mechanical equipment; principles of wind energy; solar heating and cooling, including preliminary design of active and passive solar systems; and life cycle costing.

ART 476 Specifications (3 cr.) Class 3. Detailed study of purpose and intent of specifications for specific jobs, including development of the general conditions, adaptation of selected provisions from standard specifications, and delineation of special supplemental conditions.

ART 490 Senior Project (1-6 cr.) Final project aimed at combining the skills and knowledge gained from the various areas of study. The student will be expected to report graphically, orally, and in written form on a final project approved by the adviser. Presentation will be made to a representative board of the faculty determined by the adviser.

ART 499 Architectural Technology (1-4 cr.) Hours, subject matter, and credit to be arranged with staff. Course may be repeated for up to 9 credit hours.

Biomedical Electronics Technology (BMET)

BMET 240 Introduction to Medical Electronics (3 cr.) Class 3. C: EET 154. An overview of human anatomy and physiology and introduction to physiological measurements including cardiovascular, pulmonary, and applicable pressure and temperature measurements. Operation of common biomedical electronic equipment is demonstrated. On-site hospital visits expose students to modern monitoring and intensive care biomedical equipment.

BMET 320 Biomedical Electronic Systems I (4 cr.) Class 3, Lab 3. P: BMET 240. C: EET 204. Hands-on study of medical instrumentation. The origins of biopotentials, electrocardiograms, and electrical shock are studied. A logical approach to troubleshooting is discussed. The study of patient-care equipment, including the electrocardiograph, and unit-level troubleshooting are included.

BMET 360 Biomedical Electronic Systems II (4 cr.) Class 3, Lab 3. P: BMET 320. C: EET 155. A continuation of BMET 320 with an emphasis on the electroencephalograph and filtering, the defibrillator, and the cardiac pacemaker as a digital pulse oscillator. Electrosurgical units and laser surgery, central station monitor, microprocessor-based equipment, and system-level troubleshooting are studied.

Candidacy for Degree (CAND)

CAND 991 Candidate for Degree In order to be included in all appropriate graduation processes, a student who completes the requirements for a degree at the end of a semester or session must be registered for that session in CAND 991. Certain programs require that this be done the session prior to anticipated graduation. Students should verify this requirement in advance with their adviser or department head.

Civil Engineering Technology (CET)

Students registering for CET courses must have received a grade of C– or above for all prerequisite courses.

CET 104 Fundamentals of Surveying (3 cr.) Class 2, Lab 3. P: MATH 154 or equivalent. Measurement of vertical and horizontal distances and angles using the tape, level, transit, theodolite, and EDMI. Computations of grades, traverses, areas, and curves.

CET 160 Statics (3 cr.) Class 3. P: MATH 154 or equivalent. A study of forces acting on bodies at rest, including coplanar, concurrent, and nonconcurrent systems. Centroids, moments of inertia, and friction are included.

CET 210 Surveying Computations (3 cr.) Class 2, Lab 3. P: CET 104. Accuracy, precision, and error theory pertaining to surveying

calculations. Calculations for alignment, grade, route surveying, construction surveying, building layouts, areas, and earthwork will be included.

CET 231 Soils Testing (3 cr.) Class 2, Lab 3. P: CET 160. P or C: TCM 220. The measurement of the engineering properties of soils in the laboratory and field. Identification and classification of soils by the Unified Soil Classification System and the American Association of State Highway and Transportation Officials System.

CET 260 Strength of Materials (3 cr.) Class 3. P: CET 160. C: CET 267. Stress-strain relationships of engineering materials, composite analysis, shear forces and bending moments in beams, and the analysis and design of statically determinate steel and wood beams and columns.

CET 267 Materials Testing (2 cr.) Class 1, Lab 3. C: CET 260. P or C: TCM 220. Laboratory and field testing of structural materials to determine their mechanical properties and behavior under load. Materials included are steel, aluminum, concrete, wood, and asphalt.

CET 275 Applied Civil Engineering Drafting (3 cr.) Class 2, Lab 3. P: ART 116 and ART 162. Preparation of structural construction drawings for buildings, bridges, and roads.

CET 299 Civil Engineering Technology (1-4 cr.) Hours and subject matter to be arranged with staff. Course may be repeated for up to 9 credit hours.

CET 312 Construction Surveying (3 cr.) Class 2, Lab 3. P: CET 104. Field procedures for construction surveys, including building layout and route surveys using both theodolite and electronic distance measuring (EDM) equipment. Basic field procedures to "balance in," prolong and establish lines, and lay off and measure horizontal and vertical angles. Classwork involves computations of errors and coordinates.

CET 368 Experimental Stress Analysis Lab (2 cr.) Class 1, Lab 3. P: CET 267 and MATH 221. Topics include determining the location, direction, and magnitude of stress and strain in full-size and scale-size structural systems and components.

CET 382 Steel Structures Design (3 cr.) Class 3. P: CET 260 and CET 267. Fundamentals of structural steel design, with particular attention to the design of beams, columns, and their connections.

CET 387 Reinforced Concrete Design (3 cr.) Class 3. P: CET 260 and CET 267. The fundamentals of reinforced concrete design and analysis, including beams, slabs, columns, footings, and retaining structures. Also included is an introduction to continuous construction and prestressed concrete.

CET 430 Foundation Systems (3 cr.) Class 3. P: CET 231 and CET 260. Introduction to the analysis of foundations and related systems including shallow foundations, piles, caissons, and retaining structures; soil mechanics applications in relation to the determination of settlement of foundations and slope stability; techniques of subsurface investigation; interpretation of soil reports.

CET 452 Hydraulics and Drainage (3 cr.) Class 3. P: CET 160 and senior standing. Basic hydrostatics; fundamental concepts of fluid flow in pipes and open channels; methods of estimating storm runoff; size determination of culverts, storm sewers, and open channels.

CET 484 Wood, Timber, and Formwork Design (3 cr.) Class 3. P: CET 260 and CET 267. Fundamentals of wood and timber design, including beams, columns, connections, and laminated structural members. The design of formwork for concrete structures, including walls, beams, columns, slabs, and forms for special shapes.

CET 490 Senior Project (1-6 cr.) Final project aimed at combining the skills and knowledge gained from the various areas of study. The student will be expected to report graphically, orally, and in written form on a final project approved by the adviser. Presentation will be made to a representative board of the faculty determined by the adviser.

CET 499 Civil Engineering Technology (1-4 cr.) Hours, subject matter, and credit to be arranged with staff. Course may be repeated for up to 9 credit hours.

Computer Integrated Manufacturing Technology (CIMT)

CIMT 102 Introduction to Computer Integrated Manufacturing (3 cr.) Class 3. This course provides a survey of the technical equipment and topics associated with computer integrated manufacturing (CIM) systems. Subjects include computer-aided design (CAD), numerical control, computer process control, robotics, group technology, process planning, and computer integrated production management systems including material resource planning, flexible manufacturing systems, and other innovations as they become available to industry.

CIMT 198 Industrial Practice I (1-5 cr.) P: Second-semester standing, prior acceptance into the cooperative program, and consent of the co-op adviser. Practice in industry with written reports of this practice for co-op students.

CIMT 205 Microcomputer Applications for Computer Integrated Manufacturing (3 cr.) Class 2, Lab 3. P: Consent of instructor. Applications of scheduling, engineering, economy, cost analysis, quality control, and

related areas based on microcomputer software including spreadsheets, data bases, and word processing. Cannot be taken with CPT 179, CPT 180, or CPT 184.

CIMT 224 Production Control and MRP (3 cr.) Class 3. P: MATH 151 or equivalent. Preproduction consideration of the most economical methods, operations, and materials for the manufacture of a product. Includes planning, scheduling, routing, and detailing of production control procedures.

CIMT 260 Robotics and Automated Material Handling (3 cr.) Class 2, Lab 2. P: MATH 153 and MET 105. A survey of the types of industrial robots and their applications in manufacturing. Safety, application limitations, and economic justification will be considered. Automated material handling equipment will be reviewed. Laboratory exercises will involve programming an educational robot using a teach pendant and microcomputers.

CIMT 298 Industrial Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports on this practice for co-op students.

CIMT 310 Plant Layout and Material Handling (3 cr.) Class 3. P: MET 204 or MET 328 or equivalent courses. A study and analysis of material flow in a manufacturing facility; material-handling equipment; plant layout principles for manufacturing service, storage, and office areas; and industrial packaging techniques. Emphasis is on application to manufacturing problems. Not open to students who have credit in IET 310.

CIMT 398 Industrial Practice III (1-5 cr.) P: Consent of the co-op adviser. Practice in industry with written reports of this practice for co-op students.

CIMT 460 Motion and Time Study (3 cr.) Class 2, Lab 3. P: Junior standing. Techniques of motion and time study, process charts, operation charts, multiple activity charts, micromotion study, therbligs, and stopwatch time study. Not open to students who have credit in IET 262.

CIMT 481 Integration of Manufacturing Systems (3 cr.) Class 2, Lab 2. P: Senior standing in CIMT program. This is a capstone course that emphasizes the integration of traditional manufacturing activities such as planning, facilities, materials handling, production control, etc. Students will analyze case studies and complete directed projects. Field trips may be required.

CIMT 484 Automated Measurements and Testing (3 cr.) Class 2, Lab 2. P: EET 105, EET 216, and IET 354. A study of automated measurements and testing systems. Includes measurement principles, sources of error, instrument/computer communications, and testing software design.

CIMT 497 Senior Project (3 cr.) Class 2, Lab 2. Directed work on individual projects for senior computer integrated manufacturing technology students.

CIMT 498 Industrial Practice IV (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

Computer Technology (CPT)

CPT 102 Computer Usage in EET (1 cr.) Class 2. C: EET 102 and EET 105. The structure and details of BASIC, a general-purpose programming language. Numerous problems are solved on the computer to demonstrate the use of BASIC in EET applications. (May not be used for credit by CPT majors.)

CPT 106 Using a Personal Computer (3 cr.) Class 3. The function and applications of word processing, electronic spreadsheets, data management, and other personal-computing tools. Numerous assignments are completed to demonstrate the many uses of personal computers. (May not be used for credit by CPT majors.)

CPT 115 Introduction to Data Processing (3 cr.) Class 3. P: None. Topics include the following areas of computer information: hardware, software, systems, applications, and implications (current and future). Emphasis is on mainframes and microcomputers.

CPT 122 Computer Applications in Finite Mathematics (3 cr.) Class 3. P: CPT 115, CPT 140, and MATH 153 or MATH 151. A presentation of mathematical concepts related to the computer field and used in the solution of business/industrial type problems. Topics include linear systems, matrix algebra, probability theory, and mathematics of finance.

CPT 140 Introduction to Computer Lab (1 cr.) Lab 2. P: High school algebra or equivalent. An introduction to problem-solving techniques, program design and development, programming logic, Pascal programming, remote terminal use in the CMS environment, and the use of the IUPUI computing facilities. Covers utilization of both mainframe and personal computers.

CPT 179 Data Base Management (1 cr.) Class 2, Lab 2. P: None. The function and applications of data base management. Several assignments are completed to demonstrate each component. Not open to CPT majors. This course meets for five weeks.

CPT 180 Spreadsheets (1 cr.) Class 2, Lab 2. P: None. The function and applications of a spreadsheet package integrating spreadsheets and graphics. Several assignments are completed to demonstrate each component. Not open to CPT majors. This course meets for five weeks.

CPT 181 QuickBASIC (1 cr.) Class 2, Lab 2. P: CPT 180. C: MATH 153. The structure and details of QuickBASIC. Numerous problems are solved on the computer to demonstrate the use of QuickBASIC in EET and MET applications. Not open to CPT majors. This course meets for five weeks.

CPT 182 Problem Solving Using C (1 cr.) Class 2, Lab 2. P: CPT 180. C: MATH 153. An introduction to problem solving and programming using the C language. The course includes introductory material on the C language. Not open to CPT majors. This course meets for five weeks.

CPT 183 Problem Solving Using FORTRAN (1 cr.) Class 2, Lab 2. P: CPT 180. C: MATH 153. Course will present the principles of programming using FORTRAN. Structured programming will be stressed. Not open to CPT majors. This course meets for five weeks.

CPT 184 Word Processing (1 cr.) Class 2, Lab 2. P: None. The function and applications of word processing. Several assignments are completed to demonstrate each component. Not open to CPT majors. This course meets for five weeks.

CPT 185 Advanced Problem Solving Using FORTRAN (1 cr.) Class 2, Lab 2. P: CPT 183. This course is a continuation of CPT 183. Not open to CPT majors. This course meets for five weeks.

CPT 188 Microcomputer Applications Packages (variable title) (3 cr.) Class 3. P: Varies with course content. Introduction to the topics and skills associated with a microcomputer applications package as applicable to the package offered. Since various applications packages may be offered under this title, this course may be repeated for up to 9 credit hours.

CPT 198 Data Processing Practice I (1-5 cr.) P: Sophomore standing, prior acceptance into the cooperative program, and consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

CPT 200 Computer Programming Fundamentals (3 cr.) Class 3; or Class 2, Lab 2. P: MATH 111. The presentation of the basic elements of programming digital computers, including absolute and symbolic coding, magnetic tape functions, and sequential access processing. Major emphasis will be on compiler language (FORTRAN) programming. (May not be used for credit by CPT majors.)

CPT 220 Numerical Methods I (3 cr.) Class 3; or Class 2, Lab 2. P: CPT 264 and either MATH 164 or MATH 222. Numerical methods for finding solutions to mathematical equations for analysis of tabulated data. A course consisting chiefly of the solution of specific problems by computer programming and other methods. Topics include iterative and direct solutions of linear equations, matrix operations, integration techniques, and error analysis.

CPT 222 Computer Applications of Discrete Mathematics (3 cr.) Class 3. P: CPT 115, CPT 140, and MATH 151. A presentation of mathematical concepts that bear directly on such computer areas as knowledge-based systems, architecture, data base management systems, and communications networks. Topics include set theory, Boolean algebra, combinatorics, graph theory, and an introduction to automata theory.

CPT 224 Microcomputer Tools and Applications (3 cr.) Class 3. P: CPT 115 and CPT 140. Applications of word processing, electronic spreadsheets, graphing, and other microcomputer tools, and demonstrations of their uses by several assignments. Not open to students who have credit in CPT 240 Using a Personal Computer.

CPT 225 Statistical Methods (3 cr.) Class 3. P: Any high level programming language and either MATH 151 or MATH 153. An introduction to elementary statistics with emphasis on the analysis of actual data. Topics include description and representation of sample data, probability, theoretical distributions, sampling, estimating, correlation, regression, and computer statistical routines.

CPT 232 Assembly Language Programming (3 cr.) Class 3. P: CPT 115 and CPT 140. Programming of a digital computer at the machine-language and assembly-language levels with emphasis on the meticulous step-by-step development of a program. Topics include computer hardware, stored program concept, operation codes, addresses, flow diagrams, and assembly-language translators. May be substituted for CPT 233.

CPT 233 Assembly Language for the Microcomputer (3 cr.) Class 3. P: CPT 115 and CPT 140 or their equivalent. Investigation of assembly language for the microcomputer. Emphasis on the use of assembly language to control the computer in ways not available through high-level languages. May be substituted for CPT 232.

CPT 240 Introduction to Data Communications and Networks (3 cr.) Class 3. P: CPT 232 or CPT 233. The role of data communications in modern computation. Real-time systems and data transmission. Topics include data communications applications, voice communications, network hardware and configuration, standards, services, and costs.

CPT 254 Information Systems Concepts (3 cr.) Class 3; or Class 2, Lab 2. P: Sophomore standing, one programming course (CPT 265

preferred), IET 104. Concepts of the processes of system analysis and system design. Both classical and structured approaches and tools. Definitions and attributes of information systems, life cycle, documentation, evaluation, and data administration.

CPT 263 BASIC Programming (3 cr.) Class 3. P: CPT 115. The structure and details of BASIC, a digital computer programming language whose instructions resemble elementary algebraic formulas augmented by certain English words. Numerous problems are solved on the computer to demonstrate the many facets of the language.

CPT 264 FORTRAN Programming (3 cr.) Class 3; or Class 2, Lab 2. P: CPT 115 and CPT 140. The structure and details of FORTRAN, a mathematically oriented compiler language. Numerous problems are solved on the computer to demonstrate the many facets of the language.

CPT 265 COBOL Programming (3 cr.) Class 3; or Class 2, Lab 2. P: CPT 115 and CPT 140. A study of the programming language COBOL, which is oriented toward data handling and processing tasks. The student will study the structure and details of COBOL and perform programming exercises as well as consider practical applications.

CPT 286 Computer Operating Systems I (3 cr.) Class 3. P: CPT 232 or CPT 233 and either CPT 264 or CPT 265. An introduction to computer operating systems and other systems software with emphasis on both microcomputers and mainframes. Topics include hardware architecture, multiprogramming and timesharing, command and control languages, memory management, scheduling, and interrupt handling.

CPT 288 Data Storage and Data Base Concepts (3 cr.) Class 3. P: CPT 264 or CPT 265. File-handling techniques as they relate to the three common file organizations. An introduction to data structures. Coverage of the commonly used data models with emphasis on the relational model. Topics on all aspects of a data base management system.

CPT 290 Computer Project (1-4 cr.) Independent study for sophomore students who desire to execute a complete computer-oriented project. Course may be repeated for up to 6 credit hours.

CPT 298 Data Processing Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

CPT 299 Computer Technology (1-4 cr.) Hours, credit, and subject matter to be arranged by staff. May be repeated for up to 9 credit hours.

CPT 301 Queueing Theory and Traffic Analysis (3 cr.) Class 3. P: CPT 225 and MATH 221 or equivalent courses. P or C: CPT 340. An introduction to queueing theory as it relates to traffic analysis. Emphasis is on communication network factors that affect message throughput (error handling, protocols, response times, and service disciplines) in a variety of configurations.

CPT 302 Microcomputer Organization (3 cr.) Class 3. P: CPT 222, CPT 286, and CPT 340. Microcomputer organization and microcomputer architecture emphasizing combinational circuits, microprogramming, chip interfacing, and RISC technology. Not open to students who have credit in CPT 499 Computer Organization.

CPT 303 Communications Security and Network Controls (3 cr.) Class 3. P: CPT 340 and A.A.S. in CPT or equivalent degree. A detailed study of the many hardware, software, and managerial controls needed to operate a data communication network in a safe and secure manner. Emphasis is on risk management; organizational, administrative, and technical controls; legal requirements; and professional ethics.

CPT 324 Information Center Functions (3 cr.) Class 3. P: A.A.S. in CPT or equivalent degree. A practical approach to providing support services to end-user computing departments involving the specification, evaluation, and selection of hardware/software systems within those units. Concerns of in-house standards, compatibility, and long-range planning are discussed within a framework of meeting departmental needs.

CPT 340 Data Communications (3 cr.) Class 3. P: CPT 240 and CPT 286. Principles of networking, which include topics related to the network design life cycle, protocol and software selection, interfacing of microcomputers to networks, Local Area Network (LAN) design and implementation, network operations and management, and network security.

CPT 345 Computer Graphics (3 cr.) Class 3. P: CPT 362 or CPT 366. Study and programming of graphical techniques, such as scaling, translation, rotation, and polygons. The emphasis will be on the programming aspects of graphics.

CPT 351 Expert Systems (3 cr.) Class 3. P: CPT 352 or CPT 389 or consent of instructor. This course is designed to provide hands-on experience in the creation and use of expert systems. It is designed to teach the theory and mechanics of expert system development.

CPT 352 Decision Support and Information Systems (3 cr.) Class 3. P: CPT 254. Definition of support and management information systems—similarities and differences. Use of

decision support systems (DSS) and management information systems (MIS) in organizations. Tools for modeling and simulation. Application of system analysis and system design concepts to DSS and MIS situations.

CPT 362 C Language Programming (3 cr.) Class 3. P: CPT 365 or CPT 366, and CPT 232. A study of the programming language C, a multipurpose low-level language. Students will study the structure and details of C and perform programming exercises as well as discuss C programming techniques.

CPT 365 Topics in COBOL (3 cr.) Class 3; or Class 2, Lab 2. P: CPT 265. Advanced COBOL topics concerning index-sequential files, direct files, relative files, preprocessor use, simulation, subprogram use, and handling sophisticated tables by using subscripting and indexing.

CPT 366 Pascal Programming (3 cr.) Class 3. P: One 3 credit hour programming course. A study of the Pascal language using microcomputers. This language is suitable for both technical and commercial data processing problems. Numerous problems are solved on the computer to demonstrate the many facets of this highly structured language.

CPT 374 Systems Analysis (3 cr.) Class 3. P: A.A.S. in CPT and CPT 254. Review of system analysis concepts and system development life cycle. Application of techniques used in investigation and analysis, feasibility, cost/benefit, selection, and general design of an information system. Both classical and structured approaches are applied through a semester case problem project. Documentation, evaluation, and data administration tasks are integral to the other processes.

CPT 384 Systems Design (3 cr.) Class 3. P: CPT 374. Brief review of system analysis and general design phases (CPT 374). Application of techniques and tools for system designs that meet requirements for input, output, files, processes, and controls is undertaken through a semester case problem project. Software selection decisions, conversion and implementation planning, postoperational review planning, and maintenance considerations.

CPT 386 Computer Operating Systems II (3 cr.) Class 3; or Class 2, Lab 2. P: CPT 286 and three semesters of any programming languages. A continuation of CPT 286 with emphasis on the software structure of a typical minicomputer operating system. The course stresses development of specific algorithms as they relate to the functions of processor management, memory management, and interrupt handling.

CPT 387 Evaluation and Selection of Small Computing Systems (3 cr.) Class 3. P: CPT 254 and CPT 340. A study of microcomputer and minicomputer hardware and software, microprocessor architecture, distributed processing concepts and design, specification, evaluation and selection techniques, vendor and marketplace analysis, and interfacing.

CPT 388 Topics in Programming Languages (variable title) (3 cr.) Class 3; or Class 2, Lab 2. P: One 300-level programming language course. Varies with course content (prerequisites will be included in the semester class schedule). Since various languages may be offered under this title, this course may be used for a maximum of 9 hours of credit.

CPT 389 Using a Data Base Management System (3 cr.) Class 3. P: CPT 288 and CPT 365. The study and use of a data base management system (DBMS). Topics include user language, host language interface, file management, monitoring, recovery, and reorganization.

CPT 396 Computer Laboratory (1-2 cr.) Lab 1-6. Applied computer laboratory experience carried out on an independent study basis in conjunction with other courses, assignments, or problems.

CPT 398 Data Processing Practice III (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students. May be repeated once for credit.

CPT 402 Design and Implementation of Local Area Networks (3 cr.) Class 3. P: CPT 440. P or C: CPT 486. A capstone course in which students working in groups examine local area network configurations, network software design, and develop their own software algorithms to evaluate network performance.

CPT 440 Communication Network Design (3 cr.) Class 3. P: CPT 340, and CPT 225 or equivalent. Elements of a design including line, equipment and software selection, demand measurement and design goals. Assembling these elements into the design of both centralized and distributed networks. The course concludes with an extensive laboratory design of a multi-point, private line data communication network.

CPT 442 Fiber Optics (3 cr.) Class 3. P: CPT 302 and PHYS 219. A detailed examination of ISDN and other integrated communication systems with emphasis on fiber optic technology as used on both optical and satellite systems. Topics include voice call multiplexing, modulation techniques, voice digitalization, line coding, and digital switching.

CPT 470 Software Design and Implementation (3 cr.) Class 3. P: CPT 384. A survey of tools and techniques for designing and creating quality software. The role of

reliability in the design, implementation, and test phases of software development will be discussed. Team problems will be assigned to illustrate the value of these tools and techniques.

CPT 471 Software Conversion and Maintenance (3 cr.) Class 3. P: CPT 470 or CPT 484. A survey of software conversion and maintenance techniques and tools. Maintenance will be viewed from the "people side" and the "technical side," including problem-solving style, programming style, reliability, maintainability, and documentation. Team projects will be assigned requiring application of these conversion and maintenance tools and techniques.

CPT 484 Systems Analysis and Design Project (3 cr.) Class 3. P: CPT 384. A team approach is used to analyze and design a realistic information system of moderate complexity. Synthesis of system and design concepts, principles, and practices. Project management, group dynamics, and conflict resolution are experienced and discussed.

CPT 486 Systems Programming (3 cr.) Class 3. P: CPT 386. A continuation of software concepts presented initially in CPT 386 and extended into programs such as assemblers, compilers, editors, interpreters, interfaces, and language simulators. This course emphasizes programming rather than theoretical programming concepts.

CPT 489 Data Base Analysis and Design (3 cr.) Class 3. P: CPT 384 and CPT 389. The analysis and design of a data base system. Topics include design methodologies, optimization techniques, restructuring techniques, and selection and evaluation of data base management systems.

CPT 490 Senior Project (1-4 cr.) Independent study for seniors who desire to execute a complete computer-oriented project. Course may be repeated for up to 6 credit hours.

CPT 491 Senior Design Project, Phase I (1 cr.) Lab 2. P: CPT 340, two upper-level computing electives, and A.A.S. in CPT or equivalent degree. An extensive design, analytical, or research project performed in collaboration with a faculty adviser. Specific tasks include defining an acceptable project proposal and a final project specifications report.

CPT 492 Senior Design Project, Phase II (2 cr.) Lab 4. P: CPT 491. A continuation of CPT 491, Phase II includes finalized design, prototype, and/or product; procurement of materials; oral presentation to faculty and other interested parties; and written technical report following standard format.

CPT 498 Data Processing Practice IV (5 cr.) Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students. May be repeated once for credit.

CPT 499 Computer Technology (1-4 cr.) Hours, credit, and subject matter to be arranged by staff.

Construction Technology (CNT)

Students registering for CNT courses must have received a grade of C– or above for all prerequisite courses.

CNT 198 Construction Practice I (1-5 cr.) P: Second-semester standing, prior acceptance into the cooperative education program, and consent of faculty co-op adviser. Practical experience in the construction industry with written reports of this experience for co-op students.

CNT 280 Quantity Survey (3 cr.) Class 2, Lab 3. P or C: ART 155 or CET 275 or consent of instructor. A study of methods to estimate quantities of materials required in construction. Practice in making quantity surveys.

CNT 298 Construction Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practical experience in the construction industry with written reports of this experience for co-op students.

CNT 340 Construction Scheduling (2 cr.) Class 2. P: CNT 280 or consent of instructor. A study of the planning and control of construction projects. Topics include time schedules, labor, and equipment balancing; expediting material delivery; bar charts and critical path method (CPM) network scheduling; and an introduction to the use of the computer in CPM network analysis.

CNT 344 Construction Inspection (3 cr.) Class 2, Lab 3. P: Upper-division standing or consent of instructor. Inspection procedures as applied to contracted construction, and the role inspection plays in the execution of the completed contract. The laboratory period is for field trips to construction sites.

CNT 350 Construction Project Cost and Production (3 cr.) Class 3. P: CNT 280. A study of contractors' record-keeping procedures and forms from estimate breakdown to completion of the project, with a review of current methods of production control.

CNT 390 Construction Experience (1 cr.) Consent of instructor. Minimum of 10 weeks' work experience in the construction industry, with at least five weeks' experience in the field. Written report of this experience.

CNT 398 Construction Practice III (1-5 cr.) P: Consent of the faculty co-op adviser. Practical experience in the construction industry with written reports of this experience for co-op students.

CNT 440 Construction Field Operations (3 cr.) Class 3. P: Junior standing or consent of instructor. Study of types and uses of construction equipment and machinery in relation to diverse field operations. Analysis of equipment productivity and costs.

CNT 441 Construction Operations (4 cr.) Class 4. P: Junior standing or consent of instructor. Management, methods, and equipment used in the construction of buildings, earthworks, bridges, and roads. Contractor organization, job management, and safety. Excavation, formwork, concrete, masonry, and steel erection methods.

CNT 442 Construction Costs and Bidding (3 cr.) Class 3. P: CNT 330 and CNT 340 or consent of instructor. The study of bidding practices for lump-sum and unit-price contracts used in the construction industry and in estimating total job costs. Topics include unit costs of materials and labor, overhead, subcontracts, total estimated costs, and bid price. The development of a total bid for a project is required.

CNT 445 Construction Management (3 cr.) Class 3. P: BUS L203 or consent of instructor. The study of the various methods of contracting and the documents involved. Topics include types of contracts, construction organizations, insurance, bonds, Occupational Safety and Health Administration (OSHA) requirements, and construction management.

CNT 446 Construction Financing (3 cr.) Class 3. P or C: CNT 445. Principles and sources of construction funding for contracting firms and projects during all phases of construction. Mortgage and construction loans, market and feasibility studies for construction projects, company organizational structure affecting funding, overhead and project cost control, and financial management.

CNT 470 Site Development (3 cr.) Class 3. P or C: CET 452 or consent of instructor. Principles and practices of land development, with considerations of market analysis, site selection, restrictions imposed by covenants and governmental regulations, costs, and financing. Collection of data and preparation of drawings for site development.

CNT 488 Construction Structures (3 cr.) Class 3. P: CET 382 and CET 484 or consent of instructor. Design of construction structures and erection procedures for use during construction including temporary bridges, scaffolding, sheeting, bracing, underpinning, and the study of erection stresses in bridges and buildings.

CNT 490 Senior Project (3 cr.) P: Senior standing. The development of a project that will combine the skill and knowledge gained from various areas of study. The student will be expected to present a project that has been approved by the faculty adviser to a panel of faculty chosen by the adviser. This presentation should include graphical material as well as oral and written communication.

CNT 492 Value Management for Construction (3 cr.) Class 3. P: Senior standing or consent of instructor. The study of value engineering and value management theory and procedures as applied to buildings and construction projects. Life-cycle cost theory is reviewed with regard to the construction prices from conception through the total life expectancy of the structure.

CNT 494 Engineering Economics for Construction (3 cr.) Class 3. P: Senior standing. Introduction to engineering economic methods such as decision analysis trade-off games, capital planning, feasibility, cost estimating, and life-cycle costing. Concepts of time value of money, economic evaluation methods depreciation, taxes, inflation, cost data, and cost indexes in relation to construction operations and building.

CNT 498 Construction Practice IV (1-5 cr.) P: Consent of the faculty co-op adviser. Practical experience in the construction industry with written reports of this experience for co-op students.

CNT 499 Construction Technology (1-4 cr.) Hours, subject matter, and credit to be arranged by staff. Course may be repeated for up to 9 credit hours.

Electrical Engineering Technology (EET)

Students registering for EET and BMET courses must have received a grade of C– or above for all EET and mathematics prerequisite courses.

EET 102 Electrical Circuit I (4 cr.) Class 3, Lab 3. P or C: MATH 151 or MATH 153. A study of DC electrical circuits, Ohm's Law, Kirchhoff's laws, series and parallel circuits, network theorems, mesh and nodal analysis, power, introductory magnetism, ammeters, voltmeters, ohmmeters, inductance, capacitance and transients.

EET 105 Digital Fundamentals I (3 cr.) Class 2, Lab 3. A study of logic gates, binary arithmetic codes, Boolean algebra, mapping, adders, comparators, decoders, encoders, multiplexers, and demultiplexers. Small scale (SSI) and medium scale (MSI) integrated circuits are used in combinational logic circuits.

EET 116 Electrical Circuits (4 cr.) Class 3, Lab 2. C: MATH 151. For MET and CIMT majors. A study of DC and AC electrical circuits. Topics include circuit components, (R,L,C), voltage, current, power, Ohm's Law, Kirchhoff's law series and parallel circuits, circuit theorems, electrical measurements, sinusoidal AC voltages, currents, impedance, RL circuits, RC circuits, RLC circuits,

transformers, and polyphase systems. May not be used for credit by EET majors.

EET 152 Electrical Circuits II (4 cr.) Class 3, Lab 3. P: EET 102 and MATH 151, or C: MATH 154. A study of AC electrical circuits, j operators, phasors, reactances, impedances, phase relationships, power, network theorems, resonance, frequency response, and transformers.

EET 154 Analog Electronics I (4 cr.) Class 3, Lab 3. P: EET 102 and MATH 151. P or C: EET 152. A study of the characteristics and applications of transistors, integrated circuits, and other solid-state devices. Includes rectifier circuits, waveform interpretation, AC and DC load lines, biasing techniques, equivalent circuits, single and multistage Class A small-signal amplifiers, and h-parameters.

EET 155 Digital Fundamentals II (3 cr.) Class 2, Lab 3. P: EET 102 and EET 154. A continuation of EET 105 with an emphasis on sequential logic circuits. Flip-flops, counter analysis and design, programmable counters, shift registers, logic families, introductory computer concepts, techniques of coding, memory devices, data transmission, and conversion techniques are studied. Students may not receive credit for both EET 155 and EET 225.

EET 204 Analog Electronics II (4 cr.) Class 3, Lab 3. P: EET 152 and EET 154. A study of the applications of transistors, integrated circuits, and other solid-state devices. Feedback principles as applied to amplifiers, oscillators, and regulated power supplies. Includes large-signal power amplifiers, special-purpose amplifiers, and an introduction to SPICE.

EET 205 Introduction to Microprocessors (4 cr.) Class 3, Lab 3. P or C: EET 155. A study of microprocessor architecture, interfacing, software, arithmetic, memory devices, communications, and applications. Real-time programming techniques and algorithms are stressed using the 8086 microprocessor. Students may not receive credit for both EET 205 and EET 354.

EET 212 Electrical Power and Machinery (4 cr.) Class 3, Lab 3. P: EET 152. A study of power transformers and single and polyphase circuits; introduction to the National Electric Code; study of DC machines and AC single and polyphase synchronous and induction machines.

EET 216 Electrical Machines and Controls (3 cr.) Class 3. P: MATH 151 and PHYS 219 or equivalent courses. Lecture, recitation, and demonstration are combined to acquaint the student with the elements of electrical circuits and machines as component parts of machine drives and controls within the requirements of the National Electrical Code and in conformity with the ratings and dimensional specifications of the National Electrical Manufacturers Association (NEMA). Manufacturers' catalogs and pamphlets are used freely as classroom aids. May not be used for credit by EET majors.

EET 291 Industrial Practice I (1-5 cr.) P: Second-semester standing, prior acceptance into the cooperative program, and consent of faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

EET 292 Industrial Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

EET 302 Introduction to Control Systems (4 cr.) Class 3, Lab 2. P: EET 105, EET 204, PHYS 218, and MATH 221. P or C: EET 212. A study of discrete systems including relay controls, gate logic controls, and programmable control; continuous systems including transient analysis; S operator methods; transfer functions of open-loop and closed-loop systems; and treatment of transducers, control system amplifiers, and actuators.

EET 303 Communications I (4 cr.) Class 3, Lab 2. P: EET 204 and MATH 222 or consent of instructor. A study of AM and FM modulation and detection, receivers, transmitters, networks, filters, antennas, and transmission lines through the VHF frequency spectrum.

EET 305 Advanced Microprocessors (4 cr.) Class 3, Lab 3. P: EET 205 or consent of instructor. Use of microprocessors and related components in the design of microprocessor-based systems. Microprocessor hardware selection and design, bus systems, bus interfacing, software development, high-level programming languages, and operating systems are examined. Students may not receive credit for both EET 305 and EET 454.

EET 331 Generation and Transmission of Electrical Power (4 cr.) Class 3, Lab 2. P: EET 212. A study of the generation and transmission of electrical energy. Includes techniques used by electric utilities for the protection of generating equipment and transmission lines, an introduction to the economic considerations of power plant operation and three-winding transformers, and methods of solving unbalanced three-phase systems.

EET 350 Computer Circuit Analysis (4 cr.) Class 3, Lab 3. P: EET 152 and EET 154. This course uses the computer to solve linear steady-state electrical circuit problems. Programs are written in either BASIC or FORTRAN to solve electrical circuits that contain voltage sources, current sources, resistors, transistors, field-effect transistors, capacitors, inductors, and transformers. The

solution is a computer printout of all desired voltages and currents in the electrical circuit.

EET 368 Linear Integrated Circuits (4 cr.) Class 3, Lab 2. P: EET 204. A study of the application of integrated circuit (IC) operational amplifiers and IC differential amplifiers to a multitude of applications. Specifications and limitations will also be stressed. Various special-purpose ICs that perform one given function and applications using SPICE will also be investigated.

EET 371 Automation, Instrumentation, and Process Control (4 cr.) Class 2, Lab 4. P: EET 204, EET 205, and EET 302. A project-oriented course combining three areas of EET: microcontrollers, instrumentation, and process control. Course covers automatic testing, microcontroller applications, data collection, robotics, programmable logic controllers, and graphic process control software. A final project is an integrated system.

EET 381 Electrical Distribution Systems (4 cr.) Class 3, Lab 2. P: EET 212. A study of the design and operation of industrial electric distribution systems. Estimated demand calculations, faults on power systems, power factor improvement, electric rates, voltage drops, protective devices, illumination, and the applicable portions of the National Electric Code.

EET 383 Advanced Electrical Networks (3 cr.) Class 3. P: EET 152 and MATH 222. An advanced course in network analysis that stresses network theorems and solutions of time and frequency-domain problems.

EET 393 Industrial Practice III (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

EET 394 Industrial Practice IV (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

EET 395 Industrial Practice V (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

EET 403 Communications II (4 cr.) Class 3, Lab 2. P: EET 303 or EET 383. A continuation of EET 303 with emphasis on digital communication systems and telecommunications.

EET 417 Analog and Digital Circuits (4 cr.) Class 3, Lab 3. P: EET 155 and EET 204. A study of analog and digital devices; counters, shift registers, generic array logic, linear devices, multipliers, dividers, analog circuits, memory systems, multiplexing, sequential circuit analysis, and synthesis.

EET 458 Introduction to VLSI Design (4 cr.) Class 2, Lab 4. P: EET 155 and EET 205. The use of synthesis tools for designing and building very large scale integrated (VLSI) circuits. Course covers hardware design language (HDL), simple finite state machine (FSM) design, and a CAD/VLSI representation system and Boolean truth tables to minimize and implement standard logic cells. The tools of logic compiling, design simulation, hardware floorplanning, different layout strategies, pad placement, and system routing are used to construct the complete hardware chip.

EET 472 Automatic Control Systems (4 cr.) Class 3, Lab 2. P: EET 302 and EET 383 or consent of instructor. The transfer function approach to the study of feedback control systems. Feedback control system performance and stability. Routh, Nyquist, Bode, and root-locus methods of analysis and design including cascade and feedback compensation. Analog and digital simulation. An introduction to digital control systems.

EET 490 Senior Design Project, Phase I (1 cr.) P: Two EET 300-level or above technical electives. P or C: TCM 220. An extensive individual design and/or analytical project performed in consultation with one or more faculty advisers. Collaboration with representatives of industry, government agencies, or community institutions is encouraged. Evidence of extensive and thorough laboratory performance is required. Phase I includes, but is not limited to:

1. Faculty acceptance of project proposal;
2. Defining and limiting project objectives;
3. Initial research and source contacts;
4. Procurement of materials;
5. Periodic progress reports.

EET 491 Senior Design Project, Phase II (2 cr.) P: EET 490. Phase II includes, but is not limited to:

1. Continued research and finalized design;
2. Oral presentation to faculty and other interested parties;
3. Written technical report following standard format.

EET 499 Electrical Engineering Technology (1-9 cr.) Class 0-4, Lab 3-9. Hours and subject matter to be arranged by staff.

Engineering Graphics (EG)

EG 110 Drafting Fundamentals (3 cr.) Class 1, Lab 6. P: High school geometry or equivalent. A basic course in drawing, orthographic projection, pictorial drawing, print reading, and reproduction of drawings. Problems designed to require practical reasoning and to develop good technique.

Industrial Engineering Technology (IET)

IET 104 Industrial Organization (3 cr.) Class 3. A detailed survey of organizational structure: operations, finances, marketing, accounting, management, planning, control, personnel, quality, safety, wages, policy, and human factors necessary for effective management.

IET 120 Systems and Procedures (3 cr.) Class 3. An introduction to the systems concept. Surveys recognizing and defining the systems problem; management audits and tools for systems analysis; design and control of forms; work simplification; work measurement and procedures; operations research; management and administration; and organization of the systems function.

IET 198 Industrial Practice I (1-5 cr.) P: Second-semester standing, prior acceptance into the cooperative program, and consent of the co-op adviser. Practice in industry with written reports of this practice for co-op students.

IET 204 Techniques of Maintaining Quality (3 cr.) Class 2, Lab 2. P: MATH 153 and MATH 154, or MATH 151. An analysis of the basic principles of quality control. Includes statistical aspects of tolerances; basic concept of probabilities; frequency distribution; X and R charts; and uses of mechanical, electronic, air, and light devices for checking and measuring levels of quality acceptance.

IET 220 Critical Path Analysis (2 cr.) Class 1, Lab 3. Detailed study of planning and control of a schedule by network techniques, including the time/cost analysis of CPM scheduling for application on construction projects, job shop scheduling, and related problems. Includes an introduction to PERT and the use of the computer for network analysis.

IET 224 Production Planning and Control (3 cr.) Class 3. P: MATH 151 or equivalent. Preproduction consideration of the most economical methods, machines, operations, and materials for the manufacture of a product. Includes planning, scheduling, routing, and detailed procedure of production control.

IET 250 Fundamentals of Production Cost Analysis (3 cr.) Class 3. P or C: IET 104 or consent of instructor. Survey of fundamental mechanics of accounting, principles of account classification, financial and operating statements, and the generation of cost data according to cost accounting principles and to the principles of engineering economy. Examines application of cost accounting data to specific management decisions through selected case problems.

IET 260 Motion and Time Study (3 cr.) Class 3. Techniques of motion and time study, process charts, operation charts, multiple activity charts, micromotion study, therbligs, and stopwatch time study. Not open to students who have had IET 262.

IET 262 Motion Study and Work Methods (3 cr.) Class 2, Lab 3. Examination of the various techniques of motion study, including process charts, operation charts, multiple activity charts, micro and memo motion study, therbligs, and the movie camera, along with actual practice in their use. Includes study and application of the basic principles for developing better methods of performing work.

IET 266 Work Measurement and Incentives (3 cr.) Class 2, Lab 3. P: IET 262. A study of the fundamentals of time study and work measurement with actual practice in their use. Includes stopwatch time study, measuring work with a movie camera, establishment of allowances by both stopwatch and work sampling studies, establishment and use of predetermined time values, and the construction use of work measurement formulae.

IET 276 Wage Payment Analysis (3 cr.) Class 3. Study of job evaluation and wage incentives in the manufacturing firm. History, effect of unions, incentive plans, payment methods and scales, and effective use of job descriptions are included.

IET 296 Industrial Technology Case Problems (2 cr.) Class 2. Application of theories developed in industrial technology courses to selected general case problems. Provides practice in the integration of principles.

IET 298 Industrial Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

IET 299 Industrial Engineering Technology (1-9 cr.) Class 0-4, Lab 3-9. Hours and subject matter to be arranged by staff. Course may be repeated for up to 9 credit hours.

IET 301 Cost Evaluation and Control (3 cr.) Class 3. P: IET 250. Designing, installing, and improving standard cost systems in industry, including the establishment of basic standards. Development of the mechanics of operating control reports using principles of management by exception. The use of electronic data processing for establishing and analyzing production cost standards will be emphasized.

IET 310 Plant Layout and Material Handling (3 cr.) Class 3. P: MET 204, and MET 328 or equivalent course. A study and analysis of material flow in a manufacturing facility; material handling equipment; plant layout principles for manufacturing service, storage, and office areas; and industrial packaging techniques. Emphasis is on application to

manufacturing problems. Not open to students who have credit in CIMT 310.

IET 323 Production Planning and Expediting (3 cr.) Class 2, Lab 3. P: IET 224. Methods of planning for routing, tooling, equipment, costing, and production of manufactured and processed products. Includes a detailed study of expediting procedures.

IET 324 Production Techniques (3 cr.) Class 3. P: IET 224, MET 135, or MET 335. Continuation of operation planning with emphasis on the equipment, tools, and techniques used in mass production. Adaptation of proposed plans to conform to existing facilities.

IET 340 Industrial Procurement (3 cr.) Class 3. The study of modern purchasing in a manufacturing firm with emphasis on industrial organization, quantity and quality analysis, sources, legal requirements, and related topics. Includes case discussion and analysis.

IET 351 Production Control Techniques (3 cr.) Class 3. P: IET 224 and IET 301. The study of established techniques for analyzing and improving production operations with emphasis on the application of analysis techniques such as critical path scheduling, PERT inventory control, inventory management, forecasting, and linear programming. Emphasizes the use of computer programs for solving problems.

IET 354 Attribute and Variable Sampling (3 cr.) Class 3. P: IET 204. Survey of single, double, sequential, variable, and continuous production sampling plans. Includes the calculation and plotting of OC, AOQ, and AOQL curves and determining the economic sampling number. Also includes the use of Dodge-Romig, MILSTD 105, and MILSTD 414 tables.

IET 364 Total Quality Control (3 cr.) Class 3. Determining customer needs and wants, implementing these into a design during production, monitoring field performance, and feeding back quality information to further improve the quality system.

IET 374 Nondestructive Testing (3 cr.) Class 2, Lab 2. Study of industrial X ray, ultrasonic inspection, surface penetrant inspection, magnetic particle, holography applications, and laser interferometry.

IET 398 Industrial Practice III (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

IET 460 Motion and Time Study (3 cr.) Class 2, Lab 3. P: Junior standing. Techniques of motion and time study, process charts, operation charges, multiple activity charts, micromotion study, therbligs, and stopwatch time study. Not open to students who have had IET 262.

IET 497 Senior Project (3 cr.) Class 2, Lab 2. Hours to be arranged. Directed work on individual projects for senior industrial engineering technology students.

IET 498 Industrial Practice IV (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

Mechanical Engineering Technology (MET)

MET 105 Introduction to Engineering Technology (2 cr.) Class 1, Lab 3. The purpose of this class is to provide beginning students with the academic tools necessary for success in their technology program. Topics include study tips, use of calculators, introduction to various technology laboratories, and a major emphasis on computer programming using the QuickBASIC language.

MET 111 Applied Statics (3 cr.) Class 3. P: MATH 151 or equivalent. A study of force systems, resultants and equilibrium, trusses, frames, centroids of areas, center of gravity of bodies.

MET 112 Applied Mechanisms (3 cr.) Class 3; or Class 1, Lab 5. P: EG 110. C: MATH 151 or equivalent. An analysis of motions, displacements, velocities, instant centers, cams, linkages, and gears.

MET 135 (formerly 335) Basic Machining (3 cr.) Class 2, Lab 2. A comprehensive survey of machine tools as they are used in converting workpieces into finished products, with consideration of cost, quality, quantity, and interchangeability. Actual operation analysis of many machine tool setups will be provided for comparison studies. Not open to students who have credit in MET 335.

MET 156 Graphical Computations (3 cr.) Lab 6. P: EG 110. P or C: MATH 153 or equivalent. Descriptive geometry principles applied to the solution of engineering problems; intersections and development of surfaces; layout of objects in space; and determination of clearances between objects in space.

MET 157 Electrical and Electronic Drafting (3 cr.) Class 1, Lab 5. C: MATH 111 or MATH 151. A basic drafting course for EET students. Emphasis on drawings relevant to the electrical and electronics industry. Utilization of electronic symbols, diagrams, and printed circuit boards. Computer-aided drafting applied to schematic diagrams and printed circuit board design. Problems are designed to require practical reasoning and develop good techniques. Not open to MET students.

MET 180 Materials and Processes (3 cr.) Class 2, Lab 2. A basic survey course of the materials and processes used in manufacturing today. The first portion of this course deals

with the engineering materials of industry, their selection, testing, and proper application. The second portion of the course treats the various primary processes through which these materials are changed into products. The many hands-on laboratory situations ensure that the student has full comprehension of the economic, safety, and environmental considerations necessary in modern manufacturing.

MET 198 Industrial Practice I (1-5 cr.) P: Second-semester standing, prior acceptance into the cooperative program, and consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

MET 200 Power Systems (3 cr.) Class 3. P: MATH 151 or equivalent. A survey of steam power plants, internal combustion engines, heat pumps, and refrigeration. Theory of thermodynamics and heat transfer.

MET 204 Production Drawing (3 cr.) Lab 6. P: MET 105 and EG 110 or equivalent courses. Application of principles of engineering drawing to design layout, detail, and assembly. A 2D PC CAD-centered laboratory.

MET 206 Industrial Illustration (3 cr.) Class 1, Lab 5. P: MET 204. Introduction to illustration layouts using computer-aided methods. Topics include 2D layout, 3D wireframe, solid modeling, and shaded rendering. Projects utilize primitive shapes to create 3D objects using Boolean operations.

MET 210 Applied Statics (2 cr.) Class 2. P: MATH 150 or equivalent. Force systems; resultants and equilibrium; centroids of areas; centers of gravity of bodies, trusses, frames, and beams; friction; and moments of inertia of areas and bodies.

MET 212 Applications of Engineering Mechanics (3 cr.) Class 3. P: MATH 151 or equivalent. Introduction to some applications of engineering mechanics. Study of static force systems and internal stresses and strains produced by these forces. Work, energy, and power will also be discussed. May not be used for credit by MET majors.

MET 214 Machine Elements (3 cr.) Class 3. P: MET 219 and PHYS 218. The theories and methods developed in statics, dynamics, and strength of materials are applied to the selection of basic machine components. The course will develop the fundamental principles required for the selection of the individual elements of which a machine is composed.

MET 219 Applied Strength of Materials (3 cr.) Class 3. P: MATH 151 or its equivalent and either MET 111 or MET 210. Principles of applied strength of materials primarily with reference to mechanical design.

MET 222 Computer Graphics (3 cr.) Class 2, Lab 3. P: EG 110 or equivalent, MATH 151, and BASIC programming. A survey of hardware and procedures used to make graphic displays using digitizers, plotters, printers, and cathode ray tubes. Programs are written for several applications. The course may be supplemented by visits to local industries that use related equipment.

MET 228 Machine Design (3 cr.) Lab 6. P: MET 204, MET 214, and MET 330. Practical applications in the design of machines and products using mechanical, pneumatic, hydraulic, and electrical operation and control.

MET 232 Dynamics (3 cr.) Class 3; or Class 2, Lab 2. P: MATH 221 and either MET 211 or MET 210. Basic fundamentals of dynamics: displacement, velocities, accelerations, work energy, power, impulse, momentum, and impact.

MET 235 (formerly 355) Production Machining (3 cr.) Class 2, Lab 3. P: MET 135 or MET 335. An intensive study of production processes, tools, setups, workpiece materials machinability, newer methods of machining, and the economics of efficient materials machining. Not open to students who have credit in MET 355.

MET 236 Jig and Fixture Design (3 cr.) Lab 6. P: EG 110. Application of principles in the design and construction of drilling, milling, reaming, and assembly jigs and fixtures. Information related to materials, heat treatment, and cost estimating.

MET 240 Basic Foundry (3 cr.) Class 2, Lab 2. P: MET 180. A survey of casting processes of the past, present, and future. Special emphasis is placed on developing problem-solving skills with relation to using cast parts in manufacturing. Students will gain knowledge from lectures, reading assignments, audiovisual presentations, demonstrations, and field trips. Assignment sheets with study questions will be used in preparing students for discussion sessions and tests. Each student will also be required to research and write a five-page paper on some aspect of the foundry industry or to give a demonstration in the laboratory.

MET 245 Tool and Die Design (3 cr.) Class 2, Lab 3. P: EG 110 and MET 204. Application of principles in the design and construction of jigs, fixtures, and dies. Information related to tool room drafting, materials, and cost analysis.

MET 271 (formerly 371) Programming for Numerical Control (3 cr.) Class 2, Lab 2. P: MET 135 and MATH 151 or consent of instructor. An introduction to manual, conversational, and computer-aided programming. Incremental and absolute programming systems will be discussed.

Machine-based conversational languages and computer-aided programming languages included. Not open to students who have credit in MET 371.

MET 282 Introduction to Plastics (3 cr.) Class 3; or Class 2, Lab 3. P: MET 180. A survey of the plastics industry, including a study of materials with reference to their properties, processing, and uses. Fabrication, finishing, and fastening methods are also studied in some detail with consideration given to plastic product design.

MET 288 Die Design (3 cr.) Lab 6. P: EG 110. Application of principles in the design and construction of piercing, blanking, forming, and drawing dies; single combination, compound, and progressive type dies. Cam and assembly dies. Related information as to materials, heat treatment, and cost estimating.

MET 297 Industrial Graphics Project (3 cr.) Lab 6. Directed work on individual graphics projects for fourth-semester mechanical drafting–design technology students.

MET 298 Industrial Practice II (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

MET 299 Mechanical Engineering Technology (1-3 cr.) Class 0-3, Lab 0-9. Hours and subject matter to be arranged by staff. Primarily for third- or fourth-semester students with special aptitudes. Course may be repeated for up to 9 credit hours.

MET 300 Applied Thermodynamics (3 cr.) Class 3. P: MATH 221 and MET 200. The fundamentals of thermodynamics including application of the first and second laws, enthalpy, entropy, and reversible and irreversible processes. Analysis of power cycles and gas turbines.

MET 304 Advanced AutoCad (3 cr.) Class 2, Lab 3. P: MET 157 or MET 204. Extends the potential of AutoCad. Subjects include creation of menus, icons, macros, and libraries.

MET 310 Computer-Aided Machine Design (3 cr.) Class 2, Lab 2. P: MET 214 and either CPT 200 or CPT 299. Introduction to the use of specialized programs to analyze machine components such as shafts, linkages, springs, and cams. Use of finite element analysis to analyze static mechanical systems.

MET 328 CAD/CAM for Mechanical Design and Drafting (3 cr.) Class 2, Lab 2 plus 3 arranged. P: EG 110 and MET 105 or equivalent courses. Basic operations of mechanical design–drafting. A PC CAD (2D and 3D) laboratory-centered course introducing the basic steps involved in the geometric design of mechanical parts.

MET 330 Introduction to Fluid Power (3 cr.) Class 3; or Class 2, Lab 2. P: MET 111 or MET 210. A study of the development, transmission, and use of power through fluid power circuits and controls.

MET 332 Fluid Power Circuits (3 cr.) Class 2, Lab 2. P: MET 330. Principles and practices for selecting and applying fluid power devices and related equipment to machine circuits for both linear and rotary motion. The nature of the work to be accomplished and the various fields of application will be analyzed.

MET 340 Piping and Plumbing Design (3 cr.) Class 3. P: MET 200. Design of plumbing systems, including losses in pipes, fittings, nozzles, orifices, etc. Includes steam, water, and oil systems. Piping handbooks and catalogs are used in conjunction with the State of Indiana Plumbing Code.

MET 350 Applied Fluid Mechanics (3 cr.) Class 3. P: MET 200 and either MET 111 or MET 210. The fundamentals of fluid mechanics, including properties of fluids; pressure; hydrostatic force on submerged areas; kinematics and dynamics of fluid flow; friction and sizing of pipes; selection of pumps.

MET 360 Heating, Ventilating, and Air Conditioning I (3 cr.) Class 3; or Class 2, Lab 2. P: MET 200. Investigation of basics required to design heating and ventilating systems. Heat loss, humidification, duct design, equipment selection, and solar heating are included. Codes and standards are emphasized.

MET 361 Heating, Ventilating, and Air Conditioning II (3 cr.) Class 3; or Class 2, Lab 2. P: MET 360. A study of air conditioning and refrigeration. Heat gain, psychometrics, cooling, load calculations, and equipment selection are presented, along with controls for commercial and industrial applications. Codes, standards, and manufacturers' literature are used throughout the course.

MET 370 Introduction to Numerical Control (3 cr.) Class 3. P: MET 135 (formerly MET 335) or equivalent. An introduction to the numerical control process. The course includes history, economic evaluation, additional benefits, and a discussion of system components. Primarily directed toward the manufacturing process, the course covers various types of numerical control equipment.

MET 374 Technical Sales (3 cr.) Class 3. A study of the principles and practices of selling technical products and/or services. The course covers product knowledge, buying motives, the phases of a sale, ethical and legal aspects, synergistic selling, and career opportunities in technical sales. Utilizes role playing.

MET 380 Materials and Processes (2 cr.) Class 2. Application and characteristics, both physical and chemical, of the materials most commonly used in industry; the primary

processes involved in producing these materials for industry. Open only to non-MET students.

MET 384 Instrumentation (3 cr.) Class 2, Lab 3. P: MATH 221, MET 350, PHYS 219, and STAT 301. Introduction to the basic concepts and terminology of instruments. Procedures and techniques essential to industrial measurement and transmission of data. Emphasis on pressure, flow, temperature, level measurements, and computer control.

MET 385 Fluid Power Systems Analysis (3 cr.) Class 2, Lab 2. P: MET 330 and MET 350. Procedures and techniques essential for checking integrated systems using electrical, mechanical, and fluid power equipment. Functional aspects, safety, efficiency, and the economics of systems-combining features for power and control will be analyzed including automatic, semiautomatic, and manually operated machines.

MET 398 Industrial Practice III (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

MET 414 Design of Mechanical Projects (3 cr.) Class 1, Lab 4. P: MET 204, MET 214, MET 330, and EET 216. Application of the fundamental principles of mechanical, hydraulic, and electrical technology to the design of mechanical systems. Discussion of the design process and continuation of topics in the design of machine elements. A semester design project is required.

MET 426 Internal Combustion Engines (3 cr.) Class 2, Lab 3. P: MET 200. A study of the spark ignition, compression ignition, and continuous burning internal combustion engines.

MET 428 Advanced CAD for Mechanical Design and Drafting (3 cr.) Class 2, Lab 3. P: MET 328 or equivalent. Mechanical and geometric modeling of complex surfaces, with manufacturing emphasis using wire-frame and shaded imaging techniques.

MET 491 Applied Metallurgy (3 cr.) Class 3. P: MET 180. A study of ferrous and nonferrous metals and alloys. Includes atomic structure, bonding, and arrangements of atoms; phase diagrams; reactions within solid materials; and the interrelation of these to show how structure determines the properties of a material.

MET 497 Senior Project (3 cr.) Class 2, Lab 2. Directed work on individual projects for senior mechanical technology students.

MET 498 Industrial Practice IV (1-5 cr.) P: Consent of the faculty co-op adviser. Practice in industry with written reports of this practice for co-op students.

MET 499 Mechanical Engineering Technology (1-3 cr.) Class 0-3, Lab 0-9. Hours and subject matter to be arranged by staff. Course may be repeated for up to 9 credit hours.

Supervision (SPV)

SPV 252 Human Relations in Supervision (3 cr.) Class 3. Study of the bases of human relations and organization of individual and group behavior. Special emphasis on typical supervisory relationships.

SPV 268 Elements of Law (3 cr.) Class 3. An introductory law course. A brief comparison of the American federal system and the parliamentary system of government, with an emphasis on judicial review, court jurisdiction and procedure generally, and basic law in particular.

SPV 331 Occupational Safety and Health (3 cr.) Class 3. A presentation of those aspects of occupational safety and health that are essential to the first line supervisor. Emphasis is placed on developing an understanding of the economic, legal, and social factors related to providing a safe and healthful working environment.

SPV 362 Cooperative Occupational Internship (1-5 cr.) P: Sophomore standing, prior acceptance into the cooperative program, and consent of the faculty co-op adviser. Organized and supervised work experience directed toward preparation for supervisory, personnel, and related positions. This course may be repeated for credit.

SPV 368 Personnel Law (3 cr.) Class 3. Influence of the law on personnel–human resource management. Covers such topics as discrimination based on sex, age, national origin, or handicap; recruitment and selection; affirmative action; rights of union and nonunion employees; Fair Labor Standards Act; Equal Pay Act and comparable worth; employee benefits plans; unemployment compensation; and right to discharge.

SPV 374 Supervisory Management (3 cr.) Class 3. Introduction to and overview of the fundamental concepts of supervision. Emphasis is placed on the supervisor's major functions and essential areas of knowledge, relations with others, and personal development.

SPV 375 Training Methods (3 cr.) Class 3. P: SPV 252 and SPV 374, or consent of department chair. A presentation of those aspects of job training that are essential to the first line supervisor. Emphasis is placed on developing an understanding of the way people learn jobs and job skills.

SPV 376 Personnel Supervision (3 cr.) Class 3. P: SPV 374 or consent of instructor. Analysis of selected case problems, with emphasis on

attitudes, philosophies, and responsibilities of supervisory personnel in relationship to the worker.

SPV 378 Labor Relations (3 cr.) Class 3. Problems of workers, with possible solutions as suggested by organized labor and management. Regulations concerning management, labor, the collective bargaining agreement, and grievance and arbitration procedures.

SPV 383 Human Resource Management (3 cr.) Class 3. Designed to present an overview of the human resource function as it is managed in organizations today. The course contains descriptions of each major function and cases to explore applications of human resource principles.

SPV 385 Leadership Strategies for Quality and Productivity (3 cr.) Class 3. Provides students with knowledge and applied leadership skills essential for established and continuously improving organizational effectiveness through avoidance of and solutions to workplace problems.

SPV 399 Special Topics (1-6 cr.) Hours and subject matter to be arranged by staff. Primarily for upper division majors with specific interests and aptitudes. May be repeated for up to 6 credit hours.

SPV 401 Women in Supervision (3 cr.) Class 3. An introduction to supervision and problems unique to women entering the field. The basic behavioral and organizational skills required for supervisory work are introduced, followed by a survey and discussion of problems such as self-concept, political aspects of the job, power networks, sexual harassment, and stress. The course ends with a panel discussion by successful women supervisors.

SPV 410 Survival Skills in Organizational Careers (3 cr.) Class 3. P: Within 30 credit hours of a bachelor's degree or consent of instructor. Focuses on the organization as a social system within which careers develop through the reciprocal influences of organization and people. Examines how occupations are chosen, the stages of an unfolding career, and factors that influence successful careers. Emphasizes coping with change and developing personal strategies.

SPV 474 Conference Leadership Training (3 cr.) Class 3. P: SPV 252, SPV 374, or consent of instructor. Understanding and practice of the leadership roles required in supervisory management situations. Application of group dynamics and leadership theory to informal, formal, and impromptu conferences.

SPV 475 Contemporary Supervisory Training Issues (3 cr.) Class 3. P: SPV 375 or consent of instructor. Designed for supervisors who plan to conduct employee training and development. Emphasis placed on the supervisor's role in on-the-job training. Major issues include theories involved in training and their application in the design, facilitation, and follow-up of training.

SPV 476 Compensation Planning and Management (3 cr.) Class 3. Focuses on the management of employee compensation. The major objectives are to examine the current state of compensation management and to examine the implications of recent theoretical and research developments related to compensation decisions. The class gives each student the opportunity to develop a compensation package.

SPV 479 Staffing Organizations (3 cr.) Class 3. Designed to present students with a detailed look at the recruiting function of organizations today. The focus of the material will be to give the student a sense of the challenges of recruiting qualified employees in the 1990s. Presentation will include actual examples, group exercises, and considerable class discussion.

SPV 490 Senior Research Project (3 cr.) P: Senior standing. Supervision majors only. Individual members of this seminar-type class study specific problems or areas of their own choosing in the field of supervision guided by the instructor. Class presentations are made by students on their progress, with instructor-led discussions of research methods.

Technical Communications (TCM)

TCM 220 Technical Report Writing (3 cr.) Class 3. P: ENG W131 or equivalent. Extensive application of the principles of clear writing in industrial reporting with emphasis on adaptation to the audience; organization of ideas; and a concise, objective writing style.

TCM 320 Written Communication in Science and Industry (3 cr.) Class 3. P: ENG W131 or equivalent; junior standing or consent of instructor. Analysis of current writing practices in technology and science, especially in organizational settings. Practice in designing and preparing reports for a variety of purposes and audiences.

TCM 340 Correspondence in Business and Industry (3 cr.) Class 3. P: ENG W131 or equivalent. The development and application of strategies and skills for writing letters for business and industry in technology and engineering. Applications may include resumes and letters of application; informational and persuasive letters; in-house memoranda.

TCM 350 Visual Elements of Technical Documents (3 cr.) Class 3. P: TCM 220 or consent of instructor. An introduction to the methods and principles of illustrating technical reports and manuals. Topics include the role of the technical writer in the company,

basics of visual design, visuals for manuals, visualization of technical data, and modern technology available to technical writers.

TCM 360 Communication in Engineering Practice (2 cr.) Class 1, Recitation 2. P: ENG W131 and COMM C110 or equivalents; junior standing or consent of instructor. The application of rhetorical principles to written and oral communication in the engineering professions. Topics include planning, drafting, and revising professional engineering reports; planning and delivering oral presentations; organizing information; developing persuasive arguments.

TCM 370 Oral Practicum for Technical Managers (3 cr.) Class 3. P: COMM C110 with a grade of C or better. The practical application of effective listening and speaking skills in situations typical for managers and supervisors in technology and engineering. Application may include one-to-one conversations in supervisory management, such as hiring interviews and performance reviews; technical training programs; group discussions in work units, committees, and tasks forces; informal presentations, including program and status reports; formal technical presentations; communication in international industrial environments.

Other Courses

The following is a listing of courses offered by other schools that are either required by various degree programs in the School of Engineering and Technology or are recommended alternatives or electives. The list is not exhaustive, and students are advised to consult their departments regarding courses other than those presented here. Equivalent courses at Indiana University Bloomington (IU) and Purdue University, West Lafayette (PU) are listed at the end of some entries. P—prerequisite, C—corequisite, R—recommended.

Biology (BIOL)

BIOL N212 Human Biology (2 cr.) P: None. Equiv. PU BIOL 201. Two-semester sequence in human biology, with emphasis on anatomy and physiology providing a solid foundation in body structure and function.

BIOL N214 Human Biology (2 cr.) P: BIOL N212. Equiv. PU BIOL 202. Continuation of N212.

BIOL N261 Human Anatomy (5 cr.) P: None. Equiv. IU ANAT A215. Lecture and laboratory studies of the histology and gross morphology of the human form, utilizing a cell-tissue-organ system-body approach.

Business (BUS)

BUS A201 Introduction to Financial Accounting (3 cr.) P: A100 and sophomore standing. The course covers the concepts and issues associated with corporate financial reporting. Particular emphasis is placed on understanding the role of financial accounting in the economy and how different accounting methods affect the financial statements. Credit not given for both A201 and A202.

BUS A202 Introduction to Managerial Accounting (3 cr.) P: BUS A100 and sophomore standing. The course covers the concepts and issues associated with the accounting and the management of business. Particular emphasis is given to understanding the role of accounting in product costing, costing for quality, cost-justifying investment decisions, and performance evaluation and control of human behavior. Credit not given for both A201 and A202.

BUS F301 Financial Management (3 cr.) P: BUS A201, BUS A202, BUS K201, BUS L203, ECON E201-E202, ECON E270, MATH M118-M119. Conceptual framework of the firm's investment, financing, and dividend decisions; includes working capital management, capital budgeting, and capital structure strategies.

BUS J401 Administrative Policy (3 cr.) P: BUS F301, BUS M301, BUS P301, BUS Z302. Administration of business organizations: policy formulation, organization, methods, and executive control.

BUS L203 Commercial Law I (3 cr.) P: Sophomore standing. Includes the nature of law, torts, contracts, the sale of goods, and the legal regulation of business competition. For accounting majors and others intending also to take BUS L303 in order to attain a rather broad and detailed knowledge of commercial law. Credit not given for both BUS L201 and BUS L203.

BUS M301 Introduction to Marketing Management (3 cr.) P: BUS A201, BUS A202, BUS K201, BUS L203, ECON E201-E202, ECON E270, MATH M118-M119. Overview of marketing for all business undergraduates. Marketing planning and decision making examined from the firm's and consumer's points of view; marketing concept and its company-wide implications; integration of marketing with other functions. Market structure and behavior and their relationship to marketing strategy and implementation.

BUS P301 Operations Management (3 cr.) P: BUS A201, BUS A202, BUS K201, BUS L203, ECON E201-E202, ECON E270, MATH M118-M119. A survey course concerned with the production and distribution of goods and services. Part of the integrative core, along with survey courses in finance and marketing. Topics include inventory management, demand forecasting, aggregate production planning, shop scheduling, project management, quality control, and layout and process design. Primary focus for integration is a case problem at the end of the semester.

BUS P510 Management of Service Operations (3 cr.) P: BUS P502. Operations planning and control decisions in service oriented firms are reviewed by examining the nature and characteristics of service delivery systems, investigating different design alternatives, and reviewing approaches for forecasting, scheduling, and controlling service flow and activities.

BUS P525 Operations Information and Control Systems (3 cr.) P: BUS P502. Design of information and decision systems for allocating resources and scheduling activities. Operations control includes inventory theory, demand forecasting techniques, aggregate output planning, project planning, and job-shop scheduling. Information systems include system requirements, communications, file structures, and design of computer-based systems for control of larger-scale production and logistic operations.

BUS P530 Research Management (3 cr.) P: BUS P502. Process of technological innovation within the firm, including the origination, development, and implementation of new products and processes. Technological

forecasting: exploratory, predictive, and goals-oriented approaches. Corporate strategy, project organization, generation of new product ideas, new technical enterprise. Broader issues of the transfer and diffusion of technology, the impact of technology on environmental quality, individual and social values, and public policy.

BUS P540 Operations and Logistic Strategy (3 cr.) P: BUS P502. Policy issues confronting top plant and operations management. Topics include cost reduction programs, design and implementation of improved information and control systems, organizational development and change, expansion decisions, introduction of new process technology, control of multiplant operations, international manufacturing activity.

BUS W516 Organizational Development and Change (3 cr.) P: BUS Z504. Techniques for introducing and successfully managing change in complex organizations. Forces inducing change, organizational barriers to change, strategies for overcoming resistance to change, intervention techniques, and elements of effective organizational change programs.

BUS W530 Organizations and Organizational Design (3 cr.) P: BUS Z504 or equivalent. Designing the basic organizational structure and the operating mechanisms that implement this basic structure. Design of the structure involves dividing and assigning the organization's work among positions and work groups (departments). Operating mechanisms include control procedures, information systems, reward systems, and spatial arrangements. Theories and applications to a wide variety of organizations.

BUS Z302 Managing and Behavior in Organizations (3 cr.) P: Junior standing. Integration of behavior and organizational theories. Application of concepts and theories toward improving individual, group, and organizational performance. Builds from a behavioral foundation toward an understanding of managerial processes.

BUS Z504 Organization Behavior and Theory (3 cr.) Individual behavior in organizations, group behavior in organizations, and organizational behavior in social systems. Application of organizational behavior and organization theory to management practice.

Chemistry (CHEM)

CHEM C101 Elementary Chemistry I (5 cr., 3 cr. without laboratory) P: At least one semester of high school algebra. Equiv. PU CHEM 111-112. Essential principles of chemistry; atomic and molecular structure; bonding; properties and reactions of elements and compounds; stoichiometry; solutions; acids and bases. For students who are not planning careers in the sciences and for those with no previous course work in chemistry. Lectures, recitation, laboratory. Note: Most degree programs that include CHEM C101 require laboratory. Before registering for 3 credit hours, students should be certain that this course meets the requirements of their program.

CHEM C102 Elementary Chemistry II (5 cr., 3 cr. without laboratory) P: CHEM C101. Continuation of CHEM C101. Equiv. PU CHEM 257-257L. Introduction to organic and biochemistry; organic compounds and their reactions. Lectures, recitation, laboratory.

CHEM C105 Principles of Chemistry I (5 cr., lecture, recitation, laboratory) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 115. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter.

CHEM C106 Principles of Chemistry II (5 cr., lecture, recitation, laboratory) P: CHEM C105. Equiv. PU CHEM 116. Continuation of CHEM C105. Topics in inorganic chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics.

CHEM C111 Chemical Science I (4 cr., lecture, recitation) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 101, IUPUI CHEM C105 lecture. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter. A lecture course for engineering and other students with no laboratory requirement.

CHEM C112 Chemical Science II (3 cr., lecture) P: CHEM C111. Equiv. PU CHEM 102, IUPUI CHEM C106 lecture. Continuation of CHEM C111. Topics in inorganic chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics. Included also are topics in organic chemistry.

Communication (COMM)

COMM C110 Fundamentals of Speech Communication (3 cr.) Theory and practice of public speaking; training in thought processes necessary to organize speech content for informative and persuasive situations; application of language and delivery skills to specific audiences. A minimum of six speaking situations.

COMM C180 Introduction to Interpersonal Communication (3 cr.) One-to-one and group communication principles and practices. Communication theory and models; influence of social, psychological, and environmental factors in the interview and informal group situations. Lecture, reading, and reports.

COMM C223 Business and Professional Communication (3 cr.) P: COMM C110 or

equivalent. Preparation and presentation of interviews, speeches, and oral reports appropriate to business and professional organizations; group discussion and parliamentary procedure. This is an intermediate skills course with survey characteristics.

COMM C401 Speech Communication of Technical Information (3 cr.) P: COMM C110 or equivalent. Organization and presentation of information of a practical, technical nature. Emphasis is placed on the study, preparation, and use of audiovisual materials.

COMM C402 Interview and Discussion for Business and Professions (3 cr.) P: COMM C401. Principles of communication as related to the information-getting interview, the employment interview, and problem-solving discussion; practice in using these principles.

Computer Science (CSCI)

CSCI 230 Computing I (4 cr.) P or C: MATH 163. History of computing; impact of computing in daily life. Overview of computer organization; information representation in digital computer, digital logic. Algorithmic approach to problem solving, elements of data structures: arrays, lists, stacks, and queues. Program development techniques and problem solving techniques in numerical analysis problems and in nonalgorithmic problems, such as in artificial intelligence.

CSCI 240 Computing II (4 cr.) P: 230. Large software development techniques, systems and engineering approach. Fundamentals of operating systems: process, memory, and file management. File organization techniques: sequential, random, linked, and inverted file organizations. Data base concepts: relational data models, query languages, data base systems. Programming language design, applications of artificial intelligence, and social and ethical issues in computing.

CSCI 300 Systems Programming (3 cr.) P or C: CSCI 240 and CSCI 265. Assembly language programming and structure of a simple and a typical computer. Pseudo operations, address structure, subroutines, and macros. File I/O and buffering techniques. Interfacing with high-level languages. Assemblers: one and two pass assemblers, system dependent and independent assembler features, design options. Loaders, linkers, and macro processors.

CSCI 340 Discrete Computational Structures (3 cr.) P: CSCI 240 and MATH 164. Theory and application of discrete mathematics structures and their relationship to computer science. Topics include sets, relations, functions, permutations, combinatorics, graphs, trees, Boolean algebra, recurrence relations, group theory, and finite-state automata.

CSCI 355 Introduction to Programming Languages (3 cr.) P: CSCI 265 and CSCI 340. Programming language concepts and different paradigms of programming. Topics include syntax and semantics of high-level languages, parsing methods, subprograms and their implementation, data abstraction, language translation overview including lexical analysis, syntax directed translation, symbol table handling, code generation, functional programming, logic programming, and object-oriented programming.

CSCI 403 Introduction to Operating Systems (3 cr.) P: CSCI 300 and 362. Operating system concepts; history, evolution, and philosophy of operating systems. Concurrent processes, processes coordination and synchronization, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage and file management, device management, security and protection, networking, distributed and real-time systems.

CSCI 414 Numerical Methods (3 cr.) P: MATH 262 or MATH 351. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, numerical solution of ordinary differential equations. Not open to students with credit in CSCI 512.

CSCI 437 Introduction to Computer Graphics (3 cr.) P: CSCI 362, and MATH 262 or MATH 351. An introduction to graphics hardware; implementation and interaction with operating systems. Mathematical aspects of computer graphics: 2D and 3D transformations, homogeneous coordinates, clipping, 3D views and hidden line removal, 3-D realistic viewing. High-level issues in user-interfacing design, application of computer graphics in science and industry, and application software packages.

CSCI 443 Data Base Systems (3 cr.) P: CSCI 362. Relational data base systems: architecture, theory and application. Relational data structure, integrity rules, mathematics description, data manipulation. Standard SQL and its data manipulation language, engineering aspects of data base design in industry, introduction to nonrelational data base systems.

CSCI 450 Principles of Software Engineering (3 cr.) P: CSCI 355 and CSCI 362. Tools and techniques used in software development. Lifecycle concepts applied to program specification, development, and maintenance. Topics include overall design principles in software development; the use of structured programming techniques in writing large programs; formal methods of program verification; techniques and software tools for program testing, maintenance, and documentation.

CSCI 463 Analysis of Algorithms (3 cr.) P: CSCI 362. Techniques for analyzing and comparing algorithms. Average case analysis in sorting and searching; dynamic programming: greedy algorithms, amortized analysis, and applications; matrix algorithms: polynomials, discrete Fourier transforms, and fast Fourier transforms; parallel algorithms: examples in sorting, searching, graphs, and matrices; computational complexity, polynomial complexity classes P, NP.

CSCI 485 Expert System Design (3 cr.) P: 362. Overview of AI; expert system technology; early expert system: MYCIN, DENDRAL; theoretical foundations, uncertainty measures, knowledge representation, inference engines; reasoning mechanisms: forward and backward chaining; explanation systems, expert system shells, tools, and intelligent hybrid systems.

CSCI 487 Expert System Design (3 cr.) P: 362. Study of key concepts and applications of AI. Problem-solving methods, state space search, heuristic search, knowledge representation; predicate logic, resolution, natural deduction, nonmonotonic reasoning, semantic networks, conceptual dependency, frames, scripts, and statistical reasoning; advanced AI topics in game playing, planning, learning, and connectionist models.

CSCI 502 Compiling and Programming Systems (3 cr.) P: CSCI 300. R: CSCI 470. Basic principles of compilers and compiler design; control of translation, loading, and execution; symbolic coding systems; lexical and syntactic analysis, design, and operation of assemblers and macroprocessors; design of interpretive systems. Students are expected to complete a large programming project as part of the course.

CSCI 503 Operating Systems (3 cr.) P: CSCI 403. Basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, access control; file systems; resource management; evaluation and prediction of performance.

Economics (ECON)

ECON E201 Introduction to Microeconomics (3 cr.) P: sophomore standing. ECON E201 is a general introduction to microeconomic analysis. Discussed are the method of economics, scarcity of resources, the interaction of consumers and business in the marketplace in order to determine price, and how the market system places a value on factors of production.

ECON E202 Introduction to Macroeconomics (3 cr.) P: ECON E201. An introduction to macroeconomics that studies the economy as a whole; the levels of output, prices, and employment; how they are measured and how they can be changed; money and banking; international trade; and economic growth.

ECON E270 Introduction to Statistical Theory in Economics (3 cr.) P: MATH M118. Analysis and interpretation of statistical data in business and economics. Discussion of frequency distribution, measures of central tendency and variability, statistical inference, hypothesis testing, correlation, regression, and time series.

English (ENG)

ENG W001 Fundamentals of English (3 cr.) In this developmental course, students develop fluency and amplitude in writing through in-class instruction in invention, focus, development, and revision. Grammar instruction individualized, and evaluation is based upon a portfolio of the student's work. Credit for ENG W001 does not satisfy the composition requirement for any degree program. To enter ENG W131, students must earn a C in ENG W001.

ENG W131 Elementary Composition I (3 cr.) This course, which fulfills the communications core requirements for all undergraduate students, provides instruction in exposition (the communication of ideas and information with clarity and brevity). The course emphasizes audience and purpose, revision, organization, development, advanced sentence structure, diction, development within a collaborative classroom. Evaluation is based upon a portfolio of the student's work. On the basis of math and English Placement Exam scores, a student may be exempted from the course or told to enroll in ENG W001, a 3 credit hour noncredit remedial course; the student must then satisfactorily complete ENG W001 before being allowed to enroll in W131.

ENG W132 Elementary Composition II (3 cr.) P: ENG W131 (with a grade of C or better). Stresses argumentation and research concurrently, with a secondary emphasis on critical evaluation in both reading and writing. Evaluation is based upon a portfolio of the student's work.

ENG 185 Developmental Reading (1 cr.) The purpose of this course is to increase reading efficiency by improving comprehension and developing the motor skills involved in reading speed. Flexibility in approach to and rate of reading is emphasized, e.g., studying, skimming.

ENG W231 Professional Writing Skills (3 cr.) P: ENG W131 (with a grade of C or better). Focuses on nonfiction writing for the student

whose career requires preparation of reports, proposals, and analytical papers. Emphasis on clear and direct objective writing and on investigation of an original topic written in report form. Course culminates in a primary research project.

Geology (GEOL)

GEOL G110 Geology: The Earth's Environment (3 cr.) P: None. With laboratory GEOL G120, equivalent to IU GEOL G103, IU GEOL G111, and PU GEOS 111. Description, classification, and origin of minerals and rocks. Internal processes: earthquakes, rock deformation, origin of crustal structures. External processes: landslides, streams, glaciers, groundwater, humans' geologic environment.

GEOL G221 Introductory Mineralogy (3 cr.) P: GEOL G206 and CHEM C105 or consent of instructor. Crystallography: symmetry, morphology, classes. Mineral chemistry, physics, and genesis. Description, identification, association, occurrence, and use of common and important minerals.

GEOL G222 Introductory Petrology (3 cr.) P: GEOL G221 and CHEM C106. Igneous, sedimentary, and metamorphic rocks: composition, field occurrence, characteristics, classification, origin, laboratory description, and identification.

History (HIST)

HIST H105-H106 American History I-II (3-3 cr.) I. Colonial period, Revolution, Confederation and Constitution, national period to 1865. II. 1865 to present. Political history forms framework, with economic, social, cultural, and intellectual history interwoven. Introduction to historical literature, source material, and criticism.

Mathematics (MATH)

MATH 001 Remedial Algebra (3 cr.) P: Eighth-grade mathematics. Covers the material in the first year of high school algebra. Numbers and algebra, integers, rational numbers, equations, polynomials, graphs, systems of equations, inequalities, radicals. Credit does not apply toward any degree.

MATH 111 Algebra (4 cr.) P: MATH 001 or one year of high school algebra. Real numbers, linear equations and inequalities, systems of equations, polynomials, exponents, logarithmic functions. Covers material in the third semester of high school algebra.

MATH M118 Finite Mathematics (3 cr.) P: MATH 111 or equivalent. Set theory, vectors, matrices, permutations, combinations, simple probability, conditional probability, linear programming, graphical and simplex methods, and duality theorem.

MATH M119 Brief Survey of Calculus I (3 cr.) P: MATH M118 or MATH 111 or equivalent. Sets, limits, derivatives and applications, integrals and applications, and functions of several variables.

MATH 151 Algebra and Trigonometry (5 cr.) P: MATH 111 or three semesters of high school algebra. MATH 151 is a one-semester version of 153-154. Not open to students with credit in MATH 153 or MATH 154. MATH 151 covers college-level algebra and trigonometry. Provides preparation for MATH 163 and MATH 164.

MATH 153 Algebra and Trigonometry I (3 cr.) P: MATH 111 or three semesters of high school algebra. MATH 153-154 is a two-semester version of MATH 151. MATH 153 covers college-level algebra. Provides preparation for MATH 163 and MATH 221.

MATH 154 Algebra and Trigonometry II (3 cr.) P: MATH 153 or four semesters of high school algebra. MATH 153-154 is a two-semester version of MATH 151. MATH 154 covers college-level trigonometry. Provides preparation for MATH 163 and MATH 221.

MATH 163 Integrated Calculus and Analytic Geometry I (5 cr.) P: MATH 151 or equivalent, and one year of geometry. Equiv. IU MATH M215. Review of plane analytic geometry and trigonometry, functions, limits, differentiation, applications of differentiation, integration, the fundamental theorem of calculus, and applications of integration.

MATH 164 Integrated Calculus and Analytic Geometry II (5 cr.) P: MATH 163. Equiv. IU MATH M216. Transcendental functions, techniques of integration, indeterminant forms and improper integrals, conics, polar coordinates, sequences, infinite series, and power series.

MATH 221 Calculus for Technology I (3 cr.) P: MATH 151 or equivalent and one year of geometry. Analytic geometry, the derivative and applications, the integral and applications.

MATH 222 Calculus for Technology II (3 cr.) P: MATH 221. Differentiation of transcendental functions, methods of integration, power series, Fourier series, differential equations.

MATH 261 Multivariate Calculus (4 cr.) P: MATH 164. Equiv. IU MATH M311. Spatial analytic geometry, vectors, curvilinear motion, curvature, partial differentiation, multiple integration, line integrals, Green's theorem.

MATH 262 Linear Algebra and Differential Equations (4 cr.) P:MATH 164. R: MATH 261. First-order equations, higher-order linear equations, initial and boundary value problems, power series solutions, systems of first-order equations, Laplace transforms, applications. Requisite topics of linear algebra:

vector spaces, linear independence, matrices, eigenvalues, and eigenvectors.

MATH 351 Elementary Linear Algebra (3 cr.) P: MATH 261. Not open to students with credit in MATH 511. Systems of linear equations, matrices, vector spaces, linear transformations, determinants, inner product spaces, eigenvalues, and applications.

MATH 510 Vector Calculus (3 cr.) P: MATH 261. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems, and applications to engineering and the physical sciences.

MATH 511 Linear Algebra with Applications (3 cr.) P: MATH 261. Not open to students with credit in MATH 351. Matrices, rank and inverse of a matrix, decomposition theorems, eigenvectors, and unitary and similarity transformations on matrices.

MATH 520 Boundary Value Problems of Differential Equations (3 cr.) P: MATH 261 and MATH 262. Sturm-Liouville theory, singular boundary conditions, orthogonal expansions, separation of variables in partial differential equations, spherical harmonics.

MATH 522 Qualitative Theory of Differential Equations (3 cr.) P: MATH 262 and MATH 351. Laplace transforms, systems of linear and nonlinear ordinary differential equations, brief introduction to stability theory, approximation methods, other topics.

MATH 523 Introduction to Partial Differential Equations (3 cr.) P: MATH 262 and MATH 510 or consent of instructor. Method of characteristics for quasilinear first-order equations; complete integrals; Cauchy-Kowalewsky theory; classification of second-order equations in two variables; canonical forms; difference methods of hyperbolic and parabolic equations; Poisson integral method for elliptic equations.

MATH 525 Introduction to Complex Analysis (3 cr.) P: MATH 261 and MATH 262. Complex numbers and complex-valued functions; differentiation of complex-valued functions, power series, uniform convergence; integration, contour integrals; elementary conformal mapping.

MATH 526 Principles of Mathematical Modeling (3 cr.) P: MATH 262 and MATH 510 or consent of instructor. Ordinary and partial differential equations of physical problems, simplification, dimensional analysis, scaling, regular and singular perturbation theory, variational formulation of physical problems, continuum mechanics, and fluid flow.

MATH 544 Real Analysis and Measure Theory (3 cr.) P: MATH 441 or consent of instructor. Algebras of sets, real number system, Lebesgue measure, measurable functions, Lebesgue integration, differentiation, absolute continuity, Banach spaces, metric spaces, general measure and integration theory, Riesz representation theorem.

MATH 556 Introduction to the Theory of Numbers (3 cr.) P: MATH 261. Divisibility, congruences, quadratic residues, Diophantine equations, and the sequence of primes.

MATH 626 Mathematical Formulation of Physical Problems I (3 cr.) P: Graduate standing and consent of instructor. Topics to be chosen from the following: tensor formulation of the field equations in continuum mechanics, fluid dynamics, hydrodynamic stability, wave propagation, and theoretical mechanics.

MATH 627 Mathematical Formulation of Physical Problems II (3 cr.) P: MATH 626. Continuation of MATH 626.

Music (MUS)

MUS M174 Music for the Listener (3 cr.) How to listen to music; art of music and its materials; instruments and musical forms.

Philosophy (PHIL)

PHIL P110 Topical Introduction to Philosophy (3 cr.) An introduction to philosophy through a study of several important philosophical problems. May not be taken for credit by those with credit in PHIL P112.

Physics (PHYS)

PHYS 152 Mechanics (4 cr.) P or C: MATH 164. Equiv. IU PHYS P221. Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; properties of matter; simple harmonic and wave motion.

PHYS 218 General Physics (4 cr.) P: MATH 151 or equivalent. Mechanics, conservation laws, gravitation; simple harmonic motion and waves; kinetic theory, heat, and thermodynamics for students in technology fields.

PHYS 219 General Physics (4 cr.) P: PHYS 218. Electricity, light, and modern physics.

PHYS 251 Heat, Electricity, and Optics (5 cr.) P: PHYS 152. Equiv. IU PHYS P222. Fall, day, night; Spring, day, night. Heat, kinetic theory, elementary thermodynamics, and heat transfer. Electrostatics, current electricity, electromagnetism, and magnetic properties of matter. Geometrical and physical optics.

PHYS 322 Oscillations and Waves (3 cr.) P: PHYS 251. Modes of vibration of a system; emission and absorption of waves; properties

of sound, electromagnetic, and particle waves including phenomena of refraction, reflection, dispersion, diffraction, interference, polarization, and double refraction; lasers and holography.

PHYS 330 Intermediate Electricity and Magnetism (3 cr.) P: PHYS 251. P or C: PHYS 300 and MATH 262. Electrostatics, electric currents, magnetostatics, electromagnetic induction, Maxwell's equations, electromagnetic waves.

PHYS 342 Modern Physics (3 cr.) P: PHYS 251. Equiv. IU PHYS P301. A survey of basic concepts and phenomena in atomic, nuclear, and solid-state physics.

PHYS 530 Electricity and Magnetism (3 cr.) P: PHYS 330 or equivalent. Electrostatic problems, theory of dielectrics, theory of electric conduction, electromagnetic effects due to steady and changing currents, magnetic properties of matter, Maxwell's equations, electromagnetic radiation.

PHYS 545 Solid-State Physics (3 cr.) P: Any undergraduate course in modern physics. Crystal structure, lattice vibrations, free electron theory of solids, band theory of solids, semiconductors, superconductivity, magnetism, magnetic resonance.

PHYS 550 Introduction to Quantum Mechanics (3 cr.) P: PHYS 342 and at least one other junior-level course in each of mathematics and physics or equivalent. Brief historical survey, waves in classical physics, wavepackets, uncertainty principle, operators and wave functions, Schrodinger equation and application to one-dimensional problems, the hydrogen atom, electron spin, multielectron atoms, periodic table, molecules, periodic potentials, Bloch wave functions.

PHYS 556 Introductory Nuclear Physics (3 cr.) P: PHYS 550 or equivalent. Theory of relativity, brief survey of systematics of nuclei and elementary particles, structure of stable nuclei, radioactivity, interaction of nuclear radiation with matter, nuclear reactions, particle accelerators, nuclear instruments, fission, and nuclear reactors.

Psychology (PSY)

PSY B104 Psychology as a Social Science (3 cr.) Equiv. IU PSY P102 and PU PSY 120. Introduction to scientific method; individual differences; personality; and developmental, abnormal, social, and industrial psychology.

PSY B366 Introduction to Organizational Psychology in Business and Industry (3 cr.) The study of organizational psychology as applied to business and industry. Brief coverage of historical development of organizational theory through exploring current theories' weaknesses and strengths. Special problems for business and industry and the methodology for scientific research on these problems will be presented. Some areas or problems to be discussed are organizational structure and climate, leadership and management, communication, motivation, morale, and productivity.

PSY B368 Introduction to Personnel Psychology in Business and Industry (3 cr.) Psychological methods of assessment in personnel selection and placement, evaluation, and training. Methods and problems of psychological measurement, occupational analysis, human factors engineering, job evaluation, and wages and salary administration.

PSY 570 Industrial Psychology (3 cr.) Survey of the applications of psychological principles and of research methodology to various human problems in industry, such as personnel selection and appraisal, the organizational and social context of human work, the job and work situation, human errors and accidents, and psychological aspects of consumer behavior.

PSY 572 Organizational Psychology (3 cr.) A survey of basic behavioral science research and thinking as these contribute to the understanding of individual, dyadic, group, intergroup, and other large organization behavioral phenomena. The topics covered include motivation, perception, attitudes and morale, communication, leadership, conflict, problem solving, behavior change, and organizational effectiveness.

PSY 574 Psychology of Industrial Training (3 cr.) P: 3 credit hours of psychology. Utilization of psychological measurement techniques in assessing training needs and evaluating training effectiveness and the application of learning research and theory to industrial training.

PSY 577 Human Factors in Engineering (3 cr.) Survey of human factors in engineering, with particular reference to human functions in human/machine systems, and consideration of human abilities and limitations in relation to design of equipment and work environments.

PSY I578 Occupational Analysis (3 cr.) P: PSY 570. Survey of systematic study of human work, including techniques of analysis of jobs and occupations for personnel and related purposes. Survey of occupational research and related topics. Practice in job analysis.

Sociology (SOC)

SOC R100 Introduction to Sociology (3 cr.) P: ENG W131 or consent of the instructor. Consideration of basic sociological concepts, including some of the substantive concerns and findings of sociology, source of data, and the nature of sociological perspective.

Statistics (STAT)

STAT 301 Elementary Statistical Methods I (3 cr.) P: MATH 111 or equivalent. Not open to students in the Department of Mathematical Sciences. A basic introductory statistics course with applications shown to various fields and emphasis placed on assumptions, applicability, and interpretations of various statistical techniques. Subject matter includes frequency distribution, descriptive statistics, elementary probability, normal distribution, applications, sampling distribution, estimation, hypothesis testing, and linear regression. May not be used for credit by engineering majors.

STAT 311 Introductory Probability (3 cr.) P: MATH 261 or equivalent. Fundamental axioms and laws of probability; finite sample spaces and combinatorial probability; conditional probability; Bayes Theorem; independence; discrete and continuous random variables; univariate and bivariate distributions; binomial, negative binomial, Poisson, normal, and gamma probability models; mathematical expection; moments and moment generating functions.

STAT 511 Statistical Methods I (3 cr.) P: MATH 164. Descriptive statistics; elementary probability; normal, binomial, Poisson, hypergeometric distributions; sampling distributions; testing hypotheses and estimation; one-way analysis of variance; chi-square test; correlation and regression.

STAT 512 Applied Regression Analysis (3 cr.) P: STAT 511. Linear and multiple regression; analysis of variance; random, fixed, mixed models; nested factorial; expected mean squares; pooling; modifications under relaxed assumptions; multiple comparisons; variance of estimates; analysis of covariance.

STAT 513 Statistical Quality Control (3 cr.) P: STAT 511. Control charts and acceptance sampling, continuous sampling plans, sequential analysis, statistics of combinations, and some nonparametric methods.

STAT 514 Design of Experiments (3 cr.) P: STAT 512. Fundamentals, completely randomized design, randomized complete blocks; Latin square; multiclassification; factorial; incomplete blocks and fractional replications; confounding; lattice design; general mixed factorials; split plot; optimum design.

Resident Faculty

Afolabi, Dare, *Associate Professor of Mechanical Engineering (1985); B.S. Mechanical Engineering, 1976, Thames Polytechnic, England; M.S. Acoustics and Vibration Technology, 1978, Ph.D. Mechanical Engineering, 1982, University of London, United Kingdom*

Akay, Hasan U., *Professor of Mechanical Engineering (1981); B.S. Civil Engineering, 1967, Middle East Technical University, Turkey; M.S. Civil Engineering, 1969, Ph.D. Civil Engineering, 1974, The University of Texas at Austin*

Ansty, William T., *Associate Professor of Supervision and Chair of the Department of Supervision (1973); B.S. Foreign Service, 1955, Georgetown University; M.B.A. Business Administration, 1957, Harvard University*

Arffa, Gerald L., *Professor of Supervision (1979); A.A.S. Chemical Technology, 1950, Broome County Technical College; B.S. Chemical Engineering, 1955, Clarkson College of Technology; M.B.A. Production Management, 1958, Syracuse University; Ph.D. Administrative and Engineering Systems, 1980, Union College; P.E., New York*

Bluestein, Maurice, *Assistant Professor of Mechanical Engineering Technology (1991); B.S. Mechanical Engineering, 1962, City College of New York; M.S. Mechanical Engineering, 1964, New York University; Ph.D. Biomedical Engineering, 1967, Northwestern University*

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Bowman, Michael S., *Associate Professor of Industrial Engineering Technology (1964); B.S. Mechanical Engineering, 1959, Purdue University; M.B.A. Business Administration, 1961, Indiana University; P.E., Indiana*

Buchanan, Walter W., *Assistant Professor of Electrical Engineering Technology (1985); B.A. Slavic Languages and Literatures/Mathematics, 1963, J.D., 1973, Indiana University; B.S. Interdisciplinary Engineering, 1982, M.S.E. Interdisciplinary Engineering, 1984, Purdue University; P.E., Indiana*

Burkart, Gary L. *Associate Dean and Adjunct Professor of Technology, and Executive Director, Electronics Manufacturing Productivity Facility (1991); B.S. Electrical Engineering, 1966, Montana State University; M.S. Management Science, 1982, Massachusetts Institute of Technology*

Chen, Jie, *Assistant Professor of Mechanical Engineering, School of Engineering and Technology, and Assistant Professor of Orthodontics, School of Dentistry (1990); B.S. Mechanical Engineering, 1982, Tianjin University, People's Republic of China; M.S. Biomedical Engineering, 1984, Shanghai Second Medical College, People's Republic of China; Ph.D. Mechanical Engineering, 1989, Drexel University*

Chen, Yaobin, *Associate Professor of Electrical Engineering (1990); B.S. Electrical Engineering, 1982, Nanjing Institute of Technology, People's Republic of China; M.S. Electrical Engineering, 1986, Ph.D. Electrical Engineering, 1988, Rensselaer Polytechnic Institute*

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Crozier, Robert G., *Professor of Computer Technology and Chair of the Department of Computer Technology (1972); B.S. Forestry, 1961, University of Missouri; M.S. Forestry, 1962, Ph.D. Entomology, 1966, Purdue University*

Dines, Kris A., *Associate Professor of Electrical Engineering (1990); B.S. Electrical Engineering, 1972, M.S. Electrical Engineering, 1973, Ph.D. Electrical Engineering, 1976, Purdue University*

Dunipace, Kenneth R., *Professor of Electrical Engineering (1977); B.S. Secondary Education, 1951, Ohio State University; B.S. Mechanical Engineering, 1956, Massachusetts Institute of Technology; M.E. Electrical Engineering, 1965, University of Florida; Ph.D. Electrical Engineering, 1968, Clemson University; P.E., Massachusetts, Missouri*

Ecer, Akin, *Professor of Mechanical Engineering (1979); B.S. Civil Engineering, 1966, M.S. Civil Engineering, 1967, Middle East Technical University, Turkey; Ph.D. Engineering, 1970, University of Notre Dame*

El-Sharkawy, Mohamed, *Associate Professor of Electrical Engineering (1992); B.S. Electrical Engineering, 1974, M.S. Electrical Engineering, 1979, Alexandria University, Egypt; Ph.D. Electrical Engineering, 1985, Southern Methodist University*

Feldmann, Lloyd J., Jr., *Lecturer in Manufacturing Technology (1986); B.S.*

Mechanical Engineering, 1961, University of Arizona

Fitzpatrick, Christine Y., *Assistant Dean for Student Affairs and Lecturer in Technical Communication (1984); B.S. English, 1979, M.A. English, 1981, Ball State University*

Fleenor, Edgar, *Professor of Industrial Education and Chair of the Department of Construction Technology (1965); B.S. Industrial Education, 1955, M.A. Education, 1960, Indiana State University; Ph.D. Education, 1974, Ohio State University*

Fox, Patricia L., *Assistant Dean for Financial Affairs and Lecturer in Supervision (1983); B.S. Accounting, Indiana University, 1980; M.B.A., 1985, Butler University*

Frank, Ronald M., *Associate Professor of Mechanical Engineering Technology (1963); B.S. Industrial Education, 1959, M.S. Industrial Education, 1960, Purdue University; C.Mfg.E.*

Goodwin, Clifford, *Assistant Professor of Supervision (1980); A.A.S. Aviation Technology, 1969, B.S. Supervision, 1970, Purdue University; M.A. Education, 1980, Ball State University*

Hanson, Kathleen M., *Assistant Professor of Computer Technology (1980); B.S. Mathematics, 1972, M.S. Mathematics, 1987, Purdue University*

Held, Julie A., *Assistant Professor of Technical Communication (1990); B.A. Speech Communications, 1961, M.A. Speech Communication, 1962, University of Illinois; Ph.D. English Education, 1983, Indiana University*

Katona, Thomas R., *Assistant Professor of Mechanical Engineering, School of Engineering and Technology, and Assistant Professor of Orthodontics, School of Dentistry (1991); M.S. Mechanical Engineering, 1972, Ph.D. Mechanical Engineering, 1981, D.M.D. Dentistry, 1982, University of Pennsylvania*

Kinsey, Brian D., *Assistant Professor of Construction Technology (1980); B.S. Engineering Sciences, 1972, M.S.E. Mechanical Engineering, 1975, Purdue University; P.E., Indiana*

Lamm, Nancy, *Lecturer in Engineering and Director of Retention Programs (1988); A.B. Microbiology, 1969, Indiana University; B.S.E. Bioengineering, 1983, M.S.E. Mechanical Engineering, 1989, Purdue University*

Madhavan, P. G., *Assistant Professor of Electrical Engineering, School of Engineering and Technology, and Adjunct Assistant Professor of Neurology, School of Medicine (1989); B.S. Electrical Engineering, 1975, Calicut University, India; M.S. Biomedical Engineering, 1980, Indian Institute of Technology, India; Ph.D. Electrical and Computer Engineering, 1985, McMaster University, Canada*

Maxwell, Michael P., *Associate Professor of Architectural Technology (1978); B.A.E. Architectural Engineering, 1955, University of Detroit; Reg. Architect, Indiana, Illinois*

Moll, Richard E., *Associate Professor of Mechanical Engineering Technology (1958); B.S. Industrial Education, 1955, M.S. Industrial Education, 1963, Purdue University*

Naghdi, Amir K., *Professor of Mechanical Engineering and Mathematical Sciences (1966); B.S. Mechanical Engineering, 1951, University of Tehran, Iran; M.S. Mechanical Engineering, 1958, University of Illinois; Ph.D. Engineering Sciences, 1964, Purdue University*

Needler, Marvin A., *Professor of Electrical Engineering Technology and of Electrical Engineering (1970); B.S. Electrical Engineering, 1963, M.S. Electrical Engineering, 1964, Purdue University; Ph.D. Systems Science, 1971, Michigan State University; P.E., Indiana*

O'Loughlin, Carol L., *Lecturer in Electrical Engineering (1984); B.S. Physics/Mathematics, 1957, Marquette University; M.S. Physics, 1962, Purdue University; Ph.D. Solid-State Physics, 1968, Tulane University; P.E., Indiana*

O'Loughlin, John R., *Professor of Mechanical Engineering (1969); B.E. Mechanical Engineering, 1955, Youngstown State University; M.S. Mechanical Engineering, 1958, University of Pittsburgh; Ph.D. Mechanical Engineering, 1961, Purdue University; M.B.A. Business Administration, 1977, Indiana University; P.E., Indiana*

Orr, Robert H., *Professor of Computer Technology (1985); B.S. Engineering Sciences, 1964, United States Military Academy; M.S. Information and Computer Science, 1973, Georgia Institute of Technology*

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Peale, Robert E., *Professor of Mechanical Engineering Technology and Chair of the Department of Manufacturing Technology (1963); B.S. Mechanical Engineering, 1952; M.S. Industrial Engineering, 1953, Purdue University; P.E., Indiana; C.Mfg.E.*

Pfile, Richard E., *Associate Professor of Electrical Engineering Technology and Chair of the Department of Electrical Engineering Technology (1983); B.S. Chemistry, 1974, B.S. Electrical Engineering, 1976, University of Louisville; M.S.E. Computer, Information, and Control Engineering, 1980, The University of Michigan*

Pidaparti, Ramana M., *Associate Professor of Mechanical Engineering (1989); B.S. Civil Engineering, 1980, Andhra University, India; M.S. Aeronautical Engineering, 1982, Indian Institute of Science, India; M.S. Aerospace Engineering, 1985, University of Maryland; Ph.D., Aeronautics and Astronautics, 1989, Purdue University*

Potvin, Alfred R., *Dean of the School of Engineering and Technology and Professor of Electrical Engineering (1993); B.S. Electrical Engineering, 1964, Worcester Polytechnic Institute; M.S. Electrical Engineering, 1965, Engineer Degree, Electrical Engineering, 1967, Stanford University; M.S. Psychology, 1970, M.S. Bioengineering, 1970, Ph.D. Bioengineering, 1971, The University of Michigan*

Renda, R. Bruce, *Dean Emeritus of the School of Engineering and Technology and Professor of Electrical and Mechanical Engineering (1974); B.S. Mechanical Engineering, 1952, M.S. Mechanical Engineering, 1957, Ph.D. Mechanical Engineering, 1959, Purdue University*

Rennels, Kenneth E., *Assistant Professor of Computer Integrated Manufacturing Technology (1986); B.S. Industrial Engineering, 1975, Purdue University; M.S.B.A. Management and Administrative Studies, 1979, Indiana University; P.E., Indiana*

Rizkalla, Maher E., *Associate Professor of Electrical Engineering (1986); B.S. Electrical Engineering, 1975, Assiut University, Egypt; M.S. Electrical Engineering, 1980, Cairo University, Egypt; Ph.D. Electrical Engineering, 1985, Case Western Reserve University*

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Wilkins, Harriet A., *Associate Professor of Technical Communication (1983); B.A. English, 1959, College of Emporia; M.A. Linguistics, 1975, Louisiana State University; Ph.D. Language Education, 1991, Indiana University*

Williamson, David M., *Lecturer in Computer Technology (1986); B.S. Science, 1967, Purdue University; M.S. Education, 1974, University of Illinois; A.A.S. Computer Technology, 1981, Purdue University*

Willison, Thomas K., *Professor of Electrical Engineering Technology (1966); B.S. Mathematics, 1965, M.S. Physics, 1970, Indiana State University*

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Faculty Emeriti

Beck, Richard L., *Associate Professor Emeritus of Civil Engineering Technology (1962); B.S., Light Building, 1951, University of Wisconsin; M.S. Structures, 1959, University of Illinois; P.E., Indiana*

Burley, Frank E., *Professor Emeritus of Electrical Engineering Technology (1968); B.S. Electrical Engineering, 1930, M.S. Electrical Engineering, 1931; Massachusetts Institute of Technology*

Close, Sam, *Professor Emeritus of Mechanical Engineering Technology (1966); B.M.E. Mechanical Engineering, 1947, Cleveland State University; P.E., Indiana, Ohio*

Dault, Raymond A., *Professor Emeritus of Restaurant, Hotel, and Institutional Management (1950); B.A. Hotel Administration, 1950, Michigan State University; M.B.A. Management, 1969, Indiana University*

Ebling, Daniel W., *Associate Professor Emeritus of Supervision (1967, IUPUI Columbus); B.S. Economics, 1955, Albright College; M.B.A. General Business, 1956, Indiana University*

Max, Abraham M., *Professor Emeritus of Mechanical Engineering (1968); B.S., 1934, M.S., 1935, Ph.D., 1937, University of Wisconsin*

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Seibert, William L., *Professor Emeritus of Electrical Engineering Technology (1977); B.S. Electrical Engineering, 1955, M.S. Engineering, 1972, Purdue University*

Wisner, Howard L., *Professor Emeritus of Supervision (1946); B.A., 1932, M.S., 1939, Indiana University*

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Key to Course Codes

AAE	Aeronautics and Astronautics
ANAT	Anatomy
ART	Architectural Technology
BIOL	Biology
BMET	Biomedical Electronics Technology
BUS	Business
CAND	Candidacy for Degree
CET	Civil Engineering Technology
CHEM	Chemistry
CIMT	Computer Integrated Manufacturing Technology
CNT	Construction Technology
COMM	Communication and Theatre
CPT	Computer Technology
CSCI	Computer Science
ECON	Economics
EDUC	Education
EE	Electrical Engineering
EET	Electrical Engineering Technology
EG	Engineering Graphics
ENG	English
ENGR	General Engineering
GEOL	Geology
GEOS	Geoscience
HIST	History
IE	Industrial Engineering
IET	Industrial Engineering Technology
MATH	Mathematics
ME	Mechanical Engineering
MET	Mechanical Engineering Technology
MSE	Materials Engineering
MUS	Music
PHIL	Philosophy
PHYS	Physics
PSY	Psychology
SOC	Sociology
SPV	Supervision
STAT	Statistics
TCM	Technical Communications