Purdue School of Engineering and Technology

Welcome to the Purdue School of Engineering and Technology!

The Purdue School of Engineering and Technology offers undergraduate and graduate programs that prepare students for life-long careers. The school is one of the largest degree-granting schools at IUPUI, with an enrollment of approximately 3,100 students. All degrees are awarded by Purdue University, with the exception of Indiana University degrees awarded through the Department of Music & Arts Technology.

Overview

Vision
The Purdue School of Engineering and Technology, IUPUI, will be regarded as one of America's premier urban schools of engineering and technology, recognized regionally, nationally, and internationally for its excellence in teaching and learning, research and creative activities, and civic engagement.

Mission
The Purdue School of Engineering and Technology, IUPUI, serves the greater Indianapolis metropolitan area, the State of Indiana, and the nation by providing a high-quality learning environment informed through the discovery and dissemination of knowledge via the scholarship of teaching and learning, research and creative activities, and civic engagement.

Values
The core values that define, inform, and guide the decisions within our School are as follows:

- **Excellence:** Academic excellence is our top priority. We pursue excellence in learning, teaching, research and creative activities, and civic engagement as the highest indicators of successful achievement.
- **Competition:** Competition enhances innovation. We strive to compete at the highest levels in the pursuit of extramural support for our students, as well as for our research and creative activities.
- **Collaboration:** We promote teamwork and partnerships for solving problems and disseminating and transferring knowledge, thus multiplying our accomplishments.
- **Diversity:** We value diversity in all of its forms in our research, curricula, and pedagogy and in our faculty, staff, and student composition.
- **Leadership:** We encourage and reward effective leadership at every level in the School.
- **Location:** We are fortunate to be located in the vibrant city of Indianapolis and we strive to capitalize on the urban setting to address the challenges of a global society.
- **Professionalism**: We foster and reward high standards of collegiality and integrity.
- **Responsiveness:** We are committed to community and professional service to meet the needs of our stakeholders.
- **Improvement:** We strive to continuously improve the implementation of our mission through efficient assessment and evaluation processes.
- **Identity:** We take pride in the Purdue University and Indiana University affiliations, while striving to advance the IUPUI campus identity, image, and reputation.

Accreditation & Licenses

Accreditation & Licenses

The programs listed below are accredited by the Engineering Technology Accreditation Commission (ETAC) of ABET, http://www.abet.org:

- Computer Engineering Technology
- Construction Engineering Management Technology
- Healthcare Engineering Technology Management
- Electrical Engineering Technology
- Mechanical Engineering Technology

The programs listed below are accredited by the Computing Accreditation Commission (CAC) of ABET, http://www.abet.org:

- Computer & Information Technology
- Computer Graphics Technology

The programs listed below are accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org:

- Biomedical Engineering
- Computer Engineering
- Electrical Engineering
- Energy Engineering
- Mechanical Engineering
- Motorsports Engineering

The program listed below is accredited by the Council of Interior Design Accreditation (CIDA), http://www.accredit-id.org:

- Interior Design Technology

The programs listed below are accredited by the National Associate for Schools of Music (NASM), http://nasm.arts-accredit.org:

- Music Technology
- Music Academy

The program listed below is approved by the American Music Therapy Association (AMTA), http://musictherapy.org:

- Music Therapy

Contact Information

Purdue School of Engineering and Technology
Technology Building, ET 101
799 W. Michigan Street
Indianapolis, IN 46202
(317) 274-2533
etinfo@iupui.edu

History

History

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 degree was first offered in 1969.

Today the school offers undergraduate and graduate programs leading to Purdue University degrees. Several of the programs have transfer and articulation agreements with a few Indiana colleges and universities as well as with international institutions abroad.

Requirements

Graduate Admission Requirements
Students who hold a baccalaureate degree from an accredited institution with a grade point average (GPA) of 3.00 on a 4.00-point scale, or with an overall "B" grade equivalent may be considered for admission to graduate degree programs in the School of Engineering and Technology. International applicants must submit official test score reports from the Educational Testing Service (ETS) for the Test of English as a Foreign Language (TOEFL) to be considered for admissions. Some graduate programs require official test scores for the Graduate Record Exam (GRE) from both domestic and international applications.

Undergraduate Admissions
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 and technology programs, as well as requests for admission applications, should be addressed to the IUPUI Office of Admissions, 420 University Boulevard, Campus Center 255, Indianapolis, IN 46202-5140.

Undergraduate Engineering Admission Requirements
In determining the qualifications of an applicant to undergraduate engineering programs, the Office of Admissions uses the following criteria:

- Graduation from a high school accredited by a state Department of Public Instruction.
- The extent to which the student meets or exceeds the following minimum requirements:
    - High School GPA of 3.0.
    - Completion of Core 40 including chemistry and 4 years of math including trigonometry or pre-calculus.
    - Minimum SAT scores of 570 Math and 540 Evidence Based Reading and Writing or ACT scores of 24 Math and 20 English.
- You must provide the results of your SAT or ACT, including the Written Section of the test (scores must be received at IUPUI by May 1). If your class has graduated and a fall semester has passed since you graduated, you do not need to take the SAT or ACT. Though test results are considered during the admission review, we do not deny students strictly based on their test results. The SAT or ACT is most important when considering you for dual admission to your intended major and scholarship consideration.
- Because of a limitation on the total number of applicants that may be accepted as first-year students, 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 Technology Admission Requirements
In determining the qualifications of an applicant to undergraduate technology programs, the Office of Admissions uses the following criteria:

- Graduation from a high school accredited by a state Department of Public Instruction.
- Veterans with less than 26 college credits: Admission requirements for veterans include the submission and review of the Joint Services Transcript (JST) or the Community College of the Air Force (CCAF) transcript in lieu of high school transcript review.
- The extent to which the student meets or exceeds the following minimum requirements:
    - Complete Academic Honors Diploma, Core 40, or equivalent, with
        - High School GPA of 3.0 or higher, OR
        - Minimum SAT scores of 530 Math and 500 Evidence Based Reading and Writing, or equivalent ACT scores of 21 Math and 19 English.
- You must provide the results of your SAT or ACT, including the Written Section of the test (scores must be received at IUPUI by May 1). If your class has graduated and a fall semester has passed since you graduated, you do not need to take the SAT or ACT. Though test results are considered during the admission review, we do not deny students strictly based on their test results. The SAT or ACT is most important when considering you for dual admission to your intended major and scholarship consideration.
- Because of a limitation on the total number of applicants that may be accepted as first-year students, 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.

Special Expenses

Fees and Payment Procedures

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

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 this information. Contact the Office of the Registrar, Campus Center, Room 250, 420 N. University Boulevard, IUPUI, Indianapolis, IN 46202; phone (317) 274-1519 or visit http://registrar.iupui.edu/resident.html

General Fees
In order to support programs, services, and facilities that benefit all students at IUPUI each semester students are charged a fee. All students include every person enrolled in a credit bearing course - and may be graduate, undergraduate, full and/or part time.

Often these fees are mistaken for certain optional fees for which students may or may not choose. This fee is not optional and must be paid by all students.

More information is available at http://www.iupui.edu/~fees/

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 fees.

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

Special Credit 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 nominal fee per credit hour.
3. If the credit is awarded as a result of an examination and the student does not meet either 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 a nominal fee per credit hour.

Auditing Fees
An audit form must be presented to the Office of the Registrar from a student's school or division to audit a course for record. No grades or credits are received for audits. If a course is changed from credit to audit after the first week of classes, a late program change fee will be assessed.

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 with a laboratory component may not be audited.

Other Fees
Students may also be required to pay special fees for the following services: housing, locker rental, parking, recreation, student identification card (depending on enrollment status and anticipated use), and transcript request. A complete listing of special fees is provided each term in the IUPUI *Schedule of Classes and IUPUI* Web site.

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. For information about this fee payment, refer to the IUPUI *Schedule of Classes or IUPUI* Web site www.iupui.edu.

Refunds
Refund credits are determined by the date the drop activity is processed by the IUPUI Office of the Registrar. For information about refunds, refer to https://www.bursar.iupui.edu/refunds.asp.

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 and courses scheduled from 1 to 8 weeks in length is published in the *IUPUI Schedule of Classes*.

Financial Aid
It is the goal of IUPUI to encourage students in their educational endeavors 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:

Office of Student Financial Services
Campus Center 250
420 N. University Boulevard
IUPUI
Indianapolis, IN 46202-5147
phone: (317) 274-4162
Web: http://www.iupui.edu/finaid/

Application Procedures
Potential financial aid recipients must complete the Free Application for Federal Student Aid (FAFSA), which is available from high schools, on the Web, or at the Office of Student Financial Services. The priority application deadline for any summer session and/or the following academic year is March 1, although applications will be processed as long as funds are available. Students who apply late should plan on finding other funds 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 FAFSA. 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 often not based on need, and the student does not pay back the award later. An applicant will be contacted by IUPUI if you are eligible to apply for scholarships; if an application is required, it will be sent automatically.

Grants
Grants are awarded on the basis of need only and do not have to be repaid by the student.

Student Loans
Unlike scholarships and grants, loans must be repaid. 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 Student Financial Services 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 Student Employment, 815 W. Michigan Street, Taylor Hall Third Floor (317) 274-4856, offers help in finding part-time jobs and maintains current information about part-time job opportunities. Students should contact this office for further information on employment assistance.

Work-Study Program
The Federal College Work-Study Program available at IUPUI was established by the Higher Education Act of 1965. The main purpose of the program is to give eligible students the chance to do paid work that will complement their academic programs and career aspirations. Students who have been admitted to IUPUI may apply through the Office of Student Financial Services.

Veterans Benefits
Information on benefits, including Veterans Administration paid tutorial assistance and work-study opportunities, is available from the veterans affairs representative at the Campus Center, Theater Level (lower Level), 420 University Blvd., IUPUI, Indianapolis, IN 46202; (317) 278-9163, or visit http://veterans.iupui.edu/.

Transfer Students

From IUPUI Schools, Indiana University Campuses, or Purdue University Campuses
Students wishing to transfer from these schools must have a minimum cumulative grade point average of 2.0 on a 4.0 scale and be in good academic and disciplinary standing. The required minimum cumulative grade point average may be higher in some programs. 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.

- IUPUI students or students in the IU system wishing to transfer into the School of Engineering and Technology must apply directly to their intended department. Transfers from the School of Engineering and Technology to another IUPUI school must be processed by the transfer school's recorder.
- A Purdue University student from another campus must complete an official undergraduate application through the IUPUI Office of Admissions.
- If a student seeking admission to the School of Engineering and Technology previously has been dismissed for academic reasons, he or she must file a petition for readmission that will be reviewed by the Committee on Readmissions. Students may contact Susie Bradley susjbrad@iupui.edu for a Petition for Readmission.

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

- An IUPUI application for undergraduate admission and a copy of high school records must be submitted to the Office of Admissions.
- An official transcript of all course work done, from all institutions previously attended, also must be forwarded to the Office of Admissions.
- For admission to an engineering or technology program, residents of Indiana 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 by the Office of Admissions and distributed by the Office for Academic Programs in coordination with the department in which the student enrolls.
- There is a residency requirement to receive a degree: transfer students must complete a program of study that includes at least 32 credit hours for a bachelor’s degree and at least 15 credit hours for an associate degree in the School of Engineering and Technology. For the associate degree, at least 6 out of the 15 credits are expected to be in the major. Students seeking an associate degree in Healthcare Engineering Technology Management must complete at least 20 hours of course work in the associate degree program in order to earn the degree. For the bachelor’s degree, at least 12 out of the 32 credits are expected to be in the major at the junior level or higher.
- Individual academic programs may require that transfer students complete specific courses prior to admission with advanced standing.
- Transfer students must be in good academic and disciplinary standing at the college(s) 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, must file a petition for readmission that will be reviewed by the committee on readmissions. Students may contact Susie Bradley susjbrad@iupui.edu for a Petition for Readmission.

Transfer students may receive credit in the School of Engineering and Technology for successfully completed course work of equivalent amount and character from another accredited college. However, if a student changes to a different course of study in the process of transferring from another college or university, credits for certain courses may not be applicable toward requirements in the new curriculum.

Transfer credit is not granted for work done at institutions that are not fully approved by a regional accrediting association of secondary schools and colleges. In addition to 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 is when agreements exist that specify courses or blocks of credit that will transfer into specific Purdue University degree programs.
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. All prospective transfer students are encouraged to write or visit the school for further information about their opportunities.

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 on good-faith terms, using the same criteria as those used in evaluating external credits.

Policies & Procedures

Undergraduate Policies

Probation, Dismissal, and Readmission Policy

Academic Warning
A student whose semester grade point average (GPA) falls below a 2.0, but whose cumulative GPA is a 2.0 or higher, will be placed on academic warning. Students on academic warning will be required to meet with their academic advisor before being able to register for classes. A student will be advised of academic warning status by the Office of the Associate Dean for Academic Affairs and Undergraduate Programs.

Academic Probation
A student whose cumulative grade point average (GPA) falls below a 2.0 will be placed on probation. Students on academic probation will be required to meet with their academic advisor before being able to register for classes. The student may continue studies provided the student achieves a semester GPA of at least 2.0 for each semester while on probation. Once the cumulative GPA is at least 2.0, the student will be removed from probationary status. A student will be advised of probationary status and the possibility of dismissal by the Office of the Associate Dean for Academic Affairs and Undergraduate Programs.

Dismissal
A student on probation who has completed a minimum of 12 IUPUI grade point average (GPA) hours is subject to dismissal from the School if the student fails to attain a GPA of at least 2.0 in any two consecutive IUPUI semester (fall and spring), including the semester that the student was first placed on probation.

A student can also be dismissed from the School when, in the opinion of the Associate Dean for Academic Affairs and Undergraduate Programs in consultation with the student's major department, the student has ceased making progress in the degree program. Examples of lack of progress may include, but are not limited to, average GPA in courses in the major below 2.0, multiple semesters with semester GPA below 2.0, and repeated failures in core courses in the curriculum. Students in danger of dismissal due to failure to make academic progress will be required to meet with their academic advisor.

A student will be notified of dismissal by the Office of the Associate Dean for Academic Affairs and Undergraduate Programs.

Readmission
A student dismissed for the first time from the Purdue School of Engineering and Technology or another Purdue School must remain out of school at least one regular (fall or spring) semester. During the semester out of school, the student may petition the School of Engineering and Technology for readmission. A student dismissed for the second time must remain out of school at least two regular semesters (fall and spring), but may petition for readmission during the second semester out of school. Readmission after a second dismissal is extremely rare.

A student readmitted will be informed by the Office of the Associate Dean for Academic Affairs and Undergraduate Programs. The notification will specify any conditions and restrictions affecting readmission and continuance in the degree program. Readmitted students will be placed on probation. Readmitted students must earn a GPA of at least 2.0 each semester while on probation or they will be dismissed again. Readmitted student will be removed from probation when their cumulative GPA is raised to 2.0. Students may contact Susie Bradley susjbrad@iupui.edu for a Petition for Readmission.

Acceptance of Grade Replacement & Repeating Courses

Repeated Courses (Grade Replacement Policy)
Students enrolled in the School of Engineering and Technology are permitted to apply only the provisions of the IUPUI Grade Replacement Policy that pertain to repeating a course in order to achieve a higher grade. This replacement will affect a student's academic record only at the Purdue School of Engineering and Technology at IUPUI. If the student subsequently transfers to another academic unit at IUPUI or another campus, different interpretations of the grade replacement policy may be in place.

An undergraduate student who retakes any course may elect to have only the final grade counted in computation of the cumulative semester grade point average, in accordance with the limitations listed below. After retaking the course, the enrollment and original grade will be removed from calculations used to determine the student's cumulative GPA. 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:

- Students may exercise the grade replacement option for no more than 15 credit hours, including any courses in which the former FX option was used for their 1st baccalaureate degree.
- A grade may be replaced only by another grade for the same class.
- A student may exercise the Grade Replacement Policy a maximum of two times for a single course.
- The request to remove a grade from the cumulative GPA calculation by this method is irreversible.
- The second enrollment for any course covered by this policy must have occurred during fall semester 1996 or later.

Students who plan to use the grade replacement option must complete and submit the grade replacement form to the Recorder in the Office of Academic Programs for processing after retaking the course.

Academic Regulations

E&T Course Drop Policy

Undergraduate students admitted to the School of Engineering and Technology in fall 2012 and beyond may not drop more than one course per semester. Furthermore, these students are limited to a total of eight withdrawals over the course of their academic career after admission to the School of Engineering and Technology.

If extenuating circumstances warrant an exception to this policy, the exception must be approved both by the student's academic advisor and by the Associate Dean for Academic Affairs and Undergraduate Programs.

If due to extenuating circumstances a student must withdraw from school (drop every class) during an in-progress semester, the withdrawals in that semester will count as only a single withdrawal toward the career maximum of eight.

This policy does not apply to course adjustments made during the Add/Drop (100% refund) period. For first-year students (those with less than 26 total credit hours, both beginners and transfers) served by the New Student Academic Advising Center, courses from which a student has been administratively withdrawn will not be counted toward the one-drop-per-semester limit.

For the purposes of this policy, linked lecture-lab courses taught under two different numbers are considered a single course. Likewise, the dropping all courses that make up a themed learning community will count as a single drop.

Grades and Grade Reports

Students are responsible for completing all required work in each of their courses 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 what a student has achieved 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.

For credit courses:

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

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. The F is factored into the student's grade point average.

For noncredit courses, including thesis research:

S: Satisfactory: meets course objectives (no grade point value assigned).
F: Unsatisfactory: does not meet course objectives (is factored into grade point average).

Note that no separate grades are given for course laboratory sections that have been given separate course designations for scheduling purposes.

Incomplete, Deferred, or Withdrawal grades for credit or noncredit courses (no grade point value assigned):

I: Incomplete, no grade: policies and procedures for I and IX grades for Engineering and Technology students (GRAD and UGRD)

The grade of incomplete "I" may be assigned only when:

- A student has successfully completed at least 75% of the work in a course.
- Extenuating circumstances prevent the student from completing the work within the time limits of the course.
- Faculty should conform to the Incomplete Policy before giving a student an incomplete "I."
- Faculty must fill out the Incomplete Grade Report and have the student sign. It must show what is

needed to remove the "I." Faculty must submit these completed and signed forms to the department Secretary or department PA.

- Deadline for work must be listed on Incomplete Grade Report. Although a year is allowed by the campus, students should be encouraged to finish the work as soon as possible.
- Incomplete grades will not be converted to "IX" unless there is documented extended illness or military service. This documentation must be presented to the instructor and Recorder prior to requesting the "IX." An appropriate end date for "IX" grades must be identified at the time of issue.
- GRAD students cannot be given an "IX" per Graduate Office.
- Incomplete grades will NOT be changed to "W" (withdrawal).
- All "I" and "IX" grades should be documented in Advising Record for future reference.

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 is 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 advisor. During the second half 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 advisor, and the dean, and must also present a written justification from a doctor, member of the clergy, advisor, or similar person of authority. The fact that a student merely stops attending a class will not entitle the student to a grade of W.

Uses of the Pass/Fail Option
To provide students with the opportunity to broaden their education with less worry about the grades they may earn, 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.

- Subject to the regulations of divisions or departments, students may choose this option in any course that does not already appear on their academic record and that they are otherwise eligible to take for credit with a letter grade. Students may use this option for not more than 20 percent of the total credit hours required for graduation.
- Students taking a course under this option have the same obligations as those taking 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 note either result on the student’s academic records, but will not use the course in computing the grade point average unless the student receives an F.
- This option is not available to students on probation.
- This option is available for a maximum of two courses in any one semester and one course during a summer session.
- 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.
- Courses taken under Pass/Fail option and courses taken by correspondence may not be used to fulfill graduation requirements for engineering students. Whether the courses are accepted for technology students is up to each major department.

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.

Absence from Campus
Students who interrupt their plan of study for two consecutive semester (excluding summer) may be required to meet all departmental curriculum requirements for the program offered at the time of their return. Please check with your program director for more specific information about your plan of study.

Scholastic Grade Point Averages The scholarship standing of all undergraduate degree regular students is determined by two scholastic indexes: grade point average and the degree grade point average.

Semester Grade Point Average
The 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)” above in this section of the bulletin.

Graduation Degree Grade Point Average
The graduation 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 advisor’s approval or later substitutes an equivalent course for one previously taken, only the most recent course grade is used by the school in calculating the degree grade point average. Since certain courses previously completed by the student may on occasion be omitted from a program of study, the degree grade point average and the cumulative grade point average may differ.

Graduation Degree Grade Point Average Requirements For all bachelor’s degrees in the School of Engineering and Technology, a minimum degree grade point average of 2.0 is required for graduation. Candidates

for graduation from engineering programs must also have an grade point average of 2.0 for all required engineering courses.
For the Associate of Science degree, a minimum degree grade point average of 2.0 is required for graduation.

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.

Undergraduate

The School of Engineering and Technology is unique in offering programs in both engineering and engineering technology. What is the difference between the two areas? Engineering students learn the principles and theories needed to plan, design, and create new products and are more likely to use broad analytical skills in achieving engineering solutions. Technology students learn technical methods and practices to become experts who apply technology to solve industrial problems.

Undergraduate Engineering Degree Programs

Programs for full-time students pursuing bachelor's 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 advisors.

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

- Bachelor of Science in Biomedical Engineering (BSBME)
- Bachelor of Science in Computer Engineering (BSCmpE)
- Bachelor of Science in Electrical Engineering (BSEE)
- Bachelor of Science in Energy Engineering (BSEEN)
- Bachelor of Science in Engineering (BSE)
- Bachelor of Science in Mechanical Engineering (BSME)
- Bachelor of Science in Motorsports Engineering (BSMSTE)

Undergraduate Engineering Curriculum
All 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 four years or less. Students with gaps 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 to maintain employment or for other reasons. Programs can be tailored for part-time and evening students, as classes are scheduled for both day and evening. Part-time and evening students are urged to consult their advisors to avoid future scheduling problems.

It is important for students to recognize that some flexibility is provided in each of the curricula to allow for individual differences in backgrounds and academic goals. It is students' responsibility to consult with an academic advisor 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. Engineering curricula provide wide experience in mathematical, physical, and engineering sciences as well as in social sciences and the humanities. In this way a student obtains both thorough training in engineering and a well-rounded education. Such an approach provides the best preparation for an 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 further expanding 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. Moreover, 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 only on the basis of technical skills, 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 skills, can provide a solution.

Minor in Business for Engineering Students
Indiana University Kelley School of Business and the School of Engineering and Technology have established a minor in business for engineering students. To qualify for the minor, students must meet course prerequisites and entrance requirements. In certain cases, substitutions are permitted for some requirements. Please consult with a Kelley School of Business academic advisor for more information: (317) 274-2147. Application deadlines are March 1 for the summer and fall semesters, and October 1 for the spring semester. Applications are available in the undergraduate office, Indiana University Kelley School of Business, Business/SPEA Building 3024.

Freshman Engineering Program
Director of Freshman Engineering: N. Lamm
Senior Lecturer: P. Orono
Lecturer: P. Gee
Lecturer: N. Lamm

All qualified students interested in pursuing an engineering degree at IUPUI are admitted to the Freshman Engineering Program. This includes second-degree and transfer students as well as beginning students.

While in this program, beginning students complete the basic sequence of courses common to engineering majors. These courses include calculus I and II, chemistry and physics for science and engineering majors, English composition, and public speaking. Freshman Engineering courses include ENGR 19500 Introduction to the Engineering Profession, ENGR 19600 Introduction to Engineering, ENGR 19700 Introduction to Programming Concepts (for all majors *except* electrical engineering and computer engineering), and ENGR 29700 Computer Tools for Engineering. The Freshman Engineering Program provides students with an opportunity to explore the various engineering disciplines before making a commitment to a specific curriculum.

Transfer and second-degree students remain in Freshman Engineering until the evaluation of their transfer credits is completed.

Technology Degree Programs
The School of Engineering and Technology offers a variety of technology programs at the bachelor's degree level and two at the associate level. Programs for full-time students pursuing these technology degrees are presented in this section. Although the school sets the normal length of time needed to complete each degree program, the required time may vary for individual students. For example, well-qualified students with excellent high school preparation may complete a program in less than the length of time indicated. Other students who decide to combine cooperative (co-op) education or internships with their course work may take more time to complete all degree requirements. Students may adjust their course loads for job or personal reasons, and plans of study can be tailored to meet the needs of part-time and evening students. Needing to study over a longer time should be no obstacle to completing the program successfully.

Associate of Science
The Associate of Science degrees offered in the School of Engineering and Technology at IUPUI are awarded upon successful completion of the degree requirements.

The following associate degree programs are offered by the School of Engineering and Technology at IUPUI:

- **Healthcare Engineering Technology Management (Department of Engineering Technology)**
- **Interior Design (Department of Engineering Technology)**

Bachelor of Science
The School offers Bachelor of Science degrees in eleven diverse technology areas including applied engineering, interior design, computer and graphics technologies, music technology, music therapy, organizational leadership, and technical communication. These degrees combine theory and application within a discipline, along with a general education core. In this way, a student obtains both thorough training in technology and a well-rounded education.
The following technology bachelor's degree programs are available to qualified students:

- Computer Engineering Technology
- Computer Graphics Technology
- Computer & Information Technology
- Construction Engineering Management Technology
- Electrical Engineering Technology
- Healthcare Engineering Technology Management
- Interior Design Technology
- Mechanical Engineering Technology
- Music Technology (Indiana University degree)
- Music Therapy (Indiana University degree)
- Organizational Leadership
- Technical Communication

Transfer students must meet all departmental requirements.

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

Student Learning Outcomes

Student Learning Outcomes
The School of Engineering & Technology has organized its Student Learning Outcomes (SLOs) by department. Please choose the appropriate department in the links below, or the left-hand navigation, and then find the program you are looking for. You can also click the link for the program below and it will take you directly to that program's SLOs. Students in all programs will graduate with a Bachelor of Science degree unless otherwise noted.

Please note that certificate program learning outcomes can be found under the appropriate department below the degree program learning outcomes. Any questions or concerns about the Student Learning Outcomes should be directed to the department of the program in question, or the Office of Academic Programs in ET 215.

Engineering

- Biomedical Engineering
    - Biomedical Engineering
- Electrical and Computer Engineering
    - Computer Engineering
    - Electrical Engineering
- Mechanical Engineering
    - Energy Engineering
    - Interdisciplianary Engineering
    - Mechanical Engineering
- Motorsports Engineering
    - Motorsports Engineering

Technology

- Computer Information and Graphics Technology
    - Computer & Information Technology
    - Computer Graphics Technology
    - E-Commerce Certificate
    - Information Technology Certificate
    - Network Security Certificate
- Engineering Technology
    - Computer Engineering Technology
    - Construction Engineering Management Technology
    - Electrical Engineering Technology
    - Healthcare Engineering Technology Management
    - Interior Design
    - Mechanical Engineering Technology
    - Motorsports Engineering
    - Construction Management Certificate
    - Lean Six Sigma Certificate
    - Motorsports Engineering Technology Certificate

- Quality Assurance Certificate

- Music & Arts Technology*
  - Music Technology

- Technology Leadership and Communication
  - Organizational Leadership & Supervision
  - Technical Communication
  - Human Resource Management Certificate
  - International Leadership Certificate
  - Leadership Studies Certificate
  - Technical Communication Certificate

*Music & Arts Technology students are awarded Indiana University degrees.

Biomedical Engineering (BME)

Biomedical Engineering, B.S.B.M.E.
Upon completing the undergraduate B.M.E. degree, our students will possess:

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. An ability to function on multi-disciplinary teams.
5. An ability to identify, formulate, and solve engineering problems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9. A recognition of the need for, and an ability to engage in lifelong learning.
10. A knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Computer Engineering

Computer Engineering B.S.Cmp.E.
Upon completion of this program, students will be able to demonstrate:

1. an ability to apply knowledge of mathematics, science, and engineering.
2. an ability to design and conduct experiments, as well as to analyze and interpret data.
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. an ability to function on multidisciplinary teams.
5. an ability to identify, formulate, and solve engineering problems.
6. an understanding of professional and ethical responsibility.
7. an ability to communicate effectively.
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9. a recognition of the need for, and an ability to engage in lifelong learning.
10. a knowledge of contemporary issues.
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Computer Engineering Technology

Computer Engineering Technology, B.S.
Upon completion of this program, students will be able to:

1. Demonstrate knowledge, techniques (including the use of modern tools), and skills in the use of microprocessors, programs, networks and systems encountered in the degree program's courses.
2. Use current knowledge of mathematics, science and emerging technology tools of their discipline to solve problems and demonstrate solutions.
3. Identify, analyze, and solve technical problems as required in the degree program's courses.
4. Apply and design hardware, systems, and software programs in their specialty area as demonstrated in a senior project.
5. Conduct, analyze and interpret experiments, and assess results to improve processes.
6. Function as a member of a 2-4 person team to complete a task in a timely manner. Demonstrate ability to organize work done by team members.
7. Write technical reports; present data and results coherently in oral and graphic formats.
8. Demonstrate skills for life-long learning by locating, evaluating and applying relevant information using external resources such as the Internet, data books, trade publications and library resources.
9. Demonstrate ethical conduct as described in the university's Student Code of Conduct. Demonstrate knowledge of the professional code of ethics. Demonstrate a respect for diversity as described in the university civility statement.
10. Recognize contemporary professional, societal and global issues in case studies and course projects. Identify appropriate standards and comply with them in course assignments, exams or projects.
11. Demonstrate a commitment to quality, timeliness and continuous improvement by exhibiting the ability to complete increasingly complex homework and projects throughout the degree experience.

Computer Graphics Technology

Computer Graphics Technology, B.S.
Upon completion of this program, students will be able to:

1. An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline
2. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
3. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
4. An ability to function effectively on teams to accomplish a common goal
5. An understanding of professional, ethical, legal, security and social issues and responsibilities
6. An ability to communicate effectively with a range of audiences
7. An ability to analyze the local and global impact of computing on individuals, organizations, and society
8. Recognition of the need for and an ability to engage in continuing professional development
9. An ability to use current techniques, skills, and tools necessary for computing practice

Computer & Information Technology

Computer & Information Technology, B.S.

Upon completion of the B.S. degree, CIT students will have attained:

1. An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.
2. An ability to analyze a problem, and identify and define the computing and business requirements appropriate to its solution.
3. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
4. An ability to function effectively on teams to accomplish a common goal.
5. An understanding of professional, ethical, legal, security and social issues and responsibilities.
6. An ability to communicate effectively with a range of audiences.
7. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
8. Recognition of the need for and an ability to engage in continuing professional development.
9. An ability to use current techniques, skills, and tools necessary for computing practice.
10. An ability to use and apply current technical concepts and practices in the core information technologies.
11. An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems.
12. An ability to effectively integrate IT-based solutions into the user environment.
13. An understanding of best practices and standards and their application.
14. An ability to assist in the creation of an effective project plan.

Construction Engineering Management Technology

Construction Engineering Management Technology, B.S.

At the time of graduation, a student will be able to demonstrate:

1. An ability to select and apply the knowledge, skills and modern tools of the discipline to broadly defined engineering technology utilizing techniques that are appropriate to administer and evaluate construction contracts, documents, and codes.
2. An ability to select and apply a knowledge of mathematics, science, engineering and technology to engineering technology problems that require the application of principles and applied procedures or methodologies by applying fundamental computational methods and elementary analytical techniques in sub-disciplines related to construction engineering.
3. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments, and to apply experimental results to improve processes; an ability to select appropriate construction materials and practices, estimate costs, estimate quantities, evaluate materials for construction projects, and perform economic analyses and cost estimates related to design, construction, and maintenance of systems associated with construction engineering and utilizing measuring methods, hardware, and software that are appropriate for field, laboratory, and office processes related to construction.
4. An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program education objectives.
5. An ability to function effectively as a member or leader on a technical team.
6. An ability to identify, analyze and solve broadly-defined engineering technology problems and an ability to perform standard analysis and design in at least on sub-discipline related to construction engineering.
7. An ability to apply written, oral, and graphical communication in both technical and nontechnical environments; identify and use appropriate technical literature, produce and utilize design, construction, and operations documents.
8. An understanding of the need for and an ability to engage in self-directed continuing professional development.
9. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity by applying appropriate principles of construction management, law, and ethics.
10. A knowledge of the impact of engineering technology solutions in a societal and global context.
11. A commitment to quality, timeliness, and continuous improvement.

Construction Management Certificate

Construction Management Certificate
Upon completion of this program, students will be able to demonstrate:

1. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines.
2. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
3. An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes.
4. An ability to apply creativity in the design of systems, components or processes appropriate to program objectives.
5. An ability to function effectively in teams.
6. An ability to identify, analyze and solve technical problems.
7. An ability to communicate orally.
8. An ability to communicate writen and visual.
9. Recognition of the need for, and ability to engage in lifelong learning.
10. An ability to understand professional, ethical and social responsibilities.
11. A respect for diversity and knowledge of contemporary professional, societal and global issues.
12. A committment to quality, timeliness, and continuous improvement.

E-Commerce Certificate

E-Commerce Certificate
Upon completion of this program, students will be able to:

1. Apply tools and techniques for effective Web site planning and analysis.
2. Allow individuals to develop dynamic web applications in a variety of programming languages.
3. Explore sophisticated data management and information exchange as it applies to interactive and e-commerce applications.
4. Apply optimal Web design strategies to deploy usable Web applications for a global audience.
5. Utilize current web development standards appropriately.

Electrical Engineering

Electrical Engineering, B.S.E.E.
Upon completion of this program, students will be able to demonstrate:

1. an ability to apply knowledge of mathematics, science, and engineering.
2. an ability to design and conduct experiments, as well as to analyze and interpret data.
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. an ability to function on multidisciplinary teams.
5. an ability to identify, formulate, and solve engineering problems.
6. an understanding of professional and ethical responsibility.
7. an ability to communicate effectively.
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9. a recognition of the need for, and an ability to engage in lifelong learning.
10. a knowledge of contemporary issues.
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Electrical Engineering Technology

Electrical Engineering Technology, B.S.
At the time of graduation, students will be able to:

1. Demonstrate knowledge, techniques (including the use of modern tools), and skills in the use of components, circuits, programs and systems encountered in the degree program's courses.
2. Use current knowledge of mathematics, science and emerging technology tools of their discipline to solve problems and demonstrate solutions.
3. Identify, analyze and solve technical problems as required in the degree program's courses.
4. Apply and design components, circuits, systems and software programs in their specialty area as demonstrated in a senior project.
5. Conduct, analyze and interpret experiments and assess experimental results to improve processes.
6. Function as a member of a 2-4 person team to complete a task in a timely manner. Demonstrate ability to organize work done by team members.
7. Write technical reports; present data and results coherently in oral and graphic formats.
8. Demonstrate skills for life-long learning by locating, evaluating and applying relevant information using external resources such as the Internet, data books, trade publications and library resources.
9. Demonstrate ethical conduct as described in the university's Student Code of Conduct. Demonstrate knowledge of professional code of ethics. Demonstrate a respect for diversity as described in the university civility statement.
10. Recognize contemporary professional, societal and global issues in case studies and course projects. Identify appropriate standards and comply with them in course assignments, exams or projects.
11. Demonstrate a commitment to quality, timeliness and continuous improvement by exhibiting the ability to complete increasingly complex homework and projects throughout the degree experience.

Energy Engineering

Energy Engineering, B.S.
Upon completion of this program, students possess:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. a knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Healthcare Engineering Technology Management

Healthcare Engineering Technology Management
At the time of graduation, bachelor's degree students will be able to:

1. Demonstrate knowledge and skills in the use of the electrical and/or computer components of medical equipment systems as encountered in the degree program's courses. Demonstrate a working medical vocabulary and knowledge of clinical safety requirements and regulations as encountered in the courses of the degree program.
2. Use current knowledge of mathematics, science and emerging technology tools to solve problems and demonstrate solutions.
3. Identify, analyze and integrate the technical equipment requirements with the needs of medical staff and patients as required in the courses of the degree program.
4. Apply and design solutions for issues identified in health care technology as demonstrated in a senior project.
5. Conduct, analyze and interpret experiments, and access results.
6. Function as a member of a 2-4 person team to complete a task in a timely manner. Demonstrate ability to organize work done by team members.
7. Write technical reports; present data and results coherently in oral and graphic formats.
8. Demonstrate skills for continued self-directed learning and professional development.
9. Demonstrate ethical conduct as described in the university's Student Code of Conduct. Demonstrate knowledge of professional code of ethics.
10. Demonstrate a respect for diversity as described in the university Civility statement. Recognize contemporary professional, societal and global issues in case studies and course projects.
11. Demonstrate quality, timeliness and ability to complete increasingly complex homework and projects throughout the degree experience.

Human Resource Management Certificate

Human Resource Management Certificate
Upon completion of this program, students will be able to:

1. Describe, use, and evaluate tactical and strategic human resource management principles.
2. Develop, implement and provide a safe and effective work environment.
3. Comply with local, state, and federal employment law and related public policies.
4. Promote training and development of individuals, work teams, and organizations.
5. Assess, design, develop, implement, and evaluate learning solutions in various organizational contexts.
6. Promote positive, productive employer-employee relationships.
7. Create, negotiate, and manage regulations concerning collective bargaining, grievance, and arbitration procedures.
8. Leverage compensation, benefits, rewards, and recognition to attract, motivate, and retain talent.
9. Develop policy, practice, and procedure to select talent aligned with the strategic direction of the organization.

Information Technology Certificate

Information Technology Certificate
Upon completion of this program, students will be able to:

1. Apply tools and techniques for effective Web site planning and analysis.
2. Introduce fundamental client and server side languages for developing dynamic websites.
3. Explore database development and technologies used to build database-driven web applications.
4. Apply optimal Web design strategies to deploy usable Web applications for a global audience.
5. Research, learn and apply new web technologies.

Interdisciplinary Engineering

Interdisciplinary Engineering
Upon completion of this program, students will possess:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems

6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. a knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Interior Design Technology

Interior Design Technology, A.S. and B.S.

Upon completion of this program, students will be able to:

1. Retain a global view and weigh design decisions within the parameters of ecological, socio-economic and cultural contexts.
2. Create work through informed knowledge of behavioral science and human factors.
3. Apply all aspects of the design process to creative problem solving.
4. Engage in multi-disciplinary collaborations and consensus building.
5. Be effective communicators
6. Use ethical and accepted standards of practice, be committed to professional development and the industry, and understand the value of their contribution to the built environment.
7. Apply knowledge of interiors, architecture, art and the decorative arts within a historical and cultural context.
8. Apply elements and principles of tow- and three-dimensional design.
9. Apply color principles and theories.
10. Select and specify furniture, fixtures, equipment and finish materials in interior spaces.
11. Use the principles of lighting, acoustics, thermal comfort, and indoor air quality to enhance the health, safety, welfare and performance of building occupants.
12. Retain knowledge of interior construction and building systems.
13. Use laws, codes, standards, and guidelines that impact the design of interior spaces.

International Leadership Certificate

International Leadership Certificate

Upon completion of this program, students will be able to:

1. Demonstrate Techniques to analyze and solve intercultural problems that typically occur within diverse organizations.
2. Apply knowledge and techniques to devise strategies for successfully leading a diverse workforce within an international organization.
3. Use knowledge and techniques to devise strategies for successfully managing diversity within an international organization.
4. Demonstrate substantial knowledge of at least one foreign country, or region, (or distinct subculture within the USA), including demographic profile, economic status, political climate, commerce, history, language, and cultural norms as a result of intensive experience and/or study.

Leadership Studies Certificate

Leadership Studies Certificate

Upon completion of this program, students will be able to:

1. Define and defend their personal philosophy of leadership and ethical behavior.
2. Describe behavior in organizational settings at the individual, team/group, and macro-organization levels.
3. Identify the stages of team development that offers within organizations.
4. Make leadership-oriented decisions that are ethically, legally, morally, and strategically sound.
5. Apply concepts of supervisory management, team building, personnel selection and development, decision-making, resource allocation, conflict resolution, and strategic planning to the solving of individual, team/group, and organizational problems.
6. Explain the importance of attracting, managing, and motivating a globally-diverse workforce.
7. Improve individual and organizational performance by applying the appropriate leadership theories and processes in practice.
8. Evaluate the appropriateness of leadership behaviors in given situations, and make suggestions for improving those behaviors.

Lean Six Sigma Certificate

Lean Six Sigma Certificate

Upon completion of this program, students will be able to demonstrate:

1. An ability to select and apply the knowledge, techniques, skills, and modern tools of Lean Six-Sigma to broadly-defined process improvement activities.
2. An ability to select and apply a knowledge of statistics, science, engineering, and technology to process improvement problems that require the application of principles and applied methodologies of Lean Six-Sigma.
3. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; to apply experimental results to improve processes.
4. An ability to design systems, components, or processes for broadly-defined process problems.
5. An ability to function effectively as a member or leader on a process improvement team.
6. An ability to apply written, oral, and graphical communication in both technical and nontechnical environments.
7. An understanding of the need for and an ability to engage in self-directed continuing professional development.

8. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.
9. Knowledge of the impact of process improvement solutions in a societal and global context.
10. A commitment to quality, timeliness, and continuous improvement.

Mechanical Engineering

Mechanical Engineering, B.S.

Upon completion of this program, students will possess:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturing, and sustainability
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. a knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Mechanical Engineering Technology

Mechanical Engineering Technology, B.S.

At the time of graduation, a student will possess:

1. An ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.
2. An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.
3. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; to apply experimental results to improve processes.
4. An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.
5. An ability to function effectively as a member or leader on a technical team.
6. An ability to identify, analyze, and solve broadly-defined engineering technology problems.
7. An ability to apply written, oral, and graphical communication in both technical and nontechnical environments; an ability to identify and use appropriate technical literature.
8. An understanding of the need for and an ability to engage in self-directed continuing professional development.
9. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.
10. Knowledge of the impact of engineering technology solutions in a societal and global context.
11. A commitment to quality, timeliness, and continuous improvement.

Motorsports Engineering

Motorsports Engineering

The MSTE program at IUPUI has established the following outcomes to ensure its graduates are equipped to accomplish the expected objectives. Graduates of the program will demonstrate:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Music & Arts Technology

Music Technology, B.S.

Upon completion of this program, students will be able to:

1. Think, speak, and write clearly and effectively.
2. Demonstrate acquaintance with mathematical and experimental methods of the physical and biological sciences; including analysis and historical and quantitative techniques.
3. Address culture and history from a variety of perspectives.
4. Understand and experience thinking about moral and ethical problems.
5. Respect, understand, and evaluate work in a variety of disciplines.
6. Explain and defend one’s views effectively and rationally.

7. Understand and have experience with art forms other than music.
8. Hear, identify, and work conceptually with the elements of music-rhythm, melody, harmony, and structure.
9. Understand compositional process, aesthetic properties of style, and the ways these shape and are shaped by artistic and cultural forces.
10. Demonstrate acquaintance with a wide selection of musical literature - the principal eras, genres, and cultural sources.
11. Develop and defend musical judgments.
12. Perform in areas appropriate to the student's needs and interests.
13. Sight read.
14. Understand procedures for realizing a variety of musical styles.
15. Demonstrate capacity to create derivative or original music both extemporaneously and in written form.
16. Compose and improvise at a basic level in one or more musical languages
17. Understand how technology serves the field of music as a whole.
18. Demonstrate a working knowledge of the technological developments applicable to their area of specialization.
19. Work independently on a variety of musical problems by combining their capabilities in performance; aural, verbal and visual analysis; composition and improvisation; and history and repertory.
20. Form and defend judgments about music.
21. Acquire the tools of work with a comprehensive repertory, including music from various cultures of the world and music of their own time.
22. Understand basic interrelationships and interdependencies among the various professions and activities that constitute the musical enterprise.
23. Acquire the skills necessary to assist in the development and advancement of their careers.
24. Develop teaching skills, particularly as related to their major area of study.
25. Develop improvisational skills in all areas of musicianship
26. Experience a broad range of repertory through attendance at events such as recitals, concerts, opera and music theatre productions, and other types of performances.
27. Explore areas of individual interest related to music in general or to the major.
28. Explore multidisciplinary issues that include music.
29. Practice synthesis of a broad range of musical knowledge and skills, particularly through independent study that involves a minimum of faculty guidance, where the emphasis is on evaluation at completion.

Motorsports Engineering Technology Certificate

Motorsports Engineering Technology Certificate
Upon completion of this program, students will be able to demonstrate:

1. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines.
2. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
3. An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes.
4. An ability to apply creativity in the design of systems, components or processes appropriate to program objectives.
5. An ability to function effectively in teams.
6. An ability to identify, analyze and solve technical problems.
7. An ability to communicate orally.
8. An ability to communicate writen and visual.
9. Recognition of the need for, and ability to engage in lifelong learning.
10. An ability to understand professional, ethical and social responsibilities.
11. A respect for diversity and knowledge of contemporary professional, societal and global issues.
12. A committment to quality, timeliness, and continuous improvement.

Network Security Certificate

Network Security Certificate
Upon completion of this program, students will be able to:

1. Apply information assurance and security principles to secure systems and networks.
2. Conduct accurate and comprehensive digital forensics investigations and apply appropriate rules of evidence.
3. Use an appropriate analytic framework to assess risk and recommend strategies for mitigation.
4. Analyze and produce comprehensive security policies, standards, and procedures.
5. Analyze and create comprehensive business continuity plan to include incident response, disaster recovery, and continuous operations.

Organizational Leadership

Organizational Leadership, B.S.

Upon completion of this program, students will be able to:

1. Demonstrate and apply knowledge of
    - the process and roles of leadership.
    - leadership traits.
    - leadership behavior concepts.
    - situational approaches to leadership.
    - power and influence.
    - leading during times of uncertainty, turbulence, and change.
2. Design and conduct research, as well as analyze and interpret data in order to
    - evaluate their personal leadership effectiveness.
    - evaluate their organization's effectiveness and sustainability.

- evaluate their organization's social and environmental impact.

3. Lead an organization, or processes and functions within it that meet or exceeds desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, and sustainability.
4. Function on multi-disciplinary teams.
5. Identify, formulate, and solve organizational problems.
6. Understand professional and ethical responsibility.
7. Communicate effectively verbally and nonverbally to all size audiences.
8. Understand the impact of leadership in a global, economic, environmental and societal context.
9. Demonstrate knowledge of contemporary organizational issues.
10. Use the techniques, skills, tools and concepts necessary for effective strategic and tactical planning.

Quality Assurance Certificate

Quality Assurance Certificate
At the time of graduation, a student will possess:

1. An ability to select and apply the knowledge, techniques, skills, and modern tools of Lean Six-Sigma to broadly-define process improvement activities.
2. An ability to select and apply a knowledge of statistics, science, engineering, and technology to process improvement problems that require the application of principles and applied methodologies of Lean Six-Sigma.
3. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; to apply experimental results to improve processes.
4. An ability to design systems, components, or processes for broadly-defined process problems.
5. An ability to function effectively as a member or leader on a process improvement team.
6. An ability to apply written, oral, and graphical communication in both technical and nontechnical environments.
7. An understanding of the need for and an ability to engage in self-directed continuing professional development.
8. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.
9. Knowledge of the impact of process improvement solutions in a societal and global context.
10. A commitment to quality, timeliness, and continuous improvement.

Technical Communication

Technical Communication B.S.

Students with a B.S. in Technical Communication will be able to:

1. Understand theories and principles that inform technical communication
2. Apply best practices of usability and user-centered design
3. Understand the impact of technical communication in a global workplace context
4. Understand the need for sensitivity to differences in workplace international communication
5. Clearly communicate complex technical concepts visually, orally, and in writing
6. Effectively use technology to create communication products in a variety of environments
7. Plan and manage all aspects of technical communication projects
8. Function effectively in diverse groups
9. Effectively identify, analyze, interpret, and synthesize data
10. Understand and use different style guides appropriately
11. Ethically address challenges that arise in workplace technical communication contexts
12. Metacognitively reflect on their own communication skills and abilities
13. Recognize the need to engage in life-long learning

Technical Communication Certificate

Technical Communication Certificate
Students with a Certificate in Technical Communication will be able to:

1. Understand theories and principles that inform technical communication
2. Clearly communicate complex technical concepts visually, orally, and in writing
3. Effectively use technology to create communication products in a variety of environments
4. Understand and use different style guides appropriately
5. Metacognitively reflect on their own communication skills and abilities

Awards & Scholarships

Awards & Scholarships
The Purdue School of Engineering and Technology offers scholarships through IUPUI's Office of Student Scholarships. Early admission to IUPUI is the best way to be assured of scholarship opportunities. The Purdue School of Engineering and Technology offers scholarships to incoming freshmen and continuing students. Most scholarships are merit-based awards offered at the departmental level, but some are designated specifically for new students, or for minority, women, and other students from underrepresented populations.

Information on all scholarships can be found at http://scholarships.iupui.edu/

Scholastic Recognition

Dean's List
All undergraduate students in the School of Engineering and Technology who complete at least 6 credit hours during a semester, who have a semester grade point

average of 3.8 or higher, a cumulative GPA of 2.5 or higher, and who are approved by the program faculty are placed on the Dean's List. These honor students receive certificates from the Dean recognizing their meritorious efforts.

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 bachelor's 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 conditions:

- A candidate for the bachelor's degree with distinction must have earned at least 65 hours of credit in the Purdue University or Indiana University system. A candidate for an associate degree with distinction must have earned at least 35 hours of credit in the Purdue University or Indiana University system.
- Honors are awarded according to the following cumulative semester grade point averages:
    - Top 10 percent—With Distinction
    - Top 30 percent of the top 10 percent—With Highest Distinction

Note: For the purpose of determining graduation honors, the calculated cumulative semester grade point average includes all courses taken for a grade in either the Purdue or the Indiana University system, regardless of when the courses were taken.

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

General Requirements

Undergraduate Engineering Requirements

To earn a Bachelor of Science in Engineering (B.S.E.), Bachelor of Science in Biomedical Engineering (B.S.BME.), Bachelor of Science in Computer Engineering (B.S.Cmp.E.), Bachelor of Science in Electrical Engineering (B.S.E.E.), Bachelor of Science in Energy Engineering (B.S.EEN.), Bachelor of Science in Mechanical Engineering (B.S.M.E.) or Bachelor of Science in Motorsports Engineering (B.S.MSTE.), students must satisfy the following requirements. Requirements for graduation include receiving credit in all required courses: at least 130 credit hours in the biomedical engineering program, 125 credit hours in the computer engineering program, 124 credit hours in the electrical engineering program, 128 credit hours in energy engineering, 120 credit hours in the engineering management program, 120 credit hours in the interdisciplinary engineering program, 128 credit hours in the mechanical engineering program or 128 credit hours in the motorsports 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. Students must complete 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. Students must complete at least two semesters of resident study at IUPUI, and they must complete at least 32 credit hours of appropriate course work, of which 12 credit hours must be completed in the major at the junior level or higher. 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.

Since the Mechanical Engineering (ME) program at IUPUC is part of our IUPUI Mechanical Engineering (ME) program and all courses can be taken on the Columbus campus, the IUPUI residency requirement is fulfilled for Mechanical Engineering students who complete at least two semesters of resident study at IUPUC. They must complete at least 32 credit hours of appropriate course work in residence, of which 12 credit hours must be completed in the major at the junior level or higher.

3. Students must be in active student status in the School of Engineering and Technology in order to have the degree awarded.

4. Students must have a grade point average of 2.0 in required engineering courses in addition to an overall graduation degree grade point average 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 degree grade point average 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 degree grade point average, including extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.

5. Applicants for a second bachelor's degree, after they are admitted to the second bachelor's degree program, must complete at least 32 credit hours of appropriate course work, of which 12 credit hours must be completed in the major at the junior level or higher.

6. Courses taken under the Pass/Fail option and courses taken by correspondence may not be used to fulfill graduation requirements for engineering students.

Undergraduate Technology Requirements

Associate Degree
To earn an Associate of Science (A.S.) degree, students must satisfy the following requirements:
1. Students must complete 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. Students must complete at least two semesters of resident study at IUPUI, and they must complete at least 15 credit hours of appropriate course work, of which 6 credit hours must be in the major. Students seeking an associate degree in healthcare engineering technology management must complete at least 20 hours of course work in the associate degree program in order to earn the degree. 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. Students must be in active student status in the School of Engineering and Technology in order to have the degree awarded.

4. Students must have a minimum degree grade point average of 2.0. Students who have completed all other requirements for an A.S. degree but have failed to meet tthis minimum grade point average (the average of grades earned in courses required for a degree) 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 degree grade point average, including the extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.

5. Applicants for a second A.S. degree must complete at least 15 credit hours at IUPUI of appropriate course work after admission to the second associate degree program. At least 6 of the 15 credit hours must be completed in the major. A second associate degree may not be earned in the same program.

Bachelor's Degree
To earn a Bachelor of Science (B.S.) degree, students must satisfy the following requirements.

1. Students must complete 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. Students must complete at least two semesters of resident study at IUPUI, and they must complete at least 32 credit hours of appropriate course work, of which 12 credit hours are required to be in the 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. Students must be in active student status in the School of Engineering and Technology in order to have the degree awarded.

4. Students must have a minimum degree grade point average of 2.0. Students who have completed all other requirements for a bachelor's degree but have failed to meet the minimum degree grade point average 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 degree grade point average, including extra courses, equal or exceed the minimum specified at the time when all other graduation requirements were satisfied.

5. Applicants for a second bachelor's degree must complete at IUPUI at least 32 credit hours of appropriate course work after they are admitted to the second bachelor's degree program. At least 12 of the 32 credit hours must be completed in the major at the junior level or higher.

Second Bachelor's Degrees
Applicants for a second bachelor's degree, whose first degree was from an institution other than IUPUI, IU or Purdue, must complete at IUPUI at least 32 credit hours of appropriate course work after they are admitted to the second bachelor's degree program. At least 12 of the 32 credit hours must be completed in the major at the junior level or higher.

Policy for Awarding Engineering and Technology Minors

Minimum number of credits required for a minor will be consistent with campus definitions. At least one-half of the required courses for the minor will be completed in residency at IUPUI. For returning students, at least half of the minor coursework must be completed within the past 10 years and the student must be actively enrolled at IUPUI in order to apply for the minor. Applications for the minor must be completed while the student is actively pursuing a bachelor's degree. Minors are awarded at the same time as the bachelor's degree. This policy will apply retroactively for students currently taking courses toward a minor in the School.

Policy for Awarding Undergraduate Certificate Programs

Minimum number of credits required for a certificate will be consistent with campus definitions. At least one-half of the required courses for the certificate will be completed in residency at IUPUI. For returning students, at least half of the certificate coursework must be completed within the past 10 years and the student must be actively enrolled at IUPUI in order to apply for graduation for the certificate. Applications for Graduation for a certificate must be completed while the student is in active status. Students who have met the criteria above may complete the Application for Graduation within the same term as or one term following completion for the coursework. In all cases, the student will be placed into graduation review for the earliest possible completion date if all certificate coursework is completed. This policy will apply retroactively for students currently taking courses toward a certificate in the School.

Internship and Cooperative Education Programs

Good career opportunities almost always require previous work experience. While earning a degree at the Purdue School of Engineering and Technology, Internship and Cooperative Education Programs provide essential opportunities to launch a career.

The lessons that students learn in classes and laboratories receive their ultimate test through the school's cooperative education, internship, professional work experience, and international student exchange programs. The school interacts with a broad variety of area companies to provide the technical experience required to succeed in today's globally competitive economic markets.

The Cooperative Education Program (Co-op) is a five-year professional development experience, designed to combine practical on-the-job experiences with the classroom training of a four-year college curriculum; the Internship Program allows students to work full time or part time for an employing organization while simultaneously taking courses during one semester. This internship program allows flexibility for students who wish to obtain work experience, but are not able to take a semester away from school as is required in the co-op program.

The greater metropolitan Indianapolis community offers a number of employment enrichment opportunities through extensive professional, governmental, and manufacturing resources. Our community resources provide rich, practical, well-paid professional opportunities generally unavailable at residential campuses.

After students have satisfactorily completed the first year of the academic program, they have a choice of employment programs to meet their needs.

Eligibility

To be eligible for one of the Internship/Cooperative Education Programs, a student must:

1. be admitted to the Purdue School of Engineering and Technology, IUPUI;
2. be enrolled in one of the academic programs offered by the school;
3. continue in one of the school's Bachelor of Science degree programs;
4. have satisfactorily completed the first year of an academic program;
5. meet and maintain minimum GPA requirements;
6. register for the appropriate Employment Enrichment Programs course before each work period;
7. satisfactorily complete the work period requirements;
8. attend a co-op/internship orientation session.

During periods of professional employment, students will earn a competitive salary and might also earn academic credit toward the bachelor's degree. The amount and distribution of credit is determined by the student's academic department. For further information, contact the Office of Career Services, Engineering and Technology Building (ET) 101, 799 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5160; (317) 274-2533.

Degree Programs

Engineering Degree Programs

- Bachelor of Science in Biomedical Engineering (BSBME)
- Bachelor of Science in Computer Engineering (BSCmpE)
- Bachelor of Science in Electrical Engineering (BSEE)
- Bachelor of Science in Energy Engineering (BSENE)
- Bachelor of Science in Engineering (BSE)
- Bachelor of Science in Mechanical Engineering (BSME)
- Bachelor of Science in Motorsports Engineering (BSMSTE)

Technology Degree Programs

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

- Architectural Technology
- Healthcare Engineering Technology Management
- Interior Design Technology

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

- Computer Engineering Technology
- Computer Graphics Technology
- Computer & Information Technology
- Construction Engineering Management Technology
- Electrical Engineering Technology
- Healthcare Engineering Technology Management
- Interior Design Technology
- Mechanical Engineering Technology
- Music Technology
- Organizational Leadership
- Technical Communications

Biomedical Engineering (BME)

Biomedical Engineering (BME)

Chancellor's Professor: E. Berbari (Chair)
Professor: H. Yokota
Associate Professors: J. Ji (Director of the Graduate Program), C.C. Lin, S. Na, J. Schild, J. Wallace, D. Xie, K. Yoshida
Clinical Associate Professors: K. Alfrey (Associate Chair and Director of the Undergraduate Program), W. Combs
Clinical Assistant Professor: S. Higbee
Visiting Clinical Associate Professor: S. Miller

Biomedical engineering is a discipline that advances knowledge in engineering, biology, and medicine to improve human health through cross-disciplinary activities that integrate the engineering sciences with the biomedical sciences and clinical practice. Students work in the development of new devices, algorithms, processes, and systems that advance biology and medicine and improve medical practice and health care delivery. Many students choose BME because it is people-oriented.

The mission of the Biomedical Engineering Department is to strive to attain world-class research and to provide the highest quality educational experience for our students. We expect and value excellence in conducting research, and training students to participate in research activities and professional practice. We accomplish our Mission as follows:

- By exploiting the most modern and innovative approaches, we are leaders in interdisciplinary biomedical engineering research and discovery.
- By providing students with an education in engineering principles, design, and modern biomedical science, we develop in them the knowledge and skills for productive careers in biomedical engineering.
- By committing to service to advance biomedical engineering, we contribute to the field.

Bachelor of Science in Biomedical Engineering

The bachelor's degree in Biomedical Engineering (B.S.B.M.E.) integrates the engineering analysis and design skills of the Purdue School of Engineering and Technology with the life sciences offered through the Purdue School of Science and with significant medical/clinical elements available through collaboration with the Indiana University School of Medicine.

The B.S.B.M.E. degree program combines a strong set of mathematics, science, and biomedical engineering courses into a demanding and rewarding four-year degree program aimed at solving contemporary problems in the life and health sciences. Outstanding features include instructional objectives that integrate the study of the fundamental principles of life and health sciences with rigorous engineering disciplines through a core of interdisciplinary courses that include biomechanics, biomeasurements, biomaterials, computational biology, and biosignals and systems analysis, among others. Many of the courses involve laboratory and problem solving recitation sections that lead the student through a practical encounter with methods of engineering analysis aimed at understanding and solving problems related to human health care and delivery. The Senior Design Experience is a two-semester sequence where a team approach is used to solve problems originating from the laboratories of faculty across the Schools of Engineering, Science, Dentistry, and Medicine, as well as from clinical and industrial partners. This approach will develop strong team-working skills among the students and enhance their communication skills with professionals outside of their discipline.

The senior year electives enable the student to pursue course content that develops a depth of understanding in a number of biomedical engineering expertise areas such as tissue engineering, biomolecular engineering, imaging, bioelectric phenomena, biomechanics, and regenerative biology. Students interested in pursuing careers in medicine or dentistry may also use their electives to fulfill these respective preprofessional requirements. Highly motivated students with strong academic credentials will find biomedical engineering an excellent premedical or predental degree program.

This exciting and innovative curriculum forms the basis of our program vision, whereby our students will be well educated in modern biomedical engineering, and with this knowledge they will be prepared to develop new devices, technologies, and methodologies that lead to significant improvements in human health care and delivery. The Biomedical Engineering Web site: www.engr.iupui.edu/departments/bme/index.php has the most up-to-date information concerning the plan of study for the B.S.B.M.E. degree program.

Biomedical Engineering Program Objectives

The program educational objectives of our biomedical engineering undergraduate program are to integrate engineering and life science principles into a comprehensive curriculum that produces graduates who can achieve the following career and professional accomplishments, if desired:

- Meet employer expectations in medical device companies or other health or life science related industries.
- Pursue and complete advanced graduate degrees in biomedical engineering, or related engineering or life science areas.
- Pursue and complete advanced professional degree programs in medicine, law, business, or other professional areas.

Transfer Students

Transfer students are initially admitted to the Freshman Engineering Program. Subsequent transfer into the Department of Biomedical Engineering is permitted only after consultation with a Biomedical Engineering Advisor to ensure course equivalencies and to evaluate the student's overall academic achievement. Students requesting transfer into Biomedical Engineering must submit a brief application.

Admission into Biomedical Engineering

Freshman engineering students who declare a biomedical engineering major must apply to the Department of Biomedical Engineering for formal admission by April 1 of their first year. Acceptance into the department is competitive and is based on academic qualifications, advisor's recommendation, and available space.

Biomedical Engineering 5-year B.S./M.S. Program

The Biomedical Engineering 5-year B.S./M.S. Program provides academically successful students the opportunity to earn both a Bachelor's and (non-thesis) Master's degree in a total of five years. (A thesis option is also available, but may require more time to complete depending on research progress.) To be eligible for this combined-degree program, students must maintain a GPA of at least 3.2 for the first 85 credit hours of coursework that apply towards the B.S.B.M.E. plan of study. For biomedical engineering students following the standard undergraduate plan, those 85 credit hours will be completed by the end of the first semester of the junior year.

To apply for the combined degree program, interested students should submit the Declaration of Intent to Pursue the Combined Degree no later than February 15th of the spring term immediately proceding their initial enrollment to BME 49100 (first semester senior design) in the fall. Notification of preliminary admission to the combined-degree program will be made no later than March 15th of the term of application. Full admission to the M.S.B.M.E. program is contingent upon successful completion of the BSBME program and meeting minimum grade and GPA requirements.

For more information about the B.S./M.S.B.M.E. visit: http://www.engr.iupui.edu/departments/bme/undergrad/bme-5-year-bsms.php

Graduate Programs in Biomedical Engineering

Biomedical engineering is an interdisciplinary program and a joint effort of the Purdue School of Engineering and Technology, the Purdue School of Science, and the Indiana University Schools of Medicine and Dentistry at Indiana University-Purdue University Indianapolis (IUPUI). In addition to these participating academic units, the program operates in close collaboration with several centers and facilities on campus, and with the Department of Biomedical Engineering at Purdue University, West Lafayette.

Students interested in the M.S.B.M.E. degree should apply directly to the Graduate Programs Office of the Purdue School of Engineering and Technology in Indianapolis. Students with a master's degree, or who are solely interested in the Ph.D. degree, should apply to the Department of Biomedical Engineering at West Lafayette, even though they may be resident and study on the Indianapolis campus.

For more information about the M.S.B.M.E. visit: http://engr.iupui.edu/bme/grad/msbme/index/php.

For more information about the Ph.D. program visit https://engineering.purdue.edu/BME/Academics/BMEGraduateProgram/Admissions.

Plan of Study

Bachelor of Science Plan of Study

Guidelines for selecting General Education Electives, as well as a list of approved courses, can be found on the BME website (http://www.engr.iupui.edu/departments/bme/index.php). BME, science, and technical electives must be selected in consultation with an academic advisor. These courses may include upper-level science, BME, or other engineering courses not already included on the BME plan of study. The goal of these electives is to provide depth of education in a specific sub-discipline of Biomedical Engineering.

Freshman Year

First Semester (18 credit hours)

- BIOL-K 101 Concepts of Biology I - 5 credit hours
- ENGR 19500 First-Year Engineering Projects - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- MATH 16500 Integrated Calculus and Analytic Geometry - 4 credit hours
- ENG-W 131 Reading, Writing, and Inquiry - 3 credit hours
- ENGR 19700 - Introduction to Computer Programming - 2 credit hours

Second Semester (17 credit hours)

- CHEM-C 105 Principles of Chemistry I - 3 credit hours
- CHEM-C 125 Experimental Chemistry I - 2 credit hours
- PHYS 15200 Mechanics - 4 credit hours
- MATH 16600 Analytic Geometry & Calculus I - 4 credit hours
- MATH 17100 Multidimensional Mathematics - 3 credit hours
- ENGR 29700 Computer Tools for Engineering - 1 credit hour

Sophomore Year

Third Semester (16 credit hours)

- MATH 26100 Multivariate Calculus - 4 credit hours
- PHYS 25100 Heat Electricity & Optics - 5 credit hours
- BME 24100 Introduction to Biomechanics - 4 credit hours
- CHEM-C 106 Principles of Chemistry II - 3 credit hours

Fourth Semester (18 credit hours)

- MATH 26600 Ordinary Differential Equations - 3 credit hours
- BIOL-K 324 Cell Biology - 3 credit hours
- BIOL-K 325 Cell Biology Lab - 2 credit hours
- BME 22200 Biomeasurements - 4 credit hours
- COMM-R 110 Fundamentals of Speech Communication - 3 credit hours
- General Education Elective - 3 credit hours

Junior Year

Fifth Semester (18 credit hours)

- CHEM-C 341 Organic Chemistry I - 3 credit hours
- CHEM-C 343 Organic Chemistry Lab 1 - 2 credit hours
- BME 38100 Implantable Materials & Biological Response - 3 credit hours
- BME 38300 Problems in Implantable Materials & Biological Response - 1 credit hour

- BME 33100 Biosignals and Systems - 3 credit hours
- BME 33400 Biomedical Computing - 3 credit hours
- General Education Elective - 3 credit hours

Sixth Semester (16 credit hours)

- BME 32200 Probability & Statistics of BME - 3 credit hours
- BME 35200 Tissue Behavior & Properties - 3 credit hours
- BME 35400 Problems in Tissue Behavior & Properties - 1 credit hour
- BME Gateway Elective* - 3 credit hours
- General Education Elective - 3 credit hours
- BME 40200 BME Seminar - 1 credit hour
- TCM 36000 Communications in Engineering Practice - 2 credit hours

Senior Year

Seventh Semester (15 credit hours)

- BME 49100 Biomedical Engineering Design I - 3 credit hours
- BME 41100 Quantitative Physiology - 3 credit hours
- BME 44200 Biofluid Mechanics - 3 credit hours
- BME/SCI/TECH Elective* - 3 credit hours
- BME/SCI/TECH Elective* - 3 credit hours

Eighth Semester (12 credit hours)

- BME 49200 Biomedical Engineering Design II - 3 credit hours
- BME 46100 Transport Processes in BME - 3 credit hours
- BME/TECH Elective* - 3 credit hours
- General Education Elective - 3 credit hours

*The four BME/SCI/TECH electives must be selected in consultation with an advisor to form an appropriate Depth Area.

Computer Information & Graphics Technology (CIGT)

Computer Information & Graphics Technology (CIGT)

Chair: Feng Li, Interim Chair and Associate Professor of Computer & Information Technology

Associate Chair: Dan Baldwin, Director and Assistant Clinical Professor of Computer Graphics Technology

The Department of Computer Information and Graphics Technology houses degree and certificate programs in Computer and Information Technology (CIT), Computer Graphics Technology (CGT), and a Master of Science in Technology.

Our department partners two dynamic programs, bringing together talented faculty and staff who continue to develop innovative and creative opportunities for teaching and learning both on and off campus. Internships and programs all serve as powerful tool for experiential learning for our students, and are exemplars of IUPUI's .

Both CGT and CIT degree programs are accredited by ABET Inc. a process involving voluntary review to ensure the program meets established quality standards. By participating in ABET accreditation we focus on continuous quality improvement, a hallmark of all successful organizations.

As a CIGT student, graduate, or industrial partner, you are an integral part of tomorrow's technology community. Technical skills and professional leadership competencies continue to make our graduates distinctive, unique, and highly marketable in meeting the needs of employers today. All industries seek strong, effective, and mature leaders with the technological knowledge to compete in a global workforce. CIGT programs will be the resource of choice to meet that needs and each of you will benefit from the synergy created in our department.

Computer & Information Technology

Professors: A. Jafari
Associate Professors: F. Li
Assistant Professors: X. Guo, H. Liu, X. Luo
Clinical Associate Professor: C. Justice **Lecturers:** S. Catlin, R. Elliott, S. Mithun, V. Smith

The Computer and Information Technology (CIT) program offers a Purdue Master of Science degree in Technology, a Bachelor of Science degree in Computer and Information Technology, a minor in Computer and Information Technology, and three certificate programs in web development, e-commerce development, and network security. Courses in any of the certificate programs may be applied directly to the Bachelor's degree in Computer and Information Technology.

As a CIT graduate, you will become an integral part of tomorrow's computer information technology industry community. Technical skills and professional leadership competencies continue to make our graduates distinctive, unique, and highly marketable in meeting the needs of employers today. We make IT work.

CIT has been a leader in offering degree courses that can be completed via distance education. Selected courses may be taken either partially or completely via the web.

Master of Science in Technology

The primary goal of the Technology Graduate program is to prepare the next generation of STEM professionals, practitioners, and researchers. The program provides opportunities to obtain advanced training and credentials. Successful graduates of the program earn a Master of Science (MS) in Technology awarded by Purdue University.

The MS in Technology program is designed so that graduates holding a BS degree in a technology discipline or a related area can complete their degree either as a full time student or as a part time student working full time. The program could typically be completed in 4 semesters (2 academic years) and must be completed within five years.

The MS in Technology curriculum incorporates a core set of courses, but is extremely flexible and multidisciplinary in approach. Students have the opportunity to customize the program to meet their unique needs.

The curriculum consists of a total of 33 credit hours as follows:

- Required Core Technology Courses (9 credit hours)
- Secondary Area of Study (21-24 credit hours)

- Directed Project (3 credit hours optional)

For more information, visit our Web site at http://engr.iupui.edu/departments/cigt/grad/index.php or contact Computer and Information Technology at (317) 274-9705 or via email: cit@iupui.edu.

Bachelor of Science in Computer & Information Technology

The Bachelor of Science in Computer Information Technology program is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

The Bachelor of Science degree is available with four concentrations: Web Development, Data Management, Networking Systems, and Information Security. These concentrations are designed to provide an applications-oriented, practical education that prepares students for careers as application developers (people who design, write, install and maintain a variety of IT systems, with an emphasis on Web applications); data managers (people who design, implement, program and maintain databases); network systems specialists (people who design, configure, secure and maintain IT networks); and information security specialists (people who protect information assets of an organization).

Our Program Educational Objectives provide broad statements of what CIT graduates will know and be able to do within 3-5 years after graduation. They are based on the needs of our constituents and were developed after consultation with our faculty and Industrial Advisory Board. The Program Objectives for the B.S. in Computer and Information Technology are:

1. Design, implement, and evaluate solutions to meet the IT needs of industry.
2. Provide leadership and project management for IT-related projects and services.
3. Expand their IT knowledge to add value to an organization.

Students who must interrupt their course of study for two calendar years or more will be required to meet all requirements for the program as it stands at the time of their return. Computer and Information Technology (CIT) courses over 10 years old may have to be repeated. Students should check with a CIT advisor.

The bachelor's degree requirements are fulfilled by meeting all of the requirements of a selected concentration. An overview of the requirements is provided below. For more complete information, visit our CIT BS degree website page http://www.engr.iupui.edu/departments/cigt/undergrad/bscit/index.php.

CIT BS Requirements

Overall - completion of 120 credit hours, meeting the following minimums:

- 39 credit hours in upper level courses
- 32 credit hours in residence in the School of Engineering & Technology
- 12 credit hours in upper level CIT courses
- 2.0 graduation index
- 2.0 cumulative GPA

In addition, students are required to complete at least two of the four RISE experiences - research, international, service learning, and experiential learning. See an advisor for details.

Course Distribution - degree requirements include courses in the following area:

- CIT Core (must be completed with a grade of C or better)
- CIT Concentration (must be completed with a grade of C or better)
- CIT Selectives (must be completed with a grade of C or better)
- Leadership
- General Education
- Free Electives

The general education requirements include 30 hours of the IUPUI General Education Core which aligns with the Principles of Undergraduate Learning.

For more information, visit our Web site at cit.iupui.edu or contact Computer and Information Technology at (317) 274-9705 or via email: cit@iupui.edu.

Minor in Computer Technology

The minor in Computer and Information Technology (CIT) is available to students majoring in other areas of study at IUPUI.

A minor in (CIT) requires the completion of 24 credit hours of computer technology courses, plus prerequisite requirements in mathematics. Required courses in computer technology are provided in two groupings: (a) core requirements (12 credit hours), and (b) a specialty sequence (12 credit hours). At least 12 credit hours of the minor must be taken at IUPUI. All core and specialty courses must be completed with a grade of C or better.

Students who wish to complete a minor in (CIT) must already be accepted as a major by some other department on the IUPUI campus. Students should ask their department's academic advisor whether a minor in computer technology is acceptable with their major field.

A student who applies for a computer technology minor must have completed a mathematics competency as evidenced by completing MATH-M 118 and M 119 or MATH 15300 and 15400, or MATH 15900.

Prior to continuing into the specialty sequences, a student must have:

1. attained the mathematics and computer literacy ability evidenced by college-level courses
2. completed the computer technology minor's core requirements
3. completed 30 credit hours toward his or her major
4. earned a cumulative grade point average (GPA) of 2.0 or higher

The student who has met these conditions then selects one of the specialty sequences and proceeds to complete the three courses of that selected specialty.

The computer technology specialty sequences are:

- **Application Development**

- **Network Systems**
- **Web Technologies**
- **Database Systems**
- **Information Security**

For more information and a list of required courses, visit our CIT Minor web page**.**

IT Certificate for Web Development

The IT Certificate for Web Development program requires the completion of 18 credit hours which can be completed via distance education. The IT Certificate for Web Development focuses on the principles and techniques used to develop Web-based business applications. The six courses that comprise the program cover the application development process including analysis, design, Web programming, and database integration and implementation.

Students who complete the Information Technology Certificate will be able to:

- Apply the tools and techniques for effective Web site planning and analysis
- Create dynamic data driven web sites
- Utilize both client and server side languages in developing e-commerce sites
- Apply optimal Web design strategies to deploy e-commerce Web applications for a global audience
- Research, learn and apply new web technologies

All courses in the certificate must be completed with a grade of C or better.

For more information and a list of required courses, visit our: IT Certificate for Web Development web page.

E-Commerce Development Certificate

The E-Commerce Development Certificate requires the completion of 18 credit hours, which can be completed via distance education.

The E-Commerce Development Certificate focuses on Web-based application development. Interested students should have at least two to three years of application development experience or have completed the IT Certificate for Web Development. Students in the E-Commerce Development certificate can choose to develop their programming skills using either ASP.NET or Java.

Students who complete the E-Commerce Development Certificate will be able to:

- Apply tools and techniques for effective Web site planning and analysis.
- Allow individuals to develop dynamic web applications in a variety of programming languages.
- Explore sophisticated data management and information exchange as it applies to interactive and e-commerce applications.
- Apply optimal Web design strategies to deploy usable Web applications for a global audience using a variety of browsers and platforms.
- Utilize current web development standards appropriately.

All courses in the certificate must be completed with a grade of C or better.

For more information and a list of required courses, visit our E-Commerce Development Certificate web page.

Network Security Certificate

The Network Security Certificate (NSC) requires the completion of 18 credit hours, half of which can be completed via distance education. This program is accredited by the Committee on National Security Systems (CNSS) that addresses the ever-growing need in security. The NSC provides information assurance and security education and training to students and professionals. This program is hands-on and requires students to have some networking and systems experience. Completion of the NSC provides students with a solid foundation in security techniques and prepares participants to work in information assurance and network security.

Students who complete the Network Security Certificate (NSC) will be able to:

- Apply information assurance and security principles to secure systems and networks.
- Conduct accurate and comprehensive digital forensics investigations and apply appropriate rules of evidence.
- Use an appropriate analytic framework to assess risk and recommend strategies for mitigation.
- Analyze and produce comprehensive security policies, standards, and procedures.
- Analyze and create comprehensive business continuity plan to include incident response, disaster recovery, and continuous operations.

All courses in the certificate must be completed with a grade of C or better.

For more information and a list of required courses, visit our Network Security Certificate web page.

Computer Graphics Technology

Associate Professor: M. Bannatyne
Assistant Professor: C. Rogers
Clinical Assistant Professor: D. Baldwin
Lecturers: J. Guy, J. Polk

The Computer Graphics Technology (CGT) prepares visually oriented students to succeed in a wide range of industries, spanning careers in 3D animation, visual effects, web and multimedia design, video production, and graphics design. CGT offers a Purdue Master of Science degree in Technology and a Bachelor of Science degree in Computer Graphics Technology.

CGT students are creative and technological problem solvers, and our graduates are consistently hired in this multi-billion dollar industry for their expertise in both areas.

Master of Science in Technology

The primary goal of the Technology Graduate program is to prepare the next generation of STEM professionals, practitioners, researchers, and teachers. The program provides opportunities to obtain advanced training and credentials. Successful graduates of the program earn a Master of Science (MS) in Technology awarded by Purdue University.

The MS in Technology program is designed so that graduates holding a BS degree in a technology discipline or a related area can complete their degree either as a full-time student or as a part-time student working full time. The program could typically be completed in 4 semesters (2 academic years) and must be completed within five years.

The MS in Technology curriculum incorporates a core set of courses, but is extremely flexible and multidisciplinary in approach. Students have the opportunity to customize the program to meet their unique needs.

The curriculum consists of a total of 33 credit hours as follows:

- Required Core Technology Courses (9 credit hours)
- Secondary Area of Study (21-24 credit hours)
- Directed Project (3 credit hours optional)

For more information, visit our Web site at http://engr.iupui.edu/departments/cigt/grad/index.php or contact the Department of Computer Information and Graphics Technology at (317) 274-9705.

Bachelor of Science in Computer Graphics Technology

The Bachelor of Science in Computer Graphics Technology program is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

Consistent with the criteria set by (ABET), the Program Educational Objectives of the CGT program are "*To product graduates who, during the first few years of professional practice, will...*":

- Design, implement, and evaluate graphic solutions to meet the needs of industry.
- Provide leadership and project management for graphics-related projects and services.
- Expand Technical Expertise in computer graphics technology.

Students seeking the Bachelor of Science degree in CGT can choose to study Interactive Multimedia Development or Technical Animation and Spatial Graphics alongside our outstanding and award-winning faculty, rich with industry experience.

CGT BS Requirements

Interactive Multimedia Developer (IMD) Plan of Study - completion of 120 credit hours, meeting the following minimums:

- *26 credit hours of 300-400 level CGT courses*
- 32 credit hours in residency in the School of Engineering and Technology
- 9 credit hours of Computer Information Technology (CIT) courses
- 18 credit hours of Free or Technical Electives
- 2.0 Cumulative GPA

Course Distribution - degree requirements include courses in the following areas:

- CGT Core (must be completed with a grade of C- or better)
- CGT Selectives (must be completed with a grade of C- or better)
- ART and Design
- Leadership
- Technical Communications
- Mathematics/Science
- General Education
- Free Electives

Technical Animation and Spatial Graphics (ASG) Plan of Study - completion of 120 credit hours, meeting the following minimums:

- 35 credit hours of 300-400 level CGT courses
- 32 credit hours in residency in the School of Engineering and Technology
- 12 credit hours of Free or Technical Electives
- 2.0 Cumulative GPA

Course Distribution - degree requirements include courses in the following area:

- CGT Core (must be completed with a grade of C- or better)
- CGT Selectives (must be completed with a grade of C- or better)
- Art and Design
- Leadership
- Technical Communications
- Mathematics/Science
- General Education
- Free Electives

The general education requirements include 30 hours of the IUPUI General Education Core which aligns with the Principles of Undergraduate Learning.

For more information and a list of required courses, visit our CGT B.S. degree web page.

Electrical and Computer Engineering (ECE)

Professors Y. Chen, S. Chien, M. El-Sharkawy, M. Rizkalla, D. Russomanno, P. Salama, P. Schubert
Associate Professors Z. Ben Miled, L. Christopher, D. Kim, B. King (Chair), S. Koskie, J. Lee, L. Li, S. Rovnyak
Assistant Professors E. dos Santos
Research Professors R. Tian, Q. Yi
Lecturer S. Shayesteh

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

Electrical and computer engineering programs are designed to prepare students for careers in the commercial, government, and academic sectors, where electrical and computer engineering expertise is needed in hardware and software design, information processing, circuit and electronics, control and robotics, communications and signal processing, energy systems, and manufacturing. Programs in the department are enhanced by interaction with local industry. Students have direct and routine access to full-time faculty, which further strengthens and accelerates the learning process. These advantages and the metropolitan environment of the university lead to an application-oriented, practical education that prepares students for success.

The Department of Electrical and Computer Engineering regards research as an important catalyst for excellence in engineering education. Graduate research and undergraduate design projects in the areas of signal processing, communications, image processing, computational intelligence, networking, software engineering, embedded systems, high performance computing, control, robotics, manufacturing, biometrics, nanotechnology, and ASIC and FPGA based electronics offer opportunities for applying and deepening students' expertise.

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

Minor in Electrical and Computer Engineering

The minor in Electrical and Computer Engineering provides students in related science and engineering programs with the opportunity to gain fundamental knowledge in the field of Electrical and Computer Engineering, and to participate in interdisciplinary study.

The total credit hours required is 21 credit hours. A student must take at least 12 required credit hours in the IUPUI ECE department and cannot count more than nine equivalent credit hours in ECE minor. The minor will be posted to the student's transcript concurrent with the major bachelor's degree.

Student must take all of the following courses (or equivalent courses) and receive at least a C grade for each course.

- ECE 20400 Introduction to Electrical and Electronics Circuits - 4 credit hours
- ECE 26100 Engineering Programming Lab I - 1 credit hour
- ECE 26300 Introduction to Computing in Electrical Engineering - 3 credit hours
- ECE 30100 Signals and Systems - 3 credit hours
- ECE 30200 Probabilistic Methods in Electrical and Computer Engineering - 3 credit hours
- ECE 36200 Microprocessor Systems and Interfacing - 4 credit hours

Students must take at least one of the following courses (or equivalent courses) and receive at least a C grade for the course.

- ECE 25500 Introduction to Electronics Analysis and Design - 3 credit hours
- ECE 32100 Electromechanical Motion Devices - 3 credit hours
- ECE 36500 Introduction to the Design of Digital Computers - 3 credit hours
- ECE 38200 Feedback System Analysis and Design - 3 credit hours
- ECE 44000 Transmission of Information - 4 credit hours

For more information, contact the Department of Electrical and Computer Engineering at (317) 274-9726.

Computer Engineering

B.S. in Computer Engineering

This program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

The Bachelor of Science in Computer Engineering (B.S.Cmp.E.) degree curriculum provides an in-depth education in the analytical skills, hardware, and software aspects of modern computer systems. The program builds on a strong foundation in engineering design, including traditional analog and digital circuit design. The three main areas of emphasis within the computer-engineering program are embedded systems, telecommunications and networking, and software engineering and distributed computing. Extensive laboratory experiences support the theoretical aspects of the course work. Students gain valuable digital hardware design and software design experiences throughout the curriculum. The junior and senior years strengthen the student's expertise with courses in data structures, embedded systems, computer architecture, parallel and high performance computing systems, advanced digital systems, and computer communications networks and network security.

The Program Educational Objectives of the Computer Engineering degree program are to prepare graduates who will be successful in their chosen career paths by:

1. becoming productive and valuable engineers in the private or public sector
2. pursuing and completing graduate studies, and/or
3. taking on leadership roles in their professions, as well as in their communities and the global society.

The minimum number of credit hours for graduation is 125. Semester by semester, these 125 total credit hours may be distributed as shown below. The Electrical and Computer Engineering website, http://www.engr.iupui.edu/departments/ece/ has the most up-to-date information concerning the plan of study, approved electives, and program policies and requirements. This includes requirements for use of transfer credit, requirements to move from Freshman Engineering into the BSCmpE degree program, minimum grade and GPA requirements, and readiness to begin senior design courses.

Freshman Year

First Semester (17 credit hours)

- ENGR 19500 Introduction to the Engineering Profession - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I - 4 credit hours
- CHEM-C 105 Chemical Science I - 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication - 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry - 3 credit hours

Second Semester (15 credit hours)

- PHYS 15200 Mechanics - 4 credit hours
- MATH 16600 Analytic Geometry and Calculus II - 4 credit hours
- MATH 17100 Multidimensional Math - 3 credit hours
- ECE 26100 C Programming Lab - 1 credit hour
- ECE 26300 C Programming - 3 credit hours

Sophomore Year

Third Semester (18 credit hours)

- MATH 26100 Multivariate Calculus - 4 credit hours
- PHYS 25100 Heat Electricity and Optics - 5 credit hours
- ECE 20100 Linear Circuit Analysis I - 3 credit hours
- ECE 20700 Electronic Measurement Techniques - 1 credit hour
- CSCI 24000 Advanced Programming - 4 credit hour
- ECE 21000 Sophomore Seminar - 1 credit hours

Fourth Semester (15 credit hours)

- CSCI 34000 Discrete Computational Structures - 3 credit hours
- MATH 26600 Ordinary Differential Equations - 3 credit hours
- ECE 20200 Circuit Analysis II - 3 credit hours
- ECE 27000 Digital Logic Design and Lab - 4 credit hours
- ENGR 29700 Computer Tools for Engineers - 1 credit hour
- ECE 28200 UNIX Programming for Engineers - 1 credit hour

Junior Year

Fifth Semester (15 credit hours)

- CSCI 36200 Data Structures - 3 credit hours
- ECE 30100 Signals and Systems - 3 credit hours
- ECE 36200 Microprocessor Systems and Interfacing - 4 credit hours
- TCM 36000 Comm. in Engineering Practice - 2 credit hours
- Arts & Humanities or Social Sciences Elective - 3 credit hours

Sixth Semester (15 credit hours)

- Math/Science/Technical Elective - 3 credit hours
- ECE 30200 Probabilistic Methods in Electrical and Computer Engineering - 3 credit hours
- Computer Engineering Elective - 3 credit hours
- ECE 32700 Engineering Economics (General Education Social Sciences) - 3 credit hours
- Cultural Understanding Elective - 3 credit hours

Senior Year

Seventh Semester (14 credit hours)

- ECE 36500 Introduction to the Design of Digital Computers - 3 credit hours
- ECE 48700 Senior Design I - 1 credit hour
- ECE 40100 Engineering Ethics - 1 credit hour
- Advanced Computer Engineering Elective - 3 credit hours
- Computer Engineering Elective - 3 credit hours
- Arts & Humanities Elective - 3 credit hours

Eighth Semester (16 credit hours)

- ECE 40800 Operating Systems - 3 credit hours
- ECE 48800 Senior Design - 2 credit hours
- Advanced Computer Engineering Elective - 3 credit hours
- Computer Engineering Elective - 3 credit hours
- Restricted Elective - 2 credit hours
- Cultural Understanding, Arts & Humanities, or Social Sciences Elective - 3 credit hours

Electrical Engineering

B.S. in Electrical Engineering

This program is accredited by the Engineering Accreditation Commission of ABET www.abet.org.

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

The Program Educational Objectives of the Electrical Engineering degree program are to prepare graduates who will be successful in their chosen career paths by:

1. becoming productive and valuable engineers in the private or public sector

2. pursuing and completing graduate studies, and/or
3. taking on leadership roles in their professions, as well as in their communities and the global society

The minimum number of credit hours for graduation is 124. Semester by semester, these 124 total credit hours may be distributed as shown below. The Electrical and Computer Engineering website, http://www.engr.iupui.edu/departments/ece/ has the most up-to-date information concerning the plan of study, approved electives, and program policies and requirements. This includes requirements for use of transfer credit, requirements to move from Freshman Engineering into the BSEE degree program, minimum grade and GPA requirements, and readiness to begin senior design courses.

Freshman Year

First Semester (17 credit hours)

- ENGR 19500 Introduction to the Engineering Profession - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- CHEM-C 105 Chemical Science I - 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I - 4 credit hours
- COMM-R 110 Fundamentals of Speech Communication - 3 credit hours
- Arts & Humanities Elective - 3 credit hours

Second Semester (17 credit hours)

- PHYS 15200 Mechanics - 4 credit hours
- MATH 16600 Analytic Geometry and Calculus II - 4 credit hours
- Math 17100 Multidimensional Mathematics - 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry - 3 credit hours
- Cultural Understanding Elective - 3 credit hours

Sophomore Year

Third Semester (17 credit hours)

- MATH 26100 Multivariate Calculus - 4 credit hours
- PHYS 25100 Heat Electricity and Optics - 5 credit hours
- ECE 20100 Linear Circuit Analysis I - 3 credit hours
- ECE 20700 Electronic Measurement Techniques - 1 credit hour
- ECE 26300 C Programming - 3 credit hours
- ECE 26100 C Programming Lab - 1 credit hour

Fourth Semester (16 credit hours)

- MATH 26600 Ordinary Differential Equations - 3 credit hours
- ECE 20200 Circuit Analysis II - 3 credit hours
- ECE 25500 Introduction to Electronics Analysis and Design - 3 credit hours
- ECE 20800 Electronic Design and Devices Lab - 1 credit hour
- ECE 27000 Digital Logic Design and Lab - 4 credit hours
- ENGR 29700 Computer Tools for Engineers - 1 credit hour
- ECE 21000 Sophomore Seminar - 1 credit hour

Junior Year

Fifth Semester (15 credit hours)

- ECE 30100 Signals and Systems - 3 credit hours
- ECE 31100 Electric and Magnetic Fields - 3 credit hours
- ECE 36200 Microprocessor Systems and Interfacing - 4 credit hours
- TCM 36000 Comm. In Engineering Practice - 2 credit hours
- ME 29500 Mechanics and Heat - 3 Credit hours

Sixth Semester (15 credit hours)

- ECE 30200 Probabilistic Methods in Electrical and Computer Engineering- 3 credit hours
- ECE 38200 Feedback System Analysis - 3 credit hours
- ECE 32700 Engineering Economics (General Education Social Sciences) - 3 credit hours
- Math/Science/Technical Elective - 3 credit hours
- Electrical Engineering Elective - 3 credit hours

Senior Year

Seventh Semester (15 credit hours)

- ECE 44000 Introduction to Communication Systems Analysis - 4 credit hours
- ECE 48700 Senior Design I - 1 credit hour
- ECE 40100 Ethics - 1 credit hour
- Electrical Engineering Electives - 6 credit hours
- Arts & Humanities or Social Sciences Elective - 3 credit hours

Eighth Semester (12 credit hours)

- ECE 48800 Senior Design II - 2 credit hours
- Electrical Engineering Electives - 6 credit hours
- Restricted Elective - 1 credit hour
- Cultural Understanding, Arts & Humanities, or Social Sciences Elective - 3 credit hours

Interdisciplinary Engineering

B.S in Engineering - Interdisciplinary Engineering

This program is not accredited by the Engineering Accreditation Commission of ABET.

The Electrical and Computer Engineering Department offers a Bachelor of Science in Engineering (B.S.E.) degree program for students wishing to supplement a strong core curriculum in electrical and computer engineering science and design with courses from mathematics, science, business, biomedicine, or another engineering discipline. While not ABET-accredited, the B.S.E. degree program offers the student greater flexibility to create a plan of study to accommodate broad interdisciplinary interests and objectives. The plan coincides with the traditional B.S.E.E. curriculum through the sophomore year and then diverges to include ECE electives and courses from interdisciplinary areas in the remainder of the curriculum.

The minimum number of credit hours for graduation is 120, distributed as follows for each discipline:

1. Mathematics and Physical Sciences
   - Calculus: MATH 16500, 16600, 17100, 26100, and 26600 - 18 credit hours
   - Chemistry: CHEM C10500 - 3 credit hours
   - Physics: PHYS 15200 and 25100 - 9 credit hours
2. Communications and Ethics
   - Speech: COMM R110 - 3 credit hours
   - Writing: ENG W131 - 3 credit hours
   - Communication in Engineering Practice: TCM 36000 - 2 credit hours
   - Engineering Ethics and Professionalism: ECE 21000 and 40100 - 2 credit hours
3. Humanities, Social Sciences, and Cultural Understanding
   - Electives - 9 credit hours
   - ECE 32700 or ECON-E 201 (Social Sciences) - 3 credit hours
4. Freshman Engineering Courses
   - Introduction to the Engineering Profession: ENGR 19500 - 1 credit hour
   - Introduction to Engineering: ENGR 19600 - 3 credit hours
   - ENGR 29700 - 1 credit hour
5. Electrical Engineering Courses
   - ECE Core: ECE 20100, 20200, 20700, 26100, 26300, 20800, 25500, 27000, 30100, 36200, 48700, and 48800 - 29 credit hours
   - ECE Electives (any ECE 30000-, 40000-, or 50000-level course, except ECE 32600 and ECE 32700) - 9 credit hours
6. Math/Science/Technical Elective Course - 3 credit hours
7. Interdisciplinary Area courses - 21 credit hours
8. Restricted elective - 1 credit hour

Freshman Year

First Semester (14 credit hours)

- ENGR 19500 Introduction to the Engineering Profession - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- CHEM C10500 Principles of Chemistry I - 3 credit hours
- COMM R110 Fundamentals of Speech Communication - 3 credit hours
- MATH 16500 Analytic Geometry and Integrated Calculus I - 4 credit hours

Second Semester (14 credit hours)

- ENG W13100 Reading, Writing, and Inquiry - 3 credit hours
- MATH 17100 Multidimensional Math - 3 credit hours
- MATH 16600 Integrated Calculus and Analytic Geometry II - 4 credit hours
- PHYS 15200 Mechanics - 4 credit hours

The remainder of the interdisciplinary plan of study is individualized. Students should speak to their academic advisors regarding course selection.

M.S. Graduate Programs in ECE

M.S. Graduate Programs in ECE

Students can earn the Master of Science in Electrical and Computer Engineering (M.S.E.C.E.), and the Master of Science in Engineering (M.S.E.), through the Department of Electrical and Computer Engineering at the Purdue School of Engineering and Technology at IUPUI. The M.S.E.C.E. degree is organized into several areas of study, including computer engineering, controls and automation, communication, signal processing, VLSI/ASIC design, and power systems, while the M.S.E. degree is interdisciplinary in nature and is primarily for non-electrical engineering undergraduates.

For more information about the M.S.E.C.E. program visit:

Ph.D. Graduate Programs in ECE

Ph.D. qualified students may be authorized to pursue the Ph.D. degree through the Department of Electrical and Computer Engineering at the Purdue School of Engineering and Technology at IUPUI. Programs leading to the Ph.D. in Electrical and Computer Engineering is jointly administered with the School of Electrical and Computer Engineering at Purdue University, West Lafayette.

For more information about the Ph.D. program visit:

Engineering Technology (ENT)

Engineering Technology (ENT)

Chair: R.Weissbach, Associate Professor of Electrical and Computer Engineering Technology

Program Directors:
ART- D. Nickolson
CEMT - C. McIntyre
CpET - B. Lin
EET - E. Cooney
HETM - B. Christe
INTR - E. McLaughlin
MET - P. Yearling
MSTE - A. Borme

The Department of Engineering Technology offers two degree program at the associate level and seven degree programs at the bachelor's level. ENT offers an Associate of Science degree with a major in Healthcare Engineering Technology Management (HETM) and Associate of Science with a major in Interior Design (INTR). Graduates from the HETM and INTR associate degree programs can continue their education for an additional two years of full time study and complete the course work leading to a Bachelor of Science degree. The department offers Bachelor of Science degrees in Healthcare Engineering Technology Management, Computer Engineering

Technology, Construction Engineering Management Technology, Electrical Engineering Technology, Interior Design, Mechanical Engineering Technology, and Motorsports Engineering. The ENT programs are well-suited for individuals who are curious about how things work and want a practice-oriented education. The department faculty members all have practical engineering work experience in their fields of expertise and are able to offer an educational experience that provides graduates with the skills necessary to quickly become productive employees. The faculty is dedicated to teaching and is very focused on meeting the educational needs of students. Daytime, evening and selected web-based courses are offered.

For more information, contact the Department of Engineering Technology at (317) 278-4405, e-mail cathmatt@iu.edu, or visit our Web site at **.**

Architectural Technology

Assistant Clinical Professor: D. Nicholson (Program Director)

NOTE: EFFECTIVE SUMMER 2013, ARCHITECTURAL TECHNOLOGY NO LONGER OFFERS AN ASSOCIATE OF SCIENCE DEGREE. THE ARCHITECTURAL TECHNOLOGY PROGRAM AT IUPUI PROVIDES A SERIES OF COURSES THAT SUPPORT DEGREE AND CERTIFICATE PROGRAMS, SUCH AS INTERIOR DESIGN TECHNOLOGY, SUSTAINABLE TECHNOLOGIES, AND COMPUTER GRAPHICS TECHNOLOGY.

The Architectural Technology (ART) curriculum offers a two-year associate degree program designed to provide students with the skills to work in the areas of architectural visualization, detailing, building information modeling (BIM), fundamental structural design, space planning, materials testing, inspection, and sales. The curriculum is not intended to prepare students for registration as professional architects.

Emphasis is on building science and technical design, residential and commercial construction drawings, mechanical and electrical systems in buildings, and the graphic depiction of these systems using building information modeling software. Also included are courses in mathematics, physical sciences, social sciences, communications, interior design, and the humanities.

Graduates typically find employment with architectural firms, design agencies, construction firms, building material suppliers, and various governmental agencies. Graduates are also eligible to pursue a Bachelor's degree in Computer Graphics Technology with an emphasis on Architectural Visualization. This combination of courses and skills also prepares students to apply for graduate programs in the design field (e.g., architecture, computer graphics).

The career educational objectives for Architectural Technology are:

- Demonstrate excellent technical capabilities in architectural technology and related fields.
- Be responsible citizens.
- Continue professional advancement through life-long learning
- Apply sound design methodology in multidisciplinary fields of architectural technology that is sensitive to the health, safety and welfare of the public.
- Competently use mathematical, measurement, instrumentation, and testing techniques.
- Practice effective oral, written and visual communication skills.
- Understand the environmental, ethical, diversity, cultural and contemporary aspects of their work.
- Work effectively and collaboratively in architectural, engineering and construction industries.

Associate of Science in Architecture Technology

Freshman Year

First Semester (17 credit hours)

- ART 16500 Building Systems and Materials, 3 credits
- ART 10300 Introduction to Interior Design, 3 credits
- MATH 15900 Pre-Calculus, 5 credits**
- ENG-W131 Reading, Writing, and Inquiry, 3 credits
- COMM-R 110 Fundamentals of Speech Communication, 3 credits

Second Semester (18 credit hours)

- ART 11700 Intro to Construction Graphics with CAD, 3 credits
- ART 12000 Architectural Presentation, 3 credits
- INTR 20200 INTR Materials & Applications, 3 credits
- INTR 12500 Color and Lighting of Interiors, 3 credits
- CEMT 10400 Fundamentals of Surveying, 3 credits
- Humanities/Social Science Elective, 3 credits

Sophomore Year

Third Semester (17 credit hours)

- ART 15500 Residential Construction, 3 credits
- CEMT 16000 Statics, 3 credits
- CEMT 21500 Mechanical & Electrical Systems, 4 credits
- Lab Science Selective, 4 credits
- CGT 21100 Raster Imaging for Computer Graphics, 3 credits

Fourth Semester (17 Credits)

- ART 21000 History of Architecture, 3 credits
- ART 22000 Commercial Construction, 3 credits
- TCM 22000 Technical Report Writing, 3 credits
- CEMT 26000 Strength of Materials, 3 credits
- CEMT 26700 Materials Testing, 2 credits
- INTR 12400 Space Planning for Interiors, 3 credits

***MATH 15300 and 15400 are can be substituted for MATH 15900*

Construction Engineering Management Technology

Construction Engineering Management Technology

Associate Professor: D. Koo
Clinical Professor: C. McIntyre
Visiting Associate Professor: S. Adhikari
Senior Lecturer: J. White
Lecturer: M. Ray

The Construction Engineering Management Technology program offers students a B.S. degree.

For more information, contact the Department of Engineering Technology at (317) 278-4405 or email cathmatt@iu.edu or visit our Web site at http://engr.iupui.edu/departments/ent/undergrad/cemt/index.php

Bachelor of Science in Construction Engineering Management Technology

Accredited by the Engineering Technology Accreditation Commission (ETAC), of ABET http://www.abet.org.

The Construction Engineering Management Technology curriculum is intended to further students' knowledge in areas of construction contract administration, specification writing, construction field operations, construction scheduling/project control, construction costs and bidding, construction law and ethics, construction safety and inspection, construction project monitoring and control, soils and foundations, hydraulics and drainage, construction economics, and construction management. Additional course work includes microeconomics, mathematics, and lab sciences, as well as training in written and oral communications. Students may complete all or part of their course work on a part-time basis by taking a reduced course load during the semesters they are engaged in construction-related employment.

Graduates typically find employment with engineering firms, construction firms, consulting companies, surveying companies, contractors and subcontractors, builders, construction materials testing companies, building products, materials and equipment suppliers, land developers, highway departments, utilities, and various state, city, and governmental agencies and work with titles such as project manager, project supervisor, project engineer*, contract administrator, specifications writer, safety supervisor, project estimator, project scheduler, contractor, sub-contractor, builder, surveyor, testing supervisor, product representative (typically construction materials and equipment).

*The curriculum does not prepare students for registration as professional engineers in Indiana. For other states, consultation with the state's licensing agency is recommended.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000.

Program Educational Objectives in Construction Engineering Management Technology

The Program Educational Objectives reflect career and professional accomplishments of the program's graduates a few years after graduation. They are as follows:

1. Meet the needs of construction industry employers through successful support, management, or administration of construction-related operations.
2. Receive professional recognition and/or advancement consistent with a successful career in construction management.
3. Demonstrate continued interest in professional growth by participating in professional organizations, education and industry service.

Following is a list of all required courses to achieve a Bachelor of Science degree, by semester.

Freshman Year

First Semester (16 credit hours)

- CEMT 10500 Introduction to Construction Technology: 3 credit hours
- TECH 10200 Discovering Technology:1 credit hour
- Cultural Understanding (refer to approved course list): 3 credit hours
- BUS-X 100 Introduction to Business Administration: 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry: 3 credit hours
- MATH 15300 Algebra and Trigonometry I: 3 credit hours

Second Semester (15 credit hours)

- CEMT 10400 Surveying Fundamentals: 3 credit hours
- CEMT 12000 Construction Materials and Methods: 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication: 3 credit hours
- MATH 15400 Algebra and Trigonometry II: 3 credit hours
- TCM 22000 Technical Report Writing: 3 credit hours

Sophomore Year

Third Semester (16 credit hours)

- CEMT 11000 Construction Accounting: 3 credit hours
- CEMT 21500 Constr Mech & Elec: 3 credit hours
- CEMT 27500 Applied Civil Engineering Drafting: 3 credit hours
- TCM 34000 Correspondence in Bus & Ind: 3 credit hours
- PHYS 218 General Physics I: 4 credit hours

Fourth Semester (15 credit hours)

- CEMT 16000 Statics: 3 credit hours
- CEMT 28000 Quantity Survey: 3 credit hours
- ECON-E 201 Microeconomics: 3 credit hours
- MATH 22100 Calculus for Technology I: 3 credit hours
- ART/Humanities (refer to approved course list): 3 credit hours

Junior Year

Fifth Semester (14 credit hours)

- CEMT 26000 Strength of Materials: 3 credit hours
- CEMT 26700 Materials Testing: 2 credit hours
- CEMT 31200 Construction surveying: 3 credit hours
- CEMT 30200 Construction Law & Ethics: 3 credit hours
- CEMT 34200 Construction Cost & Bidding: 3 credit hours

Sixth Semester (16 credit hours)

- CEMT 34100 Construction Scheduling: 3 credit hours

- CEMT 34700 Constr. Contract Admin & Specs: 3 credit hours
- CEMT 48400 Wood, Timber and Formwork Design: 3 credit hours
- Science Elective (CHEM-C 101 & CHEM-C 121 or GEOL-G 107 & GEOL-G 117): 4 credit hours
- Statistic Elective (STAT 30100, IET 15000, or PSY-B 305): 3 credit hours

Senior Year

Seventh Semester (16 credit hours)

- CEMT 33000 Construction Field Operations: 3 credit hours
- CEMT 35000 Construction Project Cost & Project Control: 3 credit hours
- CEMT 39000** Construction Experience: 1 credit hour
- CEMT 45200 Hydraulics and Drainage: 3 credit hours
- CEMT 45500 Constr. Safety & Inspection: 3 credit hours
- CEMT 48600 Reinforced Concrete Des & Const: 3 credit hours

Eighth Semester (12 credit hours)

- CEMT 43000 Soils and Foundations: 3 credit hours
- CEMT 44700 Project Management: 3 credit hours
- CEMT 49400 Engineering Economics for Construction: 3 credit hours
- Elective (Refer to approved list): 3 credit hours

**NOTE: CEMT 39000 requires that a minimum of a 400 hour internship be completed during the semester that the course is taken. Contact the Program Director for additional information concerning the internship.

Construction Management Certificate

This certificate is designed to provide educational opportunities for those who need or desire to learn contemporary construction management techniques and skills and employ the latest technology in doing so. This program emphasizes developing the skills required by the construction industry and relies on the use of computers, whenever possible, to provide a contemporary education in the use of the latest technology in the management process. Those who earn the certificate will qualify for entry-level positions as superintendents, project managers, estimators, or schedulers for construction-related firms and will be competent in using the latest technology.

Good candidates for the program are people who wish to acquire additional marketable skills in construction management, who wish to upgrade existing construction management skills, or who wish to earn tangible verification of acquired skills and bodies of knowledge related to construction management.

Curriculum (27 credit hours)

- CEMT 11000 Construction Accounting: 3 credit hours
- CEMT 28000 Quantity Survey: 3 credit hours
- CEMT 33000 Construction Field Operations: 3 credit hours
- CEMT 34100 Construction Scheduling and Project Control: 3 credit hours
- CEMT 34200 Construction Cost and Bidding: 3 credit hours
- CEMT 34700 Construction Contract Administration and Specifications: 3 credit hours
- CEMT 44700 Construction Project Management: 3 credit hours
- CEMT 45500 Construction Safety and Inspection: 3 credit hours
- CEMT 49400 Engr Economics for Construction: 3 credit hours

Any student who has 8 credit hours in college-level technical mathematics, including algebra, trigonometry, and calculus; proven computer competency; the ability to read and interpret construction documents; and is formally admitted to the university, may be a candidate for this certificate. Courses taken at other universities may be recognized as equivalent to selected required courses.

Contact the Program Director before starting this certificate to obtain the full certificate requirements and the flowchart for the certificate program of study. There may be other course requirements that circumstances may necessitate. Students pursuing a CEMT bachelor's degree are not eligible for this certificate.

Computer Engineering Technology

Professor: E. Cooney
Clinical Associate Professor: W. Lin *(Program Director)*
Associate Professor: D. Goodman
Lecturer: E. Freije

Bachelor of Science degree with a major in Computer Engineering Technology

Accredited by the Engineering Technology Accreditation Commission (ETAC) of ABET, http://www.abet.org

The purpose of the Computer Engineering Technology Program is to prepare students to design, develop, and implement computer-based applications. The CpET program is offered by a partnership between the Department of Engineering Technology and the Computer and Information Technology program. A major emphasis of the CpET program is practice-oriented, experiential training in all learning environment to provide students and graduates with a rich experience in computer applications.

B.S. degree graduates will be able to provide technical support for computer systems in advanced manufacturing systems, control systems, networks, telecommunication systems, embedded systems, product development, and instrumentation. Graduates of the B.S. CpET program will have titles such as software engineer, automation engineer, applications software engineer, systems analyst, telecommunications engineer, network administrator and system test engineer.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000.

It also required that students earn a minimum grade of C or better in all ECET core competency courses.

Program Educational Objectives for Computer Engineering Technology

Three to five years after graduation, alumni of the Computer Engineering Technology program at IUPUI will be able to:

1. Meet expectations of employers in technical and professional careers related to the field of Computer Engineering Technology.
2. Achieve recognition and/or advancement consistent with their education.
3. Continue growth in professional knowledge through additional education, certification or licensing.

The Bachelor of Science in Computer Engineering Technology study plan is as follows.

Freshman Year

First Semester (16 credit hours)

- TECH 10200 First Year Seminar for Tech Majors: 1 credit hour
- TECH 10500 Introduction to Engineering Technology: 3 credit hours
- MET 10400 Tech Graphics Communication: 3 credit hours
- ECET 10900 Digital Fundamentals: 3 credit hours
- ENG W131 Reading, Writing and Inquiry: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities): 3 credit hours

Second Semester (16 credit hours)

- ECET 10700 Introduction to Circuit Analysis: 4 credit hours
- ECET 15500 Digital Fundamentals II: 3 credit hours
- ECET 16400 Applied Object-Oriented Programming: 3 credit hours
- MATH 221 Calculus for Technology I: 3 credit hours
- Gen Ed Elective (see approved course list: Cultural Understanding): 3 credit hours

Sophomore Year

Third Semester (16 credit hours)

- ECET 15700 Electronics Circuit Analysis: 4 credit hours
- TCM 21800 Intro to Engr Technical Reports: 1 credit hour
- COMM R110 Fund of Speech Communications: 3 credit hours
- MATH 22200 Calculus for Technology II: 3 credit hours
- ECET 20900 Introduction to Microprocessors: 4 credit hours
- TCM 22200 Intro to Technical Documentation: 1 credit hour

Fourth Semester (14 credit hours)

- CIT 21400 Introduction to Data Management: 3 credit hours
- ECET 28400 Computer Communications: 4 credit hours
- TCM 21900 Intro to Technical Presentations: 1 credit hour
- ECET 23110 Electrical Machines: 3 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours

Junior Year

Fifth Semester (17 credit hours)

- ECET 35700 Real-Time Digital Signal Processing: 4 credit hours
- PHYS 21800 General Physics: 4 credit hours
- ECET Elective (see approved course list): 3 credit hours
- CIT 27000 Java Programming: 3 credit hours
- ECET 23120 Industrial Controls: 3 credit hours

Sixth Semester (14 credit hours)

- ECET Elective (see approved course list): 3 credit hours
- ECET Elective (see approved course list): 3 credit hours
- ECET 48404 Emerging Information, Communications & Technologies: 4 credit hours
- BUS X-100 Business Administration: Introduction: 3 credit hours
- ECET 49300 Ethics & Professionalism in Technology: 1 credit hour

Senior Year

Seventh Semester (14 credit hours)

- ECET Elective (see approved course list): 3 credit hours
- ECET 49000 Senior Design Project Phase I: 1 credit hour
- TCM 41500 Technical Communication for Design Projects: 1 credit hour
- IET 36400 Total Quality Control: 3 credit hours
- MATH/TECH Selective (see approved course list): 3 credit hours
- CHEM C101 Elementary Chemistry I LEC: 3 credit hours

Eighth Semester (13 credit hours)

- ECET Elective (see approved course list): 3 credit hours
- ECET 49100 Senior Design Project Phase II: 2 credit hours
- TCM 41600 Advanced Tech Comm for Design: 1 credit hour
- Gen Ed Elective (see approved course list: Social Science): 3 credit hours
- Sustainability Selective (see approved course list): 3 credit hours
- TECH 49100 Senior Seminar for Engineering Technology: 1 credit hour

Electrical Engineering Technology

Electrical Engineering Technology

Professors: E. Cooney (Program Director)
Clinical Associate Professor: W.Lin
Associate Professor: D. Goodman, A. Izadian, R.Weissbach (Department Chair)
Lecturer: E. Freije, J. Tabas

Bachelor of Science degree with a major in Electrical Engineering Technology

Accredited by the Engineering Technology Accreditation Commission (ETAC) of ABET, http://www.abet.org.

Graduates of this program are qualified for high-level positions as technologists with job titles such as product engineer, process automation specialist, quality engineer, audio engineer, manufacturing system integration engineer, product engineer, field service engineer, substation engineer, controls engineer, calibration specialist, and sales engineer. The courses are offered both in the day and evening.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000.

It is also required that students earn a minimum grade of C or better in all ECET core competency courses.

Program Educational Objectives for Electrical Engineering Technology

Three to five years after graduation, alumni of the Electrical Engineering Technology program at IUPUI will be able to:

1. Meet expectations of employers in technical and professional careers related to the field of Electrical Engineering Technology.
2. Achieve recognition and/or advancement consistent with their education.
3. Continue growth in professional knowledge through additional education, certification or licensing.

Freshman Year

First Semester (16 credit hours)

- TECH 10200 First Year Seminar for Tech Majors: 1 credit hour
- TECH 10500 Introduction to Engineering Technology: 3 credit hours
- MET 10400 Technical Graphics Communications: 3 credit hours
- ECET 10900 Digital Fundamentals: 3 credit hours
- ENG W131 Reading, Writing, and Inquiry: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities): 3 credit hours

Second Semester (16 credit hours)

- ECET 10700 Introduction to Circuit Analysis: 4 credit hours
- ECET 15500 Digital Fundamentals II: 3 credit hours
- COMM R110 Fundamentals of Speech Communication: 3 credit hours
- MATH 22100 Calculus for Technology: 3 credit hours
- Gen Ed Elective (See approved course list: Cultural Understanding): 3 credit hours

Sophomore Year

Third Semester (14 credit hours)

- ECET 15700 Electronics Circuit Analysis: 4 credit hours
- TCM 21800 Intro to Engr Technical Reports: 1 credit hour
- ECET 16400 Applied Object Oriented Programming: 3 credit hours
- PHYS 21800 General Physics: 3 credit hours
- MATH 22200 Calculus for Technology II: 3 credit hours

Fourth Semester (15 credit hours)

- ECET 20700 AC Electronics Circuit Analysis: 4 credit hours
- ECET 28400 Computer Communications: 4 credit hours
- TCM 21900 Intro to Technical Presentations: 1 credit hour
- MATH/TECH Selective (See approved course list): 3 credit hours
- ECET 23110 Electrical Machines: 3 credit hours

Junior Year

Fifth Semester (14 credit hours)

- ECET 20900 Introduction to Microprocessors: 4 credit hours
- TCM 22200 Intro to Technical Documentation: 1 credit hour
- ECET Elective: see approved course list: 3 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours
- ECET 23120 Industrial Controls: 3 credit hours

Sixth Semester (17 credit hours)

- ECET 30700 Analog Network Signal Processing: 4 credit hours
- ECET Elective (see approved course list): 3 credit hours
- ECET Elective (see approved course list): 3 credit hours
- Gen Ed Elective (see approved course list: Social Science): 3 credit hours
- ECET 49300 Ethics & Professionalism in Technology: 1 credit hour
- IET 35000 Engineering Economy: 3 credit hours

Senior Year

Seventh Semester (14 credit hours)

- ECET Elective (see approved course list): 3 credit hours
- ECET 49000 Senior Design Project Phase I: 1 credit hour
- TCM 41500 Technical Communication for Design Projects: 1 credit hour
- BUS-X 100 Business Administration: Intro: 3 credit hours
- CHEM C101 Elementary Chemistry I LEC: 3 credit hours
- IET 36400 Total Quality Control: 3 credit hours

Eighth Semester (13 credit hours)

- ECET Elective (see approved course list): 3 credit hours
- Sustainability Selective (see approved course list): 3 credit hours
- ECET 49100 Senior Design Project Phase II: 2 credit hours
- TCM 41600 Advanced Technical Communication for Design: 1 credit hour
- TECH Elective (see approved course list): 3 credit hours
- TECH 49100 Senior Seminar for Engineering Technology: 1 credit hour

Minor in Electrical Engineering Technology

The minor in electrical engineering technology (EET) requires completion of a minimum of 22 credit hours of ECET courses. Required courses are ECET 10700, 10900, 15700, 15500, and 20700. In addition, one course from the following list must be completed: ECET 20900, 23110 or 28400. At least 12 credit hours of minor must be completed in residence at IUPUI. Students with credit for ECET 11600 should consult the ECET department.

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

Minor in Digital Electronics Technology

The minor in Digital Electronics Technology focuses on digital and microprocessor systems. It requires completion of a minimum of 22 credit hours of EET courses. Required courses are EET 10900, 11600, 15500, 20900, and 30900. In addition, one of the following must be completed: EET 35700 or 48404. At least 12 hours of the minor must be completed in residence at IUPUI.

Students who wish to complete a minor in Digital Electronics Technology should consult a department advisor about prerequisite courses or credit for courses taken at other universities.

Healthcare Engineering Technology Management

Healthcare Engineering Technology Management

Associate Professor: B. Christe (Program Director)
Lecturer: J. Tabas

Associate of Science with a major in Healthcare Engineering Technology Management

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 hospitals located on the IUPUI campus and with other area hospitals.

The healthcare engineering technology management (HETM) curriculum enables graduates to find employment as biomedical equipment technicians, medical equipment sales personnel, medical equipment servicing/ maintenance technicians, and research technicians.

The curriculum satisfies the educational requirements of the Association for the Advancement of Medical Instrumentation (AAMI) and the Certified Biomedical Equipment Technician Examination. Courses are offered in the day, evening, and online. Not all courses are offered in all formats.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000.

Graduates of this program may choose to work toward the Bachelor of Science degree program in healthcare engineering technology management. Approximately two additional years of full-time study are necessary to complete the requirements for the B.S. in engineering technology with a major in Healthcare Engineering Technology Management.

Freshman Year of the associate degree curriculum

First Semester (15 credit hours)

- HETM 10500 Introduction to HETM: 1 credit hour (recommended not required)
- ECET 10900 Digital Fundamentals: 3 credit hours
- MATH 15300 Algebra and Trigonometry I: 3 credit hours
- ENG W131 Reading, Writing, and Inquiry: 3 credit hour
- TECH 102 First Year Seminar for Technology Majors: 1 credit hour (recommended not required)
- TECH 105 Introduction to Engineering Technology: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities or Social Science): 3 credit hours

Second Semester (19 credit hours)

- ECET 10700 Introduction to Circuit Analysis: 4 credit hours
- HETM 22000 Applied Human Biology: 3 credit hours
- ECET 15500 Digital Fundamentals II: 3 credit hours
- COMM R110 Fundamentals of Speech Communication: 3 credit hours
- MATH 15400 Algebra and Trigonometry II: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities): 3 credit hours

Sophomore Year in the associate degree curriculum

Third Semester (16 credit hours)

- ECET 15700 Electronics and Circuit Analysis: 4 credit hours
- HETM 22500 Healthcare Tech Diagnostics + Repair: 3 credit hours
- HETM 24000 The Technology of Patient Care: 3 credit hours
- MATH 22100 Calculus for Technology I: 3 credit hours
- CHEM C110 Chemistry of Life LEC: 3 credit hours

Fourth Semester (17 credit hours)

- HETM 20200 Networking & Data Comm for Healthcare Equip: 3 credit hours
- HETM 32500 Healthcare Devices and Systems: 3 credit hours

- HETM 29500 HETM Internship: 1 credit hour
- PSY B110 Introduction to Psychology: 3 credit hours
- PHYS 21800 General Physics: 4 credit hours
- Gen Ed Elective (see approved course list: Cultural Understanding): 3 credit hours

Bachelor of Science with a major in Healthcare Engineering Technology Management

Students focus on developing skills necessary to support the safe and effective use of technology in patient care. Students integrate the technical/electrical/computer aspects of medical equipment with the needs of the medical staff and patients. Graduates will become integral members of the health care team, demonstrating excellent problem solving skills blended with an emphasis on customer service toward the medical staff to result in safe and effective patient care. Some graduates may elect to work directly for medical equipment manufacturers, investigating device design, integration, sales or support.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000.

Program Educational Objectives for Healthcare Engineering Technology Management

The program educational objectives of the HETM program are to produce graduates who will hold these attributes, as measured in the early years of their careers following graduation:

1. Obtain and advance professionally in technical and multidisciplinary positions that require collaboration and customer service, successfully supporting the use of technology in healthcare.
2. Achieve recognition and/or advancement consistent with education.
3. Continue growth in professional knowledge through additional education, certification, or specialized training.

Freshman Year of the bachelor's degree curriculum

First Semester (16 credit hours)

- HETM 10500 Intro to HETM: 1 credit hour
- TECH 10200 First Year Seminar for Technology Majors: 1 credit hour (recommended not required)
- TECH 10500 Introduction to Engineering Technology: 3 credit hours
- ECET 10900 Digital Fundamentals: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities or Social Science): 3 credit hours
- ENG W131 Reading, Writing, and Inquiry: 3 credit hours

Second Semester (16 credit hours)

- ECET 10700 Introduction to Circuit Analysis: 4 credit hours
- ECET 15500 Digital Fundamentals II: 3 credit hours
- MATH 15400 Algebra & Trigonometry II: 3 credit hours
- COMM R110 Fundamentals of Speech Communication: 3 credit hours
- HETM 22000 Applied Human Biology for HETM: 3 credit hours

Sophomore Year of the bachelor's degree curriculum

Third Semester (16 credit hours)

- ECET 15700 Electronics and Circuit Analysis: 4 credit hours
- HETM 22500 Healthcare Tech Diagnostics + Repair: 3 credit hours
- HETM 24000 The Technology of Patient Care: 3 credit hours
- MATH 22100 Calculus for Technology I: 3 credit hours
- CHEM C110 Chemistry of Life LEC: 3 credit hours

Fourth Semester (14 credit hours)

- HETM 20200 Networking & Data Comm for Healthcare Equip: 3 credit hours
- HETM 32500 Healthcare Devices and Systems: 3 credit hours
- HETM 29500 HETM Internship: 1 credit hour
- PSY B110 Introduction to Psychology: 3 credit hours
- PHYS 21800 General Physics: 4 credit hours

Junior Year

Fifth Semester (15 credit hours)

- HETM 31500 Introduction to Imaging Modalities: 3 credit hours
- TCM 22000 Technical Report Writing: 3 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours
- Technical Elective - see approved list: 3 credit hours
- Gen Ed Elective (see approved course list: Cultural Understanding): 3 credit hours

Sixth Semester (15 credit hours)

- OLS Elective - see approved list: 3 credit hours
- HETM 30200 Interoperability of Healthcare Devices: 3 credit hours
- Gen Ed Elective (see approved course list: Arts & Humanities): 3 credit hours
- HETM 42000 Techn & Patient Populations: 3 credit hours
- TCM 32000 Written Communication for Science & Industry: 3 credit hour

Senior Year

Seventh Semester (14 credit hours)

- HETM 44000 Codes Reg & Patient Safety: 3 credit hours
- HETM 49000 Project Planning & Design: 1 credit hour
- HETM 49300 HETM Ethics and Professionalism: 1 credit hour
- HETM 46000 System Engr Tech for Healthcare: 3 credit hours
- OLS Elective: 3 credit hours
- HETM 40200 Healthcare Device System Security: 3 credit hours

Eighth Semester (13 credit hours)

- HETM 47000 Special Topics in HTM: 3 credit hours
- HETM 49200 Capstone Project: 1 credit hour
- Technical Elective: 3 credit hours
- HETM 30100 Healthcare Technology Financial Management: 3 credit hours
- TCM 38000 Tech Comm in the Healthcare Profession: 3 credit hours

Interior Design Technology

Interior Design Technology

Assistant Clinical Professor: E. McLaughlin (Program Director), D. Nickolson
Senior Lecturer: M.A. Frank
Lecturer: B. Huffman

Associate of Science in Interior Design Technology

The Interior Design curriculum is a two year Associate of Science (A.S.) degree program that uses the latest technology while employing faculty from the areas of interior design, architecture, fine arts, and computer graphics to provide students with the skills necessary to work as interior design assistants and be able to sit for the National Council for Interior Design Qualification (NCIDQ) exam after approximately four years of work experience.

The emphasis is on technical knowledge, methodology, and aesthetic appreciation of interior design for the health, safety, and welfare of the public; equipping students with visual presentation and communication skills; imparting awareness for environmental, business, ethical, and other contemporary issues; and linking classroom knowledge to applications in the field. These graduates can address complex design problems and manage projects. The educational objectives for the A.S. Interior Design are:

1. Demonstrate technical knowledge and application of the design process.
2. Solve problems that are quantitative in nature.
3. Analyze complex issues and apply sound design methodology in multidisciplinary fields of interior design technology.
4. Practice effective communication skills in, oral, written and visual presentations.
5. Increase knowledge and demonstrate solutions sensitive to health, safety and welfare of the public.
6. Work collaboratively and effectively in technology and design related industries.
7. Continue professional advancement through life-long learning.
8. Understand the environmental, ethical, diversity, cultural and contemporary aspects of their work.
9. Be responsible citizens.

Graduates typically find employment in residential design fields in retail settings as sales associates or as manufacture's reps for products, in the kitchen and bath industry, as CAD technicians for the interior design or architecture fields, or as self-employed designers.

Freshman Year

First Semester (15 credits)

- COMM-R 110 Fundamentals of Speech Communication: 3 credits hours
- ENG-W 131 Reading, Writing, and Inquiry: 3 credits hours
- MATH 15300 Algebra & Trig I: 3 credits hours
- HER E109 Color and Design: 3 credits hours
- INTR 10300 Introduction to Interior Design: 3 credits hours

Second Semester (15 credits)

- ART 11700 Introduction to Construction Drafting with CAD: 3 credit hours
- ART 12000 Introduction to Construction Drafting with BIM: 3 credit hours
- INTR 12400 Space Planning for Interiors: 3 credit hours
- MATH 15400 Algebra & Trigonometry II: 3 credit hours
- Life or Physical Science Selective: 3 credit hours

Sophomore Year

Third Semester (15 credits)

- ART 15500 Residential Construction: 3 credit hours
- HER E209 Drawing for Interior Design: 3 credit hours
- INTR 12500 Color and Lighting: 3 credit hours
- INTR 20200 Interior Materials and Applications: 3 credit hours
- Social Science Selective: 3 credit hours

Fourth Semester (15 credits)

- INTR 20400 History of Interiors and Furniture I: 3 credit hours
- INTR 22400 Residential I, Kitchen and Bath: 3 credit hours
- INTR 22600 Commercial Interiors I: 3 credit hours
- Life of Physical Science Selective: 3 credit hours
- Cultural Understanding Selective: 3 credit hours

Bachelor of Science in Interior Design Technology

The Interior Design curriculum is a four-year Bachelor of Science (B.S.) degree program that employs faculty from the areas of interior design, architecture, fine arts, computer graphics, and organizational leadership to provide students with the skills necessary to work as professional interior designers and be able to sit for the National Council for Interior Design Qualification (NCIDQ) exam after approximately two years of work experience.

The emphasis is on technical knowledge, methodology, and aesthetic appreciation of interior design for the health, safety, and welfare of the public; equipping students with visual presentation and communication skills; imparting an awareness for environmental, business, ethical, and other contemporary issues; and linking classroom knowledge to application in the field. These graduates can address complex design problems and manage projects.

The educational objectives for the B.S. Interior Design are:

1. Demonstrate technical knowledge and application of the design process.
2. Solve problems that are quantitative in nature.
3. Analyze complex issues and apply sound design methodology in multidisciplinary fields of interior design technology.
4. Practice effective communication skills in, oral, written and visual presentations.

5. Increase knowledge and demonstrate solutions sensitive to health, safety and welfare of the public.
6. Work collaboratively and effectively in technology and design related industries.
7. Continue professional advancement through life-long learning.
8. Understand the environmental, ethical, diversity, cultural and contemporary aspects of their work.
9. Be responsible citizens.

Graduates typically find employment in residential or commercial design fields as designers, in retail or manufacturing settings as sales associates, in design and construction industries as manufacturer's reps for products, as CAD technicians for the interior design or architecture fields, or as self-employed designers.

Freshman Year

First Semester (15 credits)

- COMM-R 110 Fundamentals of Speech Communication: 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry: 3 credit hours
- MATH 15300 Algebra & Trig I: 3 credit hours
- HER E109 Color and Design: 3 credit hours
- INTR 10300 Introduction to Interior Design: 3 credit hours

Second Semester (15 credits)

- ART 11700 Introduction to Construction Drafting with CAD: 3 credit hours
- ART 12000 Introduction to Construction Drafting with BIM: 3 credit hours
- INTR 15100 Textiles for Interiors: 3 credit hours
- CGT 21100 Raster Imaging for Computer Graphics: 3 credit hours
- MATH 15400 Algebra and Trigonometry II: 3 credit hours

Sophomore Year

Third Semester (15 credits)

- ART 15500 Residential Construction: 3 credit hours
- INTR 12400 Space Planning for Interiors: 3 credit hours
- INTR 12500 Color and Lighting: 3 credit hours
- INTR 20200 Interior Materials and Applications: 3 credit hours
- HER E209 Drawing for Interior Design: 3 credit hours

Fourth Semester (15 credits)

- ART 21000 History of Architecture: 3 credit hours
- ART 22200 Commercial Construction: 3 credit hours
- INTR 22400 Residential I, Kitchen and Bath: 3 credit hours
- INTR 20400 History of Interiors and Furniture I: 3 credit hours
- INTR 22600 Commercial Interiors I: 3 credit hours

Junior Year

Fifth Semester (15 credits)

- INTR 30400 History of Interiors and Furniture II: 3 credit hours
- INTR 32400 Residential II, Housing Design: 3 credit hours
- INTR 32500 Environmental Lighting Design: 3 credit hours
- ART 22300 Architectural 3D Modeling I: 3 credit hours
- INTR 22500 3D Interior Design: 3 credit hours

Sixth Semester (15 credits)

- INTR 32600 Commercial Interiors II: 3 credit hours
- ART 32300 Architectural 3D Modeling II: 3 credit hours
- HER H221 Art Past and Present: 3 credit hours
- OLS 37100 Project Management: 3 credit hours
- Cultural Understanding Selective: 3 credit hours

Senior Year

Seventh Semester (15 credits)

- TECH 30010 Internship: 3 credit hours
- Life Science Elective: 3 credit hours
- INTR 42600: Evidence Based Design: 3 credit hours
- INTR 45200: Building Systems: 3 credit
- INTR 48000 Senior Thesis: 3 credit hours

Eighth Semester (15 credits)

- INTR 42800 Capstone: 3 credit hours
- INTR 45300 Business Practices: 3 credit hours
- INTR 49500 Sustainable Design: 3 credit hours
- Life Science elective: 3 credit hours
- Social Science Elective: See Approved List: 3 credit hours

NOTE: A grade of a C or higher must be obtained in all INTR and ART courses in order to progress in the program.

Plan of Study effective fall 2018.

Interior Minor

The Interior Design Technology minor presents the opportunity for any student to gain simple interior design proficiencies and knowledge through coursework that may be used to supplement their primary degree while exposing the student to an innovative and diverse area of study. Studio based requirements will challenge students to complete experiential exercises and projects, while lecture based coursework required through the minor will offer the student the ability to study specialty topics such as design history, textiles or sustainability, further augmenting their comprehension of the industry.

Upon completion of the Interior Design Technology minor, students will be able to:

- Recognize and apply the basic elements and principles of design to interior environments.
- Comprehend the design process as utilized on all design projects.
- Manually draft basic floor plans precisely.
- Plan both residential and commercial spaces accurately.

- Understand the fundamental proficiencies and aptitudes required for a career in interior design.
- Effectively communicate design ideas through written, verbal, and graphic means.

Note: While the minor will supplement any student's primary discipline with additional knowledge, the minor will **not** qualify an individual to work exclusively in the field.

Curriculum (6 courses/18 credit hours)

Required Courses (2 courses)

- INTR 10300 - Introduction to Interior Design
- INTR 12400 - Space Planning for Interiors

Studio-based Elective Courses (2 courses; select from the following list:)

- ART 11700 - Introduction to Construction Drafting with CAD
- ART 12000 - Introduction to Construction Drafting with BIM
- INTR 12500 - Color and Lighting (Prereq HER-E 109)
- INTR 20200 - Interior Materials and Applications
- INTR 22400 - Residential I, Kitchen and Bath

Lecture-based Elective Courses (2 courses: select from the following list:)

- ART 21000 - History of Architecture
- INTR 15100 Textiles for Interiors
- INTR 20400 - History of Interiors and Furniture I
- INTR 30400 - History of Interiors and Furniture II
- INTR 49500 - Sustainable Design

A grade of C is required in all course work credited toward the minor.

Mechanical Engineering Technology

Mechanical Engineering Technology

Associate Professors: D. Acheson
Assistant Professor: S. Li
Assistant Clinical Professor: P Yearling (Program Director)
Lecturer: E. Herger, L. Silvian

The Department of Engineering Technology offers a Bachelor of Science degree in mechanical engineering technology. In addition, students are encouraged to enhance their knowledge base through the School of Engineering and Technology certificate program.

For more information, contact the Department of Engineering Technology at (317) 278-4405, or email cathmatt@iu.edu, or visit our Web site at: www.engr.iupui.edu/met. Certificate Program Website: http://www.engr.iupui.edu/main/academics/undergrad/certificates.php

Bachelor of Science in Mechanical Engineering Technology

Accredited by the Engineering Technology Accreditation Commission (ETAC) of ABET http://www.abet.org

This program emphasis is on putting knowledge into action, students become skilled in the generation, transmission, and utilization of mechanical and fluid energy, as well as the design and production of tools, materials, machines and their products. Graduates of this program find positions as Process Engineers, Production Engineers, Quality Engineers, Maintenance Engineers, Quality Specialists, Reliability and Test Engineers, and Facilities Managers. The courses are offered both in the day and evening.

In addition to all the school and university requirements, this degree requires that both the IU Cumulative GPA and the Degree GPA be equal to or greater than 2.000 and all required physics and mathematics courses require a C grade or better.

Program Educational Objectives for Mechanical Engineering Technology

Three to five years after graduation, alumni of the Mechanical Engineering Technology Program at IUPUI will be able to:

1. Work competently in technical and professional careers related to the field of Mechanical Engineering Technology.
2. Achieve recognition and/or advancement consistent with their education.
3. Continue growth in professional knowledge through additional education, certification, or licensing.

Freshman Year

First Semester (15 credit hours)

- ENG-W 131 Reading, Writing, and Inquiry I: 3 credit hours
- MATH 15900 Pre-calculus: 5 credit hours
- TECH 10200 Technology Learning Community: 1 credit hour
- MET 10400 Technical Graphics Communication: 3 credit hours
- TECH 10500 Introduction to Engineering Technology: 3 credit hours

Second Semester (17 credit hours)

- CHEM-C 101 Elementary Chemistry I: 3 credit hours
- MET 11100 Applied Statics: 3 credit hours
- MET 20400 Introduction to Design: 3 credit hours
- IET 10400 Industrial Organization: 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication: 3 credit hours

Sophomore Year

Third Semester (15 credit hours)

- MATH 22100 Calculus for Technology I: 3 credit hours
- MET 21100 Applied Strength of Materials: 4 credit hours
- TCM 21800 Introduction to Engineering Technical Reports: 1 credit hours
- MET 21300 Dynamics: 3 credit hours
- PHYS 21800 General Physics I: 4 credit hours

Fourth Semester (15 credit hours)

- MATH 22200 Calculus for Technology II: 3 credit hours
- MET 21400 Machine Elements: 3 credit hours
- MET 23000 Fluid Power: 3 credit hours

- MET 22000 Heat and Power: 3 credit hours
- Gen Ed Elective (see approved course list: Arts and Humanities): 3 credit hours

Junior Year

Fifth Semester (15 credit hours)

- MET 32000 or MET 32900 Applied Thermodynamics or Introduction to Heat Transfer: 3 credit hours
- TCM 35800 Technical Report Analysis and Development: 1 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours
- MET 33800 Manufacturing Process: 4 credit hours
- MET 34800 Engineering Materials: 4 credit hours

Sixth Semester (16 credit hours)

- ECET 11600 Electrical Circuits: 3 credit hours
- IET 35000 Engineering Economics: 3 credit hours
- MET 31000 Computer Aided Machine Design: 3 credit hours
- TCM 35900 Technical Reporting and Presentation: 1 credit hour
- MET 35000 Applied Fluid Mechanics: 3 credit hours
- ECET 16400 Object Oriented Programming: 3 credit hours

Senior Year

Seventh Semester (15 credit hours)

- ECET 35100 Instrumentation and Controls: 3 credit hours
- MET 32800 CAD/CAM for Mechanical Design: 3 credit hours
- Technical Selective Sustainability List: 3 credit hours
- Gen Ed Elective (see approved course list: Social Science): 3 credit hours
- Technical Selective MET, IET, or TECH 5XX: 3 credit hours

Eighth Semester (14 credit hours)

- MET 41400 Design of Mechanical Projects: 3 credit hours
- TCM 41500 Technical Communication for Mechanical Design Projects: 1 credit hours
- Gen Ed Elective (see approved course list: Cultural Understanding): 3 credit hours
- Gen Ed Elective (see approved course list: Arts or Social Science): 3 credit hours
- Technical Selective MET, IET, or TECH 5XX: 3 credit hours
- ECET 49300 Ethics & Professionalism: 1 credit hour

Motorsports Engineering

Motorsports Engineering

Lecturer A. Borme (Program Director), C. Finch

IUPUI is the first University in the United States to offer a bachelor's degree in motorsports engineering

The motorsports industry is growing and expected to continue to grow at a rapid pace. By most accounts, Indiana, North Carolina, and England are recognized as the three leading local motorsports economies. Indianapolis, while generally known as the home of open-wheel racing has a broad appeal. It is also known for sprint cars, midgets, karting, NHRA, and many other forms of racing. It is estimated that there are over 400 motorsports-related firms in the Indianapolis region including companies that produce engines, brakes, shocks, springs, and other racing products.

Bachelor of Science in Motorsports Engineering

This 4-year Bachelor of Science of Degree in Motorsports Engineering was approved in May, 2008. This program, which aims to prepare graduates for careers in the motorsports industry, as well as automotive-related companies, focuses on teaching fundamentals of engineering and will include hands-on projects that involve designing, analyzing, and building of actual systems for motorsports.

Program Educational Objectives

The program educational objectives of the Motorsports Engineering undergraduate program are to integrate engineering and life science principles into a comprehensive curriculum that produces graduates who can achieve the following career and professional accomplishments, if desired:

- Meet expectations of employers in Motorsports Engineering and related fields
- Achieve recognition and/or advancement consistent with their education
- Continue growth in professional knowledge through additional education, certification or licensing

Freshman Year

First Semester (17 credit hours)

- ENG-W 131 - Reading, Writing and Inquiry: 3 credit hours
- MATH 16500 - Calculus I: 4 credit hours
- ENGR 19500 - Learning Community: 1 credit hour
- CHEM C 105 - Chemistry I: 3 credit hours
- MSTE 27200 - Intro to Motorsports: 3 credit hours
- COMM-R 110 - Fundamentals of Speech Communication: 3 credit hours

Second Semester (18 credit hours)

- MSTE 31200 - Business of Motorsports: 4 credit hours
- MATH 16600 - Calculus II: 4 credit hours
- PHYS 15200 - General Physics I: 4 credit hours
- MSTE 29800 - Computer Modeling & Programming: 2 credit hours
- MATH 17100 - Multidimensional Math: 3 credit hours
- MSTE 29700 - Modeling for Motorsports: 1 credit hour

Sophomore Year

Third Semester (17 credit hours)

- MSTE 26100 - Multivariate Calculus: 4 credit hours
- PHYS 25100 - General Physics II: 5 credit hours
- MSTE 35000 - Computer Aided Design and Mfg.: 3 credit hours
- MSTE 21000 - Statics and Dynamics: 4 credit hours
- MSTE 21700 - Motorsports Practicum I: 1 credit hour

Fourth Semester (17 credit hours)

- MET 33800 - Manufacturing Processes: 3 credit hours
- ECE 20400 - Electrical & Electronics Circuits: 4 credit hours
- ME 27200 - Strength of Materials: 4 credit hours
- MSTE 32000 - Motorsports Design I: 3 credit hours
- ME 20000 - Thermodynamics: 3 credit hours

Junior Year

Fifth Semester (17 credit hours)

- MSTE 47200 - Vehicle Dynamics: 3 credit hours
- MSTE 33000 - Data Acquisition in Motorsports I: 3 credit hours
- MATH 26600 - Ordinary Diff. Equations: 3 credit hours
- ME 31000 - Fluid Mechanics: 4 credit hours
- MSTE 31700 - Motorsports Practicum II: 1 credit hours
- Gen Ed Elective - See approved Course List: 3 credit hours

Sixth Semester (15 credit hours)

- MSTE I 41000 - Internship: 1 credit hour
- MSTE 33100 - Data acquisition in Motorsports II: 3 credit hours
- MSTE 34000 - Dynamic Systems and Signals: 3 credit hours
- IET 15000 - Statics: 3 credit hours
- ME 34400 - Materials: 3 credit hours
- TCM 36000 - Communications/Writing: 2 credit hours

Senior Year

Seventh Semester (13 credit hours)

- MSTE 48200 - Motorsports Aero: 3 credit hours
- ME 48200 - Control Systems Analysis and Des.: 3 credit hours
- Gen Ed Elective - See approved course list: 3 credit hours
- Technical Selective - See approved course list: 3 credit hours
- MSTE 41700 - Motorsports Practicum III: 1 credit hour

Eighth Semester (14 credit hours)

- MSTE 41400 - Motorsports Design II: 3 credit hours
- MSTE 42600 - Internal Combustion Engines: 3 credit hours
- Tech Elective - See approved course list: 2 credit hours
- Gen Ed Elective - See approved course list: 3 credit hours
- PHIL P120 - Ethics: 3 credit hours

Motorsports Engineering Certificate

This certificate provides an educational opportunity in the basics of the motorsports industry. Motorsports is a rapidly expanding segment of the Indiana employment market. This certificate will assist in developing technical skills in this area. A certificate and transcript notation will be awarded upon completion of the course work.

A total of 27 credit hours and a cumulative grade point average of 2.0 on a 4.0 scale is required to receive the certificate. Two versions of the motorsports certificate exists, one with a Mechanical (MET) emphasis and one with an Electrical (EET) emphasis.

All students must complete the following courses or their equivalents.

Mechanical Engineering Technology (MET) Emphasis:

- MATH 15900 - Algebra & Trigonometry or Math 15300/15400 Algebra & Trigonometry I & II: 5 credit hours
- MET 11100 - Statics: 3 credit hours
- MET 21300 - Dynamics: 3 credit hours
- MET 38800 - Thermodynamics & Heat and Power: 4 credit hours
- MSTE 27200 - Intro to Motorsports: 3 credit hours
- MSTE 42600 - IC Engines: 3 credit hours
- MSTE 47200 - Vehicle Dynamics: 3 credit hours
- A project course with a Motorsports related project: 3 credit hours

Electrical Engineering Technology (EET) Emphasis:

- MATH 159 - Algebra & Trigonometry or MATH 15300/15400 Algebra & Trigonometry I & II: 5 credit hours
- ECET 10700 - Circuits: 4 credit hours
- MSTE 27200 - Intro to Motorsports: 3 credit hours
- ECET 15700 - Electronic Circuit Analysis: 4 credit hours
- PHYS 21800 - Physics: 4 credit hours
- MSTE 33000 - Data Acquisition for Motorsports: 3 credit hours
- MSTE 47200 - Vehicle Dynamics: 3 credit hours

A project course with a Motorsports related project: 3 credit hours

Certificate in Architectural and Interior Design Graphics

The fields of architecture and interior design are extremely interrelated. Both require practitioners to sustain specific skill sets relative to computer-aided drafting, BIM and graphics for the purpose of communicating design ideas to the public. In an age of progressive technology, it is difficult for design professionals to stay abeast the modern techniques and software programs which are needed to compete in a market flooded with fresh talent. This certificate will offer entry level training to out of date design professionals, or any individual wishing to augment their existing skill sets with the latest design related software applications.

Upon completion of the Certificate in Architectural and Interior Design Graphics, students will be able to:

- Use Computer-Aided Drawing software to communicate 2 dimensional design ideas.
- Use Computer-Aided Drawing software to communicate 3 dimensional design ideas.

- Understand color theory, surface rendering and light control in relation to technical illustration.
- Electronically model furniture, interiors and architecture for a built environment
- Create photo-realistic renderings to communicate design ideas.
- Effectively communicate graphic skill sets through a design portfolio.

The 15 credit hour curriculum:

- ART 11700 Introduction to Construction Drafting with AutoCAD: 3 credit hours
- ART 15500 Residential Construction (Revit): 3 credit hours
- CGT 21100 Raster Imaging for Computer Graphics (Photoshop): 3 credit hours
- ART 22300 3D Architectural (Sketchup): 3 credit hours
- ART 32300 3D Architectural Modeling II (Advanced Revit): 3 credit hours

Candidates for this certificate are required to be formally admitted by the IUPUI Office of Admissions, but are not required to be a student in the Purdue School of Engineering and Technology. A history of some practical experience or familiarity with the fields of interior design or architecture is recommended, but not required.

Lean Six Sigma

The Lean Six Sigma belt certification program is based on the existing Quality Assurance Certificate (QAC) course structure. Therefore, a student is able to progress from a Green Belt to Black Belt, and Quality Certification depending on the number of classes the student chooses to take.

Lean Six Sigma (LSS) is the combination of two proven methodologies for improving total organization performance through systematic and continuous process improvement. LSS has become the de facto process improvement methodology of choice in the manufacturing, healthcare, insurance and military sectors. Training is based around a graduated belt system dependent on number of training hours and project completion.

Students must complete the following:

Curriculum (15 credit hours)

- TCM 22000 - Technical Report Writing: 3 credit hours
- MATH 15300 - Algebra and Trigonometry I: 3 credit hours
- IET 36400 - Total Quality Control: 3 credit hours
- IET 45400 - Statistical Quality Control: 3 credit hours
- Undergraduate or Graduate Directed Project (approved and supervised by LSS faculty: 3 credit hours

Quality Assurance 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 putting these techniques to work in the quality control system of an industrial organization. The program includes an investigation of the concept of quality control and the impact of quality costs, determination of customer needs, and follow-up on field performance and feedback. A certificate will be presented to those who successfully complete all course work and the transcript noted.

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

All students must complete the following courses:

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

Curriculum (23 credit hours)

- MATH 15100 or MATH 15300/15400 Algebra and Trigonometry: 5 credit hours
- MET 10500 Intro to Engineering Technology: 3 credit hours
- IET 30000 Metrology for Quality Assurance: 3 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours
- IET 36400 Total Quality Control: 3 credit hours
- IET 37400 Nondestructive Testing or
    - IET 47400 Quality Improvement of Products and Processes: 3 credit hours
- IET 45400 Statistical Quality Control: 3 credit hours

Sustainable Technologies Certificate

Purpose

In the United States, sustainability has gained importance in business, industry, government, government agencies, higher education, and in the general public's consciousness. The goal of meeting today's needs without harming future generations' ability to realize their potential is a hallmark of sustainable practices, and there is widespread interest from many disciplines and sectors in developing, enhancing, and integrating sustainability into aspects of products, services, and solutions. Thus, the need to equip students with the knowledge, skills, and perspectives to make contributions to sustainability initiatives has never been greater. Green jobs are rapidly being created as the economy begins embracing sustainable, energy efficiency, and low-carbon practices. The driving forces behind the development of green jobs are businesses wishing to maintain cutting edge technology, become more energy efficient, while lowering their carbon footprint, or becoming entirely carbon neutral. The governments of the world, the U.S. being one of them, support these developments through initiatives including: federal funding, subsidies, tax reform, and carbon markets.

This certificate is designed to address a growing need for professionals who can contribute to the green global workforce with knowledge in sustainable practices in current technologies. The Sustainable Technologies Certificate will be beneficial to students who want to acquire knowledge in areas of renewable energies, green building, and sustainable design, and who may want to pursue a career in a sustainable technology. All of the Sustainable Technologies Certificate courses will be offered online.

Admission

Candidates for this certificate are required to be formally admitted by the IUPUI Office of Admissions, but not required to be a student in the Purdue School of Engineering Technology. To earn the Sustainable Technologies Certificate, or any other certificates, students must contact the department to complete paperwork to add the certificate to their program plan of study before they enroll in the last semester or sooner. Applications for graduation must be completed one semester prior to completion of the required curriculum.

Curriculum (18 credit hours)

Students are required to successfully complete a total of 6 courses (18 credit hours) to earn the certificate. No more than 6.0 units of transfer credit can be applied towards this certificate. All students must successfully complete all of the following required core courses:

- TECH 20100 - Introduction to Sustainable Principles and Practices - 3 credit hours
- TECH 30100 - Renewable Energy Technologies* - 3 credit hours
- TECH 30200 - Introduction to Green Building Technologies*[1] or
    - TECH 30400 - Green Building: Information Modeling[1] - 3 credit hours
- TECH 30300 - Energy Efficiency and Auditing - 3 credit hours
- TECH 40100 - Leadership and Economic Aspects of Sustainability - 3 credit hours
- TECH 40200 - Emerging Green Technologies* - 3 credit hours

[1] Certificate students choose only one of these courses.

Music & Arts Technology (MAT)

Chair: Debra S. Burns, Professor of Music & Arts Technology

The Department of Music and Arts Technology reflects urban culture, contemporary and digital arts. Special courses on American popular music, contemporary music performance styles, music technology and music therapy are delivered by innovative instructional technology.

The Department of Music and Arts Technology is committed to delivering quality music instruction to undergraduate and graduate students at the nation's premiere urban institution. Performance ensembles are open to students.

Ensemble groups include the IUPUI Jazz Ensemble, IUPUI Jazz Combos, Pep Band, University Choir, IUPUI Percussion Ensemble, Guitar Ensemble, Chamber Ensemble, Telematic Performing Ensemble, Electro-Acoustic Ensemble, Electronic Music Ensemble, and Laptop Orchestra.

This department awards degrees from Indiana University.

For more information, call or write: Department of Music and Arts Technology, IUPUI, 535 W. Michigan Street, Indianapolis, IN 46202, (317) 274-4000.

Web:

B.S. in Music Technology

Bachelor of Science in Music Technology

The Bachelor of Science in Music Technology (BSMT) is a four-year degree program instilling students with technical, theoretical, and creative skills required to pursue professional careers in the growing field of music technology. Students enroll in both traditional music studies, (music theory, aural skills, keyboard studies, and applied instrument lessons) as well as our wide-ranging and innovative technology courses of Recording and Production, Creative Music Technology, Digital Signal Processing for Music, and Interface and Instrument Design. The degree culminates with presentation of a capstone project, combining a student's creative, technical, theoretical, and historical knowledge. One hundred and twenty (120) hours of coursework are required with a concentration in an allied field such as computer technology. The degree is designed as a four-year course of study.

The BSMT program covers the following areas of focus:

- Essentials of Music Technology: Concepts include acoustics, psychoacoustics, analog and digitalaudio, MIDI, and digital notation.
- Recording and Production: Technical competency in industry-standard recording software, techniques, and equipment. Concepts include analog and digital recording, microphone design and placement, studio design and setup, mixing, and mastering.
- Live electronic manipulation and performance: Concepts include hardware and software for live music creation, audio interfaces and live equipment setup, control interfaces for live manipulation of analog and digital instruments, and performance practice.
- Creation and Composition through Music Technology: The use of technology in creating, composing, and making music in both live and studio practices. Concepts include composition and notation software, and the theory and practice of composition with music technology.
- Digital Signal Processing and Synthesis: Software design through the use of a graphic programming environment. Concepts include audio and video digital signal processing, sound synthesis, and interactive and generative media.
- Interface and Instrument Design: The development of new instruments and interfaces using software programming and hardware construction.

Application to the BSMT Program

Students who intend to major in Music Technology must submit a departmental application, availablefrom the Music and Arts Technology department (IT352) or online athttp://www.engr.iupui.edu/departments/mat/, as well as a university online application athttp://enroll.iupui.edu/admissions/apply/. Applicants are required to perform a live audition (see Audition Requirements below) and an interview. Applicants must have either a high school diploma (with a minimum grade point average of 3.0) or a valid GED. TOEFL score are required for international students. Additional information may be requested to document musical skills or experience with technology.

Admission Requirements

Students pursuing admission to the Bachelor of Science in Music Technology degree must complete the following:

1. Must first be accepted to IUPUI
2. Submission of the Department of Music and Arts Technology application
3. Successful audition and interview session

The audition and interview will be scheduled during a single audition time slot. Audition times can be found at http://www.engr.iupui.edu/departments/mat/. Auditions are good for a calendar year.

BSMT Audition Requirements and Expectations

Applicants to the Bachelor of Science in Music Technology are expected to show potential for success in a rigorous collegiate degree program. In addition to formal application documents, a required audition/interview session provides an opportunity for the applicant to demonstrate interests, skills, and experiences in one or more of the following areas:

1. performance capacities on one or more musical instruments or voice
2. knowledge of software or hardware music technologies
3. music composition and/or other creative endeavors related to the arts
4. comprehension of music theory

While an applicant is not required to demonstrate in all areas noted above, the audition committee seeks applicants likely to excel in a degree program balancing music technology course-work with music theory and performance/creative skills. Upon initial application, the department must be informed of a primary acoustic musical instrument/voice or a contemporary music technology instrument (example: laptop, midicontrollers, etc.) to be used in the audition. This designation will be the student's "primary" instrument for their study in the BSMT Program. Beyond demonstrating instrument performance skills, an applicant may bring hard copy materials, or computer-based demonstrations to illuminate skills and experiences in any of the other areas noted above. Please contact the department with questions of audition expectations or how best to present materials in front of the audition committee. If you are interested in auditioning for our degree program, but travel distance from Indianapolis prohibits an in-person audition, you may contact the department to request a remote video audition.

Audition Requirements -Instrumentalist or Voice as Primary Instrument

- Perform two contrasting pieces of repertoire for your instrument.
- Perform major scales in 1-2 octaves.
- Site reading examples. (provided at the audition)

Students are encouraged to choose repertoire that best represents their experience, skill level, and artistic range. For questions regarding instrument specific details, make a request to the department for this information and the appropriate instrument area coordinator will contact you.

Audition Requirements -Music Technology as Primary Instrument

The prospective student must supply three different pieces demonstrating a variety of experience and skill with music technologies. These pieces may be submitted in a recorded format for viewing at the audition, in advance (audio or video recordings, as appropriate), or performed live, if applicable. In the audition committee interview the applicant must clearly articulate their role in each submitted piece and by what means they employed music technology. The successful applicant will be able to demonstrate competency witha fully featured DAW (Logic, ProTools, Ableton Live, etc.), understand basic concepts of mixing audio, work methods for digital and analog audio, and be able to articulate standard functions of audio hardware. Experience with one or more acoustic instruments, music theory, composition and/or arranging are also desirable. The student pursuing music technology as a performance medium will take private music technology lessons for the duration of their degree program and serve performance, creative, and/or production roles with appropriate department ensembles.

Fore more information about audition expectations and details on how to schedule an audition, visit http://www.engr.iupui.edu/dapartments/mat/.

Admission Categories

Upon receipt of the completed application, letters of recommendation, transcript, evidence of musicianship, and the interview, the Graduate Admissions Committee of the IU Department of Music and Arts Technology at IUPUI may grant regular admission, grant admission on probation, or reject the application.

Music Minor

The music minor is available to students majoring in other areas of study at IUPUI. Students must submit an application for the music minor, available online athttp://www.engr.iupui.edu/departments/mat/. No audition is required for the minor.

Music Minor Requirements

The undergraduate Minor in Music requires students to complete 20 credit hours made up of the following requirements:

Core Courses	
MUS-Z111 Introduction to Music Theory	3 cr.
MUS-M174 Music for the Listener	3 cr.
Music Ensemble	
Two credits in music ensemble courses	2 cr.
or MUS-Z100 The Live Musical Performance	
Music Electives	12 cr.

All courses must be completed with a C or higher to count toward the minor. A cumulative GPA of 2.0 is required to award the minor. A minimum of 10 credit hours must be taken at IUPUI.

M.S. in Music Technology

On-Campus Program

The Master of Science in Music Technology provides graduate students an academic background in digital music production, instructional design, and multimedia development. Current graduates of this master's program have found employment in a wide range of business and educational settings. Participants develop skills in designing software, using authoring tools and languages, applying multimedia concepts, and managing technology facilities and projects. This degree is offered as an on-campus or online program.

Admission Requirements

1. Bachelor's degree (with demonstrated musical skills)
2. Minimum grade point average of 3.0 (4.0 scale)
3. Submission of a university and a department application
4. Official transcripts of all undergraduate and graduate study
5. Evidence of musicianship through performance videotape, audio cassette, CD/DVD, or live audition
6. Three letters of recommendation required to support the admission application
7. In-person or telephone admission interview with the Head of Graduate Studies
8. Non-native speakers must demonstrate English language proficiency with a minimum TOEFL score of 550/79 International students will also need to meet the application requirements of the IUPUI Office of International Affairs

Admission Categories

Upon receipt of the completed application, letters of recommendation, transcript, evidence of musicianship, and the interview, the Graduate Admissions Committee of the IU Department of Music and Arts Technology at IUPUI may grant regular admission, grant admission on probation, or reject the application.

Admission on Probation

Students who do not have an undergraduate and graduate grade point average of 3.0 or higher may be admitted on probation in exceptional cases. The probationary status continues until 9 credit hours of course work have been successfully completed. At this time student admission requests are re-evaluated. Students who are admitted on probation and incur academic probation during their first semester of study are subject to dismissal.

Degree Requirements

- 30 credit hours (18 credit hours at the 500 level or above)
- 6 credit hours in cognate courses (at the 400 level or above) to be selected from music, business, communications, computer science, education, fine arts, or law
- 6 credit hours of approved courses (at the 400 level or above) from the cognate field or other fields with the approval of the Head of Graduate Studies

Minimum Grade Point Average

- 3.0 average to continue
- No grades lower than B in core courses arecounted toward the degree
- No grades lower than C are counted toward thedegree

Residency Requirements (for on-campus students only)

- Three consecutive summers, two contiguous academic terms

Core Courses

The following courses, totaling 18 credit hours, are required of all students enrolled in the Master of Science in Music Technology program:

<u>Class/Credit Hours</u>

- N512 Foundations of Music Production - 3 cr.
- N513 Principles of Multimedia Technology - 3 cr.
- N514 Music Technology Methods - 3 cr.
- N515 Multimedia Design Applications in the Arts - 3 cr.
- N516 Advanced Interactive Design Applications in the Arts - 3 cr.
- N517 Internship in Arts Technology or N518 Arts Technology Major Project - 3 cr.

Total Credit Hours - 18

Cognate Field Courses

Six (6) credit hours are required in an approved cognate field within or outside the Department of Music and Arts Technology. Students may choose to complete the remaining 6 credit hours with emphasis in one of the following areas: music, business, communications, computer science, education, fine arts, law, or others with the approval of the department. The cognate field may become a minor if at least 12 credit hours are taken in one field.

Internship or Technology Project

Students may elect to enroll in an internship (N517) or develop a multimedia project (N518) as the summative experience in the program. Either option is supervised by the student's academic advisor and requires a full report. (These courses are part of the core courses listed previously.) Students participating in the internship are placed in an academic technology setting or an industry setting for one semester of experience working with technology and multimedia experts. No thesis is required for the degree.

Online Program: Master of Science in Music Technology

The IUPUI Department of Music and Arts Technology offers the entire Master of Science in Music Technology program "live," using streaming video, videoconferencing and audio through the Internet. All course and degree requirements are the same as the on-campus program.

Admission Requirements

- Bachelor's degree (with demonstrated musical skills)
- Minimum grade point average of 3.0 (4.0 scale)
- Submission of a university and a department application
- Official transcripts of all undergraduate and graduate study
- Evidence of musicianship through performance videotape, audio cassette, or CD/DVD
- Three letters of recommendation are required to support the admission application
- In-person or telephone admission interview with the Head of Graduate Studies
- Non-native speakers must demonstrate English language proficiency with a minimum TOEFL score of 550/79 International students will also need to meet the application requirements of the IUPUI Office of International Affairs

Admission Categories

Upon receipt of the completed application, letters of recommendation, transcript, evidence of musicianship, and the interview, the Graduate Admissions Committee of the IU Department of Music and Arts Technology at IUPUI may grant regular admission, grant admission on probation, or reject the application.

Admission on Probation

Students who do not have an undergraduate and graduate grade point average of 3.0 or higher may be admitted on probation in exceptional cases. The probationary status continues until 9 credit hours of course work have been successfully completed. At this time student admission requests are re-evaluated. Students who are admitted on probation and incur academic problems during their semesters of study are subject to dismissal.

Degree Requirements

- 30 credit hours (18 hours at the 500 level or above)
- 6 credit hours in cognate courses (at the 400 level or above) to be selected from music, business, communications, computer science, education, fine arts, or law
- 6 credit hours of approved courses (at the 400 level or above) from the cognate field or other fields with the approval of the Head of Graduate Studies

Minimum Grade Point Average

- 3.0 average to continue
- No grades lower than B in core courses are counted toward the degree
- No grades lower than C are counted toward the degree

Virtual Residency Requirement

Course enrollment during three consecutive summers, or one summer and a contiguous academic term.

Core Courses

The following courses, 18 credit hours, are required of all students enrolled in the Master of Science in Music Technology program:

Class/Credit Hours

- N512 Foundations of Music Production - 3 cr.
- N513 Principles of Multimedia Technology - 3 cr.
- N514 Music Technology Methods - 3 cr.
- N515 Multimedia Design Applications in the Arts - 3 cr.
- N516 Advanced Interactive Design Applications in the Arts - 3 cr.
- N518 Arts Technology Major Project - 3 cr.

Total Credit Hours - 18

Cognate Field Courses

Six (6) credit hours are required in an approved cognate field within or outside the Department of Music and Arts Technology. Students may choose to complete the remaining six (6) credit hours with emphasis in one of the following areas: music, business, communications, computer science, education, fine arts, law, or others with the approval of the department. The cognate field may become a minor if at least 12 credit hours are taken in one field.

Technology Project

Students develop a multimedia project (N518) as the summative experience in the program. This project is supervised by the student's academic advisor and requires a full report. (This course is part of the core courses listed previously.) No thesis is required for the degree.

M.S. in Music Therapy

The Master of Science in Music Therapy program is designed to provide board-certified (MT-BC) music therapists with advanced skills and clinical skills in music therapy, and to teach music therapists how to utilize the array of tools available in music technology for such purposes. This degree is offered on campus and online.

Admission Requirements

1. Board certified by the Certification Board for Music Therapists (MT-BC)
2. Minimum grade point average of 3.0 (4.0 scale)
3. Submission of a university
4. Official transcripts of all undergraduate and graduate study
5. Three letters of recommendation
6. In-person or telephone admission interview with music therapy faculty
7. Non-native speakers must demonstrate English language proficiency with a minimum TOEFL score of 600/97. International students will also need to meet the application requirements of the IUPUI Office of International Affairs.

Admission Categories

Upon receipt of the completed application, letters of recommendation, transcript, and interview, the Graduate Admissions Committee of the Department of Music and Arts Technology may grant regular admission, grant admission on probation, or reject the application.

Admission on Probation

Students who do not have an undergraduate and graduate grade point average of 3.0 or higher may be admitted on probation in exceptional cases. The probationary status continues until 9 credit hours of course work have been successfully completed. At this time student admission requests are re-evaluated. Students who are admitted on probation and incur academic probation during their first semester of study are subject to dismissal.

Degree Requirements

- A total of thirty (30) credit hours are required for completion of the degree, including:
- 12 credit hours in music therapy (at the 500 level or above);
- 9 credit hours in core music technology courses (at the 500 level or above);
- 6 credit hours of electives (at the 500 level or above);
- 3 credit hours of thesis

Minimum Grade Point Average

- Minimum 3.0 average to continue
- No grades lower than B in core courses are counted toward the degree
- No grades lower than C are counted toward the degree

Core Courses

The following courses are required of all students enrolled in the Master of Science in Music Therapy program:

Class/Credit Hours

- N512 Foundations of Music Production - 3 cr.
- N513 Principles of Multimedia Technology - 3 cr.
- N514 Music Technology Methods - 3 cr.
- N521 Research Methods in Arts and Music Technology - 3 cr.
- N530 Philosophy and Theory in Music Therapy - 3 cr.
- N531 Music Therapy Quantitative and Qualitative Research - 3 cr.
- N532 Music in Medicine - 3 cr.
- N533 Advanced Clinical Techniques in Music Therapy - 3 cr.
- N600 Music Therapy Thesis - 3 cr.

IUPUI Music Academy

The IUPUI Music Academy is a non-profit community music school, within the Department of Music and Arts Technology, committed to providing high quality, professional music instruction to area residents of all ages and ability levels. The academy serves over 500 people each year, ages 18 months through adulthood, by offering music classes for children and adults, ensembles, and private lessons. The academy is a member of the National Guild of Community Schools of the Arts.

For more information, contact:

IUPUI Music Academy
535 W. Michigan Street, Room 378
Indianapolis, IN 46202
musacad@iupui.edu
Phone: (317) 278-4139
Fax: (317) 278-2590
Web:

Mechanical and Energy Engineering (MEE)

Mechanical and Energy Engineering (MEE)

Professors J. Chen *(Chair),* R. Nalim, N. Paydar
Associate Professors S. Anwar, H. El-Mounayri, A. Jones, T. Katona, J. Xie, L. Zhu
Assistant Professors P. Dehrer, Y. Fu, C. Larriba, T. Lawrence, J. Ryu, A. Tovar, D. Wagner, H. Yu, J. Zhang
Lecturers K. Kincaid, J. Mendez, A. Razban

The Department of Mechanical and Energy Engineering offers programs at the bachelor's, master's, and doctoral levels. At the bachelor's level, programs described here lead to the Bachelor of Science in Mechanical Engineering (B.S.M.E.), the Bachelor of Science in Energy Engineering (B.S.E.E.N.), and the Bachelor of Science in Engineering (B.S.E.), an interdisciplinary degree. Students enrolled in the department study under faculty actively engaged in research in a variety of areas: advanced materials, biomechanics, combustion, composites, computational fluid dynamics, computer-aided design, control, experimental mechanics, fluid mechanics, finite element methods, fracture, heat transfer, manufacturing, renewable energy, battery technology, fuel cell technology, mechatronics, hybrid electric vehicles technology, robotics, solid and structural mechanics, turbomachinery, and vibration. For more information, contact the Department of Mechanical and Energy Engineering at (317) 274-9717 or visit the Department's website at www.engr.iupui.edu/department/me/index.php.

Energy Engineering

B.S. in Energy Engineering

This program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org

Energy Engineering at IUPUI is an interdisciplinary engineering degree housed in the Mechanical Engineering Department. It is a four-year Purdue University Bachelor's degree that is only offered on the IUPUI campus in Indianapolis, IN. For more details, visit the Energy Engineering website:http://engr.iupui.edu/departments/me/undergrad/bseen/index.php.

We combine courses from chemistry, mechanical engineering, physics and electrical engineering to create a strong knowledge base essential to success in this industry. Students also have the opportunity to take courses concentrating on critical energy issues such as green building, hybrid and electric transportation, fuel cells and bio fuels, and energy systems such as wind, solar and nuclear.

Whether entering the workforce directly or continuing on to further education, graduates of this program will leave equipped to tackle the exciting and meaningful challenges ahead on the energy horizon.

Graduates of the energy engineering program at IUPUI will:

1. meet or exceed the expectations of their employers.
2. pursue advanced study if desired.

3. assume leadership roles in their professions and/or communities

Semester by semester, the 128 total credit hours are distributed as follows:

Freshman Year

First Semester (17 credit hours)

- ENGR 19500 Introduction to Engineering Profession: 1 credit hour
- ENGR 19600 Introduction to Engineering: 3 credit hours
- MATH 16500 Integrated Calculus and Analytic Geometry: 4 credit hours
- CHEM-C 10500 Chemical Science I: 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication: 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry: 3 credit hours

Second Semester (16 credit hours)

- ENGR 19700 Introduction to Programming Concepts: 2 credit hours
- MATH 17100 Multidimensional Mathematics: 3 credit hours
- MATH 16600 Integrated Calculus and Analytic Geometry II: 4 credit hours
- PHYS 15200 Mechanics: 4 credit hours
- General Education Elective: 3 credit hours

Sophomore Year

Third Semester (17 credit hours)

- ENGR 29700 Computer Tools for Engineering: 1 credit hour
- MATH 26100 Multivariate Calculus: 4 credit hours
- PHYS 25100 Heat, Electricity, and Optics: 5 credit hours
- EEN 22000 Fundamentals of Electrochemical Materials & Energy Engineering: 3 credit hours
- ME 20000 Thermodynamics I: 3 credit hours
- EEN 22501 Energy Engineering Lab 1: 1 credit hour

Fourth Semester (17 credit hours)

- ECE 20400 Introduction to Electrical and Electronic Circuits: 4 credit hours
- MATH 26600 Ordinary Differential Equations: 3 credit hours
- EEN 24000 Basic Mechanics: 4 credit hours
- EEN 26000 Sustainable Energy: 3 credit hours
- EEN 26200 Engr. Design, Ethics and Entrepreneurship: 2 credit hours
- EEN 25001 Energy Engineering Lab 2: 1 credit hour

Junior Year

Fifth Semester (16 credit hours)

- ECE 49500 Fundamentals of Electrical Energy Engineering: 3 credit hours
- EEN 33000 Dynamic Systems Modeling and Measurements: 3 credit hours
- ME 27200 Strength of Materials: 3 credit hours
- EEN 31000 Fluid Mechanics: 3 credit hours
- ME 32700 Engineering Economics: 3 credit hours
- EEN 32501 Energy Engineering Lab 3: 1 credit hour

Sixth Semester (16 credit hours)

- ME 31400 Heat and Mass Transfer: 3 credit hours
- EEN 34500 Renewable Energy Systems and Design: 3 credit hours
- EEN Elective: 3 credit hours
- Statistics Elective: 3 credit hours
- GEN ED Elective General Education Elective: 3 credit hours
- EEN 35001 Energy Engineering Lab 4: 1 credit hour

Senior Year

Seventh Semester (15 credit hours)

- EEN 44500 Compressible Flow and Renewable Kinetic Energy Design: 3 credit hours
- ECE 32100 Electromechanical Motion Devices: 3 credit hours
- ME 48200 Control Systems Analysis and Design: 3 credit hours
- EEN Elective: 3 credit hours
- TCM 36000 Communication in Engineering Practice: 2 credit hours
- EEN 42501 Energy Engineering Lab 5: 1 credit hour

Eighth Semester (14 credit hours)

- EEN 46200 Capstone Design: 3 credit hours
- EEN Elective: 3 credit hours
- EEN Elective: 3 credit hours
- General Education Elective: 3 credit hours
- TECH Elective: 2 credit hours

Mechanical Engineering

B.S. in Mechanical Engineering

This program is accredited by the Engineering Accreditation Commission of ABET,www.abet.org.

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 by extensive computer experience in such areas as computer-aided design and numerical problem solving. The program's flexibility allows students to specialize in their area of interest through choosing electives. 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.

Graduates of the mechanical engineering program at IUPUI will:

1. meet or exceed the expectations of their employers.

2. pursue advanced study if desired.

3. assume leadership roles in their professions and/or communities.

The number of credit hours required for graduation is 128.

Freshman Year

First Semester (14 credit hours)

- ENGR 19500 New Student Seminar: 1 credit hour
- ENGR 19600 Introduction to Engineering: 3 credit hours
- CHEM-C 10500 Chemical Science I: 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication: 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I: 4 credit hours

Second Semester (16 credit hours)

- ENGR 19700 Introduction to Programming Concepts: 2 credit hours
- ENG-W 131 Reading, Writing, and Inquiry: 3 credit hours
- MATH 16600 Analytic Geometry and Calculus II: 4 credit hours
- PHYS 15200 Mechanics: 4 credit hours
- MATH 17100 Multidimensional Mathematics: 3 credit hours

Sophomore Year

Third Semester (17 credit hours)

- ENGR 29700 Computer Tools for Engineering: 1 credit hour
- ME 20000 Thermodynamics I: 3 credit hours
- ME 27000 Basic Mechanics I: 3 credit hours
- MATH 26100 Multivariate Calculus: 4 credit hours
- PHYS 25100 Heat, Electricity, and Optics: 5 credit hours
- ME 22501 Mechanical Engineering Lab 1: 1 credit hour

Fourth Semester (16 credit hours)

- ME 32700 Engineering Economics: 3 credit hours
- ME 26200 Engineering Design, Ethics and Entrepreneurship: 2 credit hours
- ME 27400 Basic Mechanics II: 3 credit hours
- ECE 20400 Introduction to Electrical and Electronic Circuits: 4 credit hours
- MATH 26600 Ordinary Differential Equations: 3 credit hours
- ME 25001 Mechanical Engineering Lab 2: 1 credit hour

Junior Year

Fifth Semester (16 credit hours)

- ME 27200 Mechanics of Materials: 3 credit hours
- ME 33000 Modeling and Analysis of Dynamic Systems: 3 credit hours
- ME 31000 Fluid Mechanics: 3 credit hours
- Statistics Elective: 3 credit hours
- General Education Elective: 3 credit hours
- ME 32501 Mechanical Engineering Lab 3: 1 credit hour

Sixth Semester (15 credit hours)

- ME 34400 Introduction to Engineering Materials: 3 credit hours
- ME 31400 Heat and Mass Transfer: 3 credit hours
- ME 37200 Design of Mechanisms: 3 credit hours
- ME 35001 Mechanical Engineering Lab 4: 1 credit hour
- ME 34000 Dynamic Systems and Measurements: 2 credit hours
- General Education Elective: 3 credit hours

Senior Year

Seventh Semester (18 credit hours)

- ME 41400 Thermal-Fluid Systems Design or ME 45310 Machine Design: 3 credit hours
- ME 48200 Control Systems Analysis and Design: 3 credit hours
- TCM 36000 Communication in Engineering Practice: 2 credit hours
- TECH Elective: 3 credit hours
- General Education Elective: 3 credit hours
- Restricted Elective: 3 credit hours
- ME 42501 Mechanical Engineering Lab 5: 1 credit hour

Eighth Semester (16 credit hours)

- ME 49700 Robust Design, Standards and Contemporary Issues: 1 credit hour
- ME 46200 Capstone Design: 3 credit hours
- TECH Elective: 3 credit hours
- TECH Elective: 3 credit hours
- Science/TECH Elective: 3 credit hours
- General Eduction Elective: 3 credit hours

The complete list of approved electives can be found athttp://engr.iupui.edu/departments/me/courses/me/index.php and the curriculum may be found by clicking: http://engr.iupui.edu/departments/me/undergrad/bsme/curriculum.php

B.S. in Engineering - Interdisciplinary 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 plan of study outlined for the B.S.M.E. student. 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 advisors to develop 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 and Energy has interdisciplinary engineering options in the following related fields of mechanical engineering

- Construction Engineering Management

http://engr.iupui.edu/departments/me/undergrad/bse/index.php

For information about other available options, please consult faculty in the Department of Mechanical and Energy Engineering or visit the Department's Undergraduate Programs website.

Major area courses should be discussed with the Associate Chair.

Graduate Programs in Mechanical Engineering

The Department of Mechanical Engineering has an outstanding and dedicated faculty with expertise and research interests in the areas of advanced manufacturing, bioengineering and biological systems, combustion and new engine design, design optimization, fluid mechanics, heat transfer, hybrid & electic vehicles, materials processing, mechanics and vibration, nanotechnology, renewable energy, and control systems. The faculty actively engaged in the frontiers of research and technologies in real-world engineering challenges in the above areas.

The department offers graduate programs of study that lead to various graduate certificates and the degrees of Master Science (M.S.), Master of Science in Engineering (M.S.E.), Master of Science in Mechanical Engineering (M.S.M.E.), and Doctor of Philosophy (Ph.D.). The program leading to the Ph.D. in mechanical engineering is jointly administered with the School of Mechanical Engineering at Purdue University, West Lafayette.

The department also offers combined bachelor's and master's degree programs, in which students can receive both B.S. and M.S. degrees in five years at IUPUI. These degree programs are open to qualified undergraduates at IUPUI, leading to either: 1) B.S. and M.S.M.E. degrees (B.S./M.S.M.E.) for mechanical engineering undergraduates, or 2) a B.S. degree in physics and an M.S. degree in mechanical engineering (B.P.M.M.E.) for physics undergraduates. The combined degrees prepare students for advanced engineering careers with two degrees (bachelor's and master's) in five years.

For more information about graduate programs visit: http://engr.iupui.edu/department/me/grad/index.php.

Technology Leadership & Communication (TLC)

Chair: C. Feldhaus, Professor of Organizational Leadership
Graduate Programs: M. Hovde, Associate Professor of Technical Communication
Undergraduate Program Director: E. Wager (OLS Lecturer)

The department of Technology Leadership and Communication (TLC) equips today's students with the leadership and communication knowledge, skills, and perspectives in order to augment their technical expertise to make effective contributions in a variety of organizational settings. Our undergraduate degrees and certificates in Organizational Leadership (OLS) and Technical Communication (TCM) offer students a well-rounded education that connects theory with practice. The M.S. in Technology provides professionals with an interdisciplinary credential to students interested in honing their leadership skills while drawing on a technical foundation.

TLC's faculty and staff are committed to student success. Our values:

- Excellence: Academic excellence is our top priority. We pursue excellence in learning, teaching, research and creative activities, and civic engagement as the highest indicators of successful achievement.
- Competition: Competition enhances innovation. We strive to compete at the highest levels in the pursuit of extramural support for our students, as well as for our research and creative activities.
- Collaboration: We promote teamwork and partnerships for solving problems and disseminating and transferring knowledge, thus multiplying our accomplishments.
- Diversity: We value diversity in all of its forms in our research, curricula, and pedagogy and in our faculty, staff, and student composition.
- Leadership: We encourage and reward effective leadership at every level within TLC.
- Location: We are fortunate enough to be located in the vibrant city of Indianapolis and we strive to capitalize on the urban setting to address the challenges of a global society.
- Professionalism: We foster and reward high standards of collegiality and integrity.
- Responsiveness: We are committed to community and professional service to meet the needs of our stakeholders.

Technical Communication

Technical Communication

Assistant Professor: C. Renguette (TCM Director)
Associate Professor: M. Hovde
Lecturer: M. Baechle

Rapid advances in technology increase the need to communicate complex technical information effectively to a variety of audiences and users. Technical communicators use technology to create necessary resources such as user manuals, online help, websites, training materials, specifications, etc.

Technical Communication Bachelor of Science Degree

The B.S. degree in Technical Communication requires 120 credit hours in four core areas to prepare students for professional practice in technical communication and related careers. All courses in Core Area 1 must be completed with a grade of C or better; overall GPA must be 2.0 to graduate.

Core Area 1. Technical Communication - 60 credit hours (36 required, 24 elective)
Core Area 2. Science, Technology, Engineering, Mathematics (STEM) - 18 elective credit hours
Core Area 3. General Education - 30 credit hours
Core Area 4. Relevant Electives - 12 credit hours

Certificate in Technical Communication
The Certificate in Technical Communication requires 19 credit hours. Students will complete 13 hours of required courses and 6 hours of selected courses.

Required Courses: 13 credits hours

- *Choose either* - TCM 23000 Principles and Practices of Technical Communication or TCM 22000 Technical Report Writing - 3 credit hours
- TCM 24000 - Tools for Technical Communication - 3 credit hours
- TCM 31000 - Technical and Scientific Editing - 3 credit hours
- *Choose eithe*r - TCM 25000 Career Planning in Engineering and Technology or TCM 43500 Portfolio Preparation - 1 credit hour
- Choose one technical or scientific course at or above the 200 level - 3 credit hours

Selected Courses: 6 credits hours

Choose 2 courses from this list:

- TCM 32000 - Written Communication in Science and Industry - 3 credit hours
- TCM 35000 - Visual Technical Communication - 3 credit hours
- TCM 38000 - Technical Communication in the Healthcare Professions - 3 credit hours
- TCM 39500 - Independent Study - 3 credit hours
- TCM 42000 - Field Experience - 3 credit hours
- TCM 42500 - Managing Document Quality - 3 credit hours
- TCM 45000 - Research Approaches for Technical & Professional Communication - 3 credit hours
- One relevant, approved course from another department - 3 credit hours

Organizational Leadership

Organizational Leadership

Professors: S. Hundley, C. Feldhaus
Clinical Professors: P. Fox
Assistant Professors: B. Sorge (STEM Education), J. Kim, K. Reed Hughes
Senior Lecturer: R. Wolter
Visiting Lecturer: C. Krull
Administrative Specialist: M. Haug

Organizational Leadership (OLS) provides a broad-based education for those students who desire leadership roles in business, government, technology and industry. A guiding vision of the department is to close the gap between theory and practice. In addition to a Bachelor of Science (B.S.) degree, OLS offers certificates in Human Resource Management, International Leadership, and Leadership Studies.The Certificate in Leadership Studies offers non-majors an opportunity to better understand leadership in today's complex organizations.

All OLS programs are flexible to meet the needs of both traditional and nontraditional students. As part of a relevant and practical field of study, OLS programs integrate a series of core courses with a choice of electives that permit students to earn multiple degrees, certificates, or minors. Core OLS courses offer a strong foundation in leadership, communication and general education, mathematics, and science. Concentration tracks allow students to develop their interests and talents within a particular technical or related field. Students who have successfully completed an A.S. or A.S.S. degree from Ivy Tech, Vincennes University, or another regionally accredited 2-year or 4-year institution can apply up to 64.0 credit hours of transfer credit towards completion of the IUPUI General Education Core, 24.0 credit hour related area of study outside of OLS, and other elective areas. Students who have not completed a 2-year degree program are encouraged to complete a minor, certificate, or dual baccalaureate degree through the completion of their related area of study.

Program Learning Outcomes

Students who graduate with the B.S. in Organizational Leadership will know:

- process and roles of leadership,
- effective traits of leadership,
- how leadership behavior and power influences people and organizations,
- how to apply situational approaches to leadership, and
- strategies for leading during times of uncertainty, turbulence, and change.

Students who graduate with the B.S. in Organizational Leadership will be able to:

- design and conduct organizational research, as well as analyze and interpret data,
- reflect and evaluate personal leadership style and effectiveness,
- reflect and evaluate an organization's effectiveness and sustainability,
- reflect and evaluate an organization's social and environmental impact,
- provide leadership for processes and functions within and organization such that it will meet or exceed desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, and sustainability,
- function on diverse teams,
- identify, formulate, and recommend solutions for organizational problems,
- understand professional and ethical responsibility,
- communicate effectively verbally and nonverbally to variety of audiences and contexts,
- understand the impact of leadership in a global, economic, environmental and societal context, and
- apply techniques, skills, tools, and concepts necessary for effective strategic planning.

Transfer Students

Where applicable, OLS accepts credit hours earned at Ivy Tech, Vincennes University or other similarly accredited colleges and universities to satisfy up to 64.0 credit hours of general education core and selective B.S. degree requirements.

For more information or to make an advising appointment, call(317) 278-1313or email tlcgroup@iupui.edu.

Bachelor of Science: Organizational Leadership

Organizational Leadership requires a total of 120 credit hours of department approved coursework. Students will complete the required 30.0 credit hours IUPUI General Education Core, 46.0 credit hours of OLS-specific courses including the 25.0 credit hour OLS Core Curriculum (10000, 25200, 26300, 27400, 32700, 37100,38300, 38500, 39000, 48700, and 49000); and additional 15.0 credit hours of upper level OLS electives, a minimum of 24.0 credit hours towards a minor, certificate, applied technology, or career-focused area of study; TCM 25000 or similar career planning course; 3.0 credit hours of business, technical, or professional writing; TCM 32000, and 16.0 credits of other approved electives.

OLS majors should complete Option 2: Take 3 credits of college math from List A and from List B.

Graduate Programs

The School of Engineering and Technology offers eight graduate degrees at the Master's level: Master of Science in Biomedical Engineering (M.S.B.M.E.), Master of Science in Electrical and Computer Engineering (M.S.E.C.E.), Master of Science in Mechanical Engineering (M.S.M.E.), Master of Science in Music Technology (M.S.M.T.), Master of Science in Music Therapy (M.S.M.Th.), Master of Science in Engineering (M.S.E.), Master of Science in Technology (M.S.T.), and Master of Science (M.S.).

Qualified students may pursue Ph.D. degrees in biomedical engineering, or mechanical engineering at IUPUI through co-operative doctoral programs jointly administered with the respective schools at Purdue University, West Lafayette. Students are usually expected to complete the M.S.E.C.E. or M.S.M.E. before pursuing the Ph.D. degree. The School also offers independent Ph.D. degrees in electrical and computer engineering, a Purdue University degree and in Music Technology, an Indiana University degree.

Students completing a master’s or doctoral degree through any of our programs will be well-prepared to enter the work force at a high level of responsibility and expertise. Knowledge of the dynamics of expanding new technologies and the strategic importance of high productivity prepares master’s degree graduates to advance rapidly in today’s business and industries.

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 full-time students who are preparing for careers in research. The M.S. degrees in Music Technology and Music Therapy are also offered entirely online.

For more information, call (317) 278-4960, send e-mail to etinfo@iupui.edu, or visit the Web site: www.engr.iupui.edu/main/academics/grad/index.php.

Admissions

Admissions
For information and details regarding application and admission to graduate engineering or technology programs offered by the School go to this website:

www.engr.iupui.edu/gradprogs/index.shtml

ECE Department Master's admissions information:
www.engr.iupui.edu/departments/ece/grad/admissions/index.php

ECE Department Ph.D. admissions information:
www.engr.iupui.edu/departments/ece/grad/phd-degree-programs.php

Student Learning Outcomes

Student Learning Outcomes
The School of Engineering & Technology has organized its Graduate Student Learning Outcomes by program. Please choose the appropriate program in the links below, or the left-hand navigation.

Any questions or concerns about the Student Learning Outcomes should be directed to the Office of Academic Programs in ET 215.

Engineering
- Master of Science in Biomedical Engineering
- Master of Science in Electrical & Computer Engineering
- Master of Science in Mechanical Engineering

Technology
- Master of Science in Technology
- Master of Science in Music Technology*
- Master of Science in Music Therapy*

*Music & Arts Technology students are awarded Indiana University degrees.

Biomedical Engineering

Biomedical Engineering
Upon completion of the Master's degree (**with thesis**) in Biomedical Engineering at IUPUI, students will be able to:

1. Assess the quality and relevance of published results from the literature.
2. Apply appropriate laboratory, computational, and analysis techniques in the service of answering a research question or contributing to product development relevant to biomedical engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) the results and implications of biomedical research.

Upon completion of the Master's degree (**non-thesis**) in Biomedical Engineering at IUPUI, students will be able to:
1. Apply the tools of mathematics, science, and engineering to solve problems at the interface of engineering and biology.
2. Demonstrate knowledge of biological and physiological principles that advance the broad spectrum of life science application areas that is biomedical engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) information related to the theory and practice of biomedical engineering in research, clinical or industrial settings.

Electrical & Computer Engineering

Electrical & Computer Engineering

Graduates of the Masters program in ECE will have the ability to:

1. Apply their knowledge and skills to solve advanced Electrical and Computer Engineering problems.
2. Conduct research in topics within the electrical and computer engineering area.
3. Communicate effectively.

Mechanical Engineering

Mechanical Engineering

Upon completion of the Master's degree (**with thesis**) in Mechanical Engineering at IUPUI, students will be able to:

1. Assess the quality and relevance of published results from the literature.
2. Apply appropriate laboratory, computational, and analysis techniques in the service of answering a research question or contributing to product development relevant to mechanical engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) the results and implications of mechanical engineering research.

Upon completion of the Master's degree (**non-thesis**) in Mechanical Engineering at IUPUI, students will be able to:

1. Apply the tools of mathematics, science, and engineering to solve problems in the broad area of mechanical engineering.
2. Demonstrate knowledge of mechanical engineering principles that advance the broad spectrum of application areas that is mechanical engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) information related to the theory and practice of mechanical engineering in research or industrial settings.

Technology

Technology

Upon program completion, students will be able to:

1. Identify, explain, and compare the major quantitative and qualitative approaches in measurement and evaluation within industrial, technological, educational and/or organizational contexts.
2. Use appropriate quantitative and qualitative approaches to measure and evaluate a variety of phenomena in industrial, technological, educational, and organizational settings.
3. Explain, identify, apply and utilize quantitative and qualitative processes to develop and sustain organizational cultures that emphasize quality, productivity, and continuous improvement.
4. Recognize the importance of evidence-based decision-making in industrial, technological, educational, and organizational contexts.
5. Locate and evaluate the credibility and appropriateness of research and applied studies for use in problem-solving in industrial, technological, educational, and organizational contexts.
6. Select and plan an in-depth area of study in industry, technology, education, and/or organizational leadership related to the one's personal, academic, and/or professional objectives.
7. Identify, explain, and apply major theories, concepts, models, and approaches from an in-depth discipline within industry, technology, educational, and/or organizational leadership.
8. Design and implement an appropriate project related to a specifically-identified research or applied problem in an industrial, technological, educational, or organizational context.
9. Conduct a literature review or benchmarking analysis, gather and analyze relevant data, develop sound conclusions and recommendations, and present findings in professionally-presented oral and written reports.

Music Technology

Music Technology

Upon completion of the program, students will be able to:

GENERAL

1. Investigate the components of music technology.
2. Assess commonly used music software and hardware.
3. Determine best-fit music production models for creative operations.
4. Assess personal skills and knowledge of music production field.
5. Investigate the components of music technology.
6. Explain the basic computing concepts of music sequencing and notation, including the digital electronic process with analysis of microchips and microprocessors.
7. Describe the function and operational technique of hardware components used in a typical computer music system.
8. Determine music technology project cost analysis for human resources and materials.
9. Develop a theoretical position on ethical use of technology.
10. Discuss the ethical considerations and legal implications of using software and intellectual property.
11. Final Project Example: Develop a new tool, resource, application, artistic production, literary work, or another form of informed expression that utilizes new technologies. Take the project through planning, production and completion stages, and writing pre and post assessments.
12. Identify and evaluate innovative entities in a specific area of music technology.
13. Develop a music program design utilizing storyboard and flowchart modeling.
14. Apply software to create music notation, sound samples, and music graphics.
15. Define Musical Instrument Digital Interface (MIDI) and outline its development.
16. Review major software applications related to music sequencing, timing codes, editing, notation, multimedia, and computer-based instruction.
17. Demonstrate conceptual understanding of the multimedia project design process.

18. Demonstrate understanding of psychological concepts that affect multimedia project design.
19. Learn standard media formats that are used to create media products.
20. Create a DVD or website that employs sound, text, video and or animation.
21. Submit a proposal for the final project or internship.
22. Develop a multimedia project determining project parameters, using flowcharts to display project organization, generating subject content, scripting, storyboarding, testing a beta version of the project, and submitting a full proposal.
23. Engage in ownership and responsibility for his or her culminating set of personal, academic, and professional experiences related to the internship.
24. Apply APA style guidelines in citations and written reviews.
25. Complete a report of the final project or internship in APA style.
26. Describe the nature, purposes, and types of research in technology-based arts.
27. Access and use databases, journals, and other sources of research reports and summaries, including library-based medias and online resources.
28. Recognize and interpret the basic language and vocabulary of statistics used in selected research reports.
29. Evaluate research in a systematic manner; analyze and review research.
30. Retrieve, critique, and summarize research independently.
31. Develop and review a researchable question in a written proposal.

PERFORMANCE/COMPOSITION/OTHER CREATIVE ACTIVITIES

1. Collaborate in a music production as a team member to produce a music recital.
2. Describe the function and operational technique of hardware components used in a typical computer music system.
3. Enter simple to complex music into a computer utilizing a QWERTY and synthesizer keyboard and a mouse with correct notational aesthetics.
4. Demonstrate, in a musical composition, the use of the synthesizer keyboard programming techniques and controller features (multitimbral channels, sound envelope manipulation, wheel, pedal, and sliders).
5. Use a software application to capture, edit, organize and perform with or otherwise use digital sounds.
6. Delineate the elements of MIDI messages in relation to musical performance or composition (e.g. bits, commands, status and data bytes to pitch, amplitude, velocity; and channel numbers to multitimbral composition).
7. Discuss and give examples of serial and parallel transmission including function of the MIDI connector for MIDI, out and thru.
8. Demonstrate the use of MIDI control surfaces.

PROGRAMMING

1. Program a digital audio workstation and MIDI to orchestrate and playback notated music on a synthesizer.
2. Discuss and give examples of serial and parallel transmission including function of the MIDI connector for MIDI, out and thru.
3. Explain the relationship between various MIDI numbering systems (decimal, binary, octal, and hexadecimal) and some elements of musical expression (pitch, velocity).
4. Recognize and analyze channel voice and mode messages, system commas, real time, and exclusive messages.

SCHOLARSHIP

1. Develop a theoretical position on ethical use of technology.
2. Develop a music program design utilizing storyboard and flowchart modeling.
3. Describe the function and operational technique of hardware components used in a typical computer music system.
4. Define Musical Instrument Digital Interface (MIDI) and outline its development.

MUSIC EDUCATION, SCIENCE, THERAPY/, AND HEALTH RELATED STUDIES

1. Identify and evaluate cognitive theories that apply to computer-based training.
2. Test feedback models and human interface designs.
3. Determine project cost analysis for human resources and materials.
4. Describe the function and operational technique of hardware components used in a typical computer music system.
5. Final Project Example: Develop research projects utilizing new technologies for music classroom environments, and prepared final software project model as an educational proposal presentation for a school governing board.
6. Describe the function and operational technique of hardware components used in a typical computer music system.
7. Explain the basic computing concepts of music sequencing and notation, including the digital electronic process with some analysis of microchips and microprocessors.
8. Describe the role of technology as it relates to communication, information competency, creativity, and music education.

BUSINESS AND MUSIC INDUSTRY

1. Collaborate in a music production as a team member to produce a music recital.
2. Identify and evaluate companies involved in music technology production.
3. Develop a music program design utilizing storyboard and flowchart modeling.
4. Apply software to create music notation, sound samples, and music graphics.
5. Develop a music program design utilizing storyboard and flowchart modeling.
6. Select and apply software tools to project management and timeline projections.
7. Determine project cost analysis for human resources and materials.

8. Present final software project model as a proposal presentation for a client.
9. Describe the function and operational technique of hardware components used in a typical computer music system.
10. Explain the basic computing concepts of music sequencing and notation, including the digital electronic process with some analysis of microchips and microprocessors.
11. Broaden experience and realistic understanding of applied arts technology within a selected industry (or, industries).
12. Synthesize, integrate, and extend their development of applied arts technology skills in the context of corporate environments and IT needs.
13. Construct, implement, and evaluate units of work based on appropriate learning experiences which address assigned project outcomes and capstone requirements.
14. Extend appreciation of the role of music and arts technology within the chosen industry through discussion, reflection and/or demonstration of work projects.
15. Broaden understanding of the role of project design, evaluation, and reporting in the implementation of arts technology within a given industry through facilitated, mentored, guided, and independent learning experiences.
16. Describe the components of self-marketing and entrepreneurship.
17. Review jobs in the music industry: managers, lawyers, producers, agents, manufacturers, sales, promoters, media and technical.

Music Therapy

Music Therapy

Upon program completion, students will be able to:

1. Apply knowledge from music therapy, music medicine, music technology, biological and behavioral sciences to investigate health phenomena.
    - Use criteria to evaluate theories related to individual's focus area.
    - Synthesize knowledge from psychometric theories and research as it relates to reliability and validity of measurement instruments.
    - Synthesize empirical literature (integrative review) in focus domain such that development of proposal of research builds on background knowledge.
    - Define health/or health-related concept as the phenomena of concern for research focus.
    - Explain types of knowledge and methods for knowledge generation and philosophy of science underpinnings.
    - Synthesize knowledge from minor to apply to focus domain.
    - Describe the nature, purposes, and types of research in technology-based arts.
    - Investigate the components of music technology.
    - Describe the role of technology as it relates to communication, information competency, creativity, and music education/therapy.
    - Identify and evaluate companies involved in music technology production.
    - Assess commonly used music software and hardware.
    - Identify and evaluate cognitive theories that apply to music theory.
    - Identify problem in clinical practice that requires application of research findings.
    - Ability to synthesize research literature and identify gaps in knowledge.
    - Submit an integrative review article in research focus area.
    - Demonstrate skills in scientific writing.
2. Utilize analytical and empirical methods to extend music therapy knowledge and scholarship.
    - Know research vocabulary.
    - Describes research designs and methods for application to research questions.
    - Recognize and interpret the basic language and vocabulary of statistics used in selected research reports.
    - Understand the process of design and implementation of a research project.
    - Review, summarize and critiques journal articles.
    - Critically analyzes various forms of analytical and empirical methods to generate knowledge and scholarship in music therapy.
    - Explore potential application of knowledge utilization in clinical practice.
    - Interpret research findings appropriately for application to practice.
    - Apply knowledge of descriptive and interferential analytical methods to answer research questions.
    - Explore potential application of knowledge utilization in clinical practice.
    - Apply knowledge of analytical methods to experimental design.
    - Formulate research questions or hypotheses.
    - Demonstrate ability to logically link problem identification to research hypothesis and application to practice.
    - Demonstrate data management skills.
    - Choose data collection methods or instruments consistent with theory and research question.
    - Apply APA style guidelines in citations and written reviews.
    - Develop and present a convincing written and oral argument that supports the method of choice for thesis.
    - Prepare a research proposal that builds on current research and theory.
    - Complete a report of the final project in APA style.
    - Conduct and communicate research that advances the body of scientific knowledge.
    - Prepare a data-based manuscript based on research experiences.

3. Conduct and communicate research that advances the body of scientific knowledge.
   - Identify and describe major and changing forces in healthcare and the music therapy profession.
   - Conduct and communicates research that advances the body of scientific knowledge.
   - Develop and present a convincing written argument that supports the significance of a specified problem.
   - Prepare a thesis proposal that builds on current research and theory.
   - Discuss the ethical considerations and legal implications of using software.
4. Develop a theoretical position of ethical use of technology.
5. Discuss ethical considerations when utilizing human subjects in research.
6. Engage in ownership and responsibility for his or her culminating set of personal, academic, and professional experiences.
7. Work effectively as a working member of a research team.

Contact Information

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Dept. of Music and Arts Technology
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Phone: 317.278.1311

Degree Programs

Degree Programs

- Master of Science (M.S.)
- Master of Science in Biomedical Engineering (M.S.B.M.E.)
- Master of Science in Electrical and Computer Engineering (M.S.E.C.E.)
- Master of Science in Engineering (M.S.E.)
- Master of Science in Mechanical Engineering (M.S.M.E.)
- Master of Science in Music Technology (M.S.M.T.)
- Master of Science in Music Therapy (M.S.M.Th.)
- Master of Science in Technology (M.S.T.)
- *Doctor of Philosophy in Biomedical Engineering (Ph.D.Bm.E.)
- *Doctor of Philosophy in Electrical and Computer Engineering (Ph.D.E.C.E.)
- *Doctor of Philosophy in Mechanical Engineering (Ph.D.M.E.)
- Doctor of Philosophy in Music Technology (Ph.D.)

*Jointly offered with Purdue University, West Lafayette.

Graduate Programs in Biomedical Engineering
Biomedical engineering is an interdisciplinary program and a joint effort of the Purdue School of Engineering and Technology, the Purdue School of Science, and the Indiana University Schools of Medicine and Dentistry at Indiana University–Purdue University at Indianapolis (IUPUI). In addition to these participating academic units, the program operates in close collaboration with several centers and facilities on campus, and with the Department of Biomedical Engineering at Purdue University, West Lafayette.

Students interested in the M.S.B.M.E. degree may apply directly to the Department of Biomedical Engineering in the Purdue School of Engineering and Technology. Students planning to pursue the Ph.D. degree, apply directly to the Weldon School of Biomedical Engineering at West Lafayette, even though they may be resident and study on the Indianapolis campus.

Contact for Biomedical Engineering: bmegrad@iupui.edu

For more information about the M.S.B.M.E program visit: http://engr.iupui.edu/departments/bme/grad/index.php

For more information about the Ph.D.B.M.E. program visit: http://engr.iupui.edu/departments/bme/grad/phdbme/index.php

Graduate Programs in Electrical and Computer Engineering
Students may earn the Master of Science in Electrical and Computer Engineering (M.S.E.C.E.) or the Master of Science in Engineering (M.S.E.), through the Department of Electrical and Computer Engineering at the Purdue School of Engineering and Technology at IUPUI. The M.S.E.C.E. degree is organized into several areas of study, including computer engineering, controls and automation, communication and signal processing, and

VLSI and circuit design. The M.S.E. degree provides an interdisciplinary plan of study and is typically offered to Bachelor's degree holders in fields other than electrical or computer engineering. Students with bachelor's degrees in fields other than electrical or computer engineering may pursue the M.S.E.C.E. if they successfully complete the prescribed prerequisite courses.

Qualified research-oriented students may be approved to pursue the Ph.D. degree in electrical and computer engineering at IUPUI. The Ph.D. degree is a research-oriented degree, which is organized into several areas of study, including computer engineering, controls and automation, communication and signal processing, VLSI and circuit design and power and energy.

Contact for Electrical and Computer Engineering: ecegrad@iupui.edu

For more information about the M.S.E.C.E. program visit: http://engr.iupui.edu/departments/ece/grad/index.php

For more information about the ECE Ph.D. program visit: http://engr.iupui.edu/departments/ece/grad/phd-degree-programs.php

Graduate Programs in Mechanical Engineering
The Department of Mechanical Engineering has an outstanding engineering faculty with research interests and expertise in the areas of advanced computer-aided design and manufacturing, materials, biomechanics, composites, computational fluid dynamics, computer-aided design, combustion, controls, fluid mechanics, finite element analysis, fracture, heat transfer, propulsion, robotics, solid and structural mechanics, stress analysis, and turbomachinery. The department offers graduate programs of study that lead to the degrees of Master of Science (M.S.), Master of Science in Engineering (M.S.E.), Master of Science in Mechanical Engineering (M.S.M.E.), and Ph.D. in Mechanical Engineering (Ph.D.M.E.). The program leading to the Ph.D. in mechanical engineering is jointly administered with the School of Mechanical Engineering at Purdue University, West Lafayette.

The department also offers two accelerated combined bachelor's and master's degree programs, which enable students to complete both B.S. and M.S. degrees within five years. The combined degree programs are available to high achieving mechanical engineering undergraduates leading to a combined B.S. and M.S. degrees in M.E. (B.S./M.S.M.E.) or a combined B.S. degree in Physics and M.S. degree in Mechanical Engineering (B.P.M.M.E.) for high performing physics undergraduates. The combined degrees prepare students for advanced engineering careers with two degrees (bachelor's and master's) in five years.

In addition to graduate degree programs, the department also offers graduate certificate programs in the following areas:

- Graduate Certificate in Computer-Aided Mechanical Engineering
- Graduate Certificate in Energy Management and Assessment
- Graduate Certificate in Hybrid Electric Vehicle Technology
- Graduate Certificate in Systems Engineering

Additional information about graduate and combined programs in mechanical engineering and graduate certificates are provided at this website:

http://engr.iupui.edu/departments/me/grad/index.php
Graduate Programs in Music Technology The Master of Science in Music Technology **(M.S.M.T.)** program provides professional education in areas of computer-based music technology, multimedia and interactive design, and multimedia production techniques. The primary focus is on the development of research-related competencies and integration of research findings into the development and use of music technology with specialties in 1) recording, manipulation, and live sounds; 2) the creative production of electronic music and live electronics; and 3) music technology in education and predagogy. The program, offered online or on campus, is conferred by Indiana University and accredited by the National Association for Schools of Music. The **Ph.D. in Music Technolog**y extends the research emphasis of the M.S.M.T. and is designed for students with backgrounds in music technology, music, computer science, engineering, informatics, human computer interaction, and other related fields. The principal objective of the Ph.D. is to train graduate who will conduct research and develop transformative new technologies in music and the arts; examine the practices of designing, making, and managing music technology, and apply music technology in education and industry. The Ph.D. in Music Technology is offered on campus only.

http://www.engr.iupui.edu/departments/mat/grad/msmt.php **Master of Science in Music Therapy**
The Master of Science in Music Therapy (M.S.M.Th.) program is a professional program designed to provide board-certified music therapists with advanced research and clinical practice competencies. The M.S.M.Th. degree is unique, providing music therapists with the opportunity to infuse advanced music technology concepts and skills throughout the curriculum. The M.S. in Music Therapy leverages close collaborations with the IU Schools of Medicine, Nursing, Health and Rehabilitation Sciences, providing rich resources for inter-professional collaboration and learning. The program is accredited through the National Association of Schools of Music and approved by the American Music Therapy Association (AMTA). The degree, conferred by Indiana University, is offered online or on campus.

http://www.engr.iupui.edu/departments/mat/grad/msmth.php

Master of Science in Technology
The School of Engineering and Technology offers graduate education in technology in specific technology-related discipline areas with the primary goal of developing advanced technical skills for practitioners in industry. The Master of Science in Technology (M.S.T.) degree program is designed so that graduates holding a B.S. degree in a technology discipline or a related area can complete their degree as a full-time or part-time student while working full-time. The M.S. in Technology curriculum consists of a total of 33 credit hours with plans of study ranging from "course only" to those which include a directed project. The Technology academic departments jointly offering the M.S. in Technology degree are listed below.

Department of Computer Information and Graphics Technology (CIGT)
MS in Technology degree program with disciplines in:

- Information Security and Assurance (InfoSec)
- Applied Data Management and Analytics

Department of Engineering Technology (ENT)
MS in Technology degree program with disciplines in:

- Facilities Management (A fully online IFMA-accredited program)
- Motorsports

Department of Technology Leadership and Communication (TLC)
MS in Technology degree program with disciplines in:

- Organizational Leadership (OLS)
- Human Resource Development (HRD)
- Technical Communication (TCM)

Graduate Certificate in Human Resource Development

Housed with the Department of Technology, Leadership, and Communication, the 12 credit-hour graduate Certificate in Human Resource Development (HRD) can be earned by itself or in conjunction with earning the Master of Science in Technology. The HRD Certificate provides students with a solid foundation in the fundamentals of Human Resource Development knowledge and skills.

For more information about the Technology graduate programs visit: http://engr.iupui.edu/main/academics/grad/index.php

Courses

Key to Course Descriptions

The courses listed in this section will, for the most part, be offered during the 2014–16 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.

The numbering system for courses reflects the following levels:
10000-29900: courses normally scheduled for freshmen and sophomores.
30000-49900: courses normally scheduled for juniors and seniors.
50000-59900: dual-level courses that may be scheduled for seniors and for graduate students for graduate credits.

Architectural Technology

ART 11700 Construction Drafting and CAD (3 cr.) Class 3, Lab 3.This course is intended to introduce students to AutoCAD drafting fundamentals with an emphasis on construction graphics and drawing methods used in Interior Design and Architectural Technology. This is usually the first AutoCAD class for students and aims for students to master the basic commands. In addition understanding of the visualization needed to draw and create 2-dimensional objects, introduction to creating (construction documents) is emphasized.

ART 12000 Intro to Construction Drafting with BIM (3 cr.) Class 3, Lab 2. Introduction to drafting fundamentals using building information modeling (BIM), an intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructore. Autodesk Revit will be the software presented.

ART 15500 Residential Construction (3 cr.) P: ART 11700 Class 3, Lab 3. This course is designed to introduce students to the technical design of residential buildings using BIM software. Topics include, but are not limited to: understanding the use of materials, codes, graphic terminology/conventions and construction methods used within residential buildings and the application of this understanding to a set of architectural design and working drawings.

ART 21000 History of Architecture I (3 cr.) Class 3. An introduction to the history of architecture of the Western World from the Stone Age to skyscrapers based on lectures and readings from the required texts. Lectures and readings cover the historical development of architecture in the following topics: Stone Age, Egyptian & Mesopotamian, Greek, Roman, Early Christian, Islamic, Romanesque, Gothic, Renaissance, Baroque, and the Modern Era to the present. Note: A travel abroad section of this course is occasionally offered in the summer which allows students to experience a portion of this course in Italy.

ART 22200 Commercial Construction (3 cr.) P: ART 15500 Class 3, Lab 3. To introduce the student to the process of designing and drawing commercial buildings using BIM software. Topics include, but are not limited to: understanding the use of materials, codes, graphic terminology/conventions and construction methods used within commercial construction and the application of this understanding to a partial set of architectural working drawings.

ART 22300 3D Architectural Modeling I (3 cr.) Class 3. This course will study graphic solutions to visualizing interior spaces and environments by utilizing 3D modeling software. Students will learn the fundamentals and advanced toolset in 3D modeling software while working on a semester long visualization project.

ART 29900 Architectural Technology (3 cr.) Independent Study.

ART 32300 3D Architectural Modeling II (3 cr.) P: ART 22200 and CGT 22300. Class 3. This course has been designed to expand the students' knowledge, creativity, and technique when creating 3D digital models and renderings. This class is intended to develop and refine modeling and rendering skills. Topics include but are not limited to: understanding the use of architecture, materials, lighting, etc.

ART 29900 International Design Charrette (1-4 cr.) P: By Permission
Introduction to project-management tools and techniques; practical use of tools and techniques to plan, analyze, lead and monitor a project in collaborative international design. Course content is integrated into a collaborative-design project offered in connection with partner universities in Thailand. Other sections of this course may be offered in other locations where an approved study-abroad program is active. Students participating in domestic service-learning projects may be eligible. Please note that this

is a variable credit course and those seeking transfer credit for OLS 37100 must sign up for 3 credit hours. This will involve pre-departure orientation sessions, course assignments while in country as well as assignments and a paper due upon completion of the course (post-travel). Students signing up for fewer credits (1-2) will be required to attend pre-departure orientation sessions and will be required to complete a visual diary while in country. Students seeking 4 credit hours will need to complete course work over and above those seeking credit for OLS 37100.

ART 49900 Senior Project Proposal (1 cr.) P: Senior Standing Class 1 This course prepares the student for their capstone senior project. The focus is upon project proposal creation, with attention being given to the development of the project's objectives, goals, concept statement, required resources as well as precedents, best practices and inspirations.

ART 49900 Senior Project Delivery (3 cr.) P: Senior Standing Class 3 The focus of this course is upon the development of the student's senior project. Building upon the project proposal developed in the previous term, the student works on the preliminary design, design development, documentation and presentation of a building project. This project must showcase the student's expertise in both building technology and computer graphics. Projects can be renovation/retrofit based or new construction of mid-sized buildings.

ART 49900 Special Topics in ART (Variable Titles) (3 cr.)
The following are the variable titles and course descriptions for ART 49900.

A**rchitectural Technology (3 credits)** Independent Study

Architectural Detailing (3 credits) P: ART 22200 Class 3. A course devoted to the examination of frame (wood, timber and light gage steel) construction. It explores, through a series of practical exercises, the ways in which buildings are constructed using these materials as the superstructure. Design solutions will be developed using a variety of manual and computer aided techniques.

Codes and Specifications (3 credits) P: ART 22200 Class 3. This course is designed to be a survey of the typical building code applications that one designing build environments will encounter. Students will be exposed to common scenarios around commercial and residential design as it relates to occupant safety, building and occupancy classification, etc. Students will also do assignments connecting construction documents to written specifications for projects.

Internship (3 credits) P: Junior Standing Class 3. An Internship is a 1-3 credit hour supervised pre-professional learning experience that allows students to apply their skills and knowledge in a professional setting. These experiences are designed to enhance the student's preparedness for an intended career with a business, industry, or government agency. Internships can range from 15-40 hours per week but must last the furcation of at least 10 weeks.

Biomedical Engineering

BME 22200 Biomeasurements (4 cr.) P: PHYS 25100 and ENGR 29700 C: MATH 26600. The foundations of circuit theory are developed. Electrical circuits are used in the context of biomedical applications including transducers, electrodes and the amplification and filtering of clinically relevant bioelectric signals. Laboratory exercises develop technical skills in the design and analysis of analog electrical circuits, signal processing and digital data acquisition and their safe use for biomeasurements.

BME 24100 Fundamentals of Biomechanics (4 cr.) P: PHYS 15200. This course combines didactic lecture and laboratory experiments to introduce the student to the principles of mechanics and how these concepts apply to musculoskeletal tissues.

BME 32200 Probability and Applications in BME (3 cr.) P: BME 33400. Probability theory and statistical methods are developed for life science applications. Analytical tools such as hypothesis testing, estimation of moments, sampling theory, correlation and spectral analysis are developed and applied to identifying underlying processes in biological systems, developing realistic models of physiological processes, designing experiments, and interpreting biological data.

BME 33100 Biosignals and Systems (3 cr.) P: BME 22200 and MATH 26600. This course applies mathematical analysis tools to biological signals and systems. Frequency analysis, Fourier and Laplace transforms, and state equations are used to represent and analyze continuous and discrete-time biosignals. Classic feedback analysis tools are applied to biological systems that rely on negative feedback for control and homeostasis.

BME 33400 Biomedical Computing (3 cr.) P: ENGR 29700 and MATH 26600. This course explores numerical and computational approaches to analyzing biological data and solving biological problems. Students will learn to fit and interpret biological data, apply probabilistic and differential equation modeling techniques to biological processes, and assess appropriateness of numerical tools for biomedical applications. Special attention is given to the built-in analysis functions and toolboxes of MATLAB.

BME 35200 Cell/Tissue Behavior and Properties (3 cr.) P: BIOL-K 101 and CHEM-C 106. C: BIOL-K 324. This course will introduce the students to the biological principles of cellular/tissue behaviors and properties. Topics include: fundamental concepts of cellular structure and tissue organization, biomolecular elements and their properties, cell shape, cell adhesion and migration, mechanotransduction, pattern formation in embryos, and stem cell and tissue regeneration.

BME 35400 Problems in Cell/Tissue Behavior and Properties (1 cr.) P: BME 24100 and BIOL-K 32400 C: BME 35200. This course develops quantitative biomechanical methods to analyze cell/tissue behavior and properties and to solve biomechanical engineering problems. Topics include: molecular and cellular basis for mechanics and mechanobiology, molecular/cellular experiments and tissue-level biomechanics. Students will solve problems appropriate for the class materials and conduct experiments in the area of molecular/cellular engineering.

BME 38100 Implantable Materials and Biological Response (3 cr.) P: BIOL-K 101 and CHEM-C 106. This course combines biomaterials, their biological response, and interactions between implantable materials and biological systems. Materials science of implantable materials; overview of implantable biomaterials and interactions between implants and biosystems; in vitro and in vivo biocompatibility tests; and specific examples on implant-tissue interactions, biocompatibility, and evaluation tools are presented.

BME 38300 Problems in Implantable Materials and Biological Response (1 cr.) P: BME 24100 and CHEM-C 106. C: BME 38100. BME 38300 is a co-requisite course to BME 38100, supplementing the basic science of BME 38100 with quantitative, analytical examples and problems related to fundamental engineering principles in implantable materials. Topics include: microstructure, phase transformation, and processing and design issues related to major engineering materials used for implantation purposes.

BME 39500 Selected Topics in Biomedical Engineering (3 cr.) Selected topics in BME at the junior level.

BME 40200 Senior Seminar (1 cr.) P: Junior standing in BME or consent of instructor. This course explores career and professional topics in Biomedical Engineering. Topics include resume writing, interviewing, and professional conduct; post-graduate education and life-long learning; and industrial, clinical, and research opportunities in Biomedical Engineering.

BME 41100 Quantitative Physiology (3 cr.) P: BME 33100. This course is an introductory course in physiological systems and an introductory course in classical feedback control theory for biomedical engineers. It aims to apply systems theory and classical feedforward and feedback control in the context of physiological systems. Approximately a third of the course will be devoted to physiological systems, a third to classical control theory and a third to the application of classical control and systems theory to physiological systems.

BME 44200 Biofluid Mechanics (3 cr.) P: BME 35200 and BME 35400. This course explores fluid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biofluid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed.

BME 46100 Transport Processes in BME (3 cr.) P: BME 33400. This course explores diffusion, heat and mass transfer, and transport processes in biological systems. Mathematical models of diffusion and transport are developed and applied to biomedically relevant problems.

BME 49100 Biomedical Engineering Design I (3 cr.) P: Senior standing and consent of Department Chair. This course prepares students for engineering practice through a major design experience, encompassing conceptualization, requirements generation, and system and detailed design. Essential design constraints will be reviewed and applied including: safety, economics, and manufacturability. The course encompasses lectures, case studies, team formation, project assignments and generation of initial design.

BME 49200 Biomedical Engineering Design II (3 cr.) P: Senior standing and consent of Department Chair. This course continues the design experience from BME 49100 with verification, validation, and re-design of student projects. Regulatory and ethical design constraints will be discussed. Oral presentation and report writing are required.

BME 49500 Selected Topics in Biomedical Engineering (1-6 cr.) Selected topics in BME at the junior level.

BME 49600 Biomedical Engineering Design Projects (1-6 cr.) P: Permission of Department. Independent project overseen by a faculty mentor.

BME 49700 Directed Readings - Biomedical Engineering (1-6 cr.) P: Permission of department. Independent study on a specified topic with a faculty mentor..

BME 50000 Biomedical Engineering Graduate Seminar (0 cr.) This is a graduate seminar course consisting of a series of weekly seminar presentations by Biomedical Engineering department and other IUPUI faculty members, researchers from academia, representatives from industry, and peer graduate students in the BME Department. The presentations aim to introduce students to a wide variety of current topics associated with the field of Biomedical Engineering, to broaden the students by exposing them to topics (research, methods, technical developments) outside of their topical concentration areas and develop critical thinking and technical presentation skills through discourse, inquiry, and defense; the application of the Socratic method.

BME 52700 Implantable Systems (3 cr.) P: Permission of instructor required.
BME 52700 is a three credit (3 cr) graduate level engineering course that covers issues related to how the anatomy and physiology of the target organ system impacts the design specifications for biomedical and implants and the biosensors that can be part of the command and control strategy for the implant. The course material is roughly organized according to motor (skeletal, cardiac) and sensory (vision, audition, olfaction, touch) and visceral (lungs) organ systems. For each topic area there will be a brief introduction to the physiology and neuroanatomy of the target organ system or biological environment (e.e. subcutaneous implants). Each topic area will have companion lectures demonstrating the extent to which biomedical engineers have been able to fabricate functional replacement (prosthetic) or assistive (orthotic) devices and tissue interfaces (electrodes).
For example, issues related to performance, powering, communications, command control and user interfaces for auditory and visual neuroprostheses are presented immediately following lecture materials describing these organ systems. Although not central to the course content, tissue and cellular responses to materials will be stressed throughout the semester. Topics will include normal wound healing processes, host response to implants and general biocompatibility. Lectures will emphasize fundamental principles of bioengineering as

related to the design of implantable systems and will require student participation in classroom discussions.

BME 53700 Experimental Methods in Biomedical Engineering (3 cr.) P: Permission of instructor required. BME 53700 is a three credit (3 cr.) graduate level engineering course that covers issues related to general laboratory practice, techniques, instrumentation and analysis methods utilized by Biomedical Engineering researchers working in the life sciences. Both theoretical and practical aspects of experimental design and data analysis are covered using select examples from BME life science researchers here on the IUPUI campus. Most topic areas are presented from a decidely analytical and engineering viewpoint. Student should have successfully completed courses in elementary analog electronic circuits and ordinary differential equations, and should be prepared to solve related homework problems using available software programming tools (e.g. Matlab, Maple, Visual C, Visual Basic, etc.). No prior knowledge of the biological undergraduate course in Chemistry and/or Biology.

BME 54400 Musculoskeletal Biology and Mechanics (3 cr.) P: Permission of instructor required.
This course will cover topics relevant to skeletal biology including skeletal morphology, physiology, cell biology, embryonic development, adult osteogenesis, mineral homeostasis, tissue mechanics, mechanical adaptation, failure (fracture), fracture fixation, implants, implant mechanics and disease dynamics.

BME 57100 Drug Delivery (3 cr.) P: Permission of instructor required.
This course explores the principles, techniques, and applications for therapeutic drug delivery and administration. This course will start with the fundamentals of drug administration; engineering principles such as diffusion and mass transport, with specific emphasis on transport in biological systems and barriers, pharmacokinetics, and drug distribution. We will examine the existing state of art in drug delivery systems: controlled release, biomaterials, and polymer-based delivery systems. Finally, we will also discuss the current field of biotechnology and biopharmaceuticals; identification of novel drug targets, latest development in drug discover, development, clinical trails, and product development, going from research to market using the latest examples from the pharmaceutical industry.

BME 58200 Advanced Biomedical Polymers (3 cr.)
P: "BME 59500 - Polymers for Biomedical Applications" is required for senior undergraduate students unless special permission is obtained from the course instructor.
This is an advanced polymer course that provides the most recent development of biomedical polymers and their applications and covers a variety of biomedical areas such as in cardiovascular, dental, orthopedic, opthalmologic and wound healing research. Drug, cellular and gene delivery are also covered. This course is designed for all the graduate sstudents (M.S. and Ph.D. level) in biomedical areas.

BME 59500 Selected Topics in Biomedical Engineering (1-3 cr.) P: Permission of instructor required. This course is designed primarily for specialized topic areas for which there is no specific course, workshop, or individual study plan, but having enough student interest to justify the formalized teaching of a course.

BME 69600 Advanced Biomedical Engineering Projects (1-6 cr.) P: Permission of instructor required. Individual research projects to be approved by the supervising faculty member before registering for the course. An approved written report is required.

BME 69700 Directed Reading in Biomedical Engineering (1-3 cr.) P: Permission of instructor required. Individualized reading course supervised by an appropriate faculty member. Approval for each reading course must be obtained from the department prior to registration.

BME 69800 Research MS Thesis (1-9 cr.) P: Permission of instructor required. Research MS thesis.

Candidate

CAND 99100 Candidate (0 cr.)

Computer and Information Technology

CIT 10600 Using a Personal Computer (3 cr.) Class 2, Lab 2; or Class 3. This course provides an introduction to word processing, spreadsheet, and presentation software. It also includes instruction in basic computer concepts, Windows operating systems, the Internet, collaborative tools and database concepts. Applications are taught through the use of problem solving assignments, projects, and exams.

CIT 11200 Information Technology Fundamentals (3 cr.) Class 3. This course provides students with a working knowledge of the terminology, processes, and components associated with information technology. Students will receive experience with the Internet, World Wide Web, current versions of hardware and software, networking, security, maintenance, information systems, and the application development process.

CIT 12000 Quantitative Analysis I (3 cr.) P: MATH 11100 or higher placement. An introduction to both qualitative and quantitative problem solving, featuring a systems approach that relies on graphic models to describe such concepts as relations, sequences, and logic patterns. Course includes a brief introduction to set theory, logic, and descriptions of data.

CIT 14000 Programming Constructs Laboratory (3 cr.) P: or C: CIT 12000. This course is an introduction to problem-solving techniques, program design and development, programming logic, and object-oriented terminology and concepts.

CIT 17600 Information Technology Architectures (3 cr.) P: CIT 11200. A conceptual and technological survey of the structure of information technology architectures inclusive of: operating systems, network operating systems, distributed systems architectures and distributed application architectures. Interoperability between these architectural components is explored. Current technology and trends in each architectural element are reviewed.

CIT 20200 Networking Fundamentals (3 cr.) P: CIT 20700. Students will gain hands-on experience installing and configuring local area networks, troubleshooting hardware and software issues, and creating network documentation. Students will explore topics including network performance, network management, and network security.

CIT 20300 Information Security Fundamentals (3 cr.) P: CIT 20700 or ECET 28400. This course provides students with an overview of the field of Information Security and Assurance. Students will explore current encryption, hardware, software and managerial controls needed to operate networks and computer systems in a safe and secure manner. In addition, students will participate in a semester project to re-enforce key concepts such as policy development and business contingency planning.

CIT 20700 Data Communications (3 cr.) P: or C: CIT 17600. This course provides the foundation for the understanding of data communication systems and computer networks. Topics include information representation and transmission, medium types and configuration, telephony, error handling, TCP/IP and internetworking, and diagnostic techniques.

CIT 21200 Web Site Design (3 cr.) P: Recommend CIT 11200 or computer literacy. This course is designed to give students an introduction to web site design and site creation. The course involves learning current standard XHTML fundamentals, CSS and design concepts. The proper design approach for constructing Web sites and related techniques will also be covered.

CIT 21300 Systems Analysis and Design (3 cr.) P: or C: CIT 14000 or CIT 215000, and CIT 21400. Class 3. This course provides students with the concepts, processes, and tools of systems analysis and systems design. Object-oriented methods and tools are utilized with a focus on developing web-based interfaces and prototypes.

CIT 21400 Introduction to Data Management (3 cr.) P: CIT 12000. Introduction to basic database development concepts. Extensive exploration of data manipulation using a relational DBMS and SQL. Students develop database applications using the most current database technologies.

CIT 21500 Web Programming (3 cr.) P: CIT 21200. P or C: CIT 21400. This course will provide students with the knowledge and techniques of a variety of Web programming languages. Both client and server side languages will be examined.

CIT 22000 Quantitative Analysis II (3 cr.) P: CIT 12000 or ECET 10900, and MATH 15400 or MATH 15900 or MATH-M 119. A continued investigation into the problem solving tools and techniques that focus on both hardware systems and quantitative data analysis. The course is designed for CIT majors in their second full year of study.

CIT 24200 Introduction to ASP.Net Programming (3 cr.) P: or C: CIT 21300 and CIT 21400. This course will provide students with the tools and techniques to build dynamic Web sites using the ASP.Net programming environment. Students gain hands-on experience building a database-driven Web site.

CIT 27000 Java Programming (3 cr.) P: or C: CIT 21300 and CIT 21400. Class 3. This course is an introduction to the Java programming language. Students will learn the syntax of the language, how to use objects, classes, and methods, and will perform programming exercises that illustrate how Java is used in stand-alone applications and applets.

CIT 29000 Computer Project (1-4 cr.) Independent study for sophomore students wanting to execute a complete computer-oriented project. Course may be repeated for up to 6 credit hours.

CIT 29900 Computer Technology (1-4 cr.) Hours, credit, and subject matter to be arranged by staff.

CIT 30400 Database Programming (3 cr.) P: CIT 21400 and CIT 200-level programming course. This course explores the concepts and skills required for advanced database programming and their implementation using programmatic extensions to Structured Query language (SQL). Topics include advanced data manipulation, stored procedures, triggers, and query optimization. Concepts will apply to any modern distributed database management system.

CIT 30500 Native Android Application Development (3 cr.) P: CIT 21300, and CIT 21500 or CIT 24200 or CIT 27000. This advanced programming course teaches students the skills necessary to develop applications for Google mobile computing devices running the Android operating system. Combining theory and practice, this course gives students hands-on experience with the technologies, tools, and techniques used to develop mobile software solutions for business and entertainment. Students will build data-driven and location-aware applications and be introduced to a variety of object-oriented software design patterns common to mobile application development. A variety of data storage and remote datasource-driven applications will be introduced. Students will be provided with the software necessary to implement Android applications. Students do not need a personal Android device for this course. Students are required to bring a laptop with the correct software installed.

CIT 31200 Advanced Web Site Design (3 cr.) P: CIT 21200 and CIT 200-level programming course. This course covers the tools and techniques necessary to maximize the effectiveness of deploying e-commerce Web applications and address both client and server side strategies with a focus on optimal Web design strategies. Strategies focus on internal design issues such as security, reusability, usability, accessibility and architecture and external design issues such as user interfaces, load times and multimedia.

CIT 31300 Commercial Web Site Development (3 cr.) P: CIT 21500. Class 3. This project-based course will have students develop a data driven web site to support business processes. Students will utilize both client and server side languages in developing the site.

CIT 32000 Quantitative Analysis III (3 cr.) P: CIT 22000. A continuation of statistical inference introduced in Quantitative Analysis II with emphasis on confidence intervals, hypothesis testing, analysis of variance, forecasting, including linear regression and correlation, and quality control as they apply to information technology.

CIT 32700 Wireless Communication (3 cr.) P: CIT 20700. Students will learn about the growing range of wireless technologies and their applications. The course will explore the fundamentals of each wireless technology from basic signaling properties to current and future market uses. Students will have the opportunity to gain hands-on experience with various wireless technologies.

CIT 34400 Database Security (3 cr.) P: CIT 20300 and CIT 30400. This course will cover fundamentals of database security, data auditing, basic security models, and best practices. Topics may include security architecture, access control policies, auditing and monitoring. The course combines lectures with hands-on activities through lab sessions and an application oriented project using a database system such as Oracle or SQL Server.

CIT 34600 Desktop Publishing Applications (3 cr.) P: CIT 10600 or equivalent. Interdisciplinary introduction to desktop publishing technology integrating application and hardware. Students will learn desktop publishing theory and techniques to produce flyers, newsletters, brochures, business forms, web forms, and publications with database inter-connectivity. Service learning includes a complete DTP solution for a small business or not-for-profit agency.

CIT 34700 Advanced ASP.Net (3 cr.) P: CIT 24200. This course will apply the ASP.Net framework to e-commerce applications. Advanced ASP.Net techniques will be covered such as Web services, ADO, LINQ, AJAX, and security components.

CIT 35600 Network Operating Systems Administration (3 cr.) P: or C: CIT 20200. Design and administration of network servers and workstations. Focus on basic network concepts such as user account administration, resource allocation, security issues, and Internet service management.

CIT 37300 Visual Design for Software (3 cr.) P: CIT 14000 and CIT 21200. P: or C: CIT 21300. Examination of best practices in software interface development for a variety of platforms. A study of the integration of visual elements into the systems analysis and design process, based on business and technical requirements. Topics include study of common design patterns, a review of prototyping tools, multi-modal design concepts, navigation strategies, and user acceptance testing.

CIT 37400 Systems and Database Analysis (3 cr.) P: CIT 21300. Class 2, Lab 2. Intensive exploration of application and database analysis in a synergistic environment. Students engage in collaborative, project-based activities to learn about project management, requirement analysis, modeling, and prototyping employing problem solving and team-building skills. Object-oriented and data modeling tools are used to apply class concepts.

CIT 38100 Unix Programming and Administration (3 cr.) P: CIT 35600. This course will teach students to effectively administer and develop applications in Linux/Unix. Emphasis will be on the ability to read, write and debug shell script programs. An exploration of Windows scripting languages will also be covered.

CIT 38800 Topics in Programming Languages (variable title) (3 cr.) P: One CIT 200-level programming language course. Prerequisites will be included in the semester class schedule. Class 3; or Class 2, Lab 2. Varies with course content. Since various languages may be offered under this title, this course may be repeated for a maximum of 9 hours of credit.

CIT 40200 Design and Implementation of Local Area Networks (3 cr.) P: CIT 20200. Class 2, Lab 2; or Class 3. The design, implementation, and configuration of local area networks. Students install the necessary hardware and software to set up a LAN server with several clients. Students will explore topics including "internetworking", network management, network performance, and security.

CIT 40600 Advanced Network Security (3 cr.) P: CIT 20300. This course provides students with in-depth study and practice of advanced concepts in applied systems and networking security, including security policies, access controls, IP security, authentication mechanisms, and intrusion detection and protection.

CIT 41100 iOS Mobile Application Development (3 cr.) P: CIT 21300 and (CIT 21500, CIT 24200, or CIT 27000). This advanced programming course teaches students the skills necessary to develop applications for Apple mobile computing devices running the iOS operating system. Combining theory and practice, this course gives students hands-on experience with the technologies, tools, and techniques used to develop mobile software solutions for business and entertainment. Students will build data-driven and location-aware applications and be introduced to a variety of object-oriented software design patterns common to mobile application development. A variety of data storage and remote datasource-driven applications will be introduced. Apple student developer accounts are provided. Beginning programming experience is required. Development computers are available through the Student Technology Centers. Access to a personal Macintosh computer is encouraged, but not required.

CIT 41200 XML-Based Web Applications (3 cr.) P: CIT 21200 and CIT 200 level programming course. This course covers how to build Web applications using XML. Students will learn how to create and validate data in XML documents and how to display XML documents using Cascading Style Sheets (CSS), XSL Transformations (XSLT), and the Document Object Model (DOM).

CIT 41500 Advanced Network Administration (3 cr.) P: CIT 35600. In this course students learn advanced concepts of installing, configuring, and securing various types of network servers including enterprise, Web, and mail servers. The course also covers the documentation of network systems infrastructure and the testing of hardware and software network components.

CIT 41600 Global IT (3 cr.) P: ENG-W 131 (or equivalent); Sophomore Standing; 21 Residential credit hours or equivalent. This course is designed to increase your understanding about the challenges faced by information technology (IT) professionals in a global context. You will meet and work with industry professionals whose personal experiences in IT industry, education, and international culture have impaced their careers. Each semester the course will focus on a specific country and we will analyze the current state of IT relationships between the country of focus and the United States. The course will involve classroom sessions once per week during the semester with an embedded study abroad program to the country of focus over spring break.

CIT 42000 Digital Forensics (3 cr.) P: CIT 40600 and CIT 41500. This course covers the fundamentals of computer forensics and cyber-crime scene analysis. The various laws and regulations dealing with computer forensic analysis will be discussed. Students will be introduced to the emerging international standards for computer forensic analysis, as well as a formal methodology for conducting computer forensic investigations.

CIT 43100 Applied Secure Protocols (3 cr.) P: CIT 40600. This course will emphasize the applied facets of cryptography for the information assurance and security professional. By the end of the course students will be able to apply important cryptographic principles and tools to allow networks to communicate securely.

CIT 43600 Advanced E-Commerce Development (3 cr.) P: CIT 31200, and CIT 31300 or CIT 32900 or CIT 34700. Class 2, Lab 2; or Class 3. This course will allow students the opportunity to develop a data-driven e-commerce site for a small- to medium-size company.

CIT 44000 Communication Network Design (3 cr.) P: CIT 40200. Class 2, Lab 2; or Class 3. An introduction to wide area networking (WAN), which is a technology used to extend telecommunications connectivity for information distribution over large geographic regions. Topics include architecture, design, and implementation, as well as the influence of the state and federal regulatory environments.

CIT 44400 Advanced Database Design (3 cr.) P: CIT 21400. This course addresses enterprise data management and logical database design concepts with an emphasis on needs determination and data modeling skills from an organizational perspective. Students will create data models and apply forward and reverse engineering techniques.

CIT 45100 IT Security Risk Assessment (3 cr.) P: CIT 40600. Class 2, Lab 2; or Class 3. Students will learn the basic tools of security risk assessment and risk management. Students will be able to identify and assess security risk, conduct information asset valuation, and apply risk control strategies. Other topics discussed will be: security policies, NIST Security Models, and training education and awareness. At the end of the course students will be able to assess vulnerabilities and document them according to a published assessment standard.

CIT 46000 Wireless Security (3 cr.) P: CIT 40600. Focuses on the risks and benefits associated with wireless communications as well as how the networking industry defines a secure wireless network. In addition, students gain the skills needed to properly create, configure and maintain a secure wireless network.

CIT 47900 Database Implementation and Administration (3 cr.) P: CIT 34400. Class 2, Lab 2; or Class 3. Extends knowledge of database concepts. Topics include physical database design, client/server implementation and database administration. Given a logical database design, students develop physical database structures and implement a database application. Students carry out database design, construction, and programming activities using client/server technology.

CIT 48500 Living Lab (1-6 cr.) P: Consent of Instructor. The Living Lab allows students to apply networking, security, database, website, and application development concepts and techniques learned from prior CIT courses to internal and/or external projects. The Living Lab emulates an industry IT department in which students work on one or more projects as part of an IT team. This course meets the IUPUI RISE challenge in Experiential Learning.

CIT 49000 Senior Project (1-4 cr.) Independent study for seniors wanting to execute a complete computer-oriented project. This course meets the IUPUI RISE challenge in Experiential Learning. Course may be repeated for up to 7 credit hours.

CIT 49900 Computer Technology (1-4 cr.) Hours, credit, and subject matter to be arranged by staff.

CIT 51600 Database Security (3 cr.) P: Graduate Status. This course provides an advanced training and hands-on experiences in database security and auditing. The course addresses everything from infrastructure to audit lifecycle and describes how to apply security measures in a holistic manner. It covers the basic topics, such as profiles, password policies, privileges and roles. It also explores advanced topics in database transaction security issues and provides proven techniques for designing, implementing, and certifying secure Oracle Database systems in a multitenant architecture.

CIT 52800 Information Security Risk Management (3 cr.) P: Graduate Status. Covers information security risk assessment, including the following topics: steps in performing information security risk assessment, threats to information security, technical, managerial, and operational vulnerabilities, methods for analyzing controls, methods for determining likelihood of an impact from an information security breach, and methods for determining risk. Emphasizes the development and utilization of security metrics in the risk assessment process.

CIT 53200 Wireless Security and Technology (3 cr.) P: Graduate Status. The course will provide in-depth coverage of wireless communications and security. Fundamentals and state of the art developments in the wireless security area will be included. In this course, many recent, current, and emerging developments will be discussed including advances in cellular, wireless personal networks (WPANs), wireless LANs, and fixed wireless networks. Significant details of wireless devices and corresponding security issues will be included. Many emerging challenges and solutions in wireless vulnerabilities, attacks, and solutions at various layers of the protocol stack, spanning the stack from aspects of physical communication to application and service security issues will also be included.

CIT 55000 Organizational Impact of Information Technology (3 cr.) P: Graduate Status. An enterprise view of the organizational impact of information technology as the most effective means for achieving "better, faster, cheaper operations" in today's highly competitive business environment. Examines how information technology has enabled new organizational forms and changes in business processes, products, markets, delivery systems, ways of working, and people management issues and challenges.

CIT 55100 Network Security (3 cr.) P: Graduate Status. This course focuses on in-depth conceptual and technological aspects of network security for data networks. A wide range of technical issues and topics including a study of network and distributed systems security; cryptanalysis; web security; network threats, vulnerabilities and risks, computer crime, encryption and virtual private networks, and current network security technologies such as firewalls and intrusion detection systems are discussed in this courses. Many emerging challenges and solutions in network security architectures, multilevel systems, and security management and monitoring will also be included.

Computer Graphics Technology

CGT 10100 Introduction to Computer Graphics Technology (3 cr.) Class 1. This course provides an introduction to and a survey of the discipline of computer graphics. The topics include a survey of the applications of computer graphics, the knowledge base and history of computer graphics, an examination of computer graphics technologies and careers as well as an overview of available resources for study and research in computer graphics.

CGT 11100 Design for Visualization and Communication (3 cr.) Class 2, Lab 2. An introductory design course for computer graphics majors. Students develop an understanding of the basic design elements and principles, composition and typography through exercises and projects. The focus is on visual thinking, exploring the relationship between type and image, and developing multiple solutions to a given problem.

CGT 11200 Sketching for Visualization and Communication (3 cr.) Class 2, Lab 2. This course applies fundamental computer graphics concepts of visualization, communication, and creativity within a sketching metaphor. Exercises and projects in graphic theory, problem solving, and sketching skill development provide students with activities that focus on further development within the discipline. A variety of sketching techniques are used to gather critical information and transform data into effective communication instruments.

CGT 11600 Geometric Modeling for Visualization and Communication (3 cr.) Class 2, Lab 2. Core introductory computer graphics course that provides entry-level experiences in geometric modeling. Students develop geometric analysis and modeling construction techniques and processes to produce accurate computer models for graphic visualization and communication.

CGT 11700 Illustration for Visualization and Communication (3 cr.) Class 2, Lab 2. This foundation course stresses the use of pictorial illustration for visualization and communication. Various projection systems are introduced with discussion focusing on the appropriate use of view and system utilized to accentuate and provide clear communication. A variety of digital tools are used to construct, extract, and render pictorial views using vector and raster tools.

CGT 20100 Portfolio Presentation (2 cr.) Class 0-3, Lab 0-9. This course has been designed to introduce students to the standard practices used in business and industry to identify potential employees in graphics related positions. Lectures will cover professional conduct when searching for employment and graphics standards expected in a professionally developed portfolio.

CGT 20200 Motion and Video I (3 cr.) Class 2, Lab 2. The movement of graphics and incorporation of video is prevalent within commercial production. No longer are these elements done solely by the Hollywood elite or used strictly within the film industry. Many today are utilizing all kinds of tools in digital video, audio graphics design and animation to create moving elements that tell a story and communicate concepts to solve communication problems. Students will learn basics in the production process, framing and movement.

CGT 21100 Raster Imaging for Computer Graphics (3 cr.) P: CGT 11600 and CGT 11700. Class 2, Lab 2. Digital images are produced using a variety of computer technologies. Advanced color theory, surface rendering, and light control are emphasized in relation to technical illustration, hardware characteristics, and software capabilities.

CGT 21600 Vector Imaging for Computer Graphics (3 cr.) P: CGT 21100. Class 2, Lab 2. Full-color vector illustrations for a variety of uses are produced using computer methods. Color theory, surface analysis, and rendering techniques are emphasized as they apply to vector-based illustrations.

CGT 24100 Introduction to Computer Animation (3 cr.) P: CGT 11600 and have a solid understanding and ability to construct 3D surface and solid models, and understand raster imaging. C: CGT 21100. Class 2, Lab 2. This course introduces the knowledge base on which digital animation and spatial graphics are founded and developed. Emphasis will be placed on developing a working knowledge of the mechanics of 3D geometric formats, spline-based modeling with polygon mesh & NURBS, procedural mapping of raster images, simplified polygon modeling, rendering methods, hierarchical linking, and kinematic fundamentals.

CGT 24200 Technical Graphics for Supervision (2 cr.) Class 1, Lab 2. An introduction to commonly encountered technical drawing practices; multiview representation, isometric pictorial, reading drawings, dimensioning practices, and working drawings. Emphasis is on technical graphics as technical communication through freehand sketching.

CGT 25100 Principles of Creative Design (3 cr.) P: CGT 11700. Class 2, Lab 2. This course introduces the design of the human computer interface coupled with traditional graphical design concepts applied to the creation of dynamic digital tools. Concepts are applied to multimedia and hypermedia products and the related print-based materials normally associated with them. Students learn graphic design, interface design, and information design to create effective and visually stimulating communication devices using multimedia and hypermedia tools.

CGT 29900 Select Topics in Computer Graphics (1-3 cr.) Class 0-3, Lab 0-9. This course has been designed to introduce students to the standard practices used in business and industry to identify potential employees in graphics related positions. Lectures will cover professional conduct when searching for employment and graphics standards expected in a professionally developed portfolio. Hours and subject matter to be arranged by staff. Course may be repeated for up to 9 credit hours.

CGT 31300 Digital Painting I for Computer Graphics (3 cr.) P: CGT 20100. Class 2, Lab 2. This course introduces students to digital painting techniques for graphical visualization and communication. Topics include industry standard practices and instruction in digital brush creation, digital mark making, value under painting, color palettes, and lighting and rendering to produce various computer graphics compositions.

CGT 31400 Advanced Motion Design (3 cr.) Class 2, Lab 2. This course builds on the basic principles of motion design. Students will learn advanced techniques in visual storytelling, puppetry/rigging and integration of 3D elements into the design environment. Advanced design principles will also be discussed as well as post-production techniques for animators with the focus being commercial production.

CGT 34000 Digital Lighting and Rendering for Computer Animation (3 cr.) P: CGT 29900 and have a good working knowledge of 3D modeling and basic animation techniques. Class 2, Lab 2. The development of a working knowledge of perspective display of three-dimensional models and the resulting effects of projected light sources on shade, shadow, color, texture, and atmospheric effects in architecture, product illustration, and animation. Emphasis will be placed on lighting design, analysis, and photorealistic simulation for commercial graphic applications.

CGT 34100 Motion for Computer Animation (3 cr.) P: CGT 29900. Class 2, Lab 2. An applied course covering three-dimensional computer graphic animation for graphics specialists and professionals involved in the use of technical design, time and motion study, surface texture mapping, digital lighting, color, and the technology required to produce computer animations for commercial applications in manufacturing design, marketing, and training.

CGT 34600 Digital Video and Audio (3 cr.) P: CGT 29900 and have experience in 3D modeling and animation techniques. Class 2, Lab 2. Covers the use of digital technologies for video and audio in multimedia, hypermedia, and animation products. Students examine the methods for creating, sampling, and storing digital video and digital audio and the constraints placed on these media assets when used for media-based products. Emphasis is placed upon the technology of digital video and audio including formats, data rates, compressors, and the advantages of the different technologies.

CGT 35100 Interactive Multimedia Design (3 cr.) P: CGT 25100. Class 2, Lab 2. This course introduces the many facets of interactive multimedia design and production. Students are introduced to authoring programs used for information delivery with special attention focused on the integration of various media assets for communication. There is also concentration on the storage, management, and retrieval of media assets in a production environment. Considerable time is spent on the systematic design of interactive media products to meet specified goals of communication.

CGT 35600 Programming, Development, and Data Integration (3 cr.) P: (CIT 14100 or CGT 21500) and CGT 25100 or consent of instructor. Class 2, Lab 2. A course focusing on the development of modern websites through the usage of CSS/HTML and PHP programming languages. The course stresses development strategies for managing the rapidly changing information of corporations and organizations for just-in-time distribution, using authoring programs to create websites that utilize Content Management Systems. Significant time is spent on intermediate to advanced programming and scripting.

CGT 40200 Motion and Video 2 (3 cr.) P: CGT 34600. Class 2, Lab 2. This course builds on the principles of motion design & video production. Students will learn advanced techniques in effects and integration of video and motion elements with the goal of creating realistic production and animation to be used in commercial production.

CGT 41100 Contemporary Problems and Applications in Computer Graphics (3 cr.) P: Senior standing. Class 3; or Class 2, Lab 2. Groups will to identify, design, qualify, manage, create and present a final project relative to existing or emerging issues within applied computer graphics. Activities and experiences will explore related topics such as project planning and management, user expectations, interpersonal communications skills, and quality management. The course concludes with faculty, peers and practicing professionals evaluating oral, written and media presentations of final projects.

CGT 41500 Seminar for Senior Design Project (1 cr.) P: Senior standing. Preliminary work toward the senior design project is carried out with guidance from faculty. This course includes background research, review of previous projects, definition of project requirements, and the creation of a formal project proposal.

CGT 41600 Senior Design Project (3 cr.) P: CGT 41500. Class 3; or Class 2, Lab 2. This capstone course requires students to engage in a substantive endeavor directed at solving problems related to computer graphics. Activities include the creation and management of graphic systems and media assets per the requirements of the senior design proposal. Students are required to demonstrate professional attitudes and attributes in the timely completion and presentation of their project.

CGT 44200 Production for Computer Animation (3 cr.) P: CGT 34100. Class 2, Lab 2. An applied course covering advanced spline modeling techniques, lighting techniques, applied shading, motion dynamics and controllers, particle systems, application customization programming, and pre-production development and planning. In addition to developing a working knowledge of advanced techniques, a scholarly study of emerging advancements in computer animation and spatial graphics technology will be included.

CGT 44400 The History and Technique of Visual Effects in Film (3 cr.) P: CGT 34100. Class 2, Lab 2. This lecture-based course presents the history and technique of special or visual effects in film from the 19th Century (George Melies) to the current digital age of visual effects. Emphasis is placed on the use of effects in fantasy, science fiction, and horror genres. These effects can range from the recreation of historical venues, to fictional characters and to worlds not yet seen. This course serves not only to address this facet of the history of film and cinema, but also the techniques and technology of visual effects including practical effects, miniatures, stop-motion, makeup, mechanical effects, optical effects, motion control, and the digital realm.

CGT 44600 Technical Animation Production and Direction (3 cr.) P: CGT 34100. Class 3; or Class 2, Lab 2. A variety of commercial applications of technical animation and spatial graphics are analyzed and produced with special emphasis upon client development, design, organization, scripting, storyboarding, technical production, management, and evaluation.

CGT 45100 Multimedia Application Development (3 cr.) P: CGT 35100. Class 2, Lab 2. A continuation of CGT 35100, this course builds on the basic principles of interactive multimedia and builds towards intermediate methods in interactive media. Interactive multimedia is the uses of content forms that includes a combination of text, audio, still images, animation, video, and interactivity content forms sometimes called "rich media" or interactive multimedia that describes as electronic media devices used to store and experience multimedia content. Examples of interactive multimedia are DVD menu's, Online Applications, Presentations, kiosks, ATM's, DVR Menus, Information Screens (Airports, Restaurants, etc), Computer Games, and many other forms of communication.

CGT 45600 Advanced Web Programming, Development and Data Integration (3 cr.) P: CGT 35600. Class 3; or Class 2, Lab 2. A continuation of CGT 35600 this course builds on the basic principles of web design and builds towards intermediate methods in web design and development. A course focusing on the development of modern websites through the usage of CSS/HTML and PHP programming languages. This course builds on the basic foundation that was established in CGT 35600 and extends those principles to the intermediate level. The course stresses development strategies for managing the rapidly changing information of corporations and organizations for just-in-time distribution, using authoring programs to create websites that utilize Content Management Systems. Significant time is spent on intermediate to advanced programming and scripting.

CGT 49900 Select Topics in Computer Graphics (1-3 cr.) Hours and subject matter to be arranged by staff. Course may be repeated for up to 9 credit hours.

Construction Engineering Management Technology

CEMT 10400 Fundamentals of Surveying (3 cr.) P: MATH 15400 or MATH 15900. Class 2, Lab 3. Fundamental concepts and practical applications related to measurement of vertical and horizontal distances and angles using the tape, level, transit, theodolite, and EDMI (total stations, electronic workbooks, laser levels, etc.). Computations of grades, traverses, areas, and curves. Basic concepts of topography and its uses. Identification of contours and drawing of topographical maps.

CEMT 10500 Introduction to Construction Technology (3 cr.) Class 2, Lab 2. This course introduces students to the technical aspects of reading and understanding constructions documents for the built environment. Topics include but are not limited to: building code standards, drafted drawing standards, coordination of both vertical and horizontal drawings, CSI MasterFormat, and basic drawing management. The course will develop an understanding of residential and commercial construction from preliminary design through working drawings. Laboratory time will introduce the student to computer aided drafting software.

CEMT 11000 Construction Accounting (3 cr.) P: CEMT 10500. Class 2, Lab 2. Accounting fundamentals as utilized in the construction industry with a special emphasis on basic design of construction cost accounting systems as used to manage a construction company. Use of construction cost indices for labor and materials, as well as use of construction accounting for estimating and bidding purposes. Use of accounting management software as appropriate.

CEMT 12000 Construction Materials and Systems (3 cr.) Class 2 + Lab 2. Introduction to common construction terminology, materials, methodologies, and structural systems as they relate to buildings, industrial facilities, and infrastructure. Selection of construction materials (wood, steel, concrete, and masonry) and methods for diverse applications. Site visits for experiential learning.

CEMT 12500 Construction Visualization (3 cr.) Class 2, Lab 2. Introduction to extraction and interpretation of information from construction documents as they relate to diverse types of construction projects including heavy civil, highways, utilities, water, storm-water and sewer construction, other infrastructure construction and buildings. Lab work including blue print reading, plots, and construction symbols interpretation for diverse undertakings.

CEMT 16000 Statics (3 cr.) P: MATH 15400 or MATH 15900. P or C: PHYS 21800. Class 3. Forces acting on bodies at rest, including coplanar, concurrent, and nonconcurrent systems. Includes centroids, moments of inertia, and friction.

CEMT 21500 Mechanical and Electrical Systems (4 cr.) P: CEMT 12000 and MATH 15300. Class 4. Methods for design, construction and inspection of meachanical and electrical systems for buildings. Emphasis on heating and cooling loads, equipment selection, duct and pipe sizing, codes, safety, installation, inspection, commissioning, and estimating. Responsibilities of the general contractor for HVAC (heating, ventilating, and air-condtioning) and plumbing work.

CEMT 26000 Strength of Materials (3 cr.) P: CEMT 16000. C: CEMT 26700. Class 3. Stress-strain relationships of engineering materials; composite analysis; shear forces and bending moments in beams; analysis and design of steel and wood beams and columns, beam deflections, and statistically indeterminate beam analysis.

CEMT 26700 Materials Testing (2 cr.) P: CEMT 16000. C: CEMT 26000. Class 1, Lab 3. 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.

CEMT 27500 Applied Civil Engineering Drafting (3 cr.) P: CEMT 10400 and MATH 15300. Class 2, Lab 3. Preparation of structural construction drawings for buildings, bridges, roads, and topographic drawings.

CEMT 28000 Quantity Survey (3 cr.) P: CEMT 12000, CEMT 27500. Class 2, Lab 3. A study of methods to estimate quantities of materials required in construction. Practice in making quantity surveys.

CEMT 30200 Construction Law and Ethics (3 cr.) P: CEMT 28000. Class 3. Practical focus on key legal and ethical issues applicable to the construction industry and how to manage them. Laws related to construction work, contractual relationships and strategies, torts, liabilities, bonding, insurance, risk management, dispute avoidance and resolution, liens, partnering, and ethics are among topics covered.

CEMT 31200 Construction and Route Surveying (3 cr.) P: CEMT 10400. Class 2, Lab 3. Field procedures for construction and route surveying, including highway, street, sewer, and bridge layout. Route surveying including vertical and horizontal curves, curve design, survey for streets and subdivisions, earthwork, and profiles/sections using both theodolite and electronic distance measuring (EDM) equipment. Computation of errors and coordinates and use of appropriate software.

CEMT 33000 Construction Field Operations (3 cr.) P: CEMT 34100. Class 3. Study of types and uses of construction equipment and machinery in relation to diverse field operations. Analysis of equipment productivity and costs.

CEMT 34100 Construction Scheduling and Project Control (3 cr.) P: CEMT 34200. Class 2, Lab 3. A study of the planning and control of construction projects. Topics include time schedules, labor, and equipment balancing; expediting materials delivery, bar charts, and critical path method (CPM) network scheduling, and an introduction to the use of the computer in CPM network analysis and project control programs.

CEMT 34200 Construction Cost and Bidding (3 cr.) P: CEMT 28000. Class 2, Lab 3. Course includes a study of the methods of estimating costs for labor, material, equipment, and direct overhead for construction projects; how to establish markups for indirect overhead and profit; procedures for setting up a computerized estimating system; and conceptual estimating procedures.

CEMT 34700 Construction Contract Administration and Specifications (3 cr.) P: CEMT 30200. Class 2, Lab 2. Relationship between all parties involved in the construction process. Analysis of contracts, the general and special conditions of the contract, specifications and their purpose/intent, standard specifications, adaptation of selected provisions from standard specifications, and delineation of special supplemental conditions.

CEMT 35000 Construction Project Cost and Production Control (3 cr.) P: CEMT 35000. Class 3: A study of the contractor's record-keeping procedures and forms from estimate breakdown to completion of the project, with a review of current methods of production control.

CEMT 39000 Construction Experience (1 cr.) P: See department chair about detailed requirements for this course. Experience work needs to be completed before signing up for the course. Minimum of 10 weeks of work experience in the construction industry, with at least five weeks' experience in the field. Written report of this experience.

CEMT 43000 Soils and Foundations (3 cr.) P: CEMT 48600. Class 2, Lab 3. Measurement of technical properties of soils in situ or in the laboratory, classification for engineering and construction purposes. Soil exploration, subsurface investigation, and soil reports; concept of bearing capacity; shallow and deep foundations and retaining wall, their analysis, and construction aspects. Soil-structure interaction in terms of construction, settlement, and structural service issues.

CEMT 44700 Construction Project Management (3 cr.) P: CEMT 33000. Class 3. A study of construction organizations, their forms and functions, project management procedures and documents, and financial management within a construction organization. Subjects appropriate for those working within a construction organization will be emphasized. Role playing may be incorporated.

CEMT 45200 Hydraulics and Drainage (3 cr.) P: PHYS 21800. Class 3. Basic hydrostatics: fundamental concepts of fluid flow in pipes and open channels; methods of estimating storm-water runoff; sizing of culverts, storm and sanitary sewers, and open channels.

CEMT 45500 Construction Safety and Inspection (3 cr.) P: CEMT 34700. Class 3. A study of safety and inspection requirements for construction sites and projects. Accident record keeping, reporting; requirements of the OSHA code; inspection for safety and hazards, environmental issues, and quality; risk control; and management issues related to these. Development and implementation of company safety and hazard communication and inspection programs.

CEMT 48400 Wood, Timber, and Formwork Design (3 cr.) P: CEMT 26000 , CEMT 26700. Class 3. Fundamentals of wood and timber design, including wall, beams, columns, slabs, and forms for special shapes.

CEMT 48600 Reinforced Concrete Design and Construction (3 cr.) P: CEMT 48400. Class 3. The fundamentals of reinforced concrete design and analysis. Survey of concrete structural systems and concrete construction methods and procedures. Introduction to pre-cast construction and prestressed concrete.

CEMT 49400 Engineering Economics for Construction (3 cr.) P: Senior standing. Class 3. Introduction to engineering economy and its methods related to time value of money. Economical evaluation and comparison of alternatives considering costs, returns, interest, taxes, and probability in a time span; determining feasibility, break-even points, and rate of return. Cost indices for construction.

CEMT 49900 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 and Computer Engineering

ECE 20100 Linear Circuit Analysis I (3 cr.) P: or C: MATH 26100 and PHYS 25100. C: ECE 20700. Class 3. 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; sinusoidal steady-state and impedance. Instantaneous and average power.

ECE 20200 Linear Circuit Analysis II (3 cr.) P: ECE 20100. P: or C: MATH 26600. Class 3. Continuation of ECE 20100. Use of computer-aided design programs. Complex frequency plane, resonance, scaling, and coupled circuits. Two-port network parameters. Laplace transform methods. Use of general loop and nodal equations, matrix formulations.

ECE 20400 Introduction to Electrical and Electronic Circuits (4 cr.) P: or C: PHYS 25100 and MATH 26100 Class 3. Lab 3. Students will learn basics of electrical and electronic circuits including introduction to analog and digital electronic circuits. Measurement of electrical signals using meters, probes, and oscilloscopes are covered in the laboratory component of the course. Circuits are designed for minimum hardware with emphasis on understanding analog and digital electronics with practical use of digital and analog microchips. Non-ECE majors who complete this course can continue the digital course sequence offered by the ECE department including microprocessor systems and interfacing, and digital signal processing. No credit will be given for ECE majors.

ECE 20700 Electronic Measurement Techniques (1 cr.) C: ECE 20100. Lab 3. 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.

ECE 20800 Electronic Devices and Design Laboratory (1 cr.) P: ECE 20700. C: ECE 25500. Lab 3. Laboratory experiments in the measurement of electronic device characteristics. Design of biasing networks, small signal amplifiers and switching circuits.

ECE 21000 Sophomore Seminar (1 cr.) Class 1. A lecture series on ECE Department curriculum-related topics, electrical and computer engineering systems, skills, and career topics.

ECE 25500 Introduction to Electronics Analysis and Design (3 cr.) P: ECE 20100. C: ECE 20800. Class 3. 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.

ECE 26100 Engineering Programming Lab (1 cr.) P: Completion of a pre-calculus course or equivalent; completion of 12 credit hours. C: ECE 26300. Lab 3. Introduction to problem solving using software tools, in particular the C programming language.

ECE 26300 Introduction to Computing in Electrical Engineering (3 cr.) P: Completion of a pre-calculus course or equivalent; completion of 12 credit hours. C: ECE 26100. Class 3. An introductory course in computing programming with an emphasis on program decomposition and program structure. The objective of the course is to introduce the student to problem solving using high-level languages. The students are also introduced to number concepts fundamental in 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 require no prior engineering knowledge.

ECE 26400 Advanced C Programming (3 cr.) Class 3. Continuation of a first programming course. Topics include files, structures, pointers, and the proper use of dynamic data structures. Basic knowledge of the UNIX operating system and an introductory C programming course. C programming knowledge should include basic syntax, control structures, and file I/O, as well as experience in declaring and using functions.

ECE 27000 Digital Logic Design (4 cr.) P: or C: ECE 20100 and knowledge of electrical circuits. Class 3, Lab 3. Introduction to logic design, with emphasis on practical design techniques and circuit implementation. Topics include Boolean algebra; theory of logic functions; mapping techniques and function minimization; hardware description language; logic equivalent circuits and symbol transformations; 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. A series of logic circuit experiments using CMOS integrated circuits for combination of logic and sequential circuits.

ECE 28200 UNIX Programming for Engineers (1 cr.) P: ECE 26100 and ECE 26300. Lab 2. Introduction to the UNIX operating system, including the UNIX file system, as well as UNIX tools and utilities. Introduction to Shell Programming. The emphasis will be on how these tools/ utilities are utilized in the Computing Engineering field.

ECE 30100 Signals and Systems (3 cr.) P: ECE 20200 and MATH 26600. Class 3. Signal and system representation. Fourier series and transforms, sampling and discrete Fourier transforms. Discrete-time systems, difference equation, Z-transforms. State equations, stability, characteristic values and vectors. Continuous-time systems, time and frequency domain analysis. Continuous systems with sampled inputs.

ECE 30200 Probabilistic Methods in Electrical and Computer Engineering (3 cr.) P: or C: ECE 30100. Class 3. 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. Introduction to random processes, correlation functions, spectral density functions, and response of linear systems to random inputs.

ECE 30500 Semiconductor Devices (3 cr.) P: ECE 25500, MATH 26600, and PHYS 25100. Class 3. Materials- and phenomena-based examination of devices, emphasizing the how and why of solid-state device operation.

ECE 31100 Electric and Magnetic Fields (3 cr.) P: MATH 26600 and PHYS 25100. Class 3.

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 311 and PHYS 330.

ECE 32100 Electromechanical Motion Devices (3 cr.) P: ECE 20200. C: ECE 31100. Class 3. The general theory of electromechanical motion devices relating to electric variables and electromagnetic forces. Basic concepts and operational behavior of DC, induction, brushless DC, and stepper motors used in control applications.

ECE 32600 Engineering Project Management (3 cr.) P: Sophomore Standing. Class 3. Project management is an important skill that is needed in the private and public sectors as well as specialty businesses. This course explores the challenges facing today's project managers and provides a broad understanding of the project management environment focused on multiple aspects of the project.

ECE 32700 Engineering Economics (3 cr.) P: Sophomore Standing. Class 3. Engineering economics is the application of economic techniques to the evaluation of design and engineering alternatives. The role of engineering economics is to assess the appropriateness of a given project, estimate its value, and justify it from an engineering standpoint. This course covers the time value of money and other cash-flow concepts, reviews economic practices and techniques used to evaluate and optimize engineering decisions, and discusses the principles of benefit-cost analysis.

ECE 34000 Simulation, Modeling, and Identification (3 cr.) P: ECE 20700 and ECE 30100. Class 2, Lab 3. 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.

ECE 35900 Data Structures (3 cr.) P: ECE 26300. Class 3. An introductory course in computer engineering, with emphasis on data structure and program design using the C language. The classical concepts of structured programming such as stack, queue, linked list, tree, recursion, sorting, and searching. Applications of structured programming in engineering.

ECE 36200 Microprocessor Systems and Interfacing (4 cr.) P: ECE 27000 and ECE 26300. Class 3, Lab 3. 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. Laboratory provides practical hands-on experience with microprocessor software application and interfacing techniques. Design and implementation of a simple three-bus computer; detailed study of a particular microcomputer architecture and instruction set (Motorola 6812); 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.

ECE 36500 Introduction to the Design of Digital Computers (3 cr.) P: ECE 36200. Class 3. The hardware organization of computer systems: ARM instruction set architecture, processing unit, pipeline, arithmetic/logic unit design, hardwired and microprogrammed control schemes, memory and cache organization, I/O and interrupt interface design.

ECE 36900 Discrete Mathematics for Computer Engineering (3 cr.) P: ECE 27000. Class 3. Introduction to discrete mathematical structure and finite-state machines. Topics include foundation of discrete mathematics, groups and semi-groups, group codes in computer systems, basic model of finite-state machines, state and machine identification experiments, regular expressions, and complexity.

ECE 38200 Feedback System Analysis and Design (3 cr.) P: ECE 30100. Class 3. Classical concepts of feedback system analysis and associated compensation techniques. In particular, the root locus, Bode diagram, and Nyquist criterion are used as determinants of stability.

ECE 40100 Engineering Ethics and Professionalism (1 cr.) P: Senior Standing. Class 1. Some ethical, social, political, legal, and ecological issues that practicing engineers may encounter.

ECE 40800 Operating Systems and System Programming (3 cr.) P: CSCI 36200, ECE 36500. Class 3. Students will learn to design and construct operating systems for both individual computers and distributed systems, and to apply and utilize operating system functionality to their application development. The course will cover basic concepts and methods for managing processor, main memory, storage, and network resources, including their system functions. Detailed examples are taken from a number of operating systems, emphasizing the techniques used in networked UNIX and embedded Linux.

ECE 41000 Introduction to Digital Signal Processing (3 cr.) P: ECE 30100. P or C: ECE 36200. Class 2, Lab 3. An introductory treatment of digital signal processing algorithms and implementation using high-speed digital signal processors. Sampling, architecture, addressing modes and instruction set of digital signal processors, discrete Fourier transform, fast Fourier transform, and digital filtering.

ECE 41700 Multimedia Applications (3 cr.) P: ECE30100 and ECE 36200. Class 3. An introductory treatment of multimedia algorithms and implementation using high-speed multimedia processors. Detailed discussion of architecture, addressing modes and instruction set of multimedia processors, entropy coding, transform coding, speech compression, image compression, and video compression.

ECE 42100 Advanced Digital System Design (3 cr.) P: ECE 27000 and ECE 26300. Class 3. Advanced topics in digital design. Boolean logic. Logic optimization, VLSI and ASIC design basics. Design. Simulation. Placement and routing. Logic synthesis. FPGA structure. FPGA implementation. FPGA design flow. Verilog and VHDL coding.

ECE 42400 Electromechanical Systems and Applied Mechatronics (3 cr.) P: ECE 30100. Class 3. Design, optimization, and control of electromechanical and mechatronic systems. Comprehensive dynamic analysis, modeling, and simulation of electric machines, power electronics, and sensors. Application of advanced software and hardware in mechatronic systems design and optimization.

ECE 42700 Power Electronics (3 cr.) P: ECE 25500. Class 3. Introduction to the fundamental operating principles of power conditioning circuits that are currently being used to effect power flow from ac to dc and vice versa. Emphasis is on the relationship between form and function of these circuits. Circuits discussed will include ac/dc line-commutated converters, dc/dc converters, dc/variable frequency converters, resonant converters and ac/ac converts. Computer simulations will be used as part of the course work.

ECE 43200 Elementary Power Systems Engineering (3 cr.) P: ECE 32100. Class 3. Fundamental concepts of power system analysis, transmission line parameters, basic system models, steady state performance, network calculations, power flow solutions, fault studies, symmetrical components, operating strategies and control.

ECE 44000 Transmission of Information (4 cr.) P: ECE 30100 and ECE 30200. Class 3, Lab 3. Analysis and design of analog and digital communication systems. Emphasis on engineering applications of theory to communication system design. The laboratory introduces the use of advanced engineering workstations in the design and testing of communication systems.

ECE 46100 Software Engineering (3 cr.) P: CSCI 24000. Class: 3. Introduction to software engineering principles with special emphasis on the process, methods, and tools needed to develop and test quality software products and systems.

ECE 46300 Introduction to Computer Communication Networks (3 cr.) P: ECE 26300 and ECE 26100. Class 3. An introduction to the design and implementation of computer communication networks. The focus is on the concepts and the fundamental design principles that have contributed to the global Internet's success. Topics include: digital transmission, switching and multiplexing, protocols, MAC layer design (Ethernet/802.11), LAN interconnects and switching, congestion/flow/error control, routing, addressing, performance evaluation, internetworking (Internet) including TCP/IP, HTTP, DSN, etc. This course will include one or more project.

ECE 46800 Introduction to Compilers and Translation Engineering (3 cr.) P: ECE 36200 and CSCI 36200. Class 3. Design and construction of compilers and other translators. 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 on engineering, from scratch, a compiler or interpreter for a small programming language, typically a C or Pascal subset. Projects involve implementation (and documentation) of such a system using C on UNIX.

ECE 47100 Embedded Microcontroller, Microprocessor, and DSP-Based Systems (3 cr.) P: ECE 36200 and ECE 26300. Class 3. A structured approach to the development and integration of embedded microcontroller/microprocessor/DSP-based systems. The course provides students with design experience of embedded systems. The course covers the microprocessor selection, the configuration of peripheral components, and the hardware abstraction techniques. The course also covers the C programming techniques for embedded systems and using a fixed point microprocessor for floating point calculations.

ECE 48300 Digital Control System Analysis and Design (3 cr.) P: ECE 38200. Class 3. An introduction to real-time computer-controlled systems analysis and design in both frequency domain and state space. Sampling theory and its effect on digital control design. Implementation, application, and industrial practice of digital control using digital signal processors and other microprocessors. Matlab/Simulink and its toolboxes are used. Regular computer and lab assignments.

ECE 48700 Senior Design I (1 cr.) P: Senior Standing and intent to graduate within 2 semesters. A real-life experience in engineering problem solving in a group setting from identification, planning and execution to professional-quality written and oral presentations. This is the first semester of a two semester course sequence.

ECE 48800 Senior Design II (2 cr.) P: ECE 48700. A real-life experience in engineering problem solving in a group setting from identification, planning and execution to professional-quality written and oral presentations. This is the second semester of a two semester course sequence.

ECE 49100 Engineering Design Project (1-2 cr.) P: Senior Standing and intent to graduate within 2 semesters. 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.

ECE 49500 Selected Topics in Electrical and Computer Engineering (1-4 cr.) Engineering topics.

ECE 49600 Electrical and Computer Engineering Projects (ARR cr.) P: Consent of instructor. Hours and credits to be arranged.

ECE 51000 Introduction to Biometrics (3 cr.) P: ECE 30200 or graduate standing. Class 3. Basic concepts of biometrics, biometrics systems, and fundamental theories in biometrics; help student learn how to design and develop a biometric system for multi-level security applications. Topics include introduction to biometrics, face recognition, iris recognition, fingerprint recognition, speaker recognition, other biometrics, multimodal biometrics, issues and concerns in biometrics, and future biometrics.

ECE 51500 Software Engineering for Embedded Systems (3 cr.) P: CSCI 36200 or graduate standing. Class 3. This course teaches the object-oriented software analysis and design for embedded systems. Unified Modeling Language and Shlaer/Mellor methodology will be studied. Projects will be assigned, which lead the students through the information gathering, problem analysis, model design, and model implementation cycles. The hardware/software integration will also be covered.

ECE 52702 Advanced Power Electronics Converters (3 cr.) P: ECE 20200, ECE 42700 Class 3. This course introduces students to advanced power electronics converters dealing with ac voltage. The power electronics topologies considered in this course are sorted into two groups: a) neutral-point-clamped, b) cascase, c) flying capacitor, and d) non-conventional multilevel configurations. The back-to-back converters presented are: a) three-phase to three-phase, b) single-phase to three-phase, c) single-phase to single-phase ac-dc-ac converters. A new methodology will be employed to present comprehensively multilevel and back-to-back converters topologies. The main applications of those converters are in renewable energy systems, active power filters, energy efficiency devices and motor drive systems.

ECE 53200 Computational Methods for Power System Analysis (3 cr.) P: ECE 43200 or Graduate Standing. System modeling of three-phase power networks. Computational methods and problem formulation related to load flow and fault studies, and economic dispatch of electric power systems. Assigned projects will involve implementing some of the methods and conducting simple studies.

ECE 53301 Wireless and Multimedia Computing (3 cr.) P: Graduate Standing. A treatment of Voice and Video over IP and wireless communication algorithms, protocols, standards and implementation using multicore digital signal processors and communications processor modules. Discussion of voice over IP and wireless communication algorithms, protocols and standards, and advanced wireless and voice over IP applications.

ECE 53600 Introduction to Computational Intelligence (3 cr.) P: or C: Programming skills; graduate standing or permission of instructor. Class 3. Basic concepts in theory and paradigms for neural networks, evolutionary computation, and fuzzy logic; algorithms and applications for hybrids of these tools known as computational intelligence are explored. Topics include artificial neural networks, fuzzy systems, and evolutionary computation. Implementations of a number of paradigms are presented, including particle swarm optimization. Applications to various areas such as biomedical engineering and non-linear control are examined.

ECE 53700 Multimedia Applications (3 cr.) P: ECE 30100 and ECE 36200, or Graduate Standing. Class 3. Treatment of multimedia algorithms and their hardware and software implementations using FPGA and ASIC. Detailed discussion of entropy coding, transform coding, speech compression, image compression, and video compression.

ECE 53800 Digital Signal Processing I (3 cr.) P: ECE 30100 and ECE 30200 or Graduate Standing. Class 3. Theory and algorithms for processing of deterministic and stochastic signals. Topics include discrete signals, systems, transforms, linear filtering, fast Fourier transforms, nonlinear filtering, spectrum estimation, linear prediction, adaptive filtering, and array signal processing.

ECE 53801 Discrete Event Dynamic Systems (3 cr.) P: Graduate standing or consent of instructor. Class 3. This course introduces discrete event dynamic systems with their applications in system modeling, analysis, and control. Models such as automata, Petri nets, Markov chain, and queueing systems are introduced, along with analysis of their dynamics. Discrete event simulation methods are included. Examples from various engineering applications are given.

ECE 53900 Foundations of Advanced Engineering I (3 cr.) P: ECE 27000 and ECE 30200 or graduate standing. Class 3. Several mathematical tools applied in the engineering discipline are discussed. Statistical methods, including construction of confidence interval and hypothesis testing, as well as regression and regression analysis, are discussed. Discrete tools are discussed; these include logic and mathematical reasoning, combinatorics, groupls and finite fields. Applications of some of these tools in engineering problems are introduced. Decision Theory include Bayes Theorem and applying Bayes Theorem to form decision problems.

ECE 54400 Digital Communications (3 cr.) P: ECE 44000 or Graduate Standing. Class 3. Introduction to digital communication systems and spread spectrum communications. Analog message digitization, signal space representation of digital signals, binary and M-ary signaling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal bandwidth 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.

ECE 54700 Introduction to Computer Communication Networks (3 cr.) P: ECE 30200 or Graduate Standing. Class 3. A qualitative and quantitative study of 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. Packet and circuit switching, the OSI standards for architecture and protocols, elementary queuing theory for performance evaluation, random access techniques, local area networks, reliability and error recovery, and integrated networks.

ECE 54800 Introduction to 2D & 3D Digital Image Processing (3 cr.) P: ECE 30100 or consent of instructor or graduate standing. Class 3. An introduction to 2D and 3D image processing. Lecture and projects covering a wide range of topics including 2D and 3D image analysis, image segmentation; color image processing, image sharpening, linear and filtering, image restoration, and image registration. Graduate standing.

ECE 55400 Electronic Instrumentation and Control Circuits (3 cr.) P: ECE 25500 and ECE 30100 or Graduate Standing. Class 3. Analysis and design of special amplifiers, pulse circuits, operational circuits, DC amplifiers, and transducers used in instrumentation, control, and computation.

ECE 55801 Advanced Systems on a Chip (SoC) Designs for Image Processing using FPGAs (3 cr.) P: ECE 42100 and ECE 30100 or consent of instructor or Graduate standing. Class 3. This class covers advanced concepts in using Field Programmable Gate Arrays (FPGAs) designed with an HDL (VHDL for example: Very High Speed IC Hardware Description Language). The students will learn complex interface design, advanced hardware and embedded system design and parallel processing. Projects and lessons will focus on applications in Digital Imaging Systems. Lecture and projects covering topics including: VHDL mapped to FPGA for state machine design, hardware and software VGA control, image filtering, data transfer to bus, and embedded controller integration. Graduate standing or consent of instructor.

ECE 55900 MOS VLSI Design (3 cr.) P: ECE 30500 and ECE 36500 or Graduate Standing. Class 3. 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 whose regular and/or expandable structures are primary candidates for integration. All circuits are digital and are considered in the context of the silicon-gate MOS enhancement-depletion technology. Homework requires the use of existing IC mask layout software; term projects assigned.

ECE 56401 Computer Security (3 cr.) P: Graduate Standing. In this course we will discuss the following topics: (not necessarily in this order) security policies, confidential policies, integrity policies, security models, security design, access control, cryptography, key management, authentication, program and software, security, malicious logic, intrusion detection, network security, security attacks and countermeasures, operation system security, smartcard tamper-resistant devices, phishing, legal and ethical issues in computer security, and selected topics.

ECE 56500 Computer Architecture (3 cr.) P: ECE 36500 or Graduate Standing. Class 3. An introduction to problems of designing and analyzing current machine architectures. Major topics include performance and cost analysis, pipeline processing, instruction level parallelism, GPU architecture and programming, memory hierarchy, and multiprocessor architectures.

ECE 56600 Microprocessor System Design (3 cr.) P: ECE 36500 or Graduate Standing. Class 3. An overview of advanced-architecture CISC microprocessors and their associated support components, with emphasis on incorporating these devices into both general-purpose and embedded board-level designs for multi-microprocessor systems utilizing open-architecture system buses. Survey of 32-bit CISC microprocessor, memory management, floating point support, advanced peripherals, PLD-base "glue logic" design, performance evaluation, IECEE-standard open-architecture system buses, and various pertinent interface and networking standards. Design experience is gained through a comprehensive, semester-long project.

ECE 56601 Real-time Operating Systems and Application (3 cr.) P: ECE 36500 or consent of instructor or Graduate standing. Class 3. This course introduces students to the principles of modern operating systems focusing on real-time operating systems and embedded operating systems and their applications.

ECE 56900 Introduction to Robotic Systems (3 cr.) P: ECE 38200 or Graduate Standing. Class 3. Basic components of robotic systems; selection of coordinate frames; homogeneous transformations; solutions to kinematics of manipulator arms; velocity and force/torque relations; dynamic equations using Euler-Lagrange formulation; digital simulation of manipulator motion; motion planning; obstacle avoidance; controller design using torque method; and classical controllers for manipulators. Lab experiments and final project required.

ECE 57000 Artificial Intelligence (3 cr.) P: ECE 35900 or Graduate Standing. Class 3. Basic understanding of data structures, including the proper use of arrays, lists, trees, and queues. Understanding of searching and sorting concepts. Basic understanding of probability and statistics, including Bayes rule, statistical tests of significance, and normal distribution.

ECE 57101 System Modeling and Design for Smart Devices (3 cr.) P: Graduate standing or consent of instructor Class 3. Introduction to the mobile computing and the principles to design and implement application system for a smart device, including mobile computing architecture, mobile and pervasive computing environments, applications and services, context-aware computing, and human-computer interaction.

ECE 58000 Optimization Methods for Systems and Control (3 cr.) P: Consent of Instructor or graduate standing. Class 3. Introduction to optimization theory and methods, with applications in systems and control. Nonlinear unconstrained optimization, linear programming, nonlinear constrained optimization, various algorithms and search methods for optimizations, and their analysis. Examples from various engineering applications are given.

ECE 59500 Selected Topics in Electrical and Computer Engineering (3 cr.)

ECE 60000 Random Variables and Signals (3 cr.) P: Graduate standing. Class 3. 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.

ECE 60200 Lumped System Theory (3 cr.) P: MATH 511 or consent of instructor. Class 3. An investigation of 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. Coverage includes notion of linearity, time invariance, discrete- and continuous-times state models, canonical forms, associated transfer functions and impulse response models, the state transition matrix, the Jordan form, controllability, observability, and stability.

ECE 60400 Electromagnetic Field Theory (3 cr.) P: Graduate Standing. Class 3. 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).

ECE 60600 Solid State Devices (3 cr.) P: Graduate Standing. Class 3. A relatively broad, moderate-depth coverage of semiconductor devices and related topics. Semiconductor fundamentals required in the operational analysis of solid-state devices; detailed examination of the positive-negative (PN) junction diode and PN junction devices; heterojunction surface devices including Schottky diode, the MOS capicator, and the MOSFET.

ECE 60800 Computational Models and Methods (3 cr.) P: Graduate Standing. Class 3. 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.

ECE 61000 Energy Conversion (3 cr.) P: Graduate Standing. Class 3. Electromechanical energy conversion, reference frame theory, induction machines, wound-rotor synchronous machines, permanent magnet synchronous machines, dc-to-ac conversion, brushless dc motor drives, induction motor drives.

ECE 62700 Introduction to Cryptography and Secure Communication (3 cr.) P: Graduate Standing. Class 3. This course introduces the basic concepts of cryptography, emphasizing both privacy and integrity. Various cipher systems and cryptographic tools are presented including stream ciphers, block ciphers, public-key ciphers (RSA, El Gamal and others), hash functions, message authentication codes and digital signature systems. Methods used to attack the cipher systems are discussed. As well as how the cryptographic tools are used in today's communication systems.

ECE 63700 Digital Image Processing I (3 cr.) P: ECE 53800 and Graduate Standing. Class 3. 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.

ECE 63901 Error Correction Coding and Secret Sharing (3 cr.) P: Graduate standing or consent of instructor. Class 3. The theory and practice of error control coding is examined. The study includes the arithmetic of Galois fields as well as linear block, cyclic, and convulution codes. Some applications of codes in digital communication systems and in computer systems are presented. The dual of error coding, secret sharing is also discussed. Several secret sharing schemes will be presented. Applications of secret sharing are discussed.

ECE 64900 Speech Processing by Computer (3 cr.) P: Graduate Standing (knowledge of basic digital signal processing: time and frequency domains, fourier and Z-transforms, convolution, knowledge of C or FORTRAN on UNIX). Class 3. Models of the vocal tract; identification and extraction of speech features; speech transmission and compression systems; the recognition of speech and speakers by computers; control of speech synthesizers. Computer project required.

ECE 66200 Pattern Recognition and Decision Making Processes (3 cr.) P: Graduate Standing. Class 3. Introduction to the basic concepts and various approaches of pattern recognition and decision making process. The topics include various classifier designs, evaluation of classifiability, learning machines, feature extraction and modeling.

ECE 68000 Modern Automatic Control (3 cr.) P: ECE 60200 or Consent of Instructor. Class 3. Theoretical methods in optimal control theory. Topics include the calculus of variations and the Pontryagin minimum principle with applications to minimum fuel and 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.

ECE 68400 Linear Multivariable Control (3 cr.) P: ECE 60200 or equivalent. Class 3. A state space investigation of multi-input multi-output control design problems from the geometric perspective. The course will detail the theory and design algorithms needed for a solution to the state feedback eigenvalue assignment problem, the disturbance decoupling problem with and without internal stability, the output stabilization problem, and the tracking (or regulator) problem with internal stability.

ECE 68500 Introduction to Robust Control (3 cr.) P: ECE 60200 or Equivalent Class. Class 3. Introduction to the analysis and design of robust feedback control systems. Modeling and paradigms for robust control. Robust stability and measures of robust performance. Analysis of and design for robust stability and performance.

ECE 69500 Advanced Topics in Electrical & Computer Engineering (VAR cr.)

ECE 69600 Advanced Electrical Engineering Projects (VAR cr.) Individual research projects to be approved by the supervising faculty member before registering for the course. An approved written report must be filed before credit is given. (This course cannot be used on a Ph.D. plan of study for the primary area.)

ECE 69800 Research (M.S. thesis) (1-6 cr.) Research for M.S. thesis.

Electrical and Computer Engineering Technology

ECET 10700 Introduction to Circuit Analysis (4 cr.) P: Math 602 placement test of 45 or above. Class 3, Lab 2. A study of voltage, current, power, and resistance; and Ohm's law, Kirchhoff's circuit laws, and network theorems. Circuit studies cover electronic devices: diodes, transistors, and operational amplifiers. Physical features of capacitance and inductance and their effects in transient circuits and in a-c circuits are covered. The laboratory provides experience with electronic instrumentation and circuit simulation.

ECET 10900 Digital Fundamentals (3 cr.) P: or C: MATH 11100 or higher or consent of instructor. Class 2, Lab 2. 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 and programmable logic devices are used to develop combinational and sequential circuits.

ECET 11600 Electrical Circuits (3 cr.) P: or C: MATH 15300. Class 2, Lab 2. A study of d-c and a-c circuits. This course covers circuit components, R, L, and C; voltage; current; power; Ohm's law; Kirchhoff's laws; series and parallel circuits; electrical measurements; sinusoidal voltages; currents; impedances; transformers; motors; polyphase systems, and the National Electrical Code. This course is a service course offered for non-ECET majors.

ECET 15500 Digital Fundamentals II (3 cr.) P: ECET 10900. Class 2, Lab 2. Sequential logic circuits, flip-flops, counters, programmable device logic, shift registers, logic families and introductory computer concepts.

ECET 15700 Electronics Circuit Analysis (4 cr.) P: ECET 10700 and MATH 15300. Class 3, Lab 2. A study of rectification, capacitive filters, IC regulated power supplies, transistor biasing techniques, dependent sources, operational amplifiers, and IC fabrication. Circuit fundamentals such as Kirchhoff's laws are utilized in the analysis and design of circuits. Computer-aided analysis of circuits is used.

ECET 16400 Applied Object-oriented Programming (3 cr.) P: or C: MATH 15300. Class 2, Lab 2. Problem solving and computing with emphasis on electrical engineering technology applications. Introduction to an object programming language as applied to solving electrical technology problems.

ECET 20700 AC Electronics Circuit Analysis (4 cr.) P: or C: ECET 15700 and MATH 15400. Class 3, Lab 2. A study of a-c circuits, including the j operator, phasors, reactance, and impedance. Circuit laws, network theorems, and the fundamental concepts of Fourier analysis are applied and used in the study of topics such as passive filters, IC filters, amplifiers, resonant circuits, single-phase and three-phase circuits, and elementary magnetic circuits.

ECET 20900 Introduction to Microcontrollers (4 cr.) P: ECET 10900. P: or C: ECET 16400 or CIT 26200 or CIT 27000. Class 3, Lab 2. An introduction to microprocessor hardware and software, focusing on embedded control applications. Assembly language programming, linking, input/output techniques, debugging, memory, timing and peripheral devices are studied. C programming of microcontrollers is introduced.

ECET 23100 Electrical Power and Controls (4 cr.) P: ECET 10900 and ECET 15700. Class 3, Lab 2. An introduction to transformers, induction motors, and single-phase and three-phase power systems, motor control devices, programmable logic controllers, PLC input and output devices, and PLC communications.

ECET 23110 Electrical Machines (3 cr.) P: ECET 10900 and ECET 15700. P: or C: PHYS 21800. Class 3, Lab 2. An introduction to the fundamental concepts and applications of transformers, induction motors, and single-phase and three-phase power systems. Design and optimization of power systems based on National Electrical Code guidelines. Laboratory experiments in the design, operation, and measurement of electromechanical systems.

ECET 23120 Industrial Controls (3 cr.) P: ECET 10900 and ECET 15700. P: or C: PHYS 21800. Class 3, Lab 2. An introduction to Industrial Controls with a focus on relay logic and PLC logic. Design and optimization of control systems based on National Electrical Code guidelines and methods for development of schematics and coding for industrial controls. Laboratory experiments in the design, coding, operation, and documentation of industrial control systems.

ECET 28400 Computer Communications (4 cr.) P: ECET 10700. Class 3, Lab 2. An introductory course in data communication systems. The hardware and software issues in computer communications are studied. Emphasis is on hands-on experience in computer communications, such as cabling, use of communication devices and media, choice of networking topologies, protocols, and platforms.

ECET 30200 Introduction to Control Systems (4 cr.) P: ECET 23100 or ECET 23120. Class 3, Lab 2. A continuation of the study of industrial controls including on-off, open-and closed-loop control systems, and analog-based systems. Major topics include relay controls, PLC, controls, HMI and open-PC controls, and networking.

ECET 30700 Analog Network Signal Processing (4 cr.) P: ECET 20700 and MATH 22100. Class 3, Lab 2. An advanced course in network analysis that stresses network theorems and solutions of time-domain and frequency-domain problems. Software techniques to solve mathematical problems are employed.

ECET 30900 Advanced Embedded Microcontrollers (4 cr.) P: ECET 20900. Class 3, Lab 2. A study of the advanced applications of embedded microcontrollers, including use of programmable counter/timer arrays, interrupts, multi-tasking, analog interfaces, hardware abstraction, real-time operating systems, and peripheral device drivers.

ECET 33100 Generation and Transmission of Electrical Power (4 cr.) P: ECET 20700 and ECET 23100 or ECET 23110. Class 3, Lab 2. A study of the generation and transmission of electrical energy. Includes modeling and analysis of synchronous alternators, transformers, and transmission lines, plus analytical and computer methods of solving load flow and fault conditions on balanced and unbalanced three-phase systems. Techniques used by utilities for protection and economic operation of power systems are introduced.

ECET 35100 Instrumentation Applications for Technology (3 or 4 cr.) P: MATH 22100, and ECET 11600 or ECET 10700. Class 2 or 3, Lab 2. Introduction to the basic concepts and terminology of instruments. This course covers the procedures and techniques essential to measurement of physical quantities (such as pressure, flow, temperature, and level measurement) and analysis of that data. Students will use data acquisition systems and computer control software to complete laboratory exercises.

ECET 35700 Real-Time Digital Signal Processing (4 cr.) P: ECET 20900 and Math 22100. P or C: Math 22200. Class 3, Lab 2. Architecture, instruction set, and hardware and software development tools associated with a fixed-point general-purpose DSP processor. Fundamental principles associated with the processing of discrete-time signals and common applications such as waveform generation, FIR and IIR digital filtering, and DFT-and FFT-based spectral analysis and filtering are covered.

ECET 36000 CIM in Electronics Manufacturing (4 cr.) P: P: ECET 15700 Class 3, Lab 2. This course covers the manufacture and assembly of electronic printed circuit boards from component selection and board layout to soldering and test. Special Emphasis is placed on high volume manufacturing techniques and state-of-the-art processes, such as surface mount technology (SMT).
Laboratory projects include CAD circuit board layout, using automatic placement and soldering equipment, investigating thermal characteristics of circuit boards, process design and evaluation using SPC techniques.
Effects of manufacturing processes on electrical characteristics are considered.

ECET 37100 Automation, Instrumentation, and Process Control (3 or 4 cr.) P: ECET 16400 and ECET 23100 or ECET 23120. Class 0 or 2, Lab 4 or 6. A project-oriented course combining key areas of automation, instrumentation, and process control. The course covers automatic testing, computer interfacing, data collection, robotic controls, programmable logic controllers, and graphical process control software. A final project is an integrated system.

ECET 38100 Electrical Distribution Systems (4 cr.) P: ECET 20700 and ECET 23100 or ECET 23100. Class 3, Lab 2. A study of the design and operation of electric distribution systems. Estimated demand calculations, energy conservation, faults on power systems, power quality, power factor improvement, electric rates, voltage drops, protective devices, illumination, and the applicable portions of the National Electrical Code. Both new facilities and additions to existing facilities are included.

ECET 41700 Advanced Digital Systems Design with VHDL (4 cr.) P: ECET 15500 and ECET 15700. Class 3, Lab 2. A study of Field Programmable Gate Arrays (FPGAs) and complex programmable logic using VHDL, finite-state-machine analysis and design, high-speed digital design considerations, memory systems, digital and analog devices, and A/D and D/A conversion.

ECET 43400 PC Systems II (4 cr.) P: ECET 20900 and: ECET 16400 or CIT 27000, or CIT 26200. Class 3, Lab 2. Real-time, PC-based operating systems. Programming Graphical User Interfaces for control applications using an object-oriented language. Embedded PC hardware, busses, and peripheral programming. Writing device drivers.

ECET 48300 Network Fundamentals with Microcontrollers (4 cr.) P: ECET 28400. Class 3, Lab 2. A study of computer networks and industrial network applications. Network protocols, media, and system software are examined. The focus is on the usage of data communication techniques and their applications in the industrial environment. In the laboratory students use utilities to examine different network protocols, configuring network software, using test equipment for analyzing and troubleshooting networks.

ECET 48404 Emerging Information, Communication and Technologies (4 cr.) P: ECET 28400. Class 3, Lab 2. An advanced course in the Computer Engineering Technology program that introduces and evaluates emerging systems, services and applications in information, communication, and technologies (ICT) areas. In the laboratory, students use utilities to evaluate and analyze various emerging subjects so that certain level of mastery of the subjects can be demonstrated.

ECET 49000 Senior Design Project Phase I (1 cr.) P: Three 30000- or 40000-level ECET electives. Extensive individual design and development performed in consultation with faculty. Collaboration with industry is encouraged. Evidence of extensive and thorough laboratory work is required. Written and oral presentations are emphasized. Capstone experiences are included as integral parts.

ECET 49100 Senior Design Project Phase II (2 cr.) P: ECET 49000. P: or C: TCM 37000. A continuation of ECET 49000.

ECET 49300 Ethics and Professionalism in Technology (1 cr.) P: Senior Standing. Factors involved in the ethical decision making in engineering and technology professions on both a local and global scale will be presented. Workplace issues such as socio-economic and cultural differences, professionalism, ethical codes, employee and community safety, whistle blowing, diversity and sexual harassment will be discussed. Case studies will guide student activities.

ECET 49900 Electrical and Computer Engineering Technology (1-9 cr.) Class 0-4, Lab 2-9. Hours and subject matter to be arranged by staff.

ECET 53500 Energy Management (3 cr.) P: TECH 58100 Intro to Facilities Engineering. This course introduces practical procedures to select options in order to operate and maintain commercial buildings to reduce building system energy costs and to help meet environmental standards.

Energy Engineering

EEN 22000 Fundamentals of Electrochemical Materials & Energy Engineering (3 cr.) P: CHEM C105. C: ME 20000 and EEN 22501. This course examines the chemistry and structure of materials and their correlation with various electrochemical properties including their suitability for use in conversion and storage of electrochemical energy, energy related materials, and chemical and renewable energy sources.

EEN 22501 Energy Engineering Laboratory I (1 cr.) C: EEN 22000 and ENGR 29700. Experiments on testing thermodynamics, parametric design and electrochemistry.

EEN 24000 Basic Engineering Mechanics (4 cr.) P: PHYS 15200. C: MATH 26100. This course is an introductory mechanics course in energy engineering, covers force systems and couples, equilibrium, centroids, friction, Kinematics, kinetics of particles & rigid body, Newton's second law, energy, and momentum methods; equations of motions, and application to machine elements.

EEN 25001 Energy Engineering Laboratory II (1 cr.) C: EEN 26200. Experiments on data analysis, hands-on programming with devices and fabrication.

EEN 26000 Sustainable Energy (3 cr.) P: CHEM-C 10500. C: PHYS 25100 and ME 20000. The objective of this course is to familiarize the students with various forms of available energy. The concept of these energies in terms of efficiency, raw material, safety, economy and environmental impact will be introduced.

EEN 26200 Engineering Design, Ethics, and Entrepreneurship (2 cr.) P: ENGR 19600. C: ENGR 29700 and EEN 24000 and COMM-R 110 and ENG-W 131 and EEN 25001. Basic concepts of the design process. Innovative engineering design of real life application. Engineering ethics topics. Fundamentals of Entrepreneurship. Design projects focus on open-ended problems. Design modeling, simulation, documentation and communication. Implementation and use of modern computer tools in solving design problems and completing team design projects in the area of Energy Engineering.

EEN 29700 Selected Topics in Energy Engineering (0-6 cr.) P: Sophomore standing and/or consent of instructor. Topics of contemporary importance or of special interest in Energy Engineering.

EEN 31000 Fluid Mechanics (3 cr.) P: ME 20000 and MATH 26600 and EEN 24000. C: EEN 32501. 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.

EEN 32501 Energy Engineering Laboratory III (1 cr.) C: EEN 31000 and ME 27200. Experiments on testing of fluid mechanics and energy engineering.

EEN 33000 Dynamic Systems Modeling and Measurements (3 cr.) P: ECE 20400 and MATH 26600. C: EEN 24000. This course will cover the fundamentals of instrumentation, measurement, and dynamic systems modeling. Design, selection, and usage of the instrumentation systems and the interpretation of experimental results are also introduced. Basic concepts of measurements methods, measurement system response, assessment, uncertainty analysis of measured data, sensors, signal conditioning, recording/display devices, digital techniques, instrument interface, and measurement theories on stress and strain, temperature, pressure, fluid flow and velocity will also be covered. Additionally, fundamentals of dynamic systems including mechanical, electrical, and electromechanical systems will be introduced. Laplace transform, block diagram, transient and frequency response of linear first and second order system will be covered as well.

EEN 34500 Renewable Energy System and Design (3 cr.) P: EEN 26000. C: ME 31400. This course is designed to introduce the system and design of energy conversion and storage devices for renewable energy sources. Students will first learn about energy sources available on earth including kinetic, solar, and chemical. Next, the course will provide students with a review of the thermodynamic concepts behind energy constant and energy transfer via an energy conversion device. Finally, this course will tie together concepts of renewable energy sources and thermodynamics teaching students about design elements for energy conversion and storage devices, in which renewable energy sources are converted and stored.

EEN 35001 Energy Engineering Laboratory IV (1 cr.) C: ME 31400. Experiments on testing of heat and mass transfer, and energy engineering.

EEN 39700 Selected Topics in Energy Engineering (0-6 cr.) P: Junior Standing and/or consent of instructor. Topics of contemporary importance or of special interest in Energy Engineering.

EEN 42501 Energy Engineering Laboratory V (1 cr.) C: ME 48200 Experiments on testing of mechanical measurements, control systems and alternative energy systems.

EEN 44500 Compressible Flow and Renewable Kinetic Energy Design (3 cr.) P: EEN 31000. This course is designed to introduce compressible flow, turbomachines and design of kinetic energy conversion and storage devices for wind, wave and tidal renewable energy sources. Students will first learn about compressible flow, turbomachines concepts and kinetic energy sources available on earth. Next, the course will provide students with analysis, design parameters and control renewable kinetic energies.

EEN 46200 Capstone Design (3 cr.) P: Senior Standing. C: ME 48200 and EEN 44500. Concurrent engineering design concept is introduced and practiced. Application of the design is emphasized. Design problems from all areas of energy engineering are considered. Contemporary issues pertaining to energy engineering career will be discussed.

EEN 49700 Selected Topics in Energy Engineering (0-6 cr.) P: Junior standing and/or consent of instructor. Topics of contemporary importance or of special interest in Energy Engineering.

Freshman Engineering

TECH 10200 First Year Seminar for Technology Majors (1 cr.) This course offers new and prospective technology majors strategies for success in college. Students work with an instructional team to develop the necessary skills to successfully transition to the university environment.

TECH 10400 Technical Graphics Communications (3 cr.) This course is an introduction to the graphic language used to communicate design ideas using CAD. Topics include: Sketching, multiview drawings, auxiliary views, sections views, pictorial views and dimensioning practices as well as an introduction to three-dimensional modeling, lighting and rendering.

TECH 10500 Introduction to Engineering Technology (3 cr.) Introduction to the different disciplines incorporated in engineering technology as well as the skill set needed to be a successful student in engineering technology. Focus will be on individual and professional development, problem identification, developing analytical skills, time and resource management, project planning, design, implementation and evaluation, and oral and written communication in the engineering technology profession.

ENGR 19000 An Introduction to Engineering Design (3 cr.)

ENGR 19500 Selected Topics in Engineering (Variable Titles) (0-3 cr.)

The following are the variable titles and course descriptions for ENGR 19500.

Selected Topics in Engineering I (0-3 credits) Selected topics in general or interdisciplinary engineering

First Year Engineering Projects (1-2 credit)

Introduction to the engineering Profession (1 credit) Class 1 P: none. This course introduces students to the engineering profession and to campus resources. The course is designed to help students develop essential communication and thinking skills along with the study and time-management skills needed for success in studying engineering. Collaborative techniques used in engineering practice are utilized.

ENGR 19600 Introduction to Engineering (3 cr.) C: MATH 15400 or MATH 15900 or equivalent. Class 2, Lab 2. An overview of the engineering profession and methodologies of engineering design. Students develop skills using computer-aided design and simulation software for engineering systems. Projects and homework are implemented and tested in a laboratory environment. The course also introduces the students to standard computer application software and university network and software resources.

ENGR 19700 Introduction to Programming Concepts (2 cr.) C: MATH 16500. Class 1, Lab 2. Basic concepts and applications of software programming for solving engineering problems. Topics include techniques for developing structured algorithms, data input and output, conditional statements, loops, recursion, functions, arrays, and elementary concepts in mathematical programming. Examples, homework, and applications of programming concepts make extensive use of the C programming language.

ENGR 29700 Computer Tools for Engineering (1 cr.) P: ENGR 19700. Class 1. Introduction to the use of Matlab for solving engineering problems. Topics include computational methods, data input and output, plotting and curvefittting, functions, conditional statements, loops, and introduction to Matlab toolboxes.

TECH 30100 Renewable Energy Systems (3 cr.) Course provides the students with an introduction to renewable energy sources. Topics include photovoltaic, solar thermal systems, fuel-cells, hydrogen, wind power, waste heat, bio-fuels, wave/tidal power, geothermal power and hydroelectric. Analysis of technical, economic, environment, politics, and social policy are integral components of the course.

TECH 30200 Introduction to Green Building Technology (3 cr.) This course examines, discusses and analyzes buildings. In particular, it delves into an introduction into green building science and technology. Building systems and assemblies (both residential and commercial) will be discussed and will include topics such as the principles of: thermal efficiency and comfort, climate, shading, site design, daylighting, efficient building envelopes and mechanical equipment. An emphasis will be placed upon interpreting, designing, assessing and applying green solutions and details for building construction purposes.

TECH 30300 Energy Efficiency and Auditing (3 cr.) Course discusses fundamentals of energy efficiency and energy auditing. Students will analyze audit data, research energy improvement measures, and prepare recommendations. Topics include energy audit process, energy audit reports, energy bill analysis, economic analysis, audit instrumentation, and will include a subset of the following: building envelope, electrical system, HVAC system, waste heat recover, lighting, cogeneration, and other prevalent commercial/industrial systems.

TECH 30400 Green Building Information Modeling (3 cr.) This course examines the BIM or Building Information Modeling approach to the design and construction of buildings. Topics include, but are not limited to: parametric modeling, interoperability, clash detection and BIM implications for architects, engineers, interior designers, managers and contractors. An emphasis will be placed upon interpreting, designing, and assessing how sustainable technologies (e.g., energy efficiency) can be assessed using BIM tools and modeling techniques.

TECH 40200 Emerging Green Technologies (3 cr.) This course will allow for examination of the very latest emergent green technologies in renewable energy, green buildings, and sustainable design, as well as, other green technology emerging in the marketplace or in development stages. Students will be immersed in the study of technology that is on the "bleeding edge" of technological development worldwide.

TECH 49100 Senior Seminar for Engineering Technology (1 cr.) A seminar course for programs in Engineering Technology that evaluates current practices and trends in engineering and technological industry through active learning processes.

Freshman Engineering

ENGR 20000 Cooperative Education Practice I (1 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

ENGR 20000 Career Enrichment Internship I (1 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

ENGR 25000 Cooperative Education Practice II (1 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

ENGR 25010 Career Enrichment Internship II (1 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

ENGR 30000 Cooperative Education Practice III (1 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career. *A minimum of 10 weeks and 200 hours are required for credit.

ENGR 30010 Career Enrichment Internship III (1 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career. *A minimum of 10 weeks and 200 hours are required for credit.

ENGR 35000 Cooperatice Education Practice IV (1 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career. *A minimum of 10 weeks and 200 hours are required for credit.

ENGR 40000 Cooperatice Education Practice V (1 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career. *A minimum of 10 weeks and 200 hours are required for credit.

TECH 20000 Cooperative Education Practice I (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 20010 Career Enrichment Internship I (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 25000 Cooperative Education Practice II (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 25010 Career Enrichment Internship II (1-3 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 30000 Cooperative Education Practice III (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 30010 Career Enrichment Internship III (1-3 cr.) Semester of external career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 35000 Cooperative Education Practice IV (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

TECH 45000 Cooperative Education Practice V (1-3 cr.) Semester of External career related experiences designed to enhance the student's preparedness for entering an initial or second career.

*A minimum of 10 weeks and 200 hours are required for credit.

Healthcare Engineering Technology Management (HETM)

HETM 10500 Introduction to HETM (1 cr.) Class 1. Students will explore the discipline of healthcare engineering technology management (HETM) and the professional practice of technicians in the field. Certification, codes of ethics, and potential career paths will be explored. A visit to a clinical HETM department will be included in the experience.

HETM 20200 Networking & Data Comm for Healthcare Equip (3 cr.) P: ECET 10900 Students explore basic networking concepts used in the clinical patient care environment. Security measures and communication protocols used within the patent care setting will be applied in a network. Networking topologies will be simulated and constructed. Failures will be diagnosed. HIPAA data recovery requirements will be studied and implemented with sample patient data.

HETM 21900 PC & Microprocessors for HETM (3 cr.) P: ECET 10900 This course explores fundamental computer and microprocessor components and theory including applications in health care technology. Hardware and software in specific clinical equipment will be discussed.

HETM 22000 Applied Human Biology for HETM (3 cr.) P: ENG-W 131 or equivalent Class 3. This course presents the human biology, anatomy, physiology, and medical terminology essential for biomedical equipment technicians and the devices involved in patient care. Focus is on the vocabulary necessary for effective medical communication skills in the hospital environment as part of the health care team.

HETM 22500 Healthcare Tech Diagnostics + Repair (3 cr.) P: ECET 10900. This course will explore fundamental repair theory and applications of technology used in the clinical setting, switching logic and controls, and systems repair in medical devices.

HETM 24000 The Technology of Patient Care (3 cr.) P: HETM 22000 and ECET 10700 Class 3. An overview of medical equipment used in the hospital and other medical environments to diagnose and treat patients. Sensors and physiological signals will be explained. Equipment found in various hospital departments and medical specialties will also be discussed. Patient safety and regulations will be emphasized.

HETM 29000 Biomedical Equipment Technician Practicum (4 cr.) P: HETM 32000 or C: HETM 32000. Class 3. Practice working in industry as a BMET. Students work on a variety of medical equipment and job tasks. Students receive some training in the form of in service and orientation programs. An employer evaluation, student report and a minimum of 180 work hours are required. Students may need to successfully complete a criminal background check.

HETM 29500 HETM Internship (1 cr.) P: Completion of HETM 24000 with a grade of C or better, overall GPA of 2.0 or higher. C: P or C: HETM 32500. Students experience an internship in the clinical setting exploring the professional practice of healthcare technology and the support of patient care. Students receive training through in-service and orientation programs. A minimum of 180 work hours are required. Students may be required to pass a physical exam, TB test, background check or proof of immunizations including Rubella.

HETM 29900 Biomedical Engineering Technology (1-3 cr.) Hours and subject matter to be arranged by staff.

HETM 30100 Medical Device Financial Planning (3 cr.) P: HETM 29500 or equivalent. Students will study medical device financial planning and life cycle management including pre-purchase specification and evaluation, clinical staff needs assessment, installation, training, repair and maintenance, performance assurance, and decommissioning/replacement.

HETM 30200 Interoperability of Healthcare Devices (3 cr.) P: HETM 20200. Students explore the clinical applications of computer networks, integrated medical devices, and interoperability. Special emphasis will be on technology specific to healthcare such as electronic medical records, health information exchanges, and data exchanges standards. HIPAA compliance associated with physiological data will be explored as well as clinical workflow and software.

HETM 31500 Introduction to Imaging Modalities (3 cr.) P: HETM 24000 The fundamentals of diagnostic imaging equipment will be explored. The principles of x-ray-based systems will be explored. Components and features of MRI, ultrasound, PET, and nuclear medicine will be discussed. Image storage and communication protocols will be presented.

HETM 32500 Healthcare Devices and Systems (3 cr.) P: HETM 24000 C or better, HETM 22500 and ECET 15700. Hands-on exploration of the professional practice of the support of technology involved in patient care. Topics will include patient monitoring equipment, IV and PCA pumps, surgical equipment, infection control and safety, life support equipment, and an overview of imaging modalities.

HETM 39900 Biomedical Engineering Technology (1-3 cr.) Hours and subject matter to be arranged by staff.

HETM 40100 Clinical Applications of RFID (3 cr.) P: HETM 21900 Radio frequency identification technology fundamentals will be explored as well as applications within the clinical setting. Current technologies, vendors, and trends will be discussed.

HETM 40200 Networking for Healthcare Systems (3 cr.) P: HETM 30200 and HETM 32500 Students explore the clinical applications of computer networks, integrated medical devices, interoperability, and electronic medical records. Special emphasis will be on security and HIPAA compliance associated with physiological data. Hands-on learning will be involve campus-area hospitals.

HETM 42000 Technology and Special Populations (3 cr.) P: HETM 32500 or equivalent. Class 3. This course focuses on special patient populations in the clinical environment and the equipment that supplements their care. Groups would include neonates, cardiac intensive care patients, surgical patients and trauma. Emphasis is placed on medical needs and the related technologies.

HETM 44000 Codes, Regulation & Patient Safety (3 cr.) P: HETM 32500 or equivalent. Class 3. This course explores applicable NFPA 99, JCAHO, CLIA and other regulatory agencies and their regulations governing medical equipment in the clinical environment. Case studies will be used to provide examples of interpretation and application.

HETM 46000 System Engr Tech for Healthcare (3 cr.) P: HETM 29500 Participants will gain insight into the analysis of multiple-entity clinical systems involving healthcare technology. Focus will include process analysis and improvement to satisfy clinical customer needs. Course content will explore the interdisciplinary efforts related to support the development, verification, deployment, integration, operations and user training of complex systems involving healthcare technology, as well as the creation of information about system performance associated with management decision making.

HETM 47000 Special Topics in Healthcare Technology Management (3 cr.) P: HETM 29500 This course will focus on current issues and discussion of trends in the healthcare technology management profession. Current journal articles and research will support the discussions.

HETM 49000 Project Planning and Design (1 cr.) P: Three HETM 30000 or 40000 level courses and HETM 29500 Students are expected to prepare an individual design in collaboration with industry and or the clinical setting. This course will introduce the applications of project management to the student's design. Topics include project scope, scheduling, resource limitations, stakeholder interactions, delivery and quality assurance.

HETM 49100 BMET Senior Project (3 cr.) P: Three HETM 30000 or 40000 level courses and HETM 49000. Class 3. Extensive individual design and/or evaluation performed in collaboration with faculty and health care team members. Project is performed under the supervision of health care team members. Relation to the clinical environment required. Written and oral presentation of results are required.

HETM 49200 Capstone Project (1 cr.) P: HETM 49000 Extensive individual design and/or evaluation performed in collaboration with faculty and health care team members. Project is performed under the supervision of health care team members. Relation to the clinical environment required. Written and oral presentations of results are required.

HETM 49300 HETM Ethics and Professionalism (1 cr.) P: HETM 29500 and Senior Standing in Program. Students will explore ethical, social, political, legal and ecological issues that practicing BMETs may encounter. Particular emphasis will be placed on patient safety and privacy issues.

HETM 49900 Biomedical Engineering Technology (1-3 cr.) Hours and subject matter to be arranged by staff.

Industrial Engineering Technology

IET 10400 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 the human factors necessary for effective management.

IET 15000 Quantitative Methods for Technology (3 cr.) P: MATH 15900 or MATH 15400. Application of statistical techniques to typical problems in technology. Topics include data collection, descriptive statistics calculation, hypothesis testing, sampling, continuous and discrete distributions, probability, and related topics. The course also introduces the use of spreadsheet and other software to solve statistical calculations. Introduction to SPC is included.

IET 20400 Maintaining Quality (3 cr.) P: MATH 15300 and MATH 15400, or MATH 15900. Class 2, Lab 2. 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 24000 Quality Techniques for Electronics Manufacturing (3 cr.) P: IET 15000. Survey of contemporary quality concepts and techniques. Topics include total quality management philosophy, process improvement, vendor certification, quality systems, ISO 9000 documentation, electronics industry quality applications, SPC, introduction to design experiments, basic reliability concepts, testing, and related topics. Team approaches to quality improvement and the application of the basic quality tools to improve processes are covered.

IET 30000 Metrology for Quality Assurance (3 cr.) P: MET 10500 and MATH 15900 or equivalent. Class 2, Lab 2. An analysis of the basic principles of linear and geometric dimensional metrology. Topics include basic measuring instruments; mechanical, electronic, pneumatic, and optical measuring instruments; quality data acquisition systems; coordinate measuring machines; attribute gaging; geometric functional gaging; surface integrity determination; and geometric profile measurement.

IET 30100 Cost Evaluation and Control (3 cr.) Class 3. 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. Emphasis on use of electronic data processing for establishing and analyzing production cost standards.

IET 35000 Engineering Economy (3 cr.) P: MET 10500 or TECH 10500 Class 3. Examines the concepts and techniques of analysis useful in evaluating the worth of systems, products, and services in relation to their cost. The objective is to help students grasp the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost. Project analysis will require computer proficiency. Not open to students who have credit for IET 25000.

IET 36400 Quality Control (3 cr.) Class 3. The course is aimed at determining customer needs and wants, interpreting these into a design during production, follow-up on field performance, and feeding back quality information to further improve the quality system.

IET 37400 Nondestructive Testing (3 cr.) Class 2, Lab 2. Study of industrial X-ray and ultrasonic inspection, surface penetrant inspection, magnetic particle and holography applications, and laser interferometry.

IET 45400 Statistical Process Control (3 cr.) P: IET 15000. Class 3. Design and analysis of statistical process control charts and industrial sampling plans. Not open to students who have credit for 35400.

IET 47400 Quality Improvement of Products and Processes (3 cr.) P: IET 45400 or consent of instructor. Class 3. Introduction to experimental design to improve products or processes. Topics include fractional factorial experiments, response curves, experimental noise, orthogonal arrays, and ANOVA. DOE using classical and Taguchi techniques. Introduction to QFD, FEMQ, and Six Sigma for quality improvements.

IET 59800 Directed MS Project (3 cr.) Formal investigation of a particular problem under the guidance of a member of the staff.

Interior Design Technology

INTR 10300 Introduction to Interior Design (3 cr.) Class 2, Lab 2. An overview of the field of interior design, its history, and theory. An application of the principles and elements of interior design. design process, basic hand drafting, lettering, finish and color board construction/ layout is included. This course is for those who are seeking or considering a degree in Interior Design.

INTR 12400 Space Planning for Interiors (3 cr.) P: INTR 10300. Class 2, Lab 2. Introduction to the fundamentals of design for human activity, standards for space, programming, and graphic communication. Introduction to codes, ADA guidelines and Universal Design. Manual drafting/drawing.

INTR 12500 Color and Lighting of Interiors (3 cr.) P: INTR 10300 and HER-E 109. Class 2, Lab 2. Exploration of the physiological, psychological, and phenomenal aspects of color and light in interior spaces. Application includes specification and selection of lighting fixtures and light sources.

INTR 15100 Textiles for Interiors (3 cr.) P: INTR 10300 and HER E109. Class 3. An extensive study of textiles: fiber types, yarn production, fabric construction, finishing, coloring, and printing. Focus on application of textiles for use in residential and commercial interiors.

INTR 20200 Interior Materials and Applications (3 cr.) P: INTR 10300. Class 2, Lab 2. Analyzes information related to use and specification of surfacing materials applied in interior design projects. The role of green design is introduced, and ecological issues are integrated into each category of materials analyzed.

INTR 20400 History of Interiors and Furniture I (3 cr.) Class 3. A survey of historical development of interiors, furniture, and decorative arts from early history to 1800 (early neoclassic). Emphasis is on design motifs, ornamentation, and furniture styles. This course is delivered entirely online.

INTR 22400 Residential I, Kitchen and Bath (3 cr.) P: INTR 12400, INTR 20200, and ART 12000. Class 2, Lab 2. This studio class emphasizes the design of kitchen and bath spaces, including the development of floor plans, mechanical plans, elevations, and working drawings. NKBA guidelines will be heavily explored. Manual drafting/ drawing.

INTR 22500 Three-Dimensional Interior Design Studio (3 cr.) P: INTR 12400, INTR 12500, and ART 15500. Class 2, Lab 2. This studio class examines the fundamentals of three-dimensional design, detailing and documentation along with 3D thinking and visualization of design solutions sensitive to functional, ergonomic and aesthetic objectives.

INTR 22600 Commercial Interiors I (3 cr.) P: INTR 12400, INTR 12500, INTR 20200, and ART 15500. Class 2, Lab 2. This studio course emphasizes the elements used in development of non-residential space. Studies include technological and building requirements, programming, ADA guidelines, material selection and presentation, building and life-safety codes, square footage and space planning standards.

INTR 30400 History of American Interiors and Furniture II (3 cr.) P: INTR 20400 Class 3. The survey of historical development of interiors, furniture, and decorative arts beginning with 1800 late Neoclassic and American Federal through the 20th Century. Emphasis is on design motifs, ornamentation, and furniture styles.

INTR 32400 Residential II: Housing Design (3 cr.) P: INTR 22400, INTR 22500, and MATH 15400. Class 2, Lab 2. The studio class will emphasize the design of residential space, recognizing design development as a process. Programming and space planning, schematic and design development, working drawings, plans, decorative elements, finish and material selection, budget and client presentations will also be covered.

INTR 32500 Environmental Lighting and Design (3 cr.) P: INTR 22600 and MATH 15400. Class 2, Lab 2, The study and practice of interior lighting fundamentals with an emphasis on environmentally efficient lighting systems and energy economy. Through the design process and execution of luminaire layouts, students will examine the visual process, lamp and luminaire selection, calculation methods, lighting controls and evaluation of effective solutions.

INTR 32600 Commercial Interiors II (3 cr.) P: INTR 22600 and MATH 15400. Class 2, Lab 2, This studio course emphasizes the elements used in development of nonresidential space. Studies include technological and building requirements; building and life-safety codes, ADA guidelines, square footage and space planning standards, and material selection. Heavy emphasis on the planning of systems furniture.

INTR 42600 Evidence Based Design (3 cr.) P: INTR 32600 Class 2, Lab 2 This studio course emphasizes the principles and process of design for health care and other facilities. Additionally, students will explore evidence based design practices, as well as codes and barrier free guidelines specific to health care issues in designing such spaces and buildings. Wayfinding, security, human behavior, specifications, presentations and documentation are also examined.

INTR 42800 Interior Design Capstone Design Project (3 cr.) C: INTR 48000. Class 2, Lab 2 In this B.S. Capstone course the designer tackles a semester long advanced design problem by applying the design process from project obtainment through construction documents. This class must be taken in conjunction with INTR 480.

INTR 45200 Interior Building Systems (3 cr.) P: ART 22200. Class 2, Lab 2. A survey course of building systems that covers the design implications of heating, air-conditioning, plumbing, security and electrical systems of primarily commercial buildings.

INTR 45300 Business Practices - Interior Design (3 cr.) P: Senior Standing. Class 3 This course discusses professional skills, such as developing your resume/ portfolio and interviewing for an interior design/ architectural technology position, and emphasizes the tools and processes required to succeed in professional practice. This course is delivered entirely online.

INTR 48000 Senior Thesis Project (3 cr.) C: INTR 42800. An instructor mentored research methods and application project relative to the Interior Design Technology major. This class must be taken in conjunction with INTR 42800.

INTR 49500 Sustainable Design in Engineering and Technology (3 cr.) P: Senior Standing. Class 3 Students learn to create ecological solutions with their unique disciplines. A theoretical framework on Green Design is used to identify and apply LEED concepts. Environmental concerns for better air quality and other global environment issues are explored.

Mechanical Engineering

ME 20000 Thermodynamics I (3 cr.) P: PHYS 15200. C: MATH 26100 and EEN 22501 and CHEM-C 105. First and second laws, entropy, reversible and irreversible processes, properties of pure substances. Application to engineering problems.

ME 22501 Mechanical Engineering Laboratory I (1 cr.) C: ME 20000 and ENGR 29700. Experiements in thermodynamics, parametric design and component fabrication.

ME 25001 Mechanical Engineering Laboratory II (1 cr.) C: ME 26200. Experiments on data analysis, hands-on programming with devices and fabrication.

ME 26200 Engineering Design, Ethics and Entrepreneurship (2 cr.) P: ENGR 19600 and ENGR 29700 and ME 27000 and ENG-W 131 and COMM-R 110 and ME 25001. Basic concepts of the design process. Innovative engineering design of real life applications. Engineering ethics topics. Fundamentals of

Entrepreneurship. Design projects focus on open-ended problems. Design modeling, simulation, documentation and communication. Implementation and use of modern computer tools in solving design problems and completing team design projects in the area of Mechanical Engineering.

ME 27000 Basic Mechanics (3 cr.) P: PHYS 15200. C: MATH 26100. 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. Application to structures and machine elements, such as bars, beams, trusses, and friction devices.

ME 27200 Mechanics of Materials (3 cr.) P: ME 27000. 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.

ME 27400 Basic Mechanics II (3 cr.) P: ME 27000. C: MATH 26600. 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 29500 Engineering Topics (1-5 cr.) Topics of contemporary importance or of special interest that are outside the scope of the standard undergraduate curriculum can be offered temporarily under the selected topics category until the course receives a permanent number.

ME 31000 Fluid Mechanics (3 cr.) P: ME 20000 and MATH 26600 and ME 27400. C: ME 32501. 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 31400 Heat and Mass Transfer (3 cr.) P: ME 31000. Fundamental principles of heat transfer by conduction, convection, and radiation; mass transfer by diffusion and convection. Application to engineering situations.

ME 32501 Mechanical Engineering Laboratory III (1 cr.) C: ME 31000 and ME 27200. Experiments on testing of mechanics of materials and fluid mechanics.

ME 32600 Engineering Project Management (3 cr.) P: Sophomore standing. Project management is an important skill that is needed in the private and public sectors as well as specialty businesses. This course explores the challenges facing today's project managers and provides a broad understanding of the project management environment focused on multiple aspects of the project.

ME 32700 Engineering Economics (3 cr.) P: Sophomore standing. Engineering economics is the application of economic techniques to the evaluation of design and engineering alternatives. The role of engineering economics is to assess the appropriateness of a given project, estimate its value, and justify it from an engineering standpoint. This course covers the time value of money and other cash-flow concepts, reviews economic practices and techniques used to evaluate and optimize engineering decisions, and discusses the principles of benefit-cost analysis.

ME 33000 Modeling and Analysis of Dynamic Systems (3 cr.) P: ECE 20400 and MATH 26600. C: ME 27400. Introduction to dynamic engineering systems; electrical, mechanical, fluid, and thermal components; linear system response; Fourier series and Laplace transform.

ME 34000 Dynamic Systems and Measurements (2 cr.) P: ME 33000. C: STAT Elective. 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 34400 Introduction to Engineering Materials (3 cr.) P: CHEM-C 105 and Junior standing in engineering. Class 3. 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.

ME 35001 Mechanical Engineering Laboratory IV (1 cr.) C: ME 31400 and ME 37200. Experiments on testing of dynamic systems, heat and mass transfer, and materials.

ME 37200 Design of Mechanisms (3 cr.) P: ME 26200 and ME 27200 and ME 27400. This course presents fundamental concepts on kinematics and dynamic analysis of linkages and mechanical systems; analytical and graphical approaches to analysis; vector loop and relative velocity/acceleration solutions; design and analysis of cams and gears.

ME 39700 Selected Topics in Mechanical Engineering (0-6 cr.) P: Junior Standing and/or Consent of Instructor. Topics of contemporary importance or of special interest in Mechanical Engineering.

ME 40200 Biomechanics of the Musculoskeletal System (3 cr.) P: ME 27200. Mechanical design of organisms, with emphasis on the mechanics of the musculoskeletal system. Selected topics in prosthesis design and biomaterials; emphasis on the unique biological criteria that must be considered in biomechanical engineering design.

ME 40500 Seminar & Fundamentals of Engineering Review (1 cr.) P: ME 34400, ME 37200, and Senior Standing. C: ME 48200 A seminar series on mechanical engineering career options and guidance, professional development and licensing, and preparation for the Fundamentals of Engineering (FE) examination.

ME 41400 Thermal-Fluid Systems Design (3 cr.) P: ME 26200 and STAT Elective. C: ME 31400. Application of basic heat transfer and fluid flow concepts to design of the thermal-fluid systems. Emphasis on design theory and methodology. Design experience in thermal-fluid areas such as piping systems, heat exchangers, HVAC, and energy systems. Design projects are selected from industrial applications and conducted by teams.

ME 42501 Mechanical Engineering Laboratory V (1 cr.) C: ME 48200. Experiments on testing of mechanical measurements and control systems.

ME 43000 Power Engineering (3 cr.) P: ME 20000. Rankine cycle analysis, fossil-fuel steam generators, energy balances, fans, pumps, cooling towers, steam turbines, availability (second law) analysis of power systems, energy management systems, and rate analysis.

ME 43300 Principles of Turbomachinery (3 cr.) P: ME 20000 and ME 31000. 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 44600 CAD/CAM Theory and Application (3 cr.) P: ME 26200, ENGR 19600, and ENGR 29700, or consent of instructor. Introduction to computer-aided design (CAD) and computer-aided manufacturing (CAM) theory and applications. Topics include CAD/CAM systems and integration, geometric modeling, process planning, and tool path generation, CAD/CAM interfacing with CNC (computer numerically controlled) machines, machining, and CNC programming. Projects involve CAD/CAM-based product development cycle. Hands-on experience is attained through laboratory experiment and actual CNC manufacturing.

ME 45000 Introduction to Computer-Aided Engineering (3 cr.) P: ME 26200 and 27200. Introduction to the use of finite element methods for analysis and design. Applications involving stress analysis and heat transfer of solids. The use of existing software and hardware for computer-aided engineering.

ME 45310 Machine Design (3 cr.) C: ME 37200. This course prepares the student to: apply basic mechanics (statics and dynamics), mechanics of materials, and probability and statistics to the analysis and design of machines and machine components; design for strength of various machine components; study of stress/strain and force/deflection relations in machine components; understand fundamental approaches to stress and fatigue analysis and failure prevention; incorporate design methods for machine components such as shafts, bearings, springs, gears, clutches, breaks, chains, belts, and bolted and welded joints; and solve open-ended machine design problems involving structural analysis, life prediction, cost, reliability analysis, and technical communication.

ME 45800 Composite Materials (3 cr.) P: ME 27200. Potential applications of composite materials. Basic concepts of fiber reinforced composites, manufacturing, micro and macro-mechanics, and static analysis of composite laminates. Performance (fatigue and fracture) and their application to engineering design.

ME 46200 Capstone Design (4 cr.) P: ME 34400 and ME 37200. C: ME 49700 and ME 48200 and either ME 41400 or ME 45310. Concurrent engineering design concept is introduced. Application of the design is emphasized. Design problems from all areas of mechanical engineering are considered.

ME 47200 Advanced Mechanics of Materials (3 cr.) P: ME 27200 and MATH 26600. 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 47200 and ME 55000.

ME 47400 Vibration Analysis (3 cr.) P: ME 27200, ME 27400, and ME 33000. 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 48200 Control System Analysis and Design (3 cr.) P: ME 34000. Classical feedback concepts, root locus, Bode and Nyquist techniques, state-space formulation, stability, design applications.

ME 49100 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 49700 Selected Topics in Mechanical Engineering (1-6 cr.) Topics of contemporary importance or of special interest that are outside the scope of the standard undergraduate curriculum can be offered temporarily under the selected topics category until the course receives a permanent number.

ME 50000 Advanced Thermodynamics (3 cr.) P: ME 31000. Class 3. 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 50101 Energy Assessment of Industrial Processes (3 cr.) P: Graduate Standing or Instructor Consent. The course provides and analyzes methodologies for improving energy efficiency in the manufacturing sector. The manufacturing equipment and processes will be analyzed in terms of energy consumption and optimization. It provides the technical and analytical foundation for students on assessing industrial processes to evaluate measures for optimizing energy efficiency in industrial, electrical, motor drive, compressed air, process heating, process cooling, lighting, space conditioning, combined heat and power systems. This course is designed for students who are interested in energy efficiency.

ME 50102 Energy Management Principles (3 cr.) P: Graduate Standing or Instructor Consent. This course provides energy management principles for industrial applications. Various energy management methods, commitments, and strategies for continuous improvement as well as international standards will be analyzed and integrated. This course emphasizes real world applications including: critiquing utility rates structure and assessing costs; characterizing and quantifying energy saving opportunities at industrial facilities; determining investment payback scenarios and considerations.

ME 50103 Industrial Energy Assessment: Tools and Applications (3 cr.) P: Graduate Standing or Instructor Consent. This course synthesizes advanced energy efficiency, energy auditing, and energy assessment methods and practices. Several types of industrial audits will be analyzed with respect to the methods, tools (hand and software), and industrial applications. Topics include: the audit process for energy, industrial productivity, and waste stream audits; audit components: energy bill analysis and economic analysis; audit system mechanics related to building envelop, electrical system, HVAC system, waste heat recovery, lighting, cogeneration, and other prevalent industrial systems; and measurement instrumentation issues for each industrial system. Students will enhance learning from a class project, which requires completion of an industrial scale energy audit.

ME 50104 Powertrain Integration (3 cr.) P: Graduate Standing. Class 3. The holistic view of powertrain development that includes engine, transmission, and drivline is now well accepted. Current trends indicate an increasing range of engines and transmissions in the future with, consequently, a greater diversity of combinations. Coupled with the increasing introduction of hybrid vehicles, the scope for research, novel developments and new products is clear. This course discusses engines, transmissions, and drivelines in relation to their interfaces with chassis systems. This course also explores the concept to market evolution as well as powertrain and chassis integration. Novel concepts relating, for example, to continuously variable transmissions (CVTs) and hybridization are discussed, as well as approaches to modeling, analysis, and simulation.

ME 50105 Hybrid & Electric Transportation (3 cr.) P: ME 48200 or ECE 38200. Familiarity with MATLAB / SIMULINK. Class 3. This course will cover fundamentals of hybrid electric and battery electric transportation systems with particular emphasis on automotive vehicles. It will cover basic powertrain configurations of Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV), and Battery Electric Vehicle (BEV). The principal element of these powertrain will be discussed: Battery, Electric Motor, Engine, Transmission. This course will cover fundamental design concepts for HEV/PHEV and BEV powertrain. Efficient methods of component sizing via appropriate modeling and analysis methodologies will also be introduced. A basic introduction to power electronic components and microprocessor based controllers for these powertrains will also be given. An in-depth coverage will be given on the energy and power management of HEV/PHEV and BEV powertrain once the design is complete. Introduction of various concepts and terminologies, the state of the art development, energy conversion and storage options, modeling, analysis, system integration and basic principles of vehicle controls will be covered as well. Upon completion of this course, students should be able to follow the literature on these subjects and perform modeling, design, analysis and development work in this field. A field demonstration of a PHEV will be used to further enhance the learning experience in this course.

ME 50400 Automotive Control (3 cr.) P: ECE 38200 or ME 48200 or equivalent, and familiarity with MATLAB. Class 3. Concepts of automotive control. Electro-mechanical systems that are controlled by electronic control modules via an appropriate algorithm (such as fuel injection timing control, emission control, transmission clutch control, anti-lock brake control, traction control, stability control, etc.). In-depth coverage on modeling and control of these automotive systems. MATLAB/SIMULINK modeling and simulation.

ME 50601 Design Optimization Methods (3 cr.) P: MATh 26100 and MATH 26600. In this course the general theory of optimization, concepts and problems statement are presented. Methods for minimization of a function of one or n variables with and without constraints are discussed. Response surface methods and design of experiments are shown to significantly reduce analysis time. Applications using a commercial software package to solve typical engineering design optimization problems are demonstrated. Uncertainty in the design process is introduced. In addition to engineering, the methods studied can be applied to a variety of diverse disciplines such as finance, investment portfolio management, and life sciences.

ME 50900 Intermediate Fluid Mechanics (3 cr.) P: ME 31000. Class 3. 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 51000 Gas Dynamics (3 cr.) P: ME 31000. Class 3. 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 51201 Energy Storage Devices and systems (3 cr.) P: CHEM- 106 and PHYS 25100 and ME 20000. Fundamental principles of battery science and engineering (battery reactions, charge and mass transport in batteries, battery safety, battery management, and materials development in the batteries, battery system designs and integrations), current state-of-the-art battery technology and the current technical challenges on the development of batteries, codes and standards for safe handling of batteries.

ME 52301 Nanosystems Principles (3 cr.) This is the introductory course in the nanosystems area. it introduces students to the principles and applications of nanosystems. The course begins with an introduction to the nanometer scale phenomena. It then introduces students to the basic elements resulting in nanosystems: nanoscale materials, processes, and devices. it also provides students with a basic understanding of the tools and approaches that are used for the measurement and characterization of nanosystems, and their modeling and simulation. Moreover, the course covers the applications of nanosystems in a wide range of industries, including information technology, energy, medicine, and consumer goods. The course concludes with a discussion of the societal and economical significance of these applications, including benefits and potential risks.

ME 52500 Combustion (3 cr.) P: ME 31000 and CHEM-C 105. 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 52601 Integrated Nanosystems Processes and Devices (3 cr.) P: ME 52301. This course covers processes and devices associated with integrated nanosystems. Integrated nanosystems refer to systems which consist of integrated micro-, meso- and/or macro-scale parts, and their core components are realized by nano-scare materials, processes, and devices. The course, while covering processes which result in integrated nanosystems, will focus on the theory and operation of select electronic, electromechanical, and biomedical devices which are used for information technology, sensing, medical, and other applications. The lectures will be complemented by hands-on laboratory experience.

ME 53501 Introduction to Systems Engineering (3 cr.) This course offers an examination of the principles of systems engineering and their application across the system life cycle. Special emphasis is given to concept exploration, requirements analysis and development, analysis of alternatives, preliminary design, integration, verification, and system validation. The students will use the international space station (on-orbit modules) for practical application of the principles introduced in this course. This is the first of two courses in systems engineering and is a prerequisite to the Systems & Specialty Engineering course. Both courses use the same text book and have a 15% overlap of the text material.

ME 53502 Systems and Specialty Engineering (3 cr.) P: ME 53501. This course offers an examination of the interaction between the principles of systems engineering and the "design for" specialty engineering areas. The focus of their interactions is viewed across the system life cycle. Special emphasis is given to contributions of the specialties to the essential knowledge development needed for concept exploration, requirements analysis and development, trade offs and decisions with uncertainty, preliminary design, system integration, verification, and system validation. The students will use the international space station and its support systems for practical application of the principles introduced in this course. This is the second of two courses in systems engineering and is dependent upon successfully completing ME 53501 Introduction to Systems Engineering.

ME 54200 Introduction to Renewable Energy (3 cr.) P: ME 20000. This is an introductory course on renewable energy. The students will learn the fundamental principles of the various renewable energy options and their applications and costs. After taking this course, the students will be familiar with the economic and societal impact of renewable energy systems, and be able to participate in the design or selection of renewable energy systems.

ME 54600 CAD/CAM Theory and Application (3 cr.) P: ME 26200, ENGR 19600, and ENGR 29700, or consent of instructor. Introduction to computer-aided design (CAD) and computer-aided manufacturing (CAM) theory and applications. Topics include CAD/CAM systems and integration, geometric modeling, process planning, and tool path generation, CAD/CAM interfacing with CNC (computer numerically controlled) machines, machining, and CNC programming. Projects involve CAD/CAM-based product development cycle. Hands-on experience is attained through laboratory experiment and actual CNC manufacturing.

ME 55000 Advanced Stress Analysis (3 cr.) P: ME 27200 and MATH 26600. 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 47200 and ME 55000.

ME 55100 Finite Element Analysis (3 cr.) P: ME 26200 and ME 27200. Graduate standing or consent of instructor. Concepts of finite elements methods; formulations for different engineering problems and their applications. Variational methods, the finite element concept, and applications in stress analysis, dynamics, fluid mechanics, and heat transfer.

ME 55200 Advanced Applications of Finite Element Method (3 cr.) P: ME 55100 or equivalent. Various algorithms for nonlinear and time-dependent problems in two and three dimensions. Emphasis on advanced applications with problems chosen from fluid dynamics, heat transfer, and solid mechanics areas. Independent project required.

ME 55800 Composite Materials (3 cr.) P: ME 27200. Potential applications of composite materials. Basic concepts of fiber-reinforced composites. Manufacturing, micro- and macro-mechanics, and static analysis of composite laminates. Performance (fatigue and fracture) and its application to engineering design.

ME 56000 Kinematics (3 cr.) P: ME 37200. 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 56200 Advanced Dynamics (3 cr.) P: 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 56300 Mechanical Vibrations (3 cr.) P: ME 27200, ME 27400 and ME 33000 or equivalent. Review of systems with one degree of freedom. Lagrange's equations of motion for multiple-degree-of-freedom systems. Matrix methods. Transfer functions for harmonic response, impulse response, and step response. Convolution integrals for response to arbitrary inputs. Principle frequencies and modes. Applications to critical speeds, measuring instruments, isolation, torsional systems. Nonlinear problems. Mechanics staff.

ME 56900 Mechanical Behavior of Materials (3 cr.) P: ME 27200 or equivalent. 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 57201 Analysis and Design of Robotic Manipulators (3 cr.) P: ME 58200 or equivalent. 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 58100 Numerical Methods in Mechanical Engineering (3 cr.) P: ME 31400 and ME 37200. 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 59700 Selected Topics in Mechanical Engineering (Variable Title) (3 cr.) Various courses offered on an experimental basis.

ME 60101 Fundamentals of Turbulence and Modeling (3 cr.) P: ME 50900 or consent of instructor. This course consists of three parts: (i) fundamentals of turbulence including turbulence concepts, statistical description, and Kolmogorov hypothesis. (ii) major modeling concepts and formulations such as direct numerical simulations (DNS), large eddy numerical simulation (LES), and Reynolds averaged Navier-stokes simulation (RANS). Team projects related to turbulence modeling and computation with applications in environment, industry, biomechanics for visualizing and experiencing turbulence.

ME 60601 Optimal Design of Complex Mechanical Systems (3 cr.) The objective of this research course is to prepare students to address mechanical systems design and innovation challenges through appropriate advanced optimal design methodologies. This course will be focused on current design approaches, which are rapidly expanding in research and industrial application, but are not commonly included in engineering curricula.

The course focuses on the theoretical aspects of multi-objective optimization, global approximation methods (metamodel-based optimization), and applications in mechanical engineering systems. Students of this research course will acquire an understanding of state-of-the-art analysis and optimization tools through hands-on experience and the involvement in research projects.

The research experiential learning will prepare students to design innovative mechanical systems and to increase their problem solving capabilities through the use of effective design methodologies.

ME 61400 Computational Fluid Dynamics (3 cr.) P: ME 58100 or equivalent; ME 50900 or ME 51000 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 65100 Advanced Finite Element Method of Solids (3 cr.) P: ME 55100 and ME 58100. This course is designed to teach students advanced non-linear finite element techniques for solid mechanics stress and heat transfer analysis. Those include techniques for modeling: 2D/3D continua; beams; plates; large rotations; geometric non-linearity; material non-linearity; material plasticity; heat transfer; modeling thermo-mechanical systems; frequency domain solutions; quasi-static solutions; time domain solutions; modeling of frictional contact; and modeling rigid-bodies. Applications of the modeling techniques taught in this course will be introductd. Those include: static and dynamic stress-analysis of mechanical components (such as gears, cams, chains and belts) with material and geometric non-linearity; modal analysis of mechanical components; metal forming and crashworthiness analysis.

ME 69700 Mechanical Engineering Projects II (1-6 cr.) P: Graduate Standing. Individual advanced study in various fields of mechanical engineering. May be repeated for up to 6 credit hours.

ME 69700 Selected Topics in Mechanical Engineering (Variable Title) (3 cr.) Various courses offered on an experimental basis.

ME 69800 Research (M.S. Thesis) (1-6 cr.) P: M.S. student standing with thesis option. Research credit for students in M.S. thesis option.

ME 69900 Research (Ph.D. Thesis) (1-6 cr.) P: Ph.D. student standing. Research credit for Ph.D. thesis.

Mechanical Engineering Technology

MET 10400 Technical Graphics Communication (3 cr.) P: MATH 15300 Class 1, Lab 3. An introduction to the graphic language used to communicate design ideas using CAD. Topics include: sketching, multiview drawings, auxiliary views, pictorial views, working drawings, dimensioning practices, and section views.

MET 11100 Applied Statics (3 cr.) P: TECH 10500. C: MATH 15400. Class 2, Lab 2. A study of force systems, resultants and equilibrium, trusses, frames, centroids of areas, and center of gravity of bodies.

MET 20400 Production Drawing (3 cr.) P: TECH 10400 or CGT 11000 or MET 10400, TECH 10500 or MET

10500 (Or Instructors Consent). Class: 2, Lab: 2. The design, evaluation, and documentation of engineering specifications required for manufacturability and assembly are introduced. Emphasis is on CAD-based details, assemblies, design layouts, equipment installations and related industrial practices.

MET 20500 Production Drawing and CAD II (3 cr.) P: TECH 10400 or CGT 11000 or MET 10400 (Or Instructors Consent). Class: 2, Lab: 2. Application of 3D modeling referenced from engineering drawings (assembly and detail drawings). Topics include: 3D solid modeling, solids editing, lighting and rendering.

MET 20900 Three-Dimensional NURBS Modeling (3 cr.) P: TECH 10400 or CGT 11000 (Or Instructors Consent). Class: 2, Lab: 2. Introduction to 3D geometric modeling using NURBS-based CAD modeling. Emphasis on creating, editing, manipulating and presenting 3D conceptual and production models. Efficient modeling strategies, data exchange and an overview of down-stream applications is included.

MET 21100 Applied Strength of Materials (4 cr.) P: MET 11100. C: MATH 22100. Class 3, Lab 2; or Class 4. The principles of strength, stiffness, and stability are introduced and applied primarily to mechanical components.

MET 21300 Dynamics (4 cr.) P: MET 11100. C: MATH 22100. Class 2, Lab 2; or Class 3. Kinematics and kinetics principles of rigid-body dynamics are introduced. Emphasis is on the analysis of bodies in plane motion.

MET 21400 Machine Elements (3 cr.) P: MET 21100 and PHYS 21800. Class 3. The theories and methods of statics, dynamics, and strength of materials applied to the selection of basic machine components. The course will develop the fundamental principles required to select the individual elements making up a machine.

MET 22000 Heat and Power (3 cr.) P: PHYS 21800. Class 2, Lab 2 Heat/Power is an introduction to the principles of thermodynamics and heat transfer. Basic thermodynamic processes are used to evaluate the performance of energy-based systems such as internal combustion engines, power plants, and refrigeration equipment. Typically offered Fall/Spring.

MET 23000 Fluid Power (3 cr.) P: MET 11100, PHYS 21800. Class 2, Lab 2; or Class 3. This course consists of the study of compressible and incompressible fluid statics and dynamics as applied to hydraulic and pneumatic pumps, motors, transmissions, and controls.

MET 24000 Basic Foundry (3 cr.) P: 14100 and 14200. Class 2, Lab 2. Casting processes of the past, present, and future. Special emphasis on developing problem-solving skills in using cast parts in manufacturing. Lectures, reading assignments, audiovisual presentations, demonstrations, and field trips. Assignment sheets with study questions are used in preparing students for discussion sessions and tests. Each student must also research and write a five-page paper on some aspect of the foundry industry or give a demonstration in the laboratory.

MET 27100 Programming for Numerical Control (3 cr.) P: 24200 and MATH 15900 or consent of instructor. Class 2, Lab 2. An introduction to manual, conversational, and computer-aided programming. Incremental and absolute programming systems. Machine-based conversational languages and computer-aided programming languages.

MET 29900 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 30500 Computer-Aided Design with Applications (3 cr.) P: TECH 10400 or CGT 11000 or MET 10400 (Or Instructors Consent). Class: 2, Lab: 2. This course provides advanced study of computer-aided drafting and design utilizing current industrial computer-aided design systems. The courses covers the use of these systems in three dimensional and parametric modeling applications.

MET 31000 Computer-Aided Machine Design (3 cr.) P: 21400. Class 2, Lab 2. 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 mechanical systems.

MET 32000 Applied Thermodynamics (3 cr.) P: MET 22000 and MATH 22100. Class 2, Lab 2 Following a review of fundamental concepts, advanced power and refrigeration cycles are analyzed. Applications such as gas mixtures, air-vapor mixtures, and chemical reactions of combustion processes are presented.

MET 32800 CAD/CAM for Mechanical Design (3 cr.) P: TECH 10400 or CGT 11000, TECH 10500 or MET 10500 (Or Instructor's Consent). C: MET 33800. Class: 2, Lab: 2 plus 1 arranged. 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. This class provides an overview and continues into a detailed investigation of parametric modeling. Parametric modeling concepts will be applied to problems using standard industrial practices. Students must possess a solid background in engineering or technical graphics.

MET 32900 Applied Heat Transfer (3 cr.) P: MET 22000 Class: 3, An applied approach to the introduction of basic vocabulary and concepts related to the steady state transfer (i.e., conduction, convection, radiation) will be covered. Additional topics will include heat exchangers, boilers and solar energy.

MET 33800 Manufacturing Processes (4 cr.) P: MATH 15400, MET 10400 Class (3) Lab (2). Course Covers basic fabrication and material removal manufacturing processes. Areas studied include casting, forging, material joining, forming, basic metal removal mechanisms, automated manufacturing processes, dimensional metrology for quality control and manufacturing process planning. The course emphasizes the selection and application of the various manufacturing processes.

MET 34800 Engineering Materials (4 cr.) P: CHEM-C 101. Class (3) Lab (1) This course gives an overview of the material families of metals, polymers, ceramics, and composites. Emphasis is placed on the structure, properties, and design selection for these materials for engineering applications. Problem-solving skills are developed in the areas of materials selection, evaluation, measurement, and testing. A laboratory component is included for hands-on experiences of exploring and testing properties of different families of materials, and selection of the materials for engineering applications.

MET 35000 Applied Fluid Mechanics (3 cr.) P: MET 11100. C: MATH 22100. Class 3. 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 36000 Heating, Ventilating, and Air Conditioning I (3 cr.) P: MET 22000. Class 3; or Class 2, Lab 2.Investigation of basics required to design heating and ventilating systems. Heat loss, humidification, duct design, equipment selection, and solar heating. Codes and standards emphasized.

MET 37400 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 38800 Thermodynamics & Heat Power (4 cr.) P: PHYS 21800 and MATH 22100. Class: 2, Lab 1. Course provides the engineering technology student with an introduction to the principles of thermodynamics and heat transfer. Basic thermodynamic processes are used to evaluate the performance of energy based systems such as internal combustion engines, power plants, and refrigeration equipment.

MET 41400 Design of Mechanical Projects (3 cr.) P: Senior Standing. Class 1, Lab 4. 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 42600 Internal Combustion Engines (3 cr.) P: 22000. Class 2, Lab 3. A study of the spark ignition, compression ignition, and continuous-burning internal combustion engines.

MET 42800 Advanced CAD for Mechanical Design and Drafting (3 cr.) P: 32800 or equivalent. Class 2, Lab 3. Mechanical and geometric modeling of complex surfaces, with manufacturing emphasis using wire-frame and shaded imaging techniques.

MET 47200 Vehicle Dynamics (3 cr.) P: MET 21300, MSTE 21000 or ME 27400 or equivalent or permission of instructor. Class 3. The course provides a study of vehicle chassis, suspension, and aerodynamic systems with a focus on high performance.

MET 49700 Senior Project (3 cr.) P: Senior mechanical technology students. Class 2, Lab 2. Directed work on individual projects for senior mechanical technology students.

MET 49900 Mechanical Engineering Technology (1-4 cr.) Class 0-4, Lab 0-9. Hours and subject matter to be arranged by staff. Course may be repeated for up to 9 credit hours.

MET-E 198 Employment Enrichment Experience I (1 cr.) P: Sophomore standing, a minimum GPA of 2.3, and program advisor approval. A semester or summer of external, full-time, related career experiences designed to enhance the student's preparedness for entering an initial or second career. A comprehensive written report on the internship experience is required.

MET-E 298 Employment Enrichment Experience II (1 cr.) P: Sophomore standing, a minimum GPA of 2.3, and program advisor approval. A semester or summer of external, full-time, related career experiences designed to enhance the student's preparedness for entering an initial or second career. A comprehensive written report on the internship experience is required.

MET-I 198 Career Enrichment Internship I (1 cr.) P: Sophomore standing, a minimum GPA of 2.3, and program advisor approval. A semester or summer of external, full-time, related career experiences designed to enhance the student's preparedness for entering an initial or second career. A comprehensive written report on the internship experience is required.

MET-I 298 Career Enrichment Internship II (1 cr.) P: Sophomore standing, a minimum GPA of 2.3, and program advisor approval. A semester or summer of external, full-time, related career experiences designed to enhance the student's preparedness for entering an initial or second career. A comprehensive written report on the internship experience is required.

Motorsports Engineering

MSTE 21000 Statics and Dynamics (4 cr.) P: MATH 16600 and PHYS 15200 or Permission of Instructor. Class 4. This course studies the analysis of systems in static equilibrium, systems in dynamic equilibrium, simple vibratory systems and provides for the study of either vehicle dynamics or vibrations.

MSTE 21700 Motorsports Practicum I (1 cr.) P: None. This course engages students in a hands-on experiential learning opportunity in which they participate in the design, fabrication, assembly, and preparation of a race vehicle just as they might when engaged with a race team in the motorsports industry. Students will be expected to show mastery of at least 4 of 12 key skills for success in motorsports.

MSTE 27200 Introduction to Motorsports (3 cr.) P: None Class 3. This course provides an introduction to the Motorsports Industry, including careers available, the organization and history of the industry, and technology development that has occurred due to the industry. A student project is required.

MSTE 29700 Computer Modeling for Motorsports (2 cr.) P: None An introductory course detailing methods for designing and modeling motorsports components.

MSTE 29800 Programming & Computer Modeling for Motorsports (2 cr.) P: MSTE 27200 Introductory course detailing methods for creating virtual models of objects and systems for design, analysis, and optimization of motorsports components. Virtualization methods include object-oriented programming techniques for creating mathematical models, and solid modeling techniques for visualizing objects as three-dimensional representations. The methods intriduced through this course lay the foundation for advanced courses in vehicle design, simulation, and analysis.

MSTE 29900 Motorsports Engineering Directed Study (1-3 cr.) P: Permission of Insstructor. This is a directed study course for students wishing to pursue additional motorsports studies under the direction of a faculty advisor.

MSTE 31000 Business of Motorsports I (3 cr.) P: MET 27200 or permission of instructor. This course studies basic business and management concepts as applied to the unique environment of the Motorsports Industry.

MSTE 31100 Business of Motorsports II (3 cr.) P: MSTE 31000 This course studies complex business, public relations, and management relationships including case studies from the unique environment of the Motorsports Industry.

MSTE 31200 Business of Motorsports (3 cr.) P: MSTE 27200 and ENG W131 This course will introduce students to the concept of a team organizational structure and business management as well as the important aspects of marketing and sponsorships in the motorsports industry through an examination of literature and guest speakers.

Topics will include team structure, budgeting and finances, risk management, marketing, public relations, and sponsorships with the emphasis on motorsports.

Students will also have the opportunity to learn about networking and marketing themselves in the Motorsports industry.

MSTE 31700 Motorsports Practicum II (1 cr.) P: MSTE 21700, MSTE 35000 and Junior standing. This course engages students in a hands-on experiential learning opportunity in which they participate in the design, fabrication, assembly, and preparation of a race vehicle just as they might when engaged with a race team in the motorsports industry. Students will be expected to show mastery of at least 8 of 12 key skills for success in motorsports.

MSTE 32000 Motorsports Design I (3 cr.) P: MSTE 35000, MSTE 47200 or permission of instructor. Class 3. This course explores the design concepts and approaches of the Motorsports Industry, creating connectivity between the courses of the first two years of the Motorsports Engineering BS Program and preparing students for internships in industry. A student project is required.

MSTE 33000 Data Acquisition in Motorsports (2 cr.) C: ECE 20400 Class 3. This course explores instrumentation, data acquisition, data reduction, and data analysis within the Motorsports Industry.

MSTE 33100 Data Acquisition in Motorsports II (3 cr.) P: MSTE 33000 and MSTE 47200 This course provides an in-depth discussion to instrumentation, data acquisition, data reduction, and data analysis within the Motorsports Industry featuring case studies. Requires a student project.

MSTE 34000 Dynamic Systems and Signals (3 cr.) P: MATH 26600, ME 27000 and ME 27400. Introduction to dynamic engineering systems and continuous-time and discrete-time signals, mechanical electromechanical components, linear system response, Fourier and Laplace Transforms. The course is designed to teach the student the basic concept for modeling the behavior of dynamic systems.

MSTE 35000 Computer Aided Design & Manufacturing (3 cr.) P: MSTE 29700. C: ME 27000. This course provides the basis for the computer aided engineering and analysis skills needed in the Motorsports Industry. The ability to visualize and conceptualize a real part in the physical world and produce graphical representations of it in 2D and 3D in Solidworks or an equivalent is a primary objective. Further skills to be developed include the ability to produce large assemblies of such parts with appropriate tolerancing, free form surfacing, casting shapes and casting machining, 2D drawings for use in 3D sheet metal fabrication including shrink and stretch, use of 3D models to facilitate Finite Element Analysis, Conversion of CAD model to programming of CAM machining.

MSTE 41400 Motorsports Design II (3 cr.) P: MSTE 32000 and MSTE 47200. C: MSTE 48200 This is the culminating course in the Motorsports Engineering Plan of Study, typing together concepts from all the other courses in the curriculum, and requires a capstone design project representative of a real world project within the Motorsports Industry.

MSTE 41700 Motorsports Practicum III (1 cr.) P: MSTE 31700 This course engages students in a hands-on experiential learning opportunity in which they participate in the design, fabrication, assemsbly, and preparation of a race vehicle just as they might when engaged with a race team in the motorsports industry. Students will be expected to show mastery of 12 of the 12 skills outlined in the Course Objectives.

MSTE 41800 Advanced Motorsports Practicum (1 cr.) P: MSTE 41700 This course engages students in a hands-on experiential learning opportunity in which they participate in the design, fabrication, assembly, and preparation of a race vehicle just as they might when engaged with a race team in the motorsports industry. Students will be expected to show mastery beyond the 12 skills outlined in the Course Objectives.

MSTE 42600 Internal Combustion Engines (3 cr.) Class 3. P: ME 20000 or equivalent or permission of instructor. This course covers the fundamentals of internal combustion engine design and operation, with a focus on high performance.

MSTE 47200 Vehicle Dynamics (3 cr.) P: MSTE 35000, ME 27000 and ME 27400 Class 3. The course provides a study of vehicle chassis, suspension, and aerodynamic systems with a focus on high performance.

MSTE 48200 Motorsports Aerodynamics (3 cr.) P: ME 31000, MSTE 35000 and MSTE 47200. Study of fluid flow and aerodynamics as applied to race car design and Computational Fluid Dynamic (CFD) Analysis.

MSTE 49000 Motorsports Engineering Independent Study (1-3 cr.) P: Permission of Instructor. This is an independent study course for students wishing to pursue advanced studies under the direction of a faculty advisor.

MSTE 49700 Motorsports Design Project (3 cr.) P: Permission of instructor. This is an independent study version of the MSTE 41400 culminating course in the Motorsports Engineering Plan of Study, tying together concepts from all the other courses in the curriculum, and requires a capstone design project representative of a real world project within the Motorsports Industry.

MSTE 49900 Motorsports Engineering Special Topics (1-3 cr.) P: Permission of Instructor. This is a special topics course for students wishing to pursue advanced studies under the direction of a faculty advisor.

MSTE-I 41000 Motorsports Internship (1-3 cr.) P: Sophomore standing and program advisor approval A semester or summer of external, full-time related career experiences designed to enhance the student's preparedness for entering an initial or second career. A comprehensive written report on the internship experience is required.

Music and Arts Technology

MUS-A 130 Music Theory and History 1 (3 cr.) P: MUS-Z111 (minimum grade of B) or placement test. Music Theory and History I is the first component of a four-semester, comprehensive sequence in fundamental concepts of music theory, style practice, and associated historical contexts. Courses in this sequence provide an essential understanding of music, from major historical precedents to contemporary aesthetic practices. Topics covered include: understanding of the general acoustic principles associated with music, and working effectively with pitch, rhythm, and harmony in a range of stylistic and cultural genres.

MUS-A 131 Aural Skills (2 cr.) P: MUS-Z111 (minimum grade of B) or placement test. This course teaches functional skills for identification and demonstration of harmonic, melodic, and rhythmic function in tonal music. Course content will include singing solfege, pitch and rhythmic identification/dictation, and rhythmic demonstration.

MUS-A 132 Music Technology Lab I (3 cr.) P: Departmental consent. Technology Lab 1 serves as a comprehensive introduction to concepts, theories, practices, and technologies that comprise the core of music technology today. Background and historical context will be covered. Topics will include acoustics and psycho-acoustics, analog and digital audio, MIDI, and notation software.

MUS-A 140 Music Theory and History 2 (3 cr.) P: MUS-A130 (minimum grade of C) or placement test. By the conclusion of Theory and History 2, outcomes expected of students include comprehension of 1) common practice interactions between triad-based tonal harmonic functions, 2) four part-chorale style voice-leading in the context of classical era music, 3) standard melodic practices as both chord tones and non-chord tones, 4) extensions of the triad with a chord seventh, 5) chromatically altered harmonic function, and 6) the harmonic analysis of tonal music.

MUS-A 141 Keyboard and Controllers (2 cr.) P: MUS-Z111 (minimum grade of B) or placement test. This course is designed to teach various keyboard and MIDI controller skills required of music technology majors. Skills covered include basic rudiments of piano playing, major and minor five-finger patterns, basic triads and simple chord progressions, major and minor scales, reading and playing a variety of repertoire (treble and bass clef - hands together), basic controller playing, and basic improvisation and harmonization.

MUS-A 142 Music Technology Lab II (3 cr.) P: MUS-A132 (minimum grade of C) or permission. Music Technology Lab 2 provides a broad introduction to technology used in historical and modern recording practices. Students gain hands-on experience to reinforce conceptual understandings of recording technology today. Concepts include analog recording, digital recording, DAWs, microphones, studio design and setup, signal flow and routing, mixing, and mastering.

MUS-A 200 Technology as Applied Instrument (1-2 cr.) P: Consent of Instructor. This course consists of private lessons, 30-50 minutes each week, focused on developing musical and accurate performance practices with music technology as the primary instrument. Additional applied fee.

MUS-A 230 Music Theory and History (3 cr.) P: MUS-A 140 (minimum grade of C). Music Theory and History 3 is the third component in a four-semester, comprehensive sequence in basic musicianship and application of music technology. Concepts introduced in Basic Musicianship and Technology 1-2 shall be explored with greater depth and sophisticated application. New topics include modulations, mode mixture, advanced chromaticism, large-scale formal structure and tonal ambiguity.

MUS-A 231 Musicianship Skills 3 (2 cr.) P: MUS-A 140 (minimum grade of C). In this course students will (a) develop an interest and practical skills in critical listening, (b) develop audio and musical analysis skills as integral parts of the listening experience, (c) develop a common vocabulary for the discussion of parameters relating to sound quality, (d) audition and analyze a broad range of recordings featuring diverse musical styles and production approaches, and (e) develop an interest in and understanding of "high-end" audio, from both recording and playback perspectives. Additionally, students will discuss, in detail, issues of sound quality as related to the above aspects after critically listening to a piece of recorded music. This discussion might include any or all of the following related topics: engineering techniques, mixing, mastering, composition, arrangement and music production, etc.

MUS-A 232 Music Technology Lab III (3 cr.) P: MUS-A 142 (minimum grade of C). Music Technology Lab 3 provides an in-depth coverage of technology used in contemporary recording practices. Students gain hands-on experience to reinforce conceptual understandings of recording and production. Concepts build on the Introduction to Recording Technology, including advanced analog and digital recording, Digital Audio Workstations, microphones and specialized uses, signal flow and routing, mixing, and mastering.

MUS-A 235 Electro-Acoustic Ensemble (1 cr.) A student ensemble for acquiring musical and technological skill in live performance when integrating electronic and acoustic instrument sound sources. Students may be assigned as a performer, audio engineer, creator, or any combination of these roles. Students must possess collegiate level musicianship and performance skills on an acoustic or electronic instrument. Please contact instructor for further information.

MUS-A 240 Music Theory and History 4 (3 cr.) P: MUS-A 230 (minimum grade of C). Music Theory and History 4 is the fourth component in a four-semester, comprehensive sequence in music theory and history. Course topics include the breakdown of tonality in the late 19th century, new musical developments in the 20th century and important musical trends after WWII.

MUS-A 241 Training for Music Technooogy (2 cr.) P: MUS-A 140 (minimum grade of C). This class focuses on the development of ear training skills specific to sound design in music technology. By the completion of the semester, students should be able to demonstrate a proficient knowledge in areas including: aural identification of wave forms, basic acoustics theory and aural identification of digital processes. Course content also incorporates the continued development of musicianship skills gained in A-131, A-141, and A-231.

MUS-A 242 Music Technology Lab IV (3 cr.) P: MUS-A 140 (minimum grade of C) and MUS-A 142 (minimum grade of C). Music Technology Lab 4 presents and examines technology employed for the purposes of creating, composing, and generating music in both live and studio practices. Topics include composition and notation software, theory and practice of composition with music technology, and hardware and software for live music creation.

MUS-A 500 Music Technology Graduate Seminar (0 cr.) The Music Technology Graduate Seminar is a zero (0) credit hour graduate course consisting of 15 weekly seminars by the Department of Music and Arts Technoogy and other engineering and technology faculty at IUPUI, researchers from local and national academia, reprentatives from industry, and peer graduate students in the MAT. Seminars introduce MAT graduate students to a variety of music technology related topics in academic and industrial research. Presenters will pose research questions, scientific methodologies, and technological advancements in music technology and related fields. Presentations and discussions will assist students in developing and refining critical thinking and technical presentation skills.

MUS-A 540 Music Engineering Technology (3 cr.) The course is intended to provide foundations in concepts fundamental to music technology for students who are seeking further course work or career opportunities in the field. This is critical for candidates in the Ph.D. in Music Technology and this is one of the required courses in that plan of study. Learning the concepts and models underlying software and hardware systems in Music Technology, scientific principles of sound, and digital signal theory provides the necessary language and orientation to work and do research in the field.

MUS-B 110 Horn Elective/Secondary (1-2 cr.) P: Consent of instructor. Private French horn lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-B 120 Trumpet/Cornet Elective/Secondary (1-2 cr.) P: Consent of instructor. Private trumpet/cornet lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-B 130 Trombone Elective/Secondary (1-2 cr.) P: Consent of instructor. Private trombone lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-B 200 Horn (1-2 cr.) P: Consent of instructor. BSMT majors only. Private French horn lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-B 220 Trumpet and Cornet (1-2 cr.) P: Consent of instructor. BSMT majors only. Private trumpet and cornet lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-B 230 Trombone (1-2 cr.) P: Consent of instructor. BSMT majors only. Private trombone lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Student must provide instrument.

MUS-B 250 Tuba (1-2 cr.) P: Consent of instructor. BSMT majors only. Private tuba lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Student must provide instrument.

MUS-D 100 Percussion Elective/Secondary (1-2 cr.) P: Consent of instructor. Individual percussion lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-D 200 Percussion Instruments (1-2 cr.) P: Consent of instructor. MAT majors only. Private percussion lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-E 241 Introduction to Music Fundamentals (3 cr.) Learn the basics of music reading, rhythm games, singing, keyboard skills, children's songs, and use of classroom instruments. Designed for, but not limited to, elementary education majors and others interested in using music as a learning tool.

MUS-E 536 Workshop: IUPUI Jazz Ensemble (1-3 cr.) This ensemble rehearses weekly and performs periodically on campus and at other local venues. A major concert is performed at the end of each semester. Authorization and audition are required.

MUS-E 536 Workshop: Graduate Music Technology Seminar (1-3 cr.) IUPUI focuses on implementing computer, MIDI keyboards, and multimedia into the music curriculum. Also used for campus leaders speaking on topics of media, instructional technology, distance learning, and multimedia; plus leading music technology guests.

MUS-F 451 Chamber Ensemble (1 cr.) This is a performance class, designed to further skills on each individual instrument, learn diverse styles of music, and work in a group setting. Private coaching will be offered and a performance will be scheduled for the end of the semester. Advanced musicians are encouraged. The following instruments may be included in this course: Flute, oboe, bassoon, clarinet, strings, guitar, piano, French horn, and voice. Performance at the end of the semester is required. Only 1 credit per semester will count towards BMST degree.

MUS-H 100 Harp Elective/Secondary (1-2 cr.) P: Consent of instructor. Private harp lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-L 100 Guitar Elective/Secondary (1-2 cr.) P: Consent of instructor. Private guitar lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Interview/audition required.

MUS-L 101 Beginning Guitar Class (2 cr.) Fundamentals of contemporary guitar playing, with emphasis on simple songs and chords; acoustic guitar required for class and practice.

MUS-L 102 Intermediate Guitar Class (2 cr.) P: MUS-L 101 and/or ability to read music and play chord structures proficiently. Builds on knowledge learned in MUS-L101; ability to reach chord notation, rhythms, and music notation necessary; acoustic guitar required for class and practice.

MUS-L 103 Advanced Guitar Class (2 cr.) P: MUS-L 101 or consent of instructor. Study of advanced techniques, including open tunings and slide guitar. A section for classical guitar is also available under this number.

MUS-L 153 Introduction to Music Therapy (3 cr.) Introduction to the influence of music on behavior, the healing properties of music, the use of music therapy with a variety of populations, and the development of the music therapy profession. Includes an introduction to the clinical process and music therapy procedures as well as participation in experiential activities and observations of music therapy sessions.

MUS-L 200 Guitar (1-2 cr.) P: Consent of instructor. BSMT majors only. Private guitar lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-L 253 Music Therapy Observation Practicum (1 cr.) P: Consent of instructor. Observation of professional music, recreation, and occupational therapy groups in a variety of settings with client populations of varying needs.

MUS-L 254 Music Therapy Practicum I (1 cr.) P: MUS-X 298. Students provide services to individual client in campus clinic or at local agency. Emphasis on acquiring skill in conducting music therapy assessments. Two or more hours per week and attendance at weekly seminar. Liability insurance required. May be repeated.

MUS-L 340 Music Therapy in Health Care (3 cr.) Study of music therapy methods and materials commonly used in assessment and treatment with adults and children in health care settings with an emphasis on older adult and rehabilitation services, wellness and stress management, pain management, and spiritual issues.

MUS-L 353 Music Therapy Practicum II (1 cr.) P: L 25400. Students provide music therapy services to an individual client or group with emphasis on developing treatment interventions and plans. Two or more hours per week and attendance at a weekly seminar. Liability insurance required. May be repeated.

MUS-L 354 Music Therapy Practicum III (1 cr.) P: L 35300. Students provide music therapy services to a group of clients in a local agency with an emphasis on assessment, treatment, planning, and evaluation. Involves three or more hours per week and attendance at a weekly seminar. Liability insurance required. May be repeated.

MUS-L 354 Music Therapy Practicum III (1 cr.) P: L 35300. Students provide music therapy services to a group of clients in a local agency with an emphasis on assessment, treatment, planning, and evaluation. Involves three or more hours per week and attendance at a weekly seminar. Liability insurance required. May be repeated.

MUS-L 370 Clinical Reasoning in Music Therapy (3 cr.) The purpose of this course is to introduce students to the concepts and practice of critical thinking, clinical reasoning, and clinical judgment within the field of music therapy. This course uses lecture and case-based learning units to engage students in evidence-based practice and clinical reasoning within the context of music therapy treatment planning in behavioral helath.

MUS-L 410 Administrative and Professional Issues in Music Therapy (3 cr.) Study of government and professional guidelines that influence music therapy services and documentation practices. Includes administrative skills such as proposal writing, public relations, budgeting, staff relationships, interviewing, program development, and professional ethics.

MUS-L 415 Music Therapy Technology Lab (3 cr.) This course is designed to teach various keyboard and MIDI controller skills required of music technology majors. Skills covered include basic rudiments of piano playing, major and minor five-finger patterns, basic triads and simple chord progressions, major and minor scales, reading and playing a variety of repertoire (treble and bass clef - hands together), basic controller playing, and basic improvisation and harmonization.

MUS-L 418 Psychology of Music (3 cr.) Introduction to the physical, psychological, and physiological aspects of sound and music. Survey of the theories related to sound production, acoustics, music perception and learning, and the effects of sound and music on the behavior of humans. Overview of music psychology research, and the scientific method, and research techniques. Offered online.

MUS-L 419 Research in Psychology of Music (3 cr.) Overview and implementation of research methods, statistics, and techniques applied to psychology of music principles. Includes completion of experimental project related to psychology of music or musical behavior.

MUS-L 420 Clinical Processes in Music Therapy (3 cr.) P: L 15300 or consent of instructor. Overview of the influence of music on behavior and the use of music in treatment plans with clients. Includes principles of behavior therapies as they apply to the music therapy clinical treatment process.

MUS-L 421 Music Therapy Psychiatric Practicum (1 cr.) P: L 35400. Students provide music therapy services in a hospice or medical setting with an emphasis on conducting music therapy in a single-session format. Involves three or more hours per week and attendance at a weekly seminar. Liability insurance required. May be repeated.

MUS-L 422 Music Therapy Theories and Techniques (3 cr.) P: L 42000 or permission of instructor. Study of philosophies, theories, and techniques of various music therapy, music education, and counseling models, including Analytic, Creative, and Orff music therapy. Emphasis on the integration of models to develop personal philosophies and theories of music therapy practice.

MUS-L 424 Music Therapy Internship (2 cr.) P: All degree course work must be completed prior to registration.

MUS-M 110 Special Topics in Music for Non-Music Majors (var. cr.) This is a variable topics class. At IUPUI, some of the topics could include the following: Music and Computers (3 cr.), American Music and Social Change (3 cr.).

MUS-M 174 Music for the Listener (3 cr.) A survey course covering traditional and modern music styles of the last 1,000 years. Learn how to listen to music, instruments, and musical forms. No prior music experience required. Offered on campus and through the Web.

MUS-M 340 History of Electronic Music (3 cr.) This course will give the student an understanding of the history of electronic and experimental music and how it relates to the music of the today. Students will learn the most significant works realized through computers and other electronic devices from the middle of this century through the present. The purpose of this course is to give an introduction to the history, styles, techniques, and composers of the genre. Topics will include musique concrete, MIDI, tape compositions, synthesizers, waveforms, electronic musical instruments and devices, electronic musical genres, and computer music.

MUS-M 394 Survey of African American Music (3 cr.) A survey and exploration of black music from its African origins to the present, with special emphasis on its social, economic, and political impact.

MUS-N 310 Music Technology I (3 cr.) P: MUS-A 142 (minimum grade of C) and junior standing or consent of instructor required. P: or C: MUS-A 230 (minimum grade of C). This course is an introduction to the theory and practice of electronic sound synthesis and signal processing. Graphic programming languages taught during this course are intended to provide you with a knowledge and appreciation of the broad genre of computer music, as well as a practical understanding of the fundamental techniques used in digital signal processing (DSP). Essays written by pioneering composers, theorists and philosophers in the field will fuel in-class discussions and provide context to the techniques practiced throughout the semester. In addition, this course will offer many real world examples of the use of computer music synthesis in academic and popular music, as well as the music technology industry. Topics include audio software development, simple interactive systems, and custom audio plug-ins.

MUS-N 320 Music Technology II (3 cr.) P: MUS-N 310 (minimum grade of C). This course is an overview of the theory and practice of audio/visual digital signal processing and multimedia art. Classes of software utilized in this course include graphic programming languages, DAW's, and live musical performance software. This collection of software is meant to provide you with a practical understanding of the fundamental techniques used in digital signal processing (DSP). In addition, this course will offer examples of the use of real-time digital signal processing in academic and popular music, as well as the music technology industry. Topics include audio software development, integration of audio and video in a single system, real-time audio/visual DSP, incorporating external controllers, and simple interactive systems.

MUS-N 350 Music Technology II (3 cr.) P: MUS-P 110; MUS-P 120; MUS-P 200; MUS-D 100; MUS-L 101; MUS-L 102 (minimum grade of C) The purpose of this course is to introduce students to the types of instruments typically used in music therapy clinical improvisation, gain leadership skills in leading both pitched and unpitched improvisation interventions, and learn how to process the emotional, physical and psychological experiences associated with improvisational interventions.

MUS-N 410 Music Technology III (3 cr.) P: MUS-N 310 (minimum grade of C). This course is an advanced study of music and arts technology through theexploration and understanding of new interfaces and instruments. Students must have familiarity with concepts of graphic programming, DAWs, and live musical performance software, which will be employed heavily throughout this course. Through this course studentswill develop a practical understanding of digital signal processing, experimental hardware interfaces, professional web design, electronic portfolios and resumes. In addition, this course will prepare students to develop a proposal for experimental applications in selected technology areas, such as the final capstone project for the BSMT degree. Topics may include multimedia software development, real-time video processing, mobile interface design, integration of audio and video in a single system, custom stage lighting, experimental hardware and controller development.

MUS-N 450 BSMT Capstone (3 cr.) P: MUS-N 410 (minimum grade of C) and consent of instructor. BSMT majors only. The capstone project is fundamentally about music and music technology and makes an original creative statement or addition to the field. This can take the form of creating new music technology (such as new software or a new instrument), using technology to create new music, or formulating and creating a new way to use music technology. In all capstone work creativity and the creation of new music and technology is at the core. The capstone project is an opportunity to research, design, and develop a unique and novel concept or work and will culminate in a final, juried presentation before peers and MAT faculty. Along with the presentation the capstone must include specific, tangible project outcomes, products, deliverables, or work. These are the artifacts that demonstrate the success of the capstone and serve to show the expertise and accomplishment of the creator.

MUS-N 512 Foundations of Music Productions (3 cr.) P: Consent of instructor. Examines foundations and principles of music production. Topics include publishing, print media, music composition, methods, textbooks, multimedia, computer and electronic transmission of computer imaging, sound, and video. Other aspects covered are broadcast media; televideo graphics; sampling and reproduction of sound and images; multimedia; and computer applications.

MUS-N 513 Principles of Music Technology (3 cr.) P: Consent of instructor. Examines theories and research in the use of computer technology with special focus on curriculum design and implementation of music technology in the classroom; learning and training theory paradigms, technology selection and assessment for learner-centered, individualized instruction and training. Implementation and assessment designs for specific instructional models are included.

MUS-N 514 Music Technology Methods (3 cr.) P: Consent of instructor. Applies sequencing and music notation technology to current and emerging digital arts technologies, multimedia techniques applied to sound-based stimuli and MIDI applications for video graphics, and storyboard techniques. This course explores the development of "Music Instrument Digital Interface" (MIDI) and related uses.

MUS-N 515 Multimedia Design Application in the Arts (3 cr.) P: Consent of instructor. Presents the principles and fundamentals of instructional design and design techniques using authoring tools on PC, MacIntosh, and emerging computer platforms. Included are storyboarding, planning, and organization of scripts; the use of current technology, computers, video, and digital arts equipment; computer-assisted design software tools, and management of design team concepts.

MUS-N 516 Advanced Interactive Design Applications in the Arts (3 cr.) P: MUS-N 515 or consent of instructor. Incorporates extensive analysis and use of computer and multimedia authoring tools intended for specific educational applications. Project management and programming team organization; media management and selection criteria for digital arts media development; task analysis and instructional sequencing applied to training and instruction; and assessment modeling and feedback schedules are examined.

MUS-N 517 Internship in Arts Technology (3 cr.) P: MUS-N 516 or consent of instructor. An internship for students to work with experts in arts technology fields who are using new applications in commercial and educational settings. Requirements include the development of a technology project proposal; interview, resume, and project presentation; on-site intern residency; project report; an oral and media presentation of project outcomes.

MUS-N 518 Arts Technology Development Project (3 cr.) P: Consent of instructor. Students create and present a multimedia teaching/training project that combines one or more of several elements of music technology including CD-ROM, videodisc, digital audio and video, and MIDI. Requirements include project proposal, presentation of the proposal, research and development of project, final report, and a media presentation of project.

MUS-N 519 Digital Sound Design for Multimedia I (3 cr.) P: M110 (Music and Computers), N514, or consent of instructor. Music composition and multimedia applications of MIDI systems and Digital Audio Workstations. Analog, digital, and software-based synthesis, and exploration of multi-track MIDI and digital recording.

MUS-N 520 Digital Sound Design for Multimedia II (3 cr.) P: MUS-M 110 (Music and Computers), MUS-N 514, MUS-N 519, or consent of instructor. Advanced applications of MIDI and next-generation sound file formats for producing soundtracks, multimedia events, and collaborative composition over the Internet.

MUS-N 521 Research Methods in Music and Multimedia (3 cr.) P: Consent of instructor. Introduction to the underlying principles and concepts of technology-based studies in the arts. Techniques of educational research, including integration of scientific methodology, descriptive, and inferential methods, and multimedia instrumentation in project development.

MUS-N 522 Techniques for Music Performance, Teaching, and Production at a Distance (3 cr.) P: Consent of instructor. Electronic tools for music performance, teaching, and production at a distance. Website and Internet resources including video conferencing, digital editing, and compression of video and sound wave formats. Group and individual assignments for on-line music presentations.

MUS-N 523 Historical Foundations of Music Technology (3 cr.) This course analyzes and evaluates concepts, events, designs, and creative works that have served as catalysts in the progression of music technology over time. It also explores historical paradigms that helped shape the progression of technology in music and related fields. Treatment is given to a variety of movements, music-forms, communities and entitles, that contributed to their age through technological, conceptual, and artistic innovation. Class discussions and blogs will engage the studied content, particularly as it relates to current trends, thus addressing the IUPUI Graduate Principle of Learning that states: 'students will critically and creatively solve problems in their field of study'.

Through the study of the past, the class will develop rationales for new and emerging technologies that relate to the expression of music.

MUS-N 525 Techniques of Interactive Performances (1-3 cr.) P: Consent of instructor. Techniques of Interactive Performance prepares public presentations that highlight the current underlying principles and concepts of computer music, live media, interdisciplinary, and interactive performance systems. Areas covered will include electro-acoustic music (with instruments, microphones, and computer processing), laptop music, live media manipulation, created instruments, machine learning, telematics, and networks, among others. The group generally works together with an outside group from another discipline in order to cross-synthesize the artistic realizations of each performance. Each semester the ensemble engages a project that draws on the multi-disciplinary skill set from the enrolled students.

MUS-N 530 Philosophy and Theory in Music Therapy (3 cr.) P: Consent of instructor. Philosophical and theoretical foundations of the use of music in therapy. Philosophical positions concerning science, knowledge development, theory construction, and values augment critical-thinking skills. Theories, models, and conceptual frameworks as guides to topical inquiry.

MUS-N 531 Music Therapy Quantitative and Qualitative Research (3 cr.) P: Consent of instructor. Applications of scientific methodology to music therapy theory and practice. Philosophical differences between qualitative and quantitative research paradigms, integration of theoretical concepts and practice standards with scientifically-sound research proposals.

MUS-N 532 Music in Medicine (3 cr.) P: Consent of instructor. A survey of literature describing medical applications of music. Students have the opportunity to collaborate with health care professionals who work with various client populations.

MUS-N 533 Advanced Clinical Techniques in Music Therapy (3 cr.) P: Consent of instructor. Articulation, testing, and refining of theoretically derived music therapy protocols with a client population of choice. Students will work in consultation with music therapy, nursing, and medical staff.

MUS-N 600 Thesis in Music Therapy (1-6 cr.)

MUS-N 899 Music and Arts Technology Dissertation (1-9 cr.)

MUS-P 100 Piano Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private piano lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-P 110 Beginning Piano Class 1 for Non-Music Majors (2 cr.) Learn keyboard and music reading skills; must have access to out-of-class keyboard for practice. Classes meet in Piano lab. For students with no piano experience.

MUS-P 120 Beginning Piano Class 2 for Non-Music Majors (2 cr.) P: MUS-P 110 or permission of instructor. Builds on skills acquired in MUS-P 110.

MUS-P 200 Piano (1-2 cr.) P: Consent of instructor. BSMT majors only. Private piano lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-S 110 Violin Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private violin lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-S 120 Viola Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private viola lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-S 130 Cello Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private cello lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-S 200 Violin (1-2 cr.) P: Consent of instructor. BSMT majors only. Private violin lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-S 220 Viola (1-2 cr.) P: Consent of instructor. BSMT majors only. Private viola lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-S 230 Cello (1-2 cr.) P: Consent of instructor. BSMT majors only. Private cello lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-U 355 Music and Exceptionalities (4 cr.) P: MUS-L 153 or the equivalent experience; sophomore standing or the permission of the instructor. Basic accompaniment skills on the autoharp, guitar, or piano are desirable prerequisites. Introduction to using therapeutic and recreational music activities with individuals who have special needs. Includes development of skills in planning and adapting music activities for specific goals, sequencing and leading music experiences, and structuring experiences to facilitate participant success.

MUS-U 410 Creative Arts, Health & Wellness (3 cr.)

MUS-V 100 Voice Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private voice lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-V 101 Voice Class 1 (2 cr.) Introductory aspects of voice, basic vocal techniques, and a wide variety of vocal styles and literature; students perform solo and ensemble singing. No previous music experience required.

MUS-V 200 Voice (1-2 cr.) P: Consent of instructor. BSMT majors only. Private voice lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-W 110 Flute/Piccolo Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private flute/piccolo lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-W 120 Oboe/English horn Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private oboe/English horn lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-W 130 Clarinet Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private Clarinet lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-W 150 Saxophone Elective/Secondary (1-2 cr.) P: Consent of instructor. Interview/audition required. Private saxophone lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor.

MUS-W 200 Flute and Piccolo (1-2 cr.) P: Consent of instructor. BSMT majors only. Private flute and piccolo lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-W 230 Clarinet (1-2 cr.) P: Consent of instructor. BSMT majors only. Private clarinet lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-W 250 Saxophone (1-2 cr.) P: Consent of instructor. BSMT majors only. Private saxophone lessons, 30-50 minutes each week. Additional applied fee. Time scheduled with instructor. Students must provide instrument.

MUS-X 298 Music Therapy Pre-Practicum Exam (0 cr.) P: L153 or concurrent enrollment in L153 and consent of instructor. An assessment of vocal skills, accompaniment techniques, and functional music skills required for practica courses. Includes song leadership, vocal technique, and accompaniment skills on autoharp, guitar, piano, and basic percussion instruments. Required of all music therapy and equivalency students.

MUS-X 341 Guitar Ensemble (1 cr.) P: Consent of instructor. The mission of the IUPUI Guitar Ensemble is to bring together guitar players of all abilities and styles in a friendly, non-intimidating environment.

MUS-X 350 Jazz Ensemble (1 cr.) Music of the Big Band and Jazz Band era.

MUS-X 351 Jazz Chamber Ensemble (1 cr.) Jazz Combo.

MUS-X 40 University Instrumental Ensembles (1-2 cr.) P: Consent of Instructor. IUPUI Jazz Ensemble Music of the Big Band era. This class is contingent upon enrollment of full instrumentation. Enrollment limited. Audition/interview required.

MUS-X 40 University Instrumental Ensembles (1 cr.) IUPUI Pep Band. The Pep Band is organized in the fall and performs at home basketball games in the spring. Open to all students who play a band instrument.

MUS-X 40 University Instrumental Ensembles (1 cr.) Admission is by interview only. Scottish Rite Orchestra. This ensemble will meet at the Scottish Rite Cathedral.

MUS-X 40 University Instrumental Ensembles (1 cr.) Electro-acoustic Ensemble. A student ensemble for acquiring musical and technological skill in live performance when integrating electronic and acoustic instrument sound sources. Students may be assigned as a performer, audio engineer, creator, or any combination of these roles. Students must possess collegiate level musicianship and performance skills on an acoustic or electronic instrument. Please contact instructor for further information.

MUS-X 40 University Instrumental Ensembles (1 cr.) P: Consent of Instructor. Content Creator. This course is designed as Content Creator for Ensembles.

MUS-X 430 Electronic Music Ensemble (1 cr.) P: Consent of instructor. Course offers experiences in learning the world of electronic music techniques.

MUS-X 490 Percussion Music Ensemble (1 cr.) Course offers experiences in learning world percussion techniques. No instrument required.

MUS-X 70 University Choral Ensembles (1 cr.) The following vocal ensembles are available: University Choir and IUPUI Singers.

MUS-Z 100 The Live Musical Performance (2 cr.) Examines the approach to attending live performances of music (large ensembles, chamber ensembles, solo recitals, and other multimedia performances). Students attend live performances and discuss music performances by genre to develop critical listening skills.

MUS-Z 105 Traditions in World Music (3 cr.) Explore the diversity of musical traditions found throughout the world by studying the various means of transmission, musical instruments, musical meaning, musical sound as well as the rituals, and myths commonly associated with an assortment of music cultures. No prior music experience required.

MUS-Z 111 Introduction to Music Theory (3 cr.) Recommended for singers, instrumentalists, and keyboard players. A study of fundamentals of the language and notation of music: listening, music reading and writing, and the elements of music as used in a variety of genres. Open to all students interested in a general background in music.

MUS-Z 201 History of Rock ’n’ Roll Music (3 cr.) Survey of major trends, styles, and genres of rock music of the 1950s and 1960s, focusing on the work of artists and groups who have proved to have the most enduring significance.

MUS-Z 204 Women Musicians (3 cr.) This class will explore the various roles women have played, and continue to play, in the world of music. Four distinct areas in which women engage are patronage, performance, composition, and education. Previous musical training is not required.

MUS-Z 206 Hip Hop Music (3 cr.) The purpose of this course is to familiarize with students basic history, styles, and trends in hip hop, with a focus on the music. Students will attain essential knowledge of artists, producers, and events critical to the development of hip hop as a culture.

MUS-Z 207 History of American Popular Music (3 cr.) This class examines the cultural content of music by defining Popular Music not Pop Music and by examining various decades of music in America from the early Native American music to the present day. It also delves into the changing technology climate of America from the 1860s to the present day and the impact of this technology on popular music as seen in the music business.

MUS-Z 301 History of Rock Music—’70s and ’80s (3 cr.) Survey of trends and styles in rock music of the '70s and '80s. Focuses on the artists and groups who have shaped the music of yesterday, today, and tomorrow.

MUS-Z 315 Music for Film (3 cr.) A survey of the music and sound of movie soundtracks. Class will feature film segments, which are analyzed to see how music textures, tempos, and structures affect the plot.

MUS-Z 317 Computer Music Composition I (3 cr.) P: MUS-A 230 or instructor consent. Computer Music Composition covers multiple facets of composing music that include orchestration, musical notation, score creation and influential compositional techniques. During the course, students will compose music for a variety of instrumental combinations and musical styles. This course will also incorporate discussion and analysis of key musical master works. Students will investigate key aspects of harmony, formal structure, orchestration and compositional technique that contribute to the music's historical significance.

MUS-Z 320 Special Topics in Music (Variable Title) (3 cr.)

MUS-Z 325 Social Media and the Musician (3 cr.) This course explores how web-based user-generated content can be leveraged by musicians to support their instructional and artistic goals. In particular, this course will include an overview of social media and will provide students with the opportunity to develop skills crucial to using social media tools. Students will explore podcasting, wikis, blogging, web-based video, cloud computing, social bookmarking, twitter, social networking and other emerging forms of social media. Furthermore, students will learn how to promote themselves and contribute to web communities using social media and investigate the legal implications of merging music and social media.

MUS-Z 340 Introduction to Music Business (3 cr.) An introduction to the behind-the-scenes view of today's commercial music and entertainment industries. The course will include an overview of the various careers in the music industry.

MUS-Z 345 Music Business Marketing (3 cr.) A comprehensive and hands on approach to creating both a marketing, E-marketing and promotion campaign for music business. The emphasis will be on intelligent, innovative and successful marketing and promotion strategies in today's music industry. Professionals within the music industry will be occasional guest lecturers in the class.

MUS-Z 385 History of the Blues (3 cr.) Tells the story of the blues through the music of more than two hundred artists. Styles studied include Class Blues, Country Blues, Piedmont Blues, Holy Blues, White Blues, City Blues, Rhythm and Blues, Post WWII Country Blues, Chicago Blues, Urban Blues, Swamp Blues, British Blues, and Blues Rock.

MUS-Z 390 Jazz for Listeners (3 cr.) The course focuses on how to listen to jazz and what to listen for in jazz. In addition, students will survey and learn how to recognize various historical styles of jazz and major figures that have contributed to the jazz tradition. Live examples and performances in and out of class are a regular part of classes.

MUS-Z 393 History of Jazz (3 cr.) This course is an exploration of the history of jazz with an examination of its roots, important genres and styles, historic recordings, key figures, and related materials.

MUS-Z 401 Music of the Beatles (3 cr.) An in-depth, song-by-song look at the music, lives, and times of the Beatles. The course focuses on the music and is aimed at heightening student listening skills as well as fostering a deeper appreciation for the Beatles' recordings.

MUS-Z 403 The Music of Jimi Hendrix (3 cr.) The music of Jimi Hendrix involves discussion of Hendrix's music, including influences and innovations. Also discussed is the impact of Jimi Hendrix on modern popular music.

Organizational Leadership

OLS 10000 Introduction to Organizational Leadership (1 cr.) P: Pre/OLS-Majors only. Department permission required. Class 1. This course is not offered in the summer terms. This class offers a general introduction to the processes and practices relevant to front-line supervisors, managers, and leaders at all levels of organizations. In this class you will meet the OLS faculty and learn about the OLS degree, related technology classes, and other general education and elective classes. This course is only open to students planning to complete the Organizational Leadership major at IUPUI.

OLS 11000 Introduction to Organizational Leadership and Supervision (1 cr.) P: Must be an undergraduate or instructor permission. This course develops skills in leadership. Specific areas covered include: planning and change, problem analysis and decision making, motivation, interpersonal communication, giving, and receiving feedback on performance, organizational values, and human relations.

OLS 20000 Introduction to Sustainable Principles and Practices (3 cr.) This course will introduce students to sustainability and its principles. The course focuses on how and why sustainability became important in the world. The course covers: principles of sustainability; history of sustainability; historical economic aspects of sustainability; the definitions of sustainability and sustainable development. The course also introduces students to the applications of the principles of sustainability to design, building, energy, and commerce. The course presents examples of successful international community sustainable development projects.

OLS 25200 Human Behavior in Organizations (3 cr.) A survey of the concepts that provide a foundation for the understanding of individual and group behavior in organizations of work, with special emphasis on typical interpersonal and leadership relationships.

OLS 26300 Ethical Decisions in Leadership (3 cr.) Class 3. This class is for students interested in discussing and contemplating the difficult legal and ethical situations facing managers in all sizes and types of organizations. Students in this class will read and discuss a variety of writings on ethics in the workplace and also analyze both written and videotaped legal/ethical scenarios.

OLS 27400 Applied Leadership (3 cr.) Class 3. Introduction to applied leadership in the context of organizational functions, structures, and operation.

OLS 30200 Leadership and Economic Aspects of Sustainable Technologies (3 cr.) Class 3. The main focus of this course is to learn how organizations make sustainability work in their organizations. We will learn about the triple bottom line (environment, social and economic aspects of business decisions) and how to make "sustainability" thrive in an organization. This course will look at how organizations: describe the benefits of sustainability for corporations and society; build a framework for implementing corporate sustainability; lead and design strategies for corporate sustainability; organize, perform evaluations and create reward systems for sustainability; implement social, environmental, and economic measuring systems; improve corporate processes, products, projects for sustainability; and manage reports for sustainability. This course will look at various organizations with examples of sustainable practices, such as, Interface, Novartis, CEMEX, DuPont, Timberland, and Chiquita Brands, which are making sustainable practices, thrieve in their organization.

OLS 32700 Leadership for a Global Workforce (3 cr.) P: OLS 25200 and ENG-W 131 or consent of instructor. This course is for present and future leaders interested in the increasingly diverse global workforce. The course will present a variety of leadership issues including expatriate assignments, international buisiness strategies and their cultural and managerial impact, and a review of business practices around the world.

OLS 32800 Principles of International Management (3 cr.) P: OLS 32700. Class 3. This course is a survey of issues relating to international management and international enterprise. The goal is to help students understand the principles and practices involved in managing across national boundaries so that they can be more effective leaders and managers-both domestically and internationally.

OLS 33100 Occupational Safety and Health (3 cr.) A presentation of those aspects of occupational safety and health which are most 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.

OLS 34400 Employee Benefits (2 cr.) This course will promote an understanding of employee benefit programs. Students will learn about the strategic importance of employee benefits and approaches to planning a benefits program while applying the legal, regulatory, and industry influences on employee benefits practices.

OLS 34800 HR Analytics (1 cr.) This course provides insight into uses of analytics in HR, why it is important, and how HR analytics add value to organization. Students will explore resources that will align an organization's mission and goals with key metrics and benchmarks.

OLS 36800 Employment Law (3 cr.) Class 3. This course covers the regulatory environment of the employment relationship. Topics will include discrimination and Title VII of the Civil Rights Act of 1964; recruitment and selection; affirmative action; rights of union and nonunion employees; Fair Labor Standards Act; Equal Pay Act; Employee benefit plans; unemployment compensation; and right to discharge.

OLS 37100 Project Management (3 cr.) P: ENG-W 131 and MATH 11100. Class 3. This course provides the basics of the project management discipline and allows the student to apply these skills in team-based situations. At the end of the semester, you will have a complete set of project documents from concept to termination for both an in-class example and your own simulated project.

OLS 37500 Training Methods (3 cr.) P: OLS 25200 and OLS 27400 or consent of instructor. Principles, practices, and methods of employee training. Introduction to systematic training program design, development, and evaluation. Emphasis is on the supervisor as a trainer.

OLS 37800 Labor Relations (3 cr.) An introduction to, and overview of, the fundamental concepts of labor relations, collective baragining, and dispute resolution procedures. An international comparative analysis is used to assess some of the legal, economic, and political structures of labor relations.

OLS 38300 Human Resource Management (3 cr.) An overview of human resource functions in organizations today. Descriptions of each major function; case studies to explore applications of human resource principles.

OLS 38500 Leadership for Quality and Productivity (3 cr.) P: Junior Standing; ENG-W 131. The primary course objective is to provide students with knowledge and applied leadership skills essential for establishing and continuously improving organizational effectiveness through avoidance and solution of workplace problems.

OLS 39000 Leadership Theories and Processes (3 cr.) P: OLS 32700. OLS majors must have all 100/200-level coursework completed prior to enrollment in OLS 39000 include 6.0 credit hours of math above 11100. This course integrates knowledge and skills from all Associate's level OLS classes and allows students to define, reflect upon, and improve their leadership abilities.

OLS 39900 Special Topics in OLS (Variable 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.

OLS 40800 Employee Relations (1 cr.) This course teaches the intricacies of navigating employee relations issues experienced from new hire to termination. Topics will include employee performance and discipline, legal compliance, employee separation, and retention.

OLS 42300 Go Green (3 cr.) This is an interdisciplinary course emphasizing sustainability, globalization, and an international culture experience. In this context, sustainability refers to design, engineering, manufacturing, technology and leadership processes implemented and maintained in industry and business for the purpose of being environmentally responsible, energy efficient, cost effective, and socially responsible.

OLS 45400 Gender and Diversity in Management (3 cr.) P: OLS 25200. The work force of the future will represent multiple differences including gender, race, culture, ethnicity, physical abilities, and age. Following this broad-based perspective of diversity, this course will focus on using knowledge of diversity to develop the leadership potential of individuals in organizations.

OLS 46700 Service Learning (3 cr.) P: OLS 25200. Service learning is a reflective experience in which students are actively engaged in the community and integrate that experience into the classroom.

OLS 47600 Compensation Planning and Management (3 cr.) Planning and implementation of a total compensation systems, including job analysis, job evaluation, salary survey and analysis, benefits and development of a structured pay system. Includes behavioral implications and legal compliance issues.

OLS 47700 Conflict Management (3 cr.) A study of the methods for dealing with inner-personal, interpersonal, and political disputes by means generally outside the traditional court system. Students will investigate the theoretical and practical aspects of conflict assessment, negotiation, problem solving, mediation, and arbitration.

OLS 47900 Staffing Organizations (3 cr.) An applications-oriented study of key concepts in staffing organizations, including principles and issues in conducting job analysis; preparing job descriptions/ specifications; and screening/selecting employees. Special emphasis on the design, validation, and operation of high-volume staffing systems.

OLS 48700 Leadership Philosophy (3 cr.) P: OLS 39000. A review of current managerial, education, and development theories and practices; discussions of fundamental social, economic, and political changes affecting business and the art of managing; implications of these changes for individual development and continued growth.

OLS 49000 Senior Research Project (3 cr.) P: OLS major, TCM 320, senior standing, OLS 48700, and consent of instructor. Opportunity to study specific problems in the field of supervision, personnel, and training under the guidance of a faculty member.

OLS 50100 Leadership Ethics (3 cr.) P: Graduate Standing. This course is an examination of ethical, legal and policy issues facing business and technology leaders. Topics include perspectives on business ethics and values, ethical issues and theory, personal values in the workplace, values and heuristics, responses to ethical situations, corporate social responsibility, sustainability and the responsible corporation, ethical compliance, global and local values, globalization and international business. In particular, this course will ask students to examine, analyze and understand the concept of "servant leadership" as an ethical construct for leaders. This course uses various learning tools including the case study method and involves active discussion and debate in an online setting.

OLS 51500 Foundations in Human Resource Development (3 cr.) P: Graduate Standing. A survey course emphasizing the human resource function (and its development) in the context of the work organization. Human resource development topics include exploration of various training and development techniques, the relation of training to organizational strategies, training needs analysis, evaluation of training, and career development. The strategic approach to human resource management also is covered, including what human resource professionals can and should do to help the organization succeed.

OLS 53010 Mixed Methods Research (3 cr.) P: Graduate Standing. The purpose of this course is to provide an overview of mixed methods research. It is designed for students who are interested in integrating qualitative and quantitative methodologies into singular or sequential research studies or programs of inquiry. The overview includes the philosophy and evolution of mixed methods research, purposes and characteristics of mixed methods research, research designs and corresponding questions and data analysis techniques.

OLS 56300 Sustainable Practices in Bussiness & Industry in the European Union (3 cr.) P: Graduate Standing. This course examines and critically assesses sustainable practices in businesses, industries, and/or municipalities in Germany or France. Students will spend one week in Marseille, France or Mannheim, Germany visiting, touring, and analyzing businesses, industries or municipalities on their sustainable practices. In addition, to learning about the organization's sustainable practices, students will also learn about their specific country's culture and some language skills.

OLS 57100 Advanced Project Management in Technology (3 cr.) P: Graduate Standing. This course enables the student to learn project management in technology through the application of project approaches in a team based setting. Through the application of project tools and templates, the student learns the project life-cycle approach as demonstrated through actual and simulated project situations. The course presents the terms and approaches used in industry today and allows the student to apply these methods through both individual and team based settings.

OLS 57400 Managerial Training and Development (3 cr.) P: Graduate Standing. Review of current managerial education and development theories and practices; discussion of fundamental social, economic, and political changes affecting business and the work of managing; implications of these changes for individual manager development and continued growth.

OLS 58000 Interpersonal Skills for Leaders (3 cr.) P: Graduate Standing. Development and improvement of intepersonal dynamic skills for effective leadership in organizations. Emphasis on action learning and real-world application of skills.

OLS 58100 Workshop in OLS (1-6 cr.) Explores issues in leadership and organizational change. Included are change theories, utilizing resistance to change, contemporary approaches to change, the future workplace, and researching best practices in organizational change.

OLS 58200 Leadership & Organizational Change (3 cr.) P: Graduate Standing. This course explores issues in leadership and organizational change included are change theories, utilizing resistance to change, contemporary approaches to change, the future workplace, and researching best practices in organizational change.

OLS 58300 Coaching and Mentoring in Organizations (3 cr.) P: Graduate Standing. This course explores issues and practices in technologically-driven organizations pertaining to the roles and functions that coaching and mentoring play in employees development. The focus of the course is on identifying coaching opportunities, enhancing communication skills, developing and implementing coaching and mentoring strategies, and evaluating the outcomes of these strategies.

OLS 59800 Directed MS Project (1-6 cr.) P: Consent of Instructor. A formal investigation of a particular issue or problem under the guidance of the Directed Project Chair and Advisory Committee. Not applicable to a thesis option plan of study. Enrollment is arranged with instructor and approved by the department, but in the majority of cases will involve enrollment during at least two consecutive terms for a total of three credits.

Technical Communication

TCM 18000 Exploring Intercultural Technical Communication (3 cr.) This course will explore issues in diverse technical communication workplace settings using Intergroup Dialogue. Students will explore intercultural communication, conflict resolution, social identity, community, and social justice with diverse groups. A component of this class will be engaging with clients, co-facilitators, and/or guest speakers. Topics in this course will include a variety of social identities including (but not limited to) race/ethnicity, nationality of origin/citizenship, gender, sex, sexual orientation/attraction, SES/social class, age, religion/spirituality, ability/disability status, body size/type, level of education.

TCM 19900 Selected Topics: Technical Communication (1-3 cr.) Topics of current and specialized interest for technical communicators. Hours and subject matter to be arranged by staff.

TCM 21800 Introduction to Engineering Technical Reports (1 cr.) This integrated technical communication course introduces foundational skills for technical reports in engineering. Students will practice a recursive writing process and use techniques for analyzing content for different audiences and purposes.

TCM 21900 Introduction to Technical Presentations (1 cr.) This integrated oral technical communication course introduces foundational skills for creating and delivering technical presentations.

TCM 22000 Technical Report Writing (3 cr.) P: ENG-W 131 or equivalent. Class 3. Extensive application of the principles of clear writing in business and industry with emphasis on audience, organization of ideas, and a concise writing style.

TCM 22200 Introduction to Technical Documentation (3 cr.) This integrated technical communication course introduces foundational skills for creating effective technical documentation.

TCM 23000 Principles and Practices of Technical Communication (3 cr.) P: or C: ENG-W 131 or equivalent. This course serves as a gateway into the technical communication B.S. degree. It introduces the basic principles and practices of technical communication in the workplace. This course explores the range of abilities that technical communicators need and includes applied projects that will begin to develop these abilities. The course also serves as a foundation for higher-level courses within the major of technical communication.

TCM 24000 Tools for Technical Communication (3 cr.) This course introduces students to thinking about and using software tools that technical communicators need for contemporary workplace practice. The course will develop students' conceptual knowledge of the capabilities and limitations of software that professionals employ to create, deliver, and manage technical communication. Included are principles of how technical communicators learn to use software and how they evaluate its suitability for specific situations.

TCM 25000 Career Planning in Engineering and Technology (1 cr.) Class 3. TCM 25000 will guide you through a systematic, hands-on approach to making career-related decisions. The course assumes that internship/career planning is an ongoing process and requires understanding of self and one's environment; therefore, you will leave the course with the necessary tools to find and acquire an internship, co-op, or job now and in the future.

TCM 29900 Selected Topics: Technical Communication (1-3 cr.) Topics of current and specialized interest for technical communicators. Hours and subject matter to be arranged by staff.

TCM 31000 Technical and Scientific Editing (3 cr.) P: TCM 22000 or TCM 23000 with a grade of C or higher. Class 3. TCM 31000 focuses on techniques for editing functional technical and scientific products in academic and professional settings.

TCM 32000 Written Communication in Science and Industry (3 cr.) P: ENG-W 131 with a grade of C or higher and Junior or Senior Standing. Class 3. Analysis of current writing practices in technology and science, especially in organizational settings. Practice in research and in designing and preparing reports for a variety of purposes and audiences.

TCM 34000 Correspondence in Business and Industry (3 cr.) P: ENG-W 131 with a grade of C or higher. Class 3. TCM 34000 applies the principles of clear writing in industrial, technological, and business settings, with emphasis on organizational audience, organizational of ideas, and a concise, objective writing style.

TCM 35000 Visual Technical Communication (3 cr.) P: TCM 22000 or TCM 23000 with a grade of C or higher. Topics covered in this class include methods and principles of creating visual technical communication, basics of visual design, visualization of technical data, usability of visual technical communication products, the role of technical communicators in the workplace, and modern technology available to technical communicators.

TCM 35800 Technical Reporting Analysis & Development (1 cr.) This integrated technical communication course builds advanced technical reporting skills including analysis, synthesis, and development of technical content, structure, and style for technical audiences.

TCM 35900 Technical Data Reporting & Presentation (1 cr.) This integrated technical communication course builds advanced data reporting and presentation skills for technical and non-technical workplace audiences.

TCM 36000 Communication in Engineering Practice (2 cr.) P: ENG-W 131 and COMM-R 110 or equivalents, each with a grade of C or higher and Junior or Senior Standing. 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 36200 Technical Proposal and Grant Writing (1 cr.) TCM 36200 will focus on techniques for technical proposal and grant writing in academic and professional settings.

TCM 37000 Oral Practicum for Technical Managers (3 cr.) P: ENG-W 131 and COMM-R 110 or equivalents, each with a grade of C or higher and Junior or Senior Standing. Development and application of effective listening and speaking skills in situations typical for managers and supervisors in technology and engineering: one-to-one conversations in job management, hiring interviews, and performance reviews; group discussions in work units, committees, and task forces; informal presentations to small groups; formal presentations to large groups.

TCM 38000 Technical Communication in the Healthcare Professions (3 cr.) P: ENG-W 131 with a grade of C or higher and Junior or Senior Standing. Focuses on the complex nature of effective communication in the healthcare professions. Includes principles of clear, concise, and organized writing, as well as primary and secondary research. Students examine and write documents for audiences in their organizational contexts.

TCM 39500 Independent Study in Technical Communication (1-3 cr.) P: ENG-W 131 with a grade of C or higher. Individualized project approved by instructor consenting to direct it and by program coordinator. Credit varies with scope of the project.

TCM 39900 Selected Topics: Technical Communication (1-3 cr.) Topics of current and specialized interest for technical communicators. Hours and subject matter to be arranged by staff.

TCM 41500 Technical Communication for Design Projects (1-3 cr.) This integrated course applies advanced principles and theories of technical communication in a senior design project. Students will create and manage effective oral and written communication for workplace contexts.

TCM 42000 Field Experience in Technical Communication (1-3 cr.) P: TCM 22000, or TCM 23000, or TCM 32000, or ENG-W 131 with a grade of C or higher. Full or part-time work experience in technical communications, supervised by a qualified professional in the cooperating organization and a faculty advisor. Requires periodic written and oral reports and final comprehensive written and oral reports on work experience and assigned readings. Credit varies with scope of project.

TCM 42500 Managing Document Quality (3 cr.) P: TCM 22000, TCM 23000, TCM 32000, or ENG-W 231 with a grade of C or higher. This course examines and applies principles of creating technical publications in order to pursue quality management of the process. Students will create effective publications by identifying and intervening in crucial points in the documentation cycle--planning, researching, designing, drafting, reviewing, testing, and revising.

TCM 43500 Portfolio Preparation (1 cr.) P: ENG-W 131 or equivalent with a grade of C or higher, and instructor consent. Preparation of professional portfolio for review by faculty or subject matter experts. Includes readings and development of a professional career plan.

TCM 45000 Research Approaches for Technical and Professional Communication (3 cr.) P: TCM 22000, TCM 23000, or TCM 32000, or ENG-W 231 with a grade of C or higher. Examines quantitative and qualitative research techniques practiced by professionals working in technical and business communication. It explores both primary (i.e., field) and secondary (i.e., library) research approaches for learning about content, audience, and publication design.

TCM 46000 Engineering Communication in Academic Contexts (2 cr.) P: Senior or Graduate Standing, and Department consent. Analysis of situations and genres for written and oral communication of engineering information in academic contexts. Application of rhetorical principles in preparing and delivering written and oral presentations of engineering information.

TCM 49900 Selected Topics: Technical Communication (1-3 cr.) Topics of current and specialized interest for technical communicators. Hours and subject matter to be arranged by staff.

TCM 52000 Teaching Technical and Professional Communication (3-4 cr.) This course is intended for graduate students who wish to learn the theory and practice of teaching technical and/or professional communication at K-12 or post-secondary levels.

TCM 53000 Advanced Visual Technical Communication (3-4 cr.) This course is intended for graduate students who wish to learn the theory and practice of visual technical communication.

TCM 55000 Advanced Research Approaches for Technical and Professional Communication (3-4 cr.) This course is intended for graduate students who wish to learn the theory and practice of conducting applied research in technical and/or professional communication.

Technology

TECH 50400 Motorsports Project Management (3 cr.) This course focuses on engineering and organizational project management aspects specific to the technical operation of a race team or other closely related business in the extremely fast moving world of motorsports.

TECH 50700 Measurement and Evaluation in Industry and Technology (3 cr.) This course is an introduction to measurement strategies and evaluation of data in industry and technology within the context of research design and implementation. Students in this course will learn about the research process by designing, conducting, and analyzing the data for a small empirical research project.

TECH 50801 Quality and Productivity in Industry and Technology (3 cr.) Examines the contemporary issues of continuous improvement in quality and productivity in manufacturing and service industries. Includes a close examination of the evolving philosophies bearing on the scope, improvement, and costs of quality assurance programs in industry and technology.

TECH 52100 Practicum in Motorsports Design and Application (4 cr.) This course comprises a study conducted while the student is working with a race team or associated motorsports industry organization. The student's experience will be overseen and monitored by IUPUI faculty. A project relevant to the student's individual situation will be determined by mutual agreement between the student, supervising faculty member, and industrial supervisor. The project will integrate and synthesize the various aspects of the motorsports industry in which the student has been imbedded. An industry quality technical presentation and technical report will be required.

TECH 53100 Motorsports Topics Seminar (2 cr.) This course features a variety of special topics and guest speakers tying together the concepts of design, modeling, and testing which were studied in an undergraduate program in motorsports engineering or elated field.

TECH 56300 History, Trends and Limitations of Technology (3 cr.) Students learn the fundamental concepts in engineering and technology education. This includes knowledge of information and communication systems, constructions, manufacturing processes, energy/power/transportation technologies, and the overall impact of individuals on the environment within the context of society. This course develops the philosophy and nature of technology as an education discipline. It covers an overview of the importance of technology in history. Students also learn the limitations and scope that impacts the field of engineering technology.

TECH 58100 Workshop in Technology (1-3 cr.) Advanced study of technical and professional topics. Emphasis is on new developments relating to technical, operational, and training aspects of industry and technology education.

TECH 58200 Motorsports Special Topics (3 cr.) This course involves an independent or directed study conducted under the guidance of a motorsports department faculty member.

TECH 64600 Analysis of Research in Industry and Technology (3 cr.) P: Master's student standing. Analysis of research and evaluation of research reports. Emphasis on understanding the application of fundamental statistical methods in design and interpretation of research findings in industrial, technical, and human resource development environments.