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
- 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:

- BS in Music Technology
- MS in Music Technology
- PhD in Music Technology
- BS in Music Therapy
- MS in Music Therapy
- PhD in Music Therapy
- IUPUI Music Academy

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

- Music Therapy

The program listed below is accredited by the American Council for Construction (ACCE), https://www.acce-hg.org

- Construction Management

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:

- 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) transcripts in lieu of high school transcript review.

Engineering Direct-Admit

- 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:
  - Core 40 or equivalent coursework*with a minimum GPA of 3.0
  - Completion or enrollment in pre-calculus and chemistry
  - SAT: Math score of 570 and SAT Evidenced Based Reading and Writing score of 540 or ACT: Math score of 24 and ACT English score of 20.
- Students must provide the results of their SAT or ACT, including the Written Section of the test (scores must be received at IUPUI by May 1). If the student's class has graduated and a fall semester has passed since graduation, the student will 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 students for dual admission to your intended major and scholarship consideration.

Engineering Test-Optional

- 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:
  - Core 40 or equivalent coursework*with a minimum GPA of 3.0
  - Completion or enrollment in chemistry
  - Enrolled in math during all four years
  - Enrolled in pre-calculus or higher in the senior year
  - Grades of B or higher in junior year math and beyond. Senior year math courses will be reviewed and considered, if available at the time of admission review.

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.
- The extent to which the student meets or exceeds the following minimum requirements:
  - Graduation from a high school accredited by a state Department of Public Instruction
  - Academic Honors Diploma or Core 40 or equivalent coursework* with a minimum GPA of 2.75
  - SAT: Math score of 530 or SAT Evidenced Based Reading and Writing score of 500 or ACT: Math score of 21 and ACT English score of 19
  - 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.

Technology Test-Options

- Academic Honors Diploma or Core 40 or equivalent coursework* with a minimum GPA of 3.0.

*8 semesters of mathematics including pre-calculus, 6 semesters of science, with labs, including a year of chemistry, 6 semesters of social science, 4 semesters of additional college prep courses selected from mathematics, English, science, foreign language, and social sciences.

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 Music and Arts Technology Admission Requirements

Student seeking admission to the music technology or music therapy program are required to complete the following *additional* steps for program admission:

- Complete and submit an application to the Bachelor of Science in Music Technology or Bachelor of Science in Music Therapy: https://app.getacceptd.com/iupui
- Once the Music Technology or Music Therapy application has been approved, schedule and complete an audition/interview session and two short online placement exams.

For further specifics, visit: https://go.iu.edu/410B

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 https://studentcentral.iupui.edu/personal-information/residency.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 https://studentcentral.iupui.edu/cost/tuition-fees/index.html

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 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 by going to https://studentcentral.iupui.edu/register/audit-a-course/permission-to-audit-course.html. 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 Bursar Office.

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 Bursar Office https://studentcentral.iupui.edu/pay-bill/index.html.

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://studentcentral.iupui.edu/pay-bill/receive-your-refund/index.html.

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 on the IUPUI Bursar website at https://studentcentral.iupui.edu/pay-bill/receive-your-refund/index.html.

Financial Aid
It is the goal of IUPUI to assist students in their educational endeavors by encouraging students to apply for Financial Aid to reduce financial barriers. Financial assistance is available to admitted and enrolled students who have a demonstrated financial need. Aid is available for eligible students in the form of scholarships, grants, and work study.
Students desiring further information about any of the following financial aid programs should contact

Office of Student Financial Services
Campus Center 250
420 N. University Boulevard
IUPUI
Indianapolis, IN 46202-5147
phone: (317) 274-4162
Web: https://studentcentral.iupui.edu/funding/apply-financial-aid/index.html

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 FAFSA becomes available October 1 of each year and should be submitted by the priority deadline of March 10. 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. IUPUI students are eligible each year for Financial Aid.

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
Scholarship funding may be both inside and outside IUPUI. Awards are often based on major, academic achievements and financial need. The student does not have to repay the award. Applications can be completed online at https://studentcentral.iupui.edu/funding/scholarships/apply-for-scholarships.html.

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, 911 W. North Street, University Tower, Suite 202 (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 provide eligible students 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, Second floor Suite 268, 420 University Blvd., IUPUI, Indianapolis, IN 46202; (317) 278-9163, or visit https://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 Sharel Welch welchs@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 Sharel Welch welchs@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 Undergraduate Academic Affairs and Programs.

Academic Probation (Undergraduate)
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 Undergraduate Academic Affairs and Programs.

Academic Probation (Graduate - Please contact the program department)

Dean's List (Undergraduate Only)

Dismissal (Undergraduate)
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 Undergraduate Academic Affairs and Programs.

Dismissal (Graduate - Please contact the program department)

Readmission (Undergraduate)
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 Undergraduate Academic Affairs and 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 Sharel Welch welchs@iu.edu for a Petition for Readmission.

Readmission (Graduate - Please contact the program department)

Acceptance of Grade Replacement & Repeating Courses

Repeated Courses (Grade Replacement Policy - Undergraduate Only)
Undergraduate students enrolled in the School of Engineering and Technology who are pursuing their first bachelor's degree 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 most recent grade counted in computation of the cumulative grade point average, in accordance with the limitations listed below. Any replaced grades will be excluded from the cumulative GPA, but will still appear on the student's academic record with an X to show the grade was excluded.

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 Undergraduate Academic Affairs and Programs for processing after retaking the course.

Limits on Prior Learning Assessment and Special Credit
The maximum total Prior Learning Assessment (PLA) or Special credit hours that can be applied toward B.S. degrees in the School of engineering and Technology is 30, and the maximum PLA or Special credit hours that can be applied toward A.S. degrees in the School of engineering and Technology is 15. PLA and Special credit cannot count toward residency. This includes MIL (military) credit with an (S) grade, test-out credit, and any other prior learning credit awards based on as assessment of proficiency in a specific area. This total does not include transfer credit from regionally accredited institutions of higher education or credit from established agreements that offer Credit by Credential for specific professional certification.

Students pursuing a certificate in the School of Engineering and Technology may satisfy no more than 50% of the credit hours required for the certificate with PLA or Special (credit).

Individual programs in E&T may opt to develop their own policy limits on PLA and Special credit, provided they set a limit no higher than the school limit of 30.

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 Undergraduate Academic Affairs and 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.

Overload Policy

Undergraduate students wishing to petition for an overload (enrollment in more than 18 credit hours in a given semester) must have a cumulative GPA of at least 3.2 and the approval of their academic advisor. The petition review will take into account other factors such as recent academic performance, nature of the courses being added, etc.

Overloads of 21 or more hours will not be approved except in truly exceptional circumstances, and require that the student already have a demonstrated history of academic excellence (3.9 GPA or higher) while taking heavy course loads at IUPUI.

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 canceled. 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 (Graduate and Undergraduate)

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 (Graduate and Undergraduate)
During the first half of a semester or session (until the Automatic W deadline), students may officially withdraw from classes without penalty if they obtain the approval of their advisor. During the second half of the semester (the Withdraw with W or F period), 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. For exact dates of the Automatic W and withdraw with W or F periods, see the official IUPUI calendar at https://studentcentral.iupui.edu/calendars/official-calendar.html.

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.

Residency Requirements (Undergraduate)
Associate Degree 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 a least three semesters of resident study may complete a maximum of 16 credit hours of the second year in another approved college or university.

Bachelor's degree 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 residency requirements, two summer sessions are considered equivalent to one semester.

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

Additional information on residency requirements, including requirements for Mechanical Engineering students enrolled at IUPUC, can be found here.

Residency Requirements (Graduate)
No more than 12 credit hours can apply to MS/PhD programs from external programs.

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 (Grade Replacement 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 Artificial Intelligence (BSAI)
- 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 12500 First Year Seminar for Engineering Majors, ENGR 19600 Introduction to Engineering (for all majors *except* artificial intelligence), ENGR 19700 Introduction to Programming Concepts (for all majors *except* artificial intelligence, electrical engineering and computer engineering), ENGR 29500 Transition to Engineering Profession, 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 Management
- Cybersecurity
- 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.

Purdue Civics Literacy Requirement

All undergraduate students who enter a Purdue BS degree program, either as a new freshman or as a transfer student, will be required to complete the Purdue Civics Literacy Proficiency. To obtain this proficiency, students will complete an educational activity as part of a Civics Literacy Pathway and pass the Purdue Civics knowledge test. There are two different pathways:

- *Civics literacy Podcast pathway* - Complete 12 podcasts created by the Purdue Center for C-Span Scholarship & Engagement that use C-Span material, in addition to passing the Purdue Civics knowledge test.
- *Approved course pathway* - Complete an approved Civics Literacy course, such as HIST-H 105 or POLY-S 103, with a grade of at least C-, in addition to passing the Purdue Civics knowledge test.

The Purdue Civics knowledge test must be taken through the IUPUI Testing Center, but may be retaken as many times as needed to achieve successful completion.

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
  - Artificial Intelligence
  - Computer Engineering
  - Electrical Engineering
- Mechanical Engineering
  - Energy Engineering
  - Mechanical Engineering
  - Innovative Design with Intellectual Property
- Motorsports Engineering
  - Motorsports Engineering
- Interdisciplinary Engineering (BSE)
  - Interdisciplinary Engineering

Technology

- Computer Information and Graphics Technology
  - Computer & Information Technology
  - Computer Graphics Technology
  - Cybersecurity
  - E-Commerce Development Certificate
  - Information Technology Certificate
  - Network Security Certificate
- Engineering Technology
  - Computer Engineering Technology
  - Construction Management
  - Electrical Engineering Technology
  - Healthcare Engineering Technology Management
  - Interior Design
  - Mechanical Engineering Technology
  - Medical Device Cybersecurity Certificate
  - Motorsports Engineering
  - Construction Management Certificate
  - Lean Six Sigma Certificate
  - Motorsports Engineering Technology Certificate
- Music & Arts Technology*
  - Music Technology
  - Music Therapy
- Technology Leadership and Communication
  - Organizational Leadership & Supervision
  - Technical Communication
  - Human Resource Management Certificate
  - Intergroup Dialogue Certificate
  - International Leadership Certificate
  - Leadership Studies Certificate
  - Sustainable Technologies Certificate
  - Technical Communication Certificate

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

Artificial Intelligence (AI)

Artificial Intelligence, B.S.A.I.

Upon completing the B.S. in Artificial Intelligence, our students will possess:

1. Students will be able to communicate in written and oral forms in such a way as to demonstrate their ability to present information clearly, logically, and critically.
2. Student will be able to apply mathematical, computing theoretical and computing hardware concepts when developing solutions of common computing and hardware applications.
3. Students will be to successfully complete significant programming projects.
4. Students will be able to apply artificial intelligence, machine learning and/or data analytics tools and technologies to solve data related problems and applications.
5. In the self-selected AO depth area (dependent on their plan of study choice) students will demonstrate a depth of knowledge appropriate to pursue graduate study and/or lifelong learning in that area.
6. Students will understand the impact of artificial intelligence and intelligent systems solutions in a global, economic, environmental, and societal context and demonstrate an understanding of professional and ethical responsibilities.

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 identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Computer Engineering

Computer Engineering B.S.Cmp.E.

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

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Computer Engineering Technology

Computer Engineering Technology, B.S.

Upon completion of this program, students will demonstrate:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
3. an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
4. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
5. an ability to function effectively as a member as well as a leader on technical teams.

Computer Graphics Technology

Computer Graphics Technology, B.S.

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

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

Computer & Information Technology

Computer & Information Technology, B.S.

Upon completion of the B.S. degree, CIT students will be able to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

Construction Management

Construction Management, B.S.

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

1. Create written communications appropriate to the construction discipline.
2. Create oral presentations appropriate to the construction discipline.
3. Create a construction project safety plan.
4. Create construction project cost estimates.
5. Create construction project schedules.
6. Analyze professional decisions based on ethical principles.
7. Analyze construction documents for planning and management of construction processes.
8. Analyze methods, materials, and equipment used to construct projects.
9. Apply construction management skills as a member of a multi-disciplinary team.
10. Apply electronic-based technology to manage the construction process.
11. Apply basic surveying techniques for construction layout and control.
12. Understand different methods of project delivery and the roles and responsibilities of constituencies involved in the design and construction process.
13. Understand construction risk management.
14. Understand construction accounting and cost control.
15. Understand construction quality assurance and control.
16. Understand construction project control processes.

17. Understand the legal implications of contract, common, and regulatory law to manage a construction project.
18. Understand the basic principles of sustainable construction.
19. Understand the basic principles of structural behavior.
20. Understand the basic principles of mechanical, electrical and piping systems.

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.

Cybersecurity

Cybersecurity, B.S.

Upon completion of the B.S. degree, CTS students will be able to:

1. Understand Cybersecurity requirements.
2. Implement Cybersecurity requirements.
3. Investigate Cybersecurity incidents.
4. Analyze Cyber security incidents.
5. Protect computer networks against malevolent activities by actively.
6. Effectively defend computer networks against malevolent activities by actively participating in red team blue team exercises.
7. Identify computer network vulnerabilities through penetration testing and hacking techniques
8. Correct computer Network vulnerabilities through penetration testing and hacking techniques
9. Critically analysis security issues to develop and implement security policies and to solve problems.
10. Conduct risk assessments
11. Manage risks
12. Read, interpret, write, modify, and execute simple scripts (e.g., Perl, VBScript) on Windows and UNIX sysstems (e.g., those that perform tasks such as: parsing large data files, automating manual tasks, and fetching/processing remote date).
13. Interact with other in group or teams in ways that contribute to effective working relationships and the achievement of goals.

E-Commerce Development Certificate

E-Commerce Development 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 identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Electrical Engineering Technology

Electrical Engineering Technology, B.S.

At the time of graduation, students will demonstrate:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-

defined engineering problems appropriate to the discipline;
3. an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
4. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
5. an ability to function effectively as a member as well as a leader on technical teams.

Energy Engineering

Energy Engineering

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Healthcare Engineering Technology Management

Healthcare Engineering Technology Management A.S. & B.S.

At the time of graduation, students will be able to:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
3. an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
4. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
5. an ability to function effectively as a member as well as a leader on technical teams.

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 identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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 identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Mechanical Engineering Technology

Mechanical Engineering Technology, B.S.

At the time of graduation, a student will demonstrate:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
3. an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and us appropriate technical literature;
4. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
5. an ability to function effectively as a member as well as a leader on technical teams.

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 identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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.

Music Therapy

Music Therapy, B.S.

Graduates of the Music Therapy program will display competence in the following competency areas defined by the American Music Therapy Association:

1. Music Theory and History
2. Composition and Arranging Skills
3. Major Performance Medium Skills
4. Functional Music Skills
5. Conducting skills
6. Movement Skills
7. Therapeutic Applications
8. Therapeutic Principles
9. The Therapeutic Relationship
10. Foundations and Principles of Music Therapy
11. Client Assessment
12. Treatment Planning
13. Therapy Implementation
14. Therapy Evaluation
15. Documentation
16. Termination and Discharge Planning
17. Professional Role/Ethics
18. Interprofessional Collaboration
19. Supervision and Administration
20. Research Methods

Motorsports Engineering Technology Certificate

Motorports 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.

Sustainable Technologies Certificate

Sustainable Technologies
At the time of graduation, a student will possess:

1. **Sustainable Principals and Practices** - Student will examine current sustainability issues and problems, challenge old assumptions, identify consequences, generate, and explore new questions, and make informed decisions about living and working in a sustainable world.
2. **Renewable Energies Systems** - Students will evaluate and analyze renewable energy systems (solar thermal, solar photovoltaics, bioenergy, hydroelectricity, tidal power, wind, wave, geothermal, etc.) to work towards more recommending efficient energy solutions for buildings and organizations.
3. **Energy Efficiency and Auditing** - Students will evaluate differences in multiple energy systems and recommend the best system for saving energy.
4. **Leadership and Economic Aspect of Sustainability** - Students will analyze different sustainability framework for implementing, measuring, and improving social, environment, and financial performance in an organization.
5. **Emerging Technologies** - Student will research and assess the cost and benefits of emerging green technologies.
6. **Green Building Technologies** - Students will evaluate and analyze green building design components and propose solutions for better green design and building.

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

Medical Device Cybersecurity Certificate

Medical Device Cybersecurity Certificate
At the time of graduation, students will be able to:

1. Basic networking concepts used in the clinical environment connecting medical devices.
2. Generalized security concepts for networks and computer systems.
3. Security measures and communication protocols as applied to the clinical setting.
4. Rudimentary and complex networking topologies including construction and simulated failures as applied to medical devices in the clinical setting.
5. HIPAA data recovery requirements utilizing sample patient data.
6. Assessment of medical device cybersecurity threats and risks in the clinical setting, and security planning specific to the technologies of individual medical devices.
7. Policy planning, threat detection, evaluation and testing associated with healthcare networked medical devices utilized for patient care.

Innovative Design with Intellectual Property Certificate

Innovative Design with Intellectual Property Certificate
Upon completion of this program, students will possess:

1. Employ strategies to begin a design activity, no matter how complicated.
2. Innovate using a structured approach.
3. Transform an innovation into an invention.
4. Avoid infringement of others' IP.

5. Describe alternative career choices in the intellectual property and patent law areas.

Intergroup Dialogue Certificate

Intergroup Dialogue Certificate

Upon completion students will be able to quickly demonstrate leadership capabilities to support others through intergroup conflicts and to help them better function as teams, corporate citizens, and community members. Specifically the students will be able to implement five core steps of IGD in personal, professional, or social settings.

These steps include:

1. To create a space for dialogue (a negotiated space and time to truthfully share).
2. To create rules and structure for the dialogue.
3. To set boundaries for one group to talk and the other to listen and reverse this process before drawing conclusions as a group.
4. To build community through shared space and engagement.
5. To draft plan of action for change with their voice and within their comfort zone.

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 https://studentcentral.iupui.edu/funding/scholarships/iupui-scholarships.html or email etschlr@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 baccalaureate degree with distinction must have a minimum of 65 hours of credit earned at Purdue university included in the computation of the overall GPA. A candidate for an associate degree with distinction must have a minimum of 35 hours of credit earned at Purdue university included in the computation of the overall GPA.
- The minimum overall GPA for graduation with distinction in each school shall be no less than the 90th percentile of the graduation indexes of the graduates in each school, for the spring semester , provided that the index is at least 3.30. The minimum overall GPA so determined in the spring for each school shall be applied for graduation with distinction for the subsequent summer session and fall semester. In administering this rule, all baccalaureate engineering graduates will be considered as one school.
- Of those graduates who qualify for distinction under these rules for the spring semester, the three-tenths of the baccalaureate graduates having the highest overall GPA shall be designated as graduating with highest distinction, irrespective of the schools from which they graduate. The three-tenths of the spring associate degree graduates having the highest overall GPA will be designated as graduating with highest distinction.

The minimum overall GPAs so determined for graduation with highest distinction shall be applied for graduation with highest distinction for subsequent summer session and fall semester.

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 Artificial Intelligence (B.S.A.I.), Bachelor of Science in Biomedical Engineering (B.S.B.M.E.), 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 120 credit hours in the artificial intelligence program, 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 Artificial Intelligence (BSAI)
- 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)

Technology Degree Programs

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

- 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 Management
- Cybersecurity
- Electrical Engineering Technology
- Healthcare Engineering Technology Management
- Interior Design Technology
- Mechanical Engineering Technology
- Music Technology
- Music Therapy
- Organizational Leadership
- Technical Communication

Artificial Intelligence

B.S. in Artificial Intelligence

The Bachelor of Science in Artificial Intelligence with a concentration in Intelligent Control Systems (B.S.A.I.) focuses on embedded systems, autonomous systems, optimization methods for systems and control, smart devices and systems, and system security. This concentration will prepare AI engineers with the ability to integrate AI technologies to application fields, such as autonomous transportation, smart systems, cybersecurity, smart health and Internet of Things.

This degree will prepare graduates for both careers in software using AI technologies, as well as in the hardware areas that drive AI technologies, such as smart sensors, robotics, autonomous systems, and many more.

Students who complete the BSAI degree with the Intelligent Control and Systems concentration will be well prepared for future careers in AI technologies. They will have a deep foundation in mathematics and programming, and broad knowledge of AI techniques and applications. They will also have hands-on engineering experiences and exposure to hardware/devices, especially in the context of AI technologies. Other curriculum requirements include cybersecurity and robotics.

The minimum number of credit hours for graduation is 120. Semester by semester, these 120 credit may be distributed as shown below.

Freshman Year

First Semester (17 credit hours)

- ENGR 12500 First Year Seminar for Engineering Majors - 1 credit hour
- AIE 10000 Introduction to Artificial Intelligence - 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I - 4 credit hours
- MATH 17100 Multidimensional Math - 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)

- PHYS 15200 Mechanics - 4 credit hours
- MATH 16600 Analytic Geometry and Calculus II - 4 credit hours
- ECE 29500 Python for Engineers (course in development)- 1 credit hour

- ECE 26100 C Programming Lab - 1 credit hour
- ECE 26300 C Programming - 3 credit hours
- PSY-B 110Introduction to Psychology - 3 credit hours

Sophomore Year

Third Semester (17 credit hours)

- MATH 26100 Multivariate Calculus - 4 credit hours
- MATH 26600 Ordinary Differential Equations - 3 credit hours
- CSCI 34000 Discrete Computational Structures - 3 credit hours
- CSCI 24000 Advanced Programming - 4 credit hour
- AIE 20000 Introductory Data Science (course in development) - 3 credit hours

Fourth Semester (14 credit hours)

- ECE 29500 Systems Fundamentals for Intelligent Control (course in development) - 1 credit hours
- ECE 20400 Introduction to Electrical and Electronics Circuits - 4 credit hours
- ECE 35900 Data Structures - 3 credit hours
- ECE 32700 Engineering Economics - 3 credit hours
- MATH 35100 or MATH 51100 Linear Algebra - 3 credit hour

Junior Year

Fifth Semester (16 credit hours)

- ECE 36200 Microprocessor Systems and Interfacing - 4 credit hours
- ECE 30200 Probabilistic Methods in Electrical and Computer Engineering - 3 credit hours
- AIE 30000 Intro to Artificial Intelligence-Human Computer Focus (course in development) - 3 credit hours
- Intelligent Control and Systems Elective - 3 credit hours
- List C or List E Course - 3 credit hours

Sixth Semester (14 credit hours)

- TCM 36000 Comm. in Engineering Practice - 2 credit hours
- List A or List D Course - 3 credit hours
- ECE 49500 or CSCI 46300 Algorithms - 3 credit hours
- ECE 38200 Feedback System Analysis and Design or ECE 47100 Embedded Systems- 3 credit hours
- Cultural Understanding Elective - 3 credit hours

Senior Year

Seventh Semester (13 credit hours)

- List A or List D Course - 3 credit hours
- AIE 40000 Recent Trends in AI (course in development) - 3 credit hour
- AIE 41000 AI Ethics (course in development) - 1 credit hour
- ECE 49500 Robotics (course in development) - 3 credit hours
- List B Course - 3 credit hours

Eighth Semester (13 credit hours)

- List C or List E Course- 3 credit hours
- ECE 49500 Capstone (course in development) - 3 credit hours
- Intelligent Control and Systems Elective- 1 credit hours
- List and Physical Science Elective - 3 credit hours
- Arts & Humanities Elective - 3 credit hours

When choosing electives and courses from approved lists, students must meet with requirements below.

- Must take at least one course from List B (CyberSecurity)
- Must satisfy one of the following:
  - EITHER
    - Must take ECE 38200 Feedback Sys Analysis & Design
    - Must take at least two courses from List A
    - Must take at least two courses from List C
  - OR
    - Must take ECE 47100 Embedded Systems
    - Must take at least two courses from List D
    - Must take at least two courses from List E
- Intelligent Control & Systems elective (4 credit hours) can be selected from List O as well as any ENGR coop/internship course.

LIST A

- ECE 48300 Digital Control Systems Analysis and Design
- ECE 53801 Discrete Event Systems
- ECE 57000/CSCI 5XX Advanced AI
- ECE 58000 Optimization Methods for Systems and Control
- ECE 59500 Embedded Autonomous Systems
- ECE 59500 Intro to Connected & Autonomous Vehicles

List B

- CIT 39900 Cybersecurity with Artificial Intelligence
- CIT 40600 Advanced Network Security
- CIT 49900 Cybersecurity Engineering
- CIT 52800 Information Security Risk Management
- CIT 53200/ECE 59500 Wireless Security and Technology
- ECE 56401/CSCI 5XX Computer Security

- CIT 55510 Advanced Network Security

List C

- Courses from List A
- Courses from List B
- CIT 20300 Information Security Fundamentals
- ECE 36500 Intr. to Design of Digital Computers
- CIT 41200 Data-Driven Cloud Applications
- CIT 44400 Advanced Database Design or CSCI 44300 Database Systems or ECE 59500 Database or CIT 57800 Advanced Topics in Data Management
- ECE 46300/CSCI 43600 Introduction to Computer Communication Networks or equivalent
- CIT 47900 Database Implementation and Administration
- CSCI 49000 Deep Learning or CIT 58100 Deep Learning
- CIT 49900 Big Data Analytics
- CIT 52600 Applied Data Analytics
- ECE 53301 Wireless and Mobile Computing or CIT 54600 Mobile Computing and Application Technologies
- ECE 53700 Digital Signal Processing I
- ECE 54800 Intro 2D & 3D Digital Image Processing or CS 557
- ECE 56500 Computer Architecture
- ECE 56601 Real time Operating Systems
- ECE 57101 System Modeling and Design for Smart Devices
- CSCI 57300 Data Mining
- ECE 59500 Design of Embedded Systems
- ECE 59500 Statistical Signal Processing with Machine Learning

List D

- CIT 40700 Fundamentals of Intelligent Agents
- CIT 41100 iOS Mobile Application Development
- CIT 41200 Data-Driven Cloud Applications
- CIT 45600 Expert Systems
- ECE 53301 Wireless and Multimedia Computing or CIT 54600 Mobile Computing and application Technologies
- ECE 56601 Real time Operating Systems
- ECE 57000/CSCI 5XX Advanced AI
- ECE 57101 System Modeling and Design for Smart Devices
- ECE 59500 Embedded Autonomous Systems
- ECE 59500 Design of Embedded Systems
- ECE 59500 Intr0 to Connected & Autonomous Vehicles

List E

- Courses from List D
- Courses from List B
- CIT 20300 Information Security Fundamentals
- CIT 44400 Advanced Database Design or CSCI 44300 Database Systems or ECE 59500 Database or equivalent
- ECE 46300/CSCI 43600 Introduction to Computer Communication Networks or equivalent
- ECE 48300 Digital Control Systems Analysis & Design
- CSCI 49000 Deep Learning or CIT 58100 Deep Learning
- CIT 49900 Big Data Analytics
- CIT 52600 Applied Data Analytics
- ECE 53800 Digital Signal Processing
- ECE 53801 Discrete Event Systems
- CIT 54600 Mobile Computing and Application Technologies(3)
- ECE 54800 Intro 2D & 3D Digital Image Processing or CS 55700
- ECE 56500 Computer Architecture
- ECE 56601 Real Time Operating Systems
- CSCI 57300 Data Mining
- ECE 59500 Design of Embedded Systems
- ECE 59500 Statistical Signal Processing with Machine Learning

List O

- Courses from List C
- Courses from List E
- CIT 20200 Networking Fundamentals (3): 0
- CIT 21300 Systems Analysis and Design (3): 0
- CIT 21400 Introduction to Data Management (3):
- CIT 30400 Database Programming (3):
- CIT 30500 Android Mobile Application Development (3):
- CIT 32700 Wireless Communication (3):
- CIT 35600 Network Operating Systems Administration (3):
- CIT 37400 Systems and Database Analysis (3):
- CIT 38100 Unix Programming and Administration (3):
- CIT 41500 Advanced Network Administration (3):
- CIT 44000 Communication Network Design (3):
- INFO-I 467 Internet-of-Things Interface Design for Business Innovation
- CIT 47900 Database Implementation and Administration
- cCIT 49500 Learning Lab
- CSCI 59000 Data Science or CIT 52600 Applied Data Analytics
- ECE 49600 Independent Project
- CIT 56200 Mobile and Network Forensics(3):
- CIT 57800 Advanced Topics in Data Management (3):
- CIT 47800 Advanced Topics in Data Management

Artificial Intelligence Certificate

The School of Engineering and Technology offers a 16-credit hour undergraduate certificate in Artificial Intelligence. The curriculum consists of required Artificial Intelligence Engineering (AIE) and programming courses, and an elective chosen from a list of ECE, CIT, ENGR, and ECET courses. Additional information is available by contacting the ECE department or the CIT department. Similar undergraduate certificates in Artificial Intelligence are offered at IUPUI by the School of Science and by the Luddy School of Informatics, Computing, and Engineering.

Biomedical Engineering (BME)

Biomedical Engineering (BME)

Professor Emeritus & Chancellor's Professor Emeritus: E. Berbari **Professors:** C.C. Lin, J. Wallace (Chair), H. Yokota, K. Yoshida
Associate Professors: J. Ji (Director of the Graduate Program), S. Na, J. Schild, D. Xie
Assistant Professor: R. Surowiec
Clinical Associate Professors: K. Alfrey, S. Higbee, S. Miller (Associate Chair and Director of the Undergraduate Programs
Lecturer: J. Hatch

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: https://et.iupui.edu/departments/bme/ 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 preceding their initial enrollment to BME 49101 (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 B.S.B.M.E. program and meeting minimum grade and GPA requirements.

For more information about the B.S./M.S.B.M.E. visit: https://et.iupui.edu/departments/bme/programs/undergrad/5yearBsMs/

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.

The department also offers an accelerated combined bachelor's and master's degree program which allows academically successful students the opportunity to earn both B.S. and M.S. degrees in a total of five years. For more information about the 5-year B.S./M.S.B.M.E. combined degree program visit: https://et.iupui.edu/departments/bme/programs/undergrad/5yearBsMs/

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 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. visit: https://et.iupui.edu/departments/bme/programs/grad/msbme/.

For more information about the Ph.D. program visit https://et.iupui.edu/departments/bme/programs/grad/phdbme/.

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 https://et.iupui.edu/departments/bme/programs/undergrad/bsbme/plan. 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 12500 First Year Seminar for Engineering Majors - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I - 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 and Calculus II - 4 credit hours
- MATH 17100 Multidimensional Mathematics - 3 credit hours
- ENGR 29700 Computer Tools for Engineering - 1 credit hour

Sophomore Year

Third Semester (17 credit hours)

- MATH 26100 Multivariate Calculus - 4 credit hours
- PHYS 25100 Heat Electricity & Optics - 5 credit hours
- BME 24101 Introductory Biomechanics - 3 credit hours
- BME 24300 Biomechanics Lab - 1 credit hour
- TCM 21800 Intro to Engineering Technical Reports - 1 credit hour
- CHEM-C 106 Principles of Chemistry II - 3 credit hours

Fourth Semester (16 credit hours)

- MATH 26600 Ordinary Differential Equations - 3 credit hours
- BIOL-K 324 Cell Biology - 3 credit hours
- BME 22201 Introductory Biomeasurements - 3 credit hours
- BME 22400 Biomeasurements Lab - 1 credit hour

- COMM-R 110 Fundamentals of Speech Communication - 3 credit hours
- General Education Elective - 3 credit hours

Junior Year

Fifth Semester (17 credit hours)

- CHEM-C 341 Organic Chemistry I - 3 credit hours
- BME 38100 Implantable Materials & Biological Response - 3 credit hours
- BME 38300 Implantable Materials Lab - 1 credit hour
- BME 33100 Biosignals and Systems - 3 credit hours
- BME 33400 Biomedical Computing - 3 credit hours
- TCM 35900 Tech Data Reporting and Presentation - 1 credit hour
- General Education Elective - 3 credit hours

Sixth Semester (15 credit hours)

- BME 32200 Probability & Statistics in BME - 3 credit hours
- BME 35200 Cell & Tissue Mechanics - 3 credit hours
- BME 35400 Cell & Tissue Lab - 1 credit hour
- BME 30200 Professional Development & Design in BME - 2 credit hours
- BME 38800 Applied Biomaterials - 3 credit hours
- BME 44200 Biofluid Mechanics - 3 credit hours

Senior Year

Seventh Semester (15 credit hours)

- BME 49101 Biomedical Engineering Design - 2 credit hours
- BME 41101 Quantitative Physiology - 4 credit hours
- BME 46100 Transport Processes in BME - 3 credit hours
- BME/ENGR Elective* - 3 credit hours
- BME/SCI/TECH Elective* - 3 credit hours

Eighth Semester (15 credit hours)

- BME 49200 Biomedical Engineering Design II - 3 credit hours
- BME/SCI/TECH Elective* - 3 credit hours
- BME/ENGR Elective* - 3 credit hours
- General Education Elective - 3 credit hours
- General Education Elective - 3 credit hours

*The four BME/ENGR/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, Chair and Professor of Computer & Information Technology
Associate Chair: Chris Rogers, Director and Associate 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

Chair: F. Li, Chair and Professor of Computer & Information Technology
Associate Chair: Chris Rogers, Director and Associate Professor of Computer Graphics Technology
Professors: A. Jafari, F. Li
Associate Professors X. Luo
Assistant Professors: M. Abdallah, T. Li, A. Savoy, R. Tian
Clinical Associate Professor: C. Justice**Teaching Professor**: R. Elliott
Senior Lecturer: S. Mithun
Lecturers: C. Hampton, J. Kane

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 CYBERSECURITY AND TRUSTED SYSTEMS

The objective of this program is to prepare students to enter the workforce in the rapidly advancing field of cybersecurity and to address the security challenges and risks that industry encounters daily. The M.S. in

Cybersecurity and Trusted Systems provides the student the opportunity to develop foundational knowledge and the necessary cybersecurity skill set to prepare for engineering/information technology careers.

The M.S.in Cybersecurity and Trusted Systems program is designed so that graduates holding a B.S. 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.

Successful graduates of the program earn a Master of Science (M.S.) in Cybersecurity and Trusted Systems awarded by Purdue University.

The curriculum consists of a total of 30 credit hours as follows:

- Primary Cybersecurity Courses (9 credit hours)
- Foundational Cybersecurity Courses (9 credit hours)
- Elective Cybersecurity Courses (6 credit hours)
- Elective Courses (6 credit hours)

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

FIVE-YEAR COMBINED BSCIT/MSTECH PROGRAM IN CIT

This combined degree program will provide high quality students with intensive training and the opportunity to do supervised, applied research in an area of Computer and Information Technology (CIT). Student will receive two degrees in fewer years than it would take to pursue these degrees sequentially.

Master's degree Application Requirements:

1. All student in the CIT Bachelor's program are eligible if they have attained a 3.1 GPA in the first 84 credit hours of coursework.

2. Applications must provide a resume, statement of purpose, and one letter of reference from student's undergraduate faculty advisor.

3. Students should consult their undergraduate academic advisor as early as possible to prepare for admission into the program.

For more information, visit our website at: https://et.iupui.edu/departments/cigt/programs/cit/undergrad/5yearbsms

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: **https://et.iupui.edu/departments/cigt/programs/cit/grad/** 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 **https://et.iupui.edu/departments/cigt/programs/cit/undergrad/bscit/**.

CIT BS Requirements

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

- 36 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**.

Bachelor of Science in Cybersecurity Requirements

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

- 36 credit hours in upper level courses
- 32 credit hours in residence in the School of Engineering and Technology
- 12 credit hours in upper level Cyber 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 areas:

- Cyber Core (must be completed with a grade of C or better)
- Cyber Concentration (must be completed with a grade of C or better)
- Cyber 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 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: .

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: C. Rogers

Assistant Professor:
Lecturers: M. Cole, 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 https://et.iupui.edu/departments/cigt/ 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

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

- 67 credit hours of CGT core courses
- 32 credit hours in residence in the School of Engineering & Technology
- 2.0 graduation degree GPA
- 2.0 IU Program GPA

In addition, students are required to complete at least one internship that fulfills the RISE experience of experiential learning. See an advisor for details.

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

- CGT Core (must be completed with a grade of C- or better)
- CGT Concentration (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 website at: https://et.iupui.edu/departments/cigt or contact Computer Graphics Technology at (317) 278-7322 or via email: cgt@iupui.edu.

Minor in Computer Graphics Technology

The minor in Computer Graphics Technology is available to students majoring in other areas of study at IUPUI.

A minor in Computer Graphics Technology requires the completion of 15 credit hours of computer graphics technology courses. Students are required to complete a core of 6 credit hours, and then may choose a focus for the remaining 9 credit hours. This focus includes the areas of Animation, Multimedia Development, Themed Attraction Design, or Motion Graphics.

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 Computer Graphics Technology 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 Graphics Technology is acceptable with their major field of study.

For more information and a list of required courses, visit our website at: https://cgt.iupui.edu/Curriculum/Themed%20Entertainment%20minor.html.

Certificate in Themed Entertainment

The Certificate for Themed Entertainment Design requires the completion of 18 credit hours which can be completed via distance education. The Certificate for Themed Entertainment Design focuses on the industry, principles and techniques in the development of themed entertainment experiences.

Students who complete the Themed Entertainment Design Certificate will be able to:

- Students will gain an overview of the themed attraction industry
- Students will be able to articulate the scope of a project, the audience and the goals of the project
- Students will learn about the various components of a themed experience
- Students will be able to articulate the process of planning a project

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 website at: https://cgt.iupui.edu/Curriculum/Themed%20Entertainment%20Concentration.html

Cybersecurity

Bachelor of Science in Cybersecurity

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

- 36 credit hours in upper level courses
- 32 credit hours in residence in the School of Engineering and Technology

- 12 credit hours in upper level Cyber 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 areas:

- Cyber Core (must be completed with a grade of C or better)
- Cyber Concentration (must be completed with a grade of C or better)
- Cyber 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 website at cit.iupui.edu or contact Computer and Information Technology at (317) 274-9705 or via email: cit@iupui.edu.

Electrical and Computer Engineering (ECE)

Professors Y. Chen, S. Chien, M. El-Sharkawy, L. Li, M. Rizkalla, D. Russomanno, P. Salama, P. Schubert
Associate Professors Z. Ben Miled, L. Christopher, E. dos Santos, D. Kim, B. King (Chair), S. Koskie, J. Lee, S. Rovnyak
Assistant Professors Q. Zhang
Senior 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 engineering 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, circuits 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. Undergraduate and graduate research and undergraduate design projects in the areas of signal processing, IoT, machine learning, deep learning, cybersecurity, cryptography, power, communications, image processing, artificial intelligence, networking, software engineering, embedded systems, high performance computing, gpu programming, control, robotics, manufacturing, medical imaging, nanotechnology, micro-electronics, 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.

Admission into Electrical and Computer Engineering

Freshman engineering students who declare a computer engineering or electrical engineering major must complete all Freshman Engineering requirements, including minimum grade requirements, before registering for ECE courses and being accepted into the department. For the freshman-year course lists and grade requirements, visit: https://et.iupui.edu/departments/ece/students/policies/.

Electrical and Computer Engineering 5-year B.S./M.S. Program

The Department of Electrical and Computer Engineering offers a 5-year B.S./M.S. Program for both BSEE and BSCmpE majors. The program provides academically successful students the opportunity to earn both a Bachelor's and a master's degree in five years. To be eligible for this combined-degree program, students must have a minimum 3.2 cumulative GPA at the beginning of the junior year in the bachelor's degree program, and must maintain this GPA throughout the remainder of the undergraduate program.

For more information about the BS/MS program, visit: https://et.iupui.edu/departments/ece/programs/5yearbsms/.

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 l - 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 eceugadv@iupui.edu.

ECE Undergraduate Academic Policies

Freshman Requirements

All freshman-year course requirements must be completed in order to register for any ECE courses, with the exception of ECE 32700, an IUPUI General Education Core Social Science course. Computer Engineering students who have been admitted to the School of Engineering and Technology may take ECE 26300 and ECE 26100 (C Programming) concurrent with the freshman engineering courses.

- Freshman year course requirements include ENGR 12500, ENGR 19600, MATH 16500, MATH 17100, PHYS 15200, CHEM-C 105, ENG-W 131, COMM-R 110. A minimum grade of C is required in ENG-W 131 and COMM-R 110. A minimum grade of C- is required in all other freshman year courses except CHEM-C 105.

Senior Design Courses

Students must have senior standing in the degree programs to take ECE 48700, the first of the two-course senior design sequence.

- For a student to have senior standing in the degree program, the student must have successfully completed all freshman, 200-, and 300-level required courses, with the following exceptions:
  - For computer engineering students, ECE 36500 may be taken during the senior year.
  - For electrical engineering students, in *rare* cases ECE 31100 or ECE 38200 may be taken during the senior year. However, students are strongly urged to complete both of these required courses during their junior year in the program, as their senior design work will be impacted.

Minimum Grade Requirements

For students admitted to the School of Engineering & Technology with a declared major of Electrical Engineering or Computer Engineering, a minimum grade of C- is required in the courses listed below

- ENGR 12500, ENGR 19600, ENGR 29700;
- MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600;
- PHYS 15200, PHYS 25100;
- ECE courses:
  - 20100, 20200, 20700, 20800 (EE only), 21000, 25500 (EE only), 26100, 26300, 27000, 30100, 30200
- CSCI courses (CmpE only):
  - 24000, 34000
- A minimum grade of C is required in the courses listed below:
  - ENG-W 131, COMM-R 110

Transfer Credit and Course Substitutions

The use of any transfer credit to fulfill a degree requirement must be approved by the faculty in the ECE department. The ECE department does not accept transfer credit for engineering required or elective courses at the 300-level or higher, with the exception of some Purdue University courses (C- or higher required for Purdue Courses). A grade of C or higher is required for all other transferred credit.

- New transfer students will have their transfer credit from previously attended institutions evaluated and approved for use toward degree requirements during their initial semester at IUPUI, before being admitted into the ECE department
- Current IUPUI electrical or computer engineering students, whether in the ECE Department, E&T New Student Academic Advising Center, or University College, must receive approval by the ECE faculty in advance and in writing for any course substitution or use of transfer credit to meet degree requirements, whether the course is taken at IUPUI or is transferred from any other university. Approval is on a case-by-case basis. The approval process is found here: https://et.iupui.edu/departments/ece/students/policies.
  - Except for general education courses chosen from the IUPUI Cultural Understanding, Arts and Humanities, and Social Sciences lists, the ECE department will not accept transfer credit for courses that do not require proctored, in-person exams. Video or online proctoring, browser lockdowns, or other similar methods

do not satisfy this requirement. The ECE department will not accept transfer credit for courses taken at other institutions if the transfer course conflicts with an IUPUI course taken by the student at the same time.

- Approval of a particular course for transfer to ECE in the past is not a blanket approval for use of that course in the future, except for defined 2+2 or dual degree programs.

Pre- and Corequisites

The ECE Department faculty enforces all pre- and co-requisites, including minimum grade requirements. All minimum grade requirements must be satisfied for a pre- or co-requisite to be successfully completed. Pre- and co-requisites for courses include the specific courses listed, *and* all pre- and co-requisites of those listed courses.

For instance, you must have a grade of C- or higher in ECE 20100, PHYS 25100, and MATH 26100 in order to satisfy the pre-requisites for ECE 20200. A grade lower than C- in any one of those courses means that the requisites have not been satisfied, and you cannot take ECE 20200.

If a student has registered for a course and does not meet the course requisites, the student must drop or withdraw from the course. Enrollment in a class does not entitle a student to remain in the course without meeting ECE Department requirements, course requisites, and minimum grades.

When the term 'senior standing' is used by the ECE Department as a pre-requisite, or in course or degree program information, this refers to senior standing in the degree program. See the section on Senior Design Courses above.

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 ethical problem solvers 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, https://et.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 12500 First Year Seminar for Engineering Majors - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I - 4 credit hours
- CHEM-C 105 Principles of Chemistry 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
- Restricted 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
- Arts & Humanities 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 ethical problem solvers 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, https://et.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 12500 First Year Seminar for Engineering Majors - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- CHEM-C 105 Principles of Chemistry 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
- Restricted 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
- 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 C105 - 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
   - First Year Seminar for Engineering Majors: ENGR 12500 - 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 12500 First Year Seminar for Engineering Majors - 1 credit hour
- ENGR 19600 Introduction to Engineering - 3 credit hours
- CHEM C105 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, Professor of Electrical and Computer Engineering Technology

Program Directors:
CM - D. Koo (Interim)
CpET - B. Lin
EET - D. Goodman
HETM - R. Weissbach (Interim)
INTR - E. McLaughlin
MET - P. Yearling
MSTE - C. Finch

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 Computer Engineering Technology, Construction Management, Electrical Engineering Technology, Healthcare Engineering Technology Management, Interior Design Technology, Mechanical Engineering Technology, and Motorsports Engineering. The ENT programs are well-suited for individuals who are curious about how things work and desire an education at the intersection of theory and experiential learning.. 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 tlewalle@iupui.edu, or visit our Web site at .

Architectural Technology

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.

Construction Management

Construction Management

Associate Professor: D. Koo (Interim Program Director)
Senior Lecturer: M. Ray, J. White

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

For more information, contact the Department of Engineering Technology at (317) 278-4405 or email Tiffany Lewallen at tlewalle@iu.edu or visit our Web site at https://et.iupui.edu/departments/ent/

Bachelor of Science in Construction Management

The Construction Management program is a candidate program for accreditation by the American Council for Construction Education (ACCE) https://www.acce-hg.org

The Construction Management 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 Program GPA and the Degree GPA be equal to or greater than 2.000.

Program Educational Objectives in Construction Management

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)

- CMGT 11000 - Introduction to Construction Technology: 3 credit hours
- TECH 10200 - First Year Seminar for Technology Majors:1 credit hour
- Gen Ed Elective - see approved Cultural Understanding course list): 3 credit hours
- COMM-R110 - Fundamentals of Speech Communication: 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)

- CMGT 15000 - Surveying: 3 credit hours
- BUS-A 200 - Foundations of Accounting: 3 credit hours
- CMGT 12000 - Materials and Methods: 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)

- CMGT 25000 - Mechanical & Electrical Systems: 3 credit hours
- TCM 34000 - Correspondence in Bus & Ind: 3 credit hours
- Science Elective - CHEM-C 101 & CHEM-C 121 or GEOL-G 107 & GEOL-G 117: 4 credit hours
- ECON-E 201 - Microeconomics: 3 credit hours
- BUS-L 203 - Commercial Law I: 3 credit hours

Fourth Semester (15 credit hours)

- CMGT 21000 - Quantity Take-Off: 3 credit hours
- CMGT 26000 - Statics: 3 credit hours

- Gen Ed Elective - see approved Arts & Humanities course list: 3 credit hours
- MATH 22100 - Calculus for Technology I: 3 credit hours
- ECON-E 202 - Macroeconomics: 3 credit hours

Junior Year

Fifth Semester (15 credit hours)

- CMGT 31000 - Cost Estimating: 3 credit hours
- CMGT 35000 - Materials Testing: 2 credit hours
- CMGT 36000 - Strength of Materials: 3 credit hours
- PHYS 21800 - General Physics I: 4 credit hours
- BUS-F 300 - Introduction to Financial Management: 3 credit hours

Sixth Semester (16 credit hours)

- CMGT 32000 - Scheduling and Project Control: 3 credit hours
- CMGT 33000 - Administration and Specifications: 3 credit hours
- CMGT 37000 - Temporary Structures in Construction: 3 credit hours
- CMGT 38000 - Infrastructure Planning, Engineering, and Economics: 3 credit hours
- *CMGT 39000 - Construction Experience III: 1 credit hour
- BUS-M 300 - Introduction to Marketing: 3 credit hours

Senior Year

Seventh Semester (15 credit hours)

- CMGT 41000 - Equipment and Field Operations: 3 credit hours
- CMGT 42000 - Safety and Inspection: 3 credit hours
- CMGT 45000 - Structural Systems and Analysis: 3 credit hours
- STAT 30100 - Introduction to Statistical Methods: 3 credit hours
- BUS-P 300 - Introduction to Operations Management: 3 credit hours

Eighth Semester (12 credit hours)

- CMGT 43000 - Jobsite Management: 3 credit hours
- CMGT 44000 - Project Management Capstone: 3 credit hours
- CMGT 46000 - Soils and Foundations: 3 credit hours
- **BUS Elective - Business Elective (refer to the courses below): 3 credit hours

*NOTE: CMGT 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.

**BUS-D 301 - The International Business Environment, BUS-Z 302 Managing and Behavior in Organizations, BUS-Z 340 - Personnel - Human Resources Management.

Computer Engineering Technology

Senior Lecturer: E. Freije (Program Diretor)

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 the Student Program Summary (program 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 22100 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 (15 credit hours)

- CIT 21400 Introduction to Data Management: 3 credit hours
- ECET 28404 Contemporary Communication Systems: 4 credit hours
- TCM 21900 Intro to Technical Presentations: 1 credit hour
- ECET 30903 Advanced Embedded Microcontrollers: 3 credit hours
- PHYS 21800 General Physics: 4 credit hours

Junior Year

Fifth Semester (16 credit hours)

- ECET 38404 Fundamentals of Contemporary Signal Processing: 4 credit hours
- IET 15000 Quantitative Methods for Technology: 3 credit hours
- ECET Elective (see approved course list): 3 credit hours
- ECET 33400 Embedded Cross-Platform 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 Technical Communications 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

Professor: R. Weissbach (Department Chair)**Associate Professor:** D. Goodman (Program Director)
Clinical Associate Professor: W.Lin
Associate Professor: A. Izadian
Senior Lecturer: E. Freije

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 the Student Program Summary (program 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 (15 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: 4 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 28404 Contemporary Communication Systems: 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
- BUS-X 100 Business Administration: Intro: 3 credit hours
- TCM 41500 Technical Communication for Design Projects: 1 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
- TECH Elective (see approved course list): 3 credit hours
- TCM 41600 Advanced Technical Communications for Design: 1 credit hour
- 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 28404. 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 38404 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

Lecturer:P. Pash (Program Director)

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 the Student Program Summary (program 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 hours
- TECH 102 First Year Seminar for Technology Majors: 1 credit hour (recommended but 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 26500 Healthcare Devices and Systems: 3 credit hours
- HETM 29500 HETM Internship: 1 credit hour or OLS 33100 Occupational Safety & Health with OSHA Certificate: 3 credit hours
- 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 the Student Program Summary (program 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. Be employed and well-compensated in a healthcare technology-related field with a strong demand for skills learned in the HETM program.
2. Work in a stable, supportive environment with the opportunity for career advancement and collaboration with other HETM industry professionals.
3. Continue to work with emerging technology and receive continuing education and/or certification in the HETM profession while providing indirect patient care.

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 but 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 26500 Healthcare Devices and Systems: 3 credit hours
- HETM 29500 HETM Internship: 1 credit hour or OLS 33100 Occupational Safety & Health with OSHA Certificate: 3 credit hours
- 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 Technology & 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 HETM: 3 credit hours
- HETM 49200 Capstone Project: 1 credit hour
- Technical Elective: 3 credit hours
- HETM 30100 Medical Device Financial Planning: 3 credit hours
- TCM 38000 Tech Comm in the Healthcare Profession: 3 credit hours

Interior Design Technology

Interior Design TechnologyClinical Associate
Professor: E. McLaughlin (Program Director), D. Nickolson
Senior Lecturer: M.A. Frank
Lecturer: B. Morrow

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
- HER E209 Drawing for Interior Design: 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
- CGT 21100 Raster Imaging for Computer Graphics: 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 2021.

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 Professor: D. Acheson
Clinical Associate Professor: P Yearling (Program Director)
Lecturer: L. Silvian, V. Yasinskiy

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 Tiffany Lewallen, or visit our Web site at: https://et.iupui.edu/departments/ent/programs/met/. Certificate Program Website: https://et.iupui.edu/departments/ent/programs/met/undergrad/certificates/

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 the Program 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 (15 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 hour**s**

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 Capstone Selective (Either MET 41400 or MET 49700): 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

Associate Professor: H. Dalir
Senior Lecturer: C. Finch (Program Director)

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.

Admission into Motorsports Engineering

First-year engineering students who declare a Motorsports Engineering major must apply to the Department of Engineering Technology for formal admission to continue in the Motorsports Engineering program by April 1 of their first year. Acceptance into the Motorsports Engineering program is competitive and is based on academic qualifications, advisor's recommendation, and available space. Program acceptance requires completion of all first year courses and a minimum **program** GPA of 2.500 for continuation in the program as well as an application.

Minimum Grade Requirements

For students admitted to the School of Engineering & Technology with a declared major of Motorsports Engineering, a minimum grade of C is required in all courses with the MSTE prefix.

All minimum grade requirements must be satisfied for a pre- or co-requisite to be successfully completed.

If a student has registered for a course and does not meet the course requisites, the student must drop or withdraw from the course. Enrollment in a class does not entitle a student to remain in the course without meeting MSTE program requirements, course requisites, and minimum grades.

When the term senior standing is used by the MSTE program as a pre-requisite, or in course or degree program information, this refers to senior standing in the degree program.

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 12500 - First Year Seminar: 1 credit hour
- CHEM-C 105 - Principles of 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 (16 credit hours)

- MSTE 31201 - Business of Motorsports: 3 credit hours
- MATH 16600 - Calculus II: 4 credit hours
- PHYS 15200 - General Physics I: 4 credit hours
- MATH 17100 - Multidimensional Math: 3 credit hours
- MSTE 29701 - Modeling for Motorsports: 2 credit hour

Sophomore Year

Third Semester (17 credit hours)

- MATH 26100 - Multivariate Calculus: 4 credit hours
- PHYS 25100 - Heat, Electricity, and Optics: 5 credit hours
- MSTE 29800 - Computer Modeling & Programming: 2 credit hours
- ME 20000 - Thermodynamics: 3 credit hours
- ME 27000 - Basic Mechanics I: 3 credit hour

Fourth Semester (17 credit hours)

- MET 33800 - Manufacturing Processes: 4 credit hours
- ECE 20400 - Electrical & Electronics Circuits: 4 credit hours
- ME 27200 - Strength of Materials: 3 credit hours
- ME 27400 - Basic Mechanics II: 3 credit hours
- MATH 26600 - Ordinary Diff. Equations: 3 credit hours

Junior Year

Fifth Semester (15 credit hours)

- MSTE 47200 - Vehicle Dynamics: 3 credit hours
- MSTE 33001 - Data Acquisition in Motorsports I: 2 credit hours
- ME 31002 - Fundamentals of Fluid Mechanics: 3 credit hours
- ME 32501 - Mechanical Engineering Laboratory III: 1 credit hour
- MSTE 34000 - Dynamic Systems and Signals: 3 credit hours
- MSTE 35000 - Computer Aided Design and Analysis: 3 credit hours

Sixth Semester (15 credit hours)

- MSTE 33100 - Race Engineering: 3 credit hours
- MSTE 32000 - Motorsports Design: 3 credit hours
- MSTE 31700 - Motorsports Practicum II: 1 credit hours
- ME 34400 - Intro to Engineering Materials: 3 credit hours
- TCM 36000 - Comm in Engineering Practice: 2 credit hours
- STAT Elective - STAT Elective: 3 credit hours

Senior Year

Seventh Semester (16 credit hours)

- MSTE 48200 - Motorsports Aerodynamics: 3 credit hours
- ME 48200 - Control Systems Analysis and Des.: 3 credit hours
- Gen Ed Electives - See approved Arts & Humanities course list: 3 credit hours
- Gen Ed Electives - See approved Cultural Understanding course list: 3 credit hours
- Technical Elective - See approved course list: 3 credit hours
- MSTE 41700 - Motorsports Practicum III: 1 credit hour

Eighth Semester (15 credit hours)

- MSTE 41400 - Motorsports Design II: 3 credit hours
- MSTE 42600 - Internal Combustion Engines: 3 credit hours
- Tech Elective - See approved course list: 3 credit hours
- Gen Ed Elective - See approved Social Science course list: 3 credit hours
- PHIL-P 120 - Ethics: 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 12000 Intro to Construction Drafting with BIM (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 Green Belt

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 (16 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
- IET 49900 - Lean Six Sigma Seminar: 1 credit hour

Medical Device Cybersecurity Certificate

Medical Device Cybersecurity Certificate

Indiana University-Purdue University Indianapolis and the Medical Device Innovation, safety, and Security Consortium (MDISS) have partnered to offer a Purdue University Certificate in this specialized area.

The coursework includes 4 courses:

- **CIT 20300** - Information Security Fundamentals - 3 credit hours
  - no pre-requisite knowledge
- **HETM 20200** - Networking and Data Communication for Healthcare Equipment - 3 credit hours
  - Pre-requisite is a fundamental knowledge of electronics. Working professionals easily meet this pre-req as part of their entry-level competencies.
- **HETM 30200** - Interoperability of Healthcare Devices - 3 credit hours
  - Pre-requisite is HETM 20200.
- **HETM 40200** - Healthcare Device system Security - 3 credit hours
  - Pre-requisite is HETM 30200 and the equivalent of HETM 32500, Exploring Medical Devices. Working professionals easily meet this pre-req as part of their entry-level competencies.

Designed for technicians who support the safe and effective use of medical technology, each course will feature approximately 40 hours of content and laboratory work spaced over 15 weeks. All offered online - no campus visits required.

To Apply:

Deadlines: fall semester start: June 1, spring semester start: December 1

Admission requirements: must have completed at least 26 credits from any regionally accredited college or university or be a veteran.

If you are a veteran, please contact the program director for admissions information.

For more information, contact:

Lacretia Githiri, Academic Advisor

lgithiri@iupui.edu

Motorsports Engineering Technology Certificate

Motorsports Engineering Technology 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 29 credit hours and a 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 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 22000** - Heat/Power: 3 credit hours
- **MET 32000** - Applied Thermodynamics: 3 credit hours
- **MSTE 27200** - Intro to Motorsports: 3 credit hours
- **MET 42600** - IC Engines: 3 credit hours
- **MET 47200** - Vehicle Dynamics: 3 credit hours
- A project course with a Motorsports related topic: 3 credit hours

Construction Management Certificate

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 (15 credit hours)

- **CMGT 21000** Quantity Take-Off: 3 credit hours
- **CMGT 32000** Scheduling and Project Control: 3 credit hours
- **CMGT 31000** Cost Estimating: 3 credit hours
- **CMGT 33000** Contract Administration and Specifications: 3 credit hours
- **CMGT 42000** Safety and Inspection: 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 Construction Management bachelor's degree are not eligible for this certificate.

Music & Arts Technology (MAT)

Chair: D. Burns, Professor of Music & Arts Technology

The department offers graduate and undergraduate programs in music technology and music therapy. All degree programs are focused on technological innovation in the arts to improve access to high quality performing arts and understand the influence of the performing arts on health and well-being. We are training dedicated 21st century musicians with a progressive education emphasizing integrtions of science and sound. Our students learn the technical, theoretical, and creative skills required to be successful in today's music professions.

Our department andprograms are accredited by the National Association of Schools of Music (NASM), requiring routine self-evaluation to meet evolving quality standards. Our Bachelor and Master of Science in Music Therapy degrees are also approved by the AmericanMusic Therapy Association (AMTA).

The Department of Music and Arts Technology performance ensembles and private lessons are open to both major and non-major students.

Ensemble groups include the Jazz Combos, University Choir, IUPUI Percussion Ensemble, Guitar Ensemble, Telematic Performing Ensemble, Electro-Acoustic Ensemble (E/A), Electronic Music Ensemble (ExME), and DISEnsemble.

This department awards degrees from Indiana University.

For more information contact: Department of Music and Arts Technology, IUPUI, 535 W. Michigan Street, Indianapolis, IN 46202, (317) 274-4000 or matinfo@iupui.edu.

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:

1. Essentials of Music Technology: Concepts include acoustics, psychoacoustics, analog and digital audio, MIDI, and digital notation.
2. 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.
3. 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.
4. 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.
5. 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.
6. Interface and Instrument Design: The development of new instruments and interfaces using software programming and hardware construction.

Application to the BSMT Program

Students who wish to pursue a Bachelor of Science in Music Technology degree must submit both an IUPUI university online application and a Music and Arts Technology online application. If approved to do so via this application process, prospective students will also be required to take an audition/interview and two short online placement exams.

Admission Requirements

- First, acceptance to IUPUI - Apply Here.

- Second, submission of the Department of Music and Arts Technology application - Apply Here.
- Third, if approved, complete a scheduled audition/ interview session and two short online placement exams (see Audition Information below).

Upcoming audition dates are available from Music and Arts Technology online application.

General Audition Information

The required audition session allows applicants to demonstrate interests, skills, and experiences in 1) music performance and creativity, 2) contemporary music technologies, 3) other arts-related creative, technological, and/or engineering fields, and 4) comprehension of music theory. Applicants are not required to demonstrate in all of these areas, though the audition committee is seeking applicants likely to excel in a degree balancing music technology course work with music theory and performance/creative skills.

A "primary instrument" declared for degree entry is to be used in the audition for a performance/creativity skill demonstration (i.e. a specific instrumental/voice, or "applied music technology" such as laptop/software, midi controllers, etc.). This choice determines a student's path for individual studio instruction throughout the degree. Regardless of primary instrument, applicants are encouraged to bring computer-based demonstrations to illuminate skills and experiences in areas noted above.

Audition requests will be processed only after submitting your application. If an audition is approved and scheduled, you will receive information on how to take two short online placement exams related to the degree program. These online exams must be completed prior to the audition date. Note that 1) your acceptance into IUPUI as a student and 2) the departmental application must both be completed at least three weeks prior to the date of the requested audition.

For detailed departmental audition information click here

For questions, please contact Ms. Julie Wynn, Academic Advisor, Department of Music and Arts Technology 317-278-3264 julwynn@iupui.edu

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 at https://et.iupui.edu/departments/mat/programs/minor/ No audition is required for the minor. Students must also submit an application to graduate for the Music Minor ahering to the deadlines set by the IUPUI Office of the Registrar. More information on how to submit the application to graduate, including deadlines, an be found heres: https://et.iupui.edu/students/graduation/

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 are counted toward the degree
- No grades lower than C are counted toward the degree

Residency Requirements (for on-campus students only)

- Two contiguous academic terms

Core Courses

The following courses form the core of the MSMT program. Students enrolled in the Master of Science in Music Technology program must select courses from this list,

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.
- N517 Internship in Arts Technology or N518 Arts Technology Major Project - 3 cr.
- N523 Historical Foundations of Music Technology - 3 cr.
- N525 Interactive Performance Techniques - 3 cr.

Total Required 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 form the core of the MSMT program. Students enrolled in the Master of Science in Music Technology program must select courses from this list totaling 18 credit hours.

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.
- N517 Internship in Arts Technology or N518 Arts Technology Major Project - 3 cr.
- N523 Historical Foundations of Music Technology - 3 cr.
- N525 Interactive Performance Techniques - 3 cr.

Total Required 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 application
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 electives (at the 500 level or above);
- 9 credit hours of science specialization (including 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

- N521 Research Methods in Arts and Music Technology - 3 cr.
- N530 Philosophy and Theory in Music Therapy - 3 cr.
- N532 Music in Medicine - 3 cr.
- N533 Advanced Clinical Techniques in Music Therapy - 3 cr.
- N600 Music Therapy Thesis - 6-9 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:

B.S. in Music Therapy

Bachelor of Science in Music Therapy

The Bachelor of Science in Music Therapy (BSMTh) is a 4.5 year degree program approved by the American Music Therapy Association. The BSMTh provides students with the musical, technical, and therapeutic skills to practice as entry-level music therapists in a variety of clinical fields. Students engage in traditional academic music studies (music theory, aural skills, and music history), piano, voice, guitar, percussion, improvisation, music technology, psychology, and music therapy specific courses. One hundred twenty (120) hours of course work are required for the BSMTh. The degree culminates in a six-month clinical internship after the completion of approximately eight semesters of course work and on-campus clinical training. Students who successfully complete the BSMTh curriculum, including internship, are eligible to take the Music Therapy Board of Certification Exam and earn the credential, Music Therapist-Board Certified (MT-BC).

The BSMTh program covers the following areas of focus:

- Clinical Musicianship
- Music Therapy Foundations
- Clinical and Counseling Skills
- Clinical Reasoning
- Creativity, Health, and Wellness
- Music Technology in Music Therapy
- Social Justice and Professional Advocacy

Students can expect to work with a wide variety of clients and patients in clinical settings in and around the Indianapolis area.

Application to the BSMTh Program

Students who wish to pursue a Bachelor of Science in Music Therapy degree must submit both an IUPUI university online application and a Music and Arts Technology online application. If approved to do so via this application process, prospective students will also be required to take an audition/interview and two short online placement exams (see Audition Information below). While a prior formal music education is not required to be admitted the program, some previous informal musical experiences (local choirs or bands, acapella groups, orchestra, music tech programming, solo performance, etc.) are required.

Admission Requirements

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

- First, acceptance to IUPUI - Apply Here
- Second, submission of the Department of Music and Arts Technology application - Apply Here
- Third, if approved, complete a scheduled audition/ interview session and two short online placement exams (see audition Information below).

Upcoming audition dates are available from the Music and Arts Technology online application.

General Audition Information

The required audition/interview session allows applicants to demonstrate: 1) an explanation of interest in the discipline of music therapy, 2) performance capabilities on one or more musical instruments, 3) vocal performance capability, 4) creative endeavors related to the arts, and 5) activities related to community service and/or therapeutic care.

A "primary instrument" declared for degree entry is to be used in the audition for a performance/creativity skill demonstration (i.e. a specific instrumental/voice, or "applied music technology" such as laptop/software, midi controllers, etc.). All BSMTh students focus on piano, voice, and guitar in lessons; however, students are encouraged to continue study on additional instruments as they so choose.

Audition requests will be processed only after submitting your application. if an audition is approved and scheduled, you will receive information on how to take two short online placement exams related to the degree program. These online exams must be completed prior to the audition date. note that: 1) your acceptance into IUPUI as a student; and, 2) the departmental application must both be completed at least three weeks prior to the date of the requested audition.

For detailed departmental audition information click here.

For questions, please contact Ms. Julie Wynn, Academic Advisor, Department of Music and Arts Technology 317-278-3264 julwynn@iupui.edu.

Mechanical and Energy Engineering (MEE)

Mechanical and Energy Engineering (MEE)

Professors: J. Chen *(Chair),* M. Agarwal, X. Du, R. Nalim, N. Paydar, J.Xie
Associate Professors: S. Anwar, H. Dalir, H. El-Mounayri, A. Jones, T. Katona, A. Tovar, D. Wagner, H. Yu, J. Zhang, L. Zhu
Assistant Professors: B. Anasori, N. Holguin, C. Larriba, M. Noor-A-Alam, H. Shin, X. Wei, S. Yang

Clinical Associate Professor: A. Razban

Clinical Assistant Professor: H. Piroozi
Lecturers: E. Adams, S. James, J. Mendez, P. Orono

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 https://et.iupui.edu/departments/mee/.

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 and Energy 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: https://et.iupui.edu/departments/mee/programs/een/.

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 12500 First Year Seminar for Engineering Majors (Grade of C- or better required): 1 credit hour
- ENGR 19600 Introduction to Engineering (Grade of C- or better required): 3 credit hours
- MATH 16500 Integrated Calculus and Analytic Geometry (Grade of C- or better required): 4 credit hours
- CHEM-C 105 Principles of Chemistry I (Grade of C- or better required): 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication (Grade of C- or better required): 3 credit hours
- ENG-W 131 Reading, Writing, and Inquiry (Grade of C- or better required): 3 credit hours

Second Semester (16 credit hours)

- ENGR 19700 Introduction to Programming Concepts (Grade of C- or better required): 2 credit hours
- MATH 17100 Multidimensional Mathematics (Grade of C- or better required): 3 credit hours
- MATH 16600 Integrated Calculus and Analytic Geometry II (Grade of C- or better required): 4 credit hours
- PHYS 15200 Mechanics (Grade of C- or better required): 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 (Grade of C-or better required): 4 credit hours
- PHYS 25100 Heat, Electricity, and Optics: 5 credit hours
- EEN 22001 Fundamentals of Energy Materials: 3 credit hours
- ME 20000 Thermodynamics I: (Grade of C- or better required) 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 (Grade of C- or better required): 4 credit hours
- MATH 26600 Ordinary Differential Equations (Grade of C- or better required): 3 credit hours
- EEN 24000 Basic Mechanics: 4 credit hours
- EEN 26000 Sustainable Energy: 3 credit hours
- EEN 26201 Design, Ethics and Entrepreneurship: 2 credit hours
- EEN 25001 Energy Engineering Lab 2: 1 credit hour

Junior Year

Fifth Semester (16 credit hours)

- ME 32700 Engineering Economics: 3 credit hours
- EEN 33001 Modeling and Measurement of Dynamic Systems: 3 credit hours
- Statics Elective: 3 credit hours
- ME 27200 Strength of Materials: 3 credit hours
- EEN 31000 Fluid Mechanics: 3 credit hours
- EEN 32501 Energy Engineering Lab 3: 1 credit hour

Sixth Semester (15 credit hours)

- GEN ED Elective General Education Elective: 3 credit hours
- TECH Elective: 2 credit hours
- ECE 49500 Fundamentals of Electrical Energy Engineering: 3 credit hours
- EEN 35001Energy Engineering Lab 4: 1 credit hours

- ME 31401 Fundamentals of Heat and Mass Transfer: 3 credit hours
- EEN 34500 Renewable Energy Systems and Design: 3 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 (15 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
- EEN Elective: 3 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 12500 First Year Seminar for Engineering Majors (Grade of C- or better required): 1 credit hour
- ENGR 19600 Introduction to Engineering (Grade of C- or better required): 3 credit hours
- CHEM-C 105 Principles of Chemistry I (Grade of C- or better required): 3 credit hours
- COMM-R 110 Fundamentals of Speech Communication (Grade of C- or better required): 3 credit hours
- MATH 16500 Analytic Geometry and Calculus I (Grade of C- or better required): 4 credit hours

Second Semester (16 credit hours)

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

Sophomore Year

Third Semester (17 credit hours)

- ENGR 29700 Computer Tools for Engineering: 1 credit hour
- ME 20000 Thermodynamics I (Grade of C- or better required): 3 credit hours
- ME 27000 Basic Mechanics I (Grade of C- or better required): 3 credit hours
- MATH 26100 Multivariate Calculus (Grade of C- or better required): 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 26201 Design, Ethics and Entrepreneurship (Grade of C- or better required): 2 credit hours
- ME 27400 Basic Mechanics II (Grade of C- or better required): 3 credit hours
- ECE 20400 Introduction to Electrical and Electronic Circuits (Grade of C- or better required): 4 credit hours
- MATH 26600 Ordinary Differential Equations (Grade of C- or better required): 3 credit hours
- ME 25001 Mechanical Engineering Lab 2: 1 credit hour

Junior Year

Fifth Semester (16 credit hours)

- ME 27200 Mechanics of Materials (Grade of C- or better required): 3 credit hours
- ME 33000 Modeling and Analysis of Dynamic Systems (Grade of C- or better required): 3 credit hours

- ME 31002 Fundamentals of Fluid Mechanics (Grade of C- or better required): 3 credit hours
- Statistics Elective (Grade of C- or better required): 3 credit hours
- General Education Elective: 3 credit hours
- ME 32501 Mechanical Engineering Lab 3: 1 credit hour

Sixth Semester (17 credit hours)

- ME 34400 Introduction to Engineering Materials: 3 credit hours
- ME 31401 Fundamentals of Heat and Mass Transfer: 3 credit hours
- ME 37200 Design of Mechanisms (Grade of C- or better required): 3 credit hours
- ME 35001 Mechanical Engineering Lab 4: 1 credit hour
- ME 34001 Dynamic Systems and Measurements: 2 credit hours
- General Education Elective: 3 credit hours
- TCM 36000 Communication in Engineering Practice: 2 credit hours

Senior Year

Seventh Semester (16 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
- 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 40600 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
- GEN ED (Depth) Elective: 3 credit hours

The complete list of approved electives can be found at https://et.iupui.edu/departments/mee/programs/ and the curriculum may be found by clicking: https://et.iupui.edu/departments/mee/programs/me/undergrad/bsme/

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. Each customized plan will include the following:

- At least 32 credit hours of college level mathematics and basic sciences
- At least 48 credit hours of engineering topics
- At least 9 credit hours of general education that compliments the curriculum
- A culminating major design experience

To start in the Interdisciplinary Engineering program please contact an advisor in the Mechanical and Energy Engineering Department.

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 & electric 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 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: https://et.iupui.edu/departments/mee/programs/me/grad/.

Innovative Design with Intellectual Property Certificate

Innovative Design with Intellectual Property Certificate (IP)

This certificate introduces students to intellectual property (IP) requirements for creating novel, non-obvious, and non-infringing designs. It teaches IP concepts through enhanced critical thinking skills and innovation. More specifically, students will be prepared to engage in prior art review, and design with an understanding of what is needed to obtain an enforceable protection and avoid infringement of existing patents and other vehicles of IP protection. Perhaps more importantly, graduates will have new career options including choices for becoming patent engineers (liaisons between engineering departments and corporate managements) and patent agents (everything

a patent attorney can do minus providing options), in addition to the traditional technical career choices but with the enhanced new approach to structured innovation. In order to obtain the certificate, students will be prepared and required to take the patent bar examination a step toward becoming certified to practice patent law before the U.S. Patent and Trademark Office.

The certificate is a 12-credit hour curriculum for students enrolled in a degree seeking program in engineering or science.

Curricular requirements:

- 3-credit design course (e.g., ME 26201+ME 25001, EEN 26201+EEN 25001, ECE 27000, or BME 24101)
- 3-credit introductory design course (Innovative Prod. Design Emphasis Intel. Property)
- 3-credit advanced patent design course (Design for Patentability)
- 3-credit soft IP design course (IP Rights for Engineers)

Technology Leadership & Communication (TLC)

Chair: C. Renguette, Associate Professor of Technical Communication
OL Undergraduate Programs: C. Krull, Lecturer
TCM Undergraduate Programs: J. Stella, Lecturer
TLC Graduate Programs: M. Hovde, Associate Professor of Technical Communication, Chair; B. Sorge, Associate Professor of STEM Education Research, Co-Chair

The Department of Technology Leadership and Communication (TLC) equips today's students with leadership and communication knowledge, skills, and perspectives to augment their technical and professional expertise to contribute to organizational success in a variety of settings. Our degrees and certificates in Organizational Leadership (OL) and Technical Communication (TCM) offer students a well-rounded education that connects theory with practice.

TLC's faculty and staff are committed to student success. Our values as espoused in the TLC Department Strategic Plan 2018-2023 include:

- **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 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.
- **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 TLC, E&T, and IUPUI identity, image, and reputation.
- **Internationalization:** We value the development of intercultural competence, embracing and implementing values and principles associated with social responsibility and cultural competence, and cross-cultural knowledge, skills, and abilities.

Technical Communication

Technical Communication

Associate Professor: C. Renguette (TLC Department Chair)
Associate Professor: M. Hovde (TLC Graduate Programs Co-Chair)
Lecturer: J. Stella (TCM Program Director)

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.

- Foundation Courses: 3-4 credits hours
- Immediate Courses: 3-4 credits hours
- Specialized Courses: 3-4 credit hours
- Electives: 9-10 credits to bring the total to 19

Technical Communication 5-year B.S./M.S. Program

The TCM 5-year B.S./M.S.Program provides academically successful students the opportunity to earn both a Bachelor's and Master's degree in five years. Students with a 3.2 overall GPA may apply to the accelerated BS/MS in their junior year. Students will complete the first three years of undergraduate degree requirements (about 90 credit hours), take both undergraduate and graduate courses in the fourth year (about 30 additional credit hours), and finish the master's degree graduate courses in the fifth year of study (at least 141 credit hours). Students must maintain a 3.0 or higher GPA in all graduate courses. The timeline for completion is based on full-time enrollment (15 or more credit hours per semester). However, part-time students are eligible to apply. Students will receive the bachelor's degree prior to completing the graduate degree requirement.

To apply for the combined degree program, interested students should submit the online TCM 4+1 application in the spring term of their junior year. Full admission to the M.S. program is contingent upon successful completion of TCM B.S. program and meeting minimum grade and GPA requirements.

Organizational Leadership

Organizational Leadership

Professors: C. Feldhaus, S. Hundley
Associate Professor: B. Sorge (STEM Education)
Clinical Professor: P. Fox
Assistant Professors: K. Reed Hughes, K. Rose
Lecturers: C. Krull (OL Program Director), C. Rownd, E. Wager
Assistant to the Chair: D. Lampert

Organizational Leadership (OL) 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, OL offers an accelerated BS/MS degree, certificates in Human Resource Management, International Leadership, Leadership Studies, Sustainable Technologies, and the Honors Minor in Leadership. All OL programs are available fully online. The Certificate in Leadership Studies offers non-majors an opportunity to better understand leadership in today's complex organizations.

All OL programs are flexible to meet the needs of both traditional and nontraditional students. As part of a relevant and practical field of study, OL 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.

Organizational Leadership Program Learning Outcomes

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

- Implement strategies for personal, professional, and organizational success.
- Illustrate ways human behaviors influence organizational culture and success.
- Differentiate responsibilities of supervisors, managers and leaders.
- Identify how ethical issues influence organizational activities and decisions.
- Distinguish ways diverse workplace contexts affect organizational behavior and leadership.
- Apply project management techniques to the completion of organizational initiatives.
- Employ best practices for human resource management in organizations.
- Apply quality, project, and change management principles for continuous improvement.
- Interpret how leadership theories, styles, and processes impact organizations.
- Apply techniques for effective communication in a variety of workplace contexts.
- Design research studies to identify a problem, define a research purpose, create a research question or hypothesis, collect, analyze and interpret that data, and arrive at reasoned conclusions to influence organizational decision making.

Bachelor of Science: Organizational Leadership

Organizational Leadership requires a total of 120 credit hours of department approved coursework. Students will complete the required IUPUI General Education Core, 46.0 credit hours of OLS-specific courses including the 25.0 credit hours OLS Core Curriculum (10000, 25200, 26300, 27400, 32700, 37100,38300, 38500, 39000, 48700, and a senior capstone course); and an additional 15.0 credit hours or more of OL Pathway electives; a minimum of 24.0 credits of non-OLS coursework in an approved minor, certificate, applied technology, or career-focused area of study; TECH 10200 or a similar learning seminar, TCM 25000 or similar career planning course; 3.0 credit hours of business, technical, or professional writing; TCM 32000; and 18.0 credits of other approved electives.

Transfer Students

Where applicable, OL 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. To be considered for use towards OL B.S. course requirements, all transfer credit requires a minimum grade of C or higher.

Organizational Leadership 5-year B.S./M.S. Program

The OL 5-year B.S./M.S. Program provides academically successful students the opportunity to earn both a Bachelor's and Master's degree in five years. Students

with a 3.2 overall GPA may apply to the accelerated BS/MS in their junior year. Students will complete the first three years of undergraduate degree requirements (about 90 credit hours), take both undergraduate and graduate courses in the fourth year (about 30 additional credit hours), and finish the master's degree graduate courses in the fifth year of study (at least 141 credit hours). Students must maintain a 3.0 or higher GPA in all graduate courses. The timeline for completion is based on full-time enrollment (15 or more credit hours per semester); however, part-time students are eligible to apply. Students may apply for the bachelor's degree prior to completing the graduate degree requirements.

To apply for the combined degree program, interested students should submit the online OL 4+1 application in the spring term of their junior year. Full admission to the M.S. program is contingent upon successful completion of OL B.S. program and meeting minimum grade and GPA requirements.

Human Resource Management Certificate

The Certificate in Human Resource Management requires 18 credit hours. Students will complete 9 credits of specific OLS courses and 9 credits of elective courses. This certificate provides a thorough explanation of the human resource professional's role in helping individuals, work groups, and organizations succeed. This Program is open to students in any undergraduate student admitted to IUPUI. Courses are available fully online or on campus.

Required Courses: complete 9 credits with a grade of C- or higher

- OLS 38300 Human Resource Management - 3 credit hours
- OLS 36800 Employment Law - 3 credit hours
- OLS 47900 Staffing Organizations - 3 credit hours

Selective Courses: complete 9 credits with a grade of C- or higher

- OLS 33100 Occupational Safety and Health - 3 credit hours
- OLS 34400 Employee Benefits - 2 credit hours
- OLS 34800 HR Analytics - 1 credit hour
- OLS 37500 Training Methods - 3 credit hours
- OLS 37800 Labor Relations - 3 credit hours
- OLS 40800 Employee Relations - 1 credit hour
- OLS 47600 Compensation Planning and Management - 3 credit hours

Leadership Studies Certificate

The Certificate in Leadership Studies requires 18 credit hours. This certificate equips students with the knowledge, skills, experience, attitudes, perspectives, and tools necessary to understand the broad-based concepts associated with leadership in a variety of individual, organizational, and community settings in an ever changing, pluralistic, global society. To view all requirements, visit the Leadership Studies Certificate website.

Honors Minor in Leadership

The Honors Minor in Leadership requires 15 credit hours. This minor is open to high-potential IUPUI undergraduates with a cumulative GPA of 3.2 or higher admitted to the IUPUI Honors College or other campus honors programs. Students admitted to the Honors Minor must take a sequence of interdisciplinary courses to explore diverse leadership principles and practices. Student must declare intent to pursue the certificate through the Department of Technology Leadership and Communication. To learn more, visit the Honors Minor in Leadership website.

International Leadership Certificate

Undergraduate students who successfully complete all requirements for completion of the International Leadership Certificate program through Organizational Leadership will:

1. Develop awareness of personal experiences and other cultural contexts that shaped their own world view, biases, behaviors, and attitudes.
2. Demonstrate understanding of intercultural perspectives, values, communication styles, beliefs, practices, and how these differences influence organizational and work contexts.
3. Analyze complex intercultural or global organizational problems by applying theories, historical perspectives, facts, and examples from more than one area of study to develop appropriate solutions or recommendations.
4. Evaluate personal growth across diverse and immersive learning experiences with culturally different others within and outside of the program requirements.
5. Evaluate personal growth across diverse and immersive learning experiences with culturally different others within the outside of the program requirements.

Certificate Requirements:

Students will complete 12 credit hours of core classes with a grade of C or higher grade in each class. This certificate requires an immersive international experience (study abroad, international internship, or other department-approved intercultural learning course).

To learn more, visit the International Leadership Certificate website.

For more information about OL undergraduate programs, call (317)278-1313 or email TLCgroup@iupui.edu.

Intergroup Dialogue Certificate

The Certificate in Intergroup Dialogue (IGD) is the first undergraduate interdisciplinary certificate, serving IUPUI's strategic plan initiative to promote an inclusive campus culture. The certificate is a collaborative effort between:

- IU School of Liberal Arts
- IU School of Public and Environmental Affairs
- IU School of Social Work
- Purdue School of Engineering and Technology
- IUPUI Office of Intercultural Literacy, Capacity, and Engagement

By earning the IGD certificate, you will learn about intercultural communication, conflict resolution, civil discourse, and leadership.

The curriculum includes courses in the following areas:

- General Education (3 credit hours): The course is dialogue-intensive and incorporates the four-stage IGD teaching model.
- Leadership Development and Communication Skills (3 credit hours): The course is designed to train you to facilitate dialogues for other students.
- Social Identity and Diversity (3 credit hours): The course provides additional context in social identity and diversity issues relevant to your chosen field.
- Capstone (3 credits hours): The course is a 400-level course that guides you to facilitate dialogues in subsequent general education "dialogue-intensive" courses for your peers.

Note: At least one class must be taken through the school from which you wish to receive the certificate.

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.

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. The Sustainable Technologies Certificate courses are fully online. To learn more visit the Department of Technology Leadership and Communication website.

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:

- OLS 20000 - 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
- OLS 30200 - 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.

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 Cybersecurity and Trusted Systems (M.S.C.T.S.), 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.).

The School also offers independent Ph.D. degrees in Biomedical Engineering, Electrical and Computer Engineering or Mechanical Engineering, a Purdue University degree and in Music Technology or Music Therapy, Indiana University degrees. Students are usually expected to complete the M.S.B.M.E., M.S.E.C.E., M.S. or M.S.M.E. before pursuing the Ph.D. 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.

In addition to full degrees, the Purdue School of Engineering & Technology also offers a variety of graduate-level certificates that can be earned as a stand-alone credit or that can be applied to the requirements of a variety of graduate degrees. For more information about these certificates, see https://bulletins.iu.edu/iupui./2021-2022/schools/purdue-enginer-tech/graduate/certificates/index.shtml.

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.

Several graduate programs are also offered completely online. Those graduate programs are: M.S. in Music Technology, M.S. in Music Therapy, Ph.D. in Music Therapy, M.S. in Facilities Management, M.S. in Technology with concentrations in Organizational Leadership, and Technical Communication.

For more information, call (317) 278-4961, send e-mail to etinfo@iupui.edu, or visit the Web site: https://et.iupui.edu/prospective/graduate/.

Admissions

Admissions
For information and details regarding application and admission to graduate engineering or technology programs offered by the School go to this website: https://et.iupui.edu/prospective/graduate/admissions/

BIOMEDICAL ENGINEERING DEPARTMENT

Master's Admissions Information: https://et.iupui.edu/departments/bme/programs/grad/msbme/

5-Year BS Neuroscience/MS BME Admissions Information: https://et.iupui.edu/departments/bme/programs/grad/5yr_neuro/

MD/MS Admissions Information: https://et.iupui.edu/departments/bme/programs/grad/md-msbme/

Ph.D. Admissions Information: https://et.iupui.edu/departments/bme/programs/grad/phdbme/

COMPUTER INFORMATION & GRAPHICS TECHNOLOGY Department Master's Admissions Information:**https://et.iupui.edu/departments/cigt/programs/cit/grad/**

MS in Cybersecurity & Trusted Systems admission information:https://et.iupui.edu/departments/cigt/programs/cit/grad/cybersecurity/

ELECTRICAL & COMPUTER ENGINEERING Department Master's Admissions Information:
https://et.iupui.edu/departments/ece/programs/grad/msece/applications

ECE Department Ph.D. admissions information:
https://et.iupui.edu/departments/ece/programs/grad/phdece/applications

ENGINEERING TECHNOLOGY Department Master's Admissions Information:**https://et.iupui.edu/departments/ent/graduate**

MECHANICAL & ENERGY ENGINEERING Department Master's Admission Information:https://et.iupui.edu/departments/mee/programs/me/grad/msme/

MEE 5Year BS/MS inMechanical admission information:https://et.iupui.edu/departments/mee/programs/me/undergrad/5yearbsms/

MEE Graduate Certificates admission information:https://et.iupui.edu/departments/mee/programs/me/grad/certificates/

MEE Department Ph.D. admission information:https://et.iupui.edu/departments/mee/programs/me/grad/phde/

Music and Arts Technology Department M.S. in Music Technology admission information:https://et.iupui.edu/departments/mat/programs/mt/grad/msmt/

Music and Arts Technology Department Ph.D. in Music Technology admission information:https://et.iupui.edu/departments/mat/programs/mt/grad/phdmt/

Music and Arts Technology Department M.S. in Music Therapy admission information:https://et.iupui.edu/departments/mat/programs/mth/grad/msmth/

Music and Arts Technology Department Ph.D. in Music Thrapy admission information:

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
- Master of Science in Engineering with a Major in Motorsports Engineering
- Master of Science and Master of Science in Engineering
- Ph.D. in Biomedical Engineering
- Ph.D. in Electrical & Computer Engineering
- Ph.D. in Mechanical Engineering
- Computer-Aided Mechanical Engineering Certificate
- Digital Signal Processing Certificate
- Engineering Design Innovation Certificate
- Energy Management & Assessment Certificate
- Hybrid Electric Vehicle Technology Certificate
- Power & Energy Processing Certificate
- Systems Engineering Certificate

Technology
- Master of Science in Cybersecurity & Trusted Systems
- Master of Science in Facilities Management
- Master of Science in Technology
- Master of Science in Music Technology*
- Master of Science in Music Therapy*
- Ph.D. in Music Technology*
- Ph.D. in Music Therapy*
- Engineering Leadership Certificate
- Human Resources Development Certificate (HRD)
- Project Management Certificate

*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.

Biomedical Engineering

Ph.D. in Biomedical Engineering

Upon completion of the Ph.D. degree in Biomedical Engineering at IUPUI, students will be able to:

1. Demonstrate an in-depth knowledge of general fundamental engineering concepts in areas such as biomechanics, biomaterials, and bioinstrumentation.
2. Demonstrate mastery of at least one sub-discipline of biomedical engineering.
3. Integrate sub-disciplines of biomedical engineering into an applied area of life or sciences in which they can apply their problem solving skills and integrate into their research.
4. Search, read, and synthesize peer-reviewed literature, and apply acquired knowledge in the selected field of study.
5. Present and communicate results to peers through international conference, posters, seminars, and/or journal publications.
6. Develop skills to design solid methodologies, algorithms/techniques/systems, and experiments to solve general problems with real data.
7. Think critically and creatively to invent new methodologies and systems.
8. Propose original research and conduct this research independently.
9. Communicate and defend scholarly works.

Digital Signal Processing Certificate

Digital Signal Processing Certificate

Graduates of the Digital Signal Processing Certificate 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.

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.
3. Communicate (in speech, writing, and appropriate supporting visuals) information related to the theory and practice of mechanical engineering in research or industrial settings.

Master of Science in Engineering for Motorsports Engineering

Master of Science in Engineering in Motorsports Engineering

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

1. Assess the quality and relevance of publsihed 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 motorsports engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) the results and implications of motorsports engineering research.

Upon completion of the Master's degree in Engineering (non-thesis) with a major in Motorsports 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 motorsports engineering.
2. Demonstrate knowledge of motorsports engineering principles that advance the broad spectrum of application areas that is motorsports engineering.
3. Communicate (in speech, writing, and appropriate supporting visuals) information releated to the theory and practice of motorsports engineering in research or industrial settings.

Music Technology

Music Technology

The M.S. in Music Technology focuses on the development of professional competencies and integration of research findings into the development and use of music technology with specialties in 1) recording, manipulation, and live sound; 2) the creative production of electronic music and live electronics; and 3) music technology in education and pedagogy. Learning outcomes for the M.S. in Music Technology comes from the essential and specialized competencies identified by the National Association for Schools of Music standards and guidelines for music technology programs.

M.S. in Music Technology

Essential Competencies for Music Technology (NASM IV.G.2.a.1-11, revised for graduate learning):

- Organize and differentiate the scope, integrative nature, and various functions of music technology as a field, including various applications of music technology in music, technological development, research, pedagogy, and in other fields.
- Apply, analyze, and critique various terminologies and procedures in music, and technology, and their combinations as employed in and associated with the work of music technology. This includes, but is not limited to, their respective vocabularies of practice, ways work is conceptualized, developed, synthesized, and finalized, and phases of production, presentation, and/or distribution.
- Determine the appropriate scientific methods to test and solve music technology problems, including (a) problem identification, information gathering, solution development, and testing, and (b) knowledge and skill to produce evidence-based decisions about what is useful, usable, effective, and desirable during the course of music technology project development and production.
- Anticipate the needs or expectations of users, audiences, and/or contexts associated with supervising professional work in music technology.
- Advanced capabilities in specific areas of musicianship consistent with the music technology areas that constitute the degree program's focus. Aural skills are essential. Abilities to apply advanced knowledge of the properties of musical structures and processes to solving music technology problems are essential.
- Advanced knowledge of current technologies and technological principles widely applicable to music technology, including but not limited to those associated with recording, manipulating, and presenting music and sound, signal flow and processing, music communication protocols, synthesis and interface technologies, sound synthesis, and interactive and generative media.
- Develop industry standard technologies at a professional level to achieve goals and objectives associated with specific areas of music technology. These goals may be in terms such as mastery of production techniques, artistic expression, integration in other fields, relationships with other technologies and media, etc.
- Integrate knowledge of science, engineering, and math concepts and other aspects of the science of sounds and the electrical manipulations of sounds to generate new music technology methods and models.
- Possess an evaluative understanding of the connections among music, technology, music technology, and culture, including the evolution of music technology, the impact of technology on music and culture, technological influences on multiple musical styles, including contemporary styles, and their cultural contexts, and information and means for projecting future possibilities in music technology; and basic understanding of these connections with regard to current and emerging Internet- and network-based program, services, and environments related to the creation, sharing, and distribution of music.
- In depth understanding of and adherence to the principles, laws, regulations, and ethical considerations and practices associated with music technology and intellectual property as it is both acquired and created by individuals.
- Comprehensive capabilities to use and integrate the above competencies in at least one area of music technology to produce professional-level work in at least one area, and basic level work in a second area.

Recording, Manipulation, and Live Sound (NASM IV.G.b.1)

- Appraise and utilize industry-standard recording and other types of music technology studios and equipment.
- Exhibit expertise in the use of music, digital, and other technological interfaces.
- Demonstrate high levels of aural and music analysis skills.
- Integrate scientific knowledge of acoustics and electronics.
- Integrate advanced capabilities in audio recording and sound manipulation.
- Teach and assess capabilities in audio engineering, studio sound, and live performance sound.

Creative Production of Electronic Music and Live ElectronicsC (NASM IV.G.b.2)

- Engage in using and creating with technologies, protocols, and techniques associated with analog and digital instruments and various forms of synthesis; interfaces; programming language(s); interactive and generative media; and networks of digital and other instruments.

- Supervise the development and production of real-time and recorded performances using digital and emerging technologies.
- Differentiate and select various keyboard-based and/or non-keyboard-based controllers and user interfaces based on compositional and performance needs.
- Formulate and defend an understanding of compositional principles, logics, narrative structures, and strategies.

Music Technology in Education and Pedagogy (NASM IV.G.b.4)

- Conceive and develop specific technologically based products associated with instruction and evaluation.
- Create interactive applications for educational purposes.
- Integrate understanding of the elements, natures, and content of musical instruction in areas such as aural perception, music theory, music history, music teacher preparation, composition, and improvisation, and their relationships to the capabilities of current and emerging technology.

Music Therapy

M.S. in Music Therapy

The learning outcomes and competencies for the M.S. in Music Therapy are derived from the National Association for Schools of Music standards and guidelines and the advanced competencies outlined by the American Music Therapy Association (AMTA).

Upon program completion, students will be able to:

Music Therapy Theory (NASM XIV.F.1.a.1 and AMTA Competencies I.1.A)

- Differentiate and apply music therapy theories of clinical practice, supervision, education, and corresponding implications for research.
- Use current theoretical, clinical and research literature from music therapy and related fields to identify emerging models and to predict/propose future models and trends for music therapy.
- Articulate and defend a personal philosophy, approach, and/or theory to music therapy.

Advanced Competencies in Clinical Practice (NASM XIV.F.1.a.2 and AMTA advanced competencies .I.B.2.0 and .4.0)

- Apply and evaluate the music therapy evidence base in clinical practice.
- Develop essential skills and techniques needed for effective, support clinical supervision.
- Create and assess theoretically grounded music therapy clinical interventions across clinical areas and theoretical orientations.

Research Competencies AMTA Advanced Competencies 1.A (NASM XIV.F.1.b.1 and AMTA Advanced Competencies I.D)

- Identify gaps in the clinical and research evidence to develop meaningful research hypotheses or research questions.
- Synthesize the music therapy and related literature to create a conceptual framework explaining the relationship between a music-based intervention and relevant outcomes.
- Create a research proposal matching questions/ hypotheses, conceptual framework, and corresponding research design and analytic plan.
- Conduct research according to ethical principles for protection of human participants.

Mechanical Engineering

Ph.D. Mechanical Engineering

Upon completion of the Ph.D. in Mechanical Engineering at IUPUI, students will be able to:

1. PhD students will have a deep understanding in the area of research of the student's thesis.
2. PhD students will be able to think critically and creatively.
3. PhD students will be able to identify and conduct original research and scholarship.
4. PhD students will be able to document research outcomes comprehensively for publication.
5. PhD students will effectively communicate their field of study.
6. PhD students will conduct research in an ethical and responsible manner.

Electrical & Computer Engineering

Ph.D. in Electrical & Computer Engineering

Graduates of the Ph.D. 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.

Power and Energy Processing Certificate

Power and Energy Processing Certificate

Graduates of the Power and Energy Processing Certificate 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.

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.

ECE and MEE

Hybrid Electric Vehicle Technology Certificate
Graduates of the Hybrid Electric Vehicle Technology Certificate 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.

Graduates of the Hybrid Electric Vehicle Technology Certificate program in MEE will have the ability to:

1. Identify EV/HEV/PHEV powertrain system components.
2. Analyze EV/HEV/PHEV powertrain system.
3. Optimally design EV/HEV/PHEV powertrain system.
4. Model EV/HEV/PHEV powertrain system to evaluate vehicle performance.

Energy Management and Assessment Certificate

Energy Management and Assessment Certificate
Upon completion of the Energy Management and Assessment Certificate program in Mechanical and Energy Engineering at IUPUI, students will be able to:

1. Understand the energy assessment of industrial equipment and processes and how to improve energy efficiency.
2. Understand the fundamentals of energy management principals.
3. Familiar with major energy assessment audit tools.
4. Have hands on experience on energy assessment.

System Engineering Certificate

Systems Engineering Certificate

Upon completion of the Systems Engineering Certificate in Mechanical and Energy Engineering at IUPUI, students will be able to:

1. Analyze systems engineering problems to achieve optimized solutions.
2. Understand and apply best practices for the uses of modeling in the lifecycle of a system and its architecture.
3. Apply systems engineering methods in the graduate's area of specialization.
4. Effectively communicate with customers and stakeholders.
5. Work effectively within and across multifunctional teams and disciplines.

Music Technology

Ph.D. in Music Technology

Educational Outcomes for the Ph.D. in Music Technology from the Department of Music and Arts Technology. School of Engineering and Technology.

The requisite competencies outcomes are measured by the following:

1. Final grades in required coursework (B or better), through work assignments comprised of written papers, software constructs, research reviews, technology projects, and public presentation.
2. Candidacy requirements fulfilled.
3. Completion of Dissertation or equivalent set of papers.
4. Public presentation of research via appropriate conferences such as International Computer Music Association, Audio Engineering Society, New Interfaces for Music Expression, and College Music Society.
5. Publication of peer-review articles, book chapters, and essays in genre-appropriate journals.
6. Awarding of grants and project commissions at the appropriate professional level.
7. External and University awards and honors for academic excellence, service and contribution.
8. Post-graduation employment positions in the educational and professional music technology field.

Technology

Human Resource Development (HRD)
Upon program completion, students will be able to:

1. Synthesize the history of and historical influences of HRD.
2. Analyze and evaluate leader-follower relationships in organizations.
3. Design appropriate approaches to employee development and training.
4. Analyze the role of change management and leadership in organizations.
5. Synthesize HRD related professional competencies, roles, and practices in real world analysis and application.
6. Apply HRD principles within modern organizational contexts, used within managerial/supervisory/ leadership positions.

7. Analyze how key facets of HRD professional roles are practiced in a variety of sectors and industries including engineering and technology.
8. Implement personal and professional ethics for management.
9. Analyze reasons, including ethical and moral leadership in the change process, that organizational change may be unsuccessful.
10. Communicate effectively with various stakeholders regarding research-to-practice in HRD including training and development, organizational development, workforce development, leadership development, career development, and coaching and mentoring.

Technology

Project Management

Upon program completion, students will be able to:

1. Carry out project activities with integrity, care, and trustworthiness while maintaining compliance with internal and external guidelines.
2. Demonstrate commitment to financial, social, and environmental impacts of projects.
3. Create a collaborative project team environment.
4. Communicate effectively with project stakeholders.
5. Recognize, evaluate, and respond to system interactions.
6. Lead projects to support individual and team needs.
7. Tailor project work to specific contexts.
8. Build quality into processes and deliverables.
9. Evaluate and navigate complexity in managing projects.
10. Optimize risk responses.
11. Build adaptability and resiliency into the organization's and project team's approaches to help the project accommodate change, recover from setbacks, and advance the work of the project.
12. Enable change to achieve and envisioned future state.
13. Evaluate and adjust project alignment to business objectives and intended benefits and value.

Technology

Certificate in Engineering Leadership

Upon program completion, students will be able to:

1. Analyze and synthesize theories of and approaches to organizational change.
2. Analyze the role of change management and leadership in a variety of organizations.
3. Demonstrate leadership in recruiting, retaining, rewarding, and developing current and future workforces.
4. Apply project management approaches in individual and team-based settings.
5. Apply project life-cycle approaches.
6. Apply principles of effective professional technical communication in industrial, technological, and business settings.
7. Research, select, and present complex technical concepts to various audiences.
8. Research, analyze, synthesize, and communicate concepts of intellectual property (IP) including copyright, trademark, and patents.
9. Apply IP concepts in engineering design choices.
10. Conduct research in patent databases.
11. Apply principles of technology commercialization from an intellectual property perspective when preparing patent application.

Cybersecurity and Trusted Systems

Cybersecurity and Trusted Systems

Upon program completion, students will be able to:

1. Implement cybersecurity principles and policies.
2. Implement security and privacy-protection methods, including algorithm development and program them in a variety of languages and platforms (Python, Java, C/C++).
3. Integrate the information assurance analysis process to domain-specific settings. This process requires reviewing the domain-specific constraints and cybersecurity characteristics to develop an efficient information assurance implementation with the necessary security specirfications.Apply advanced analysis techniques/topics to information assurance, such topics include applied data analytics, as well as cloud computing, visualization, and computer systems.
4. Design, develop, and test solutions to specific cybersecurity problems.

Computer-Aided Mechanical Engineering Certificate

Computer-Aided Mechanical Engineering Certificate

Upon completion of the Computer-Aided Mechanical Engineering Certificate, students will be able to:

1. Understand the theoretical foundations of engineering modeling.
2. Be able to create engineering models for various mechanical components.
3. Analyze the models to evaluate performance.

Engineering Design Innovation Certificate

Engineering Design Innovation Certificate

Upon completion of the Engineering Design Innovation Certificate program in Mechanical and Energy Engineering at IUPUI, students will be able to:

1. To gain skills to innovatively solve complex engineering problems via studio based practices.
2. To apply creative design methodologies to develop innovative engineering products.

Music Therapy

Ph.D. in Music Therapy

Educational Outcomes for the Ph.D. in Music Therapy from the Department of Music and Arts Technology. School of Engineering and Technology.

At the completion of the degree, Ph.D. students will be able to:

1. Synthesize and apply comprehensive knowledge of relevant theories for music therapy research and practice.

2. Create a cogent research program investigating the role of music and/or music therapy in education and health.
3. Implement a multi-faceted, culturally competent clinical supervision practice.
4. Apply professional competencies in degree and curriculum development.
5. Elucidate a clear and compelling philosophy of music therapy research and education.

Master of Science and Master of Science in Engineering for Motorsports Engineering

Master of Science and Master of Science in Engineering
Upon completion of the M.S. and M.S.E. at IUPUI, students will be able to:

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

Facilities Management

Facilities Management
Upon program completion, students will be able to:

1. Understand the FM history, practice and profession.
2. Plan, manage and lead projects.
3. Manage building systems, facility operations, occupant services and maintenance operation.
4. Apply assessment, management and leadership principles of facility organizations and their stakeholders.
5. Apply financial management tools to the Facility program and organization.
6. Apply human factor principles to the facility operation and stakeholders.
7. Create effective written and oral communications.

Contact Information

E&T Graduate Programs Office
799 West Michigan Street, ET 215
Indianapolis, IN 46202-5160
Phone: 317.278-4961
gradengr@iupui.edu or gradtech@iupui.edu

Dept. of Biomedical Engineering
723 West Michigan Street, SL 220
Indianapolis, IN 46202-5132
Phone: 317.278-2415
https://et.iupui.edu/departments/bme/

Dept. of Computer Information and Graphics Technology 799 West Michigan Street, ET 301
Indianapolis, IN 46202-5160
Phone: 317.274.9705

Dept. of Electrical and Computer Engineering
723 West Michigan Street, SL 160
Indianapolis, IN 46202-5160
Phone: (317) 278-9726

ecegrad@iupui.edu
https://et.iupui.edu/departments/ece/

Dept. of Engineering Technology
799 West Michigan Street, ET 201
Indianapolis, IN 46202-5160
Phone: 317.278.4405

Dept. of Mechanical and Energy Engineering
723 West Michigan Street, SL 260
Indianapolis, IN 46202-5132
Phone: 317.274.9717

Dept. of Music and Arts Technology
535 West Michigan Street, IT 352
Indianapolis, IN 46202
Phone: 317.274.4000

Dept. of Technology Leadership and Communication
799 West Michigan Street, ET 331
Indianapolis, IN 46202-5160
Phone: 317.278.1311

Degree Programs

Degree Programs

- Master of Science in Biomedical Engineering (M.S.B.M.E.)
- Master of Science in Cybersecurity and Trusted Systems (M.S.C.T.S.)
- Master of Science in Electrical and Computer Engineering (M.S.E.C.E.)
- Master of Science in Engineering in Motorsports Engineering (M.S.E.)
- Master of Science in Facilities Management (M.S.)
- 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.)
- Master of Science and Master of Science Engineering (IDE)
- *Doctor of Philosophy in Biomedical Engineering (Ph.D.B.M.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.)
- Doctor of Philosophy in Music Therapy (Ph.D.)

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.

M.S.B.M.E.: Students interested in the Master's degree in BME may apply directly to the Department of Biomedical Engineering in the Purdue School of Engineering and Technology. Qualified research-oriented student may plan

to pursue a thesis-based Master's degree. Form more information, please visit: https://et.iupui.edu/departments/bme/programs/grad/msbme/

Ph.D.B.M.E.: Students interested in the Ph.D. degree inBME may also apply directly to the Department of Biomedical Engineering in the Purdue School of Engineering and Technology at IUPUI. For more information, please visit: https://et.iupui.edu/departments/bme/programs/grad/phdbme/

B.S./M.S.B.M.E.: The department also offers an accelerated combined Bachelor's and Master's degree programs which allows academically successful students the opportunity to earn both B.S. and M.S. degrees in a total of five years. For more information about the 5-year B.S./M.S.B.M.E., combined degree program, visit: https://et.iupui.edu/departments/bme/programs/undergrad/5yearBsMs/.

B.S. Neuroscience/M.S.B.M.E.: Similarly, the department offers an accelerated master's degree program to allow academically successful students in the B.S. Neuroscience program to earn a M.S.B.M.E. degree in one year following the B.S. Neuroscience degree. For more information about the 5-year B.S. Neuroscience/M.S.B.M.E. program visit: https://et.iupui.edu/departments/bme/programs/grad/5yr_neuro/

M.D./M.S.B.M.E.: The BME department, together with the Indiana University School of Medicine (IUSM) offer a combined degree program on the IUPUI campus that integrates a Master's degree in BME with the Doctor of Medicine degree program. For more information about this program visit: https://et.iupui.edu/departments/bme/programs/grad/md-msbme/.

Contact for Biomedical Engineering: bmegrad@iupui.edu

For more information about the M.S.B.M.E program visit: https://et.iupui.edu/departments/bme/programs/grad/msbme/

For more information about the Ph.D.B.M.E. program visit: https://et.iupui.edu/departments/bme/programs/grad/phdbme/

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, robotics, energy engineering, renewable energy, mechatronics, 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.

The ECE department also offers an accelerated combined bachelor's and master's degree programs, which enables students to complete both B.S. and M.S. degrees within 5 years. For more information for the BS/MS program: https://et.iupui.edu/departments/ece/programs/5yearbsms/

The M.S. and M.S.E. degree programs are designed for students who desire broad flexibility and the opportunity for interdisciplinary Study.

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

- Graduate Certificate in Digital Signal Processing
- Graduate Certificate in Hybrid Electric Vehicle Technology
- Graduate Certificate in Power and Energy Processing

For more information on these graduate certificate: https://et.iupui.edu/departments/ece/programs/grad/

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: https://et.iupui.edu/departments/ece/programs/grad/msece/

For more information about the ECE Ph.D. program visit: https://et.iupui.edu/departments/ece/programs/grad/phdece/

Graduate Programs in Mechanical Engineering

The Department of Mechanical and Energy Engineering has an outstanding engineering faculty with research interests and expertise in the areas of advanced computer-aided design and manufacturing, materials, energy nanotechnology, biomechanics, composites, computational fluid dynamics, 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 department also offers two accelerated and 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 combined B.S. and M.S. degrees in M.E. (B.S./M.S.M.E.); energy engineering undergraduates leading to a combined B.S. degree in Energy Engineering and M.S. degree in M.E.; or physics undergraduates leading to combined B.S. degree in Physics and M.S. degree in Mechanical Engineering (B.P.M.M.E.). The combined degrees prepare students for advanced engineering careers with two degrees (bachelor's and master's) in five years.

The M.S. and M.S.E. degree programs are designed for students who desire broad flexibility and the opportunity for interdisciplinary study.

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 degree programs in mechanical engineering and graduate certificates are provided at this website:

https://et.iupui.edu/departments/mee/programs/me/undergrad/5yearbsms/

Graduate Program in Motorsports Engineering The M.S. Degree in Engineering (M.S.E.) - Motorsports Engineering Major is applicable for either students seeking additional motorsport industry training immediately after completion of their bachelor's degree in an engineering program or for industry professionals wishing to resume their studies to complete a master's degree. The Motorsports Major provides an integrated experience in motorsports with emphasis on race engineering. Students pursuing the Motorsports Major may choose from a course only (non-thesis) option or thesis option requiring a research thesis in an area related to the motorsports industry. Both options require 30 credit hours. The non-thesis program requires a minimum of 30 credit hours of course work, and the thesis program requires a minimum of 21 credit hours of course work in addition to an acceptable research thesis (9 credit).

The program also offers an accelerated combined bachelor's and master's degree programs, which enable students to complete both B.S. and M.S.E. degrees within five years. The combined degree programs are available to high achieving motorsports engineering undergraduates leading to a combined B.S. and M.S.E. degrees in motorsports.

The Motorsports Engineering Program has an outstanding engineering faculty with research interests and expertise in the areas of advanced aerodynamics, vehicle dynamics, materials, composites, vehicle simulations, computational fluid dynamics, computer-aided design, finite element analysis, solid and structural mechanics, and stress analysis.

Additional information about graduate and combined programs in motorsports engineering are provided at this website: https://et.iupui.edu/departments/ent/programs/mste/msemste/

Graduate Program in Facilities Management The Master of Science in Facilities Management (M.S.) is designed for working professionals. The curriculum, based on International Facility Management Association's (IFMA) core competencies, was developed to provide students with a strong foundational knowledge in the areas of; facilities planning and management: facilities engineering systems: management of IT, telecommunications of video infrastructure: energy management for buildings: facilities contract management: financial aspects of facilities management: quality and productivity in industry: project management; and facilities maintenance and operation: culminating in an independent directed project experience. Additional coursework includes one elective in an area of interest including healthcare facilities management and emergency preparedness for facilities personnel.

The M.S. in Facilities Management is designed to develop skills in three critical areas: 1. facilities management, 2. applied facility science, and 3. business principles and management. Students are required to complete 33 credit hours (11 courses) which includes a directed project. The program can be completed in 2 calendar years following the prescribed plan of study. Students can take a reduced semester course load extending the time to completion but are still required to show continuous enrollment and progress and complete the degree within 5 years.

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 pedagogy. The program, offered online or on campus, is conferred by Indiana University and accredited by the National Association for Schools of Music.

https://et.iupui.edu/departments/mat/programs/mt/grad/msmt/

The **Doctor of Philosophy in Music Technology** 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 graduates 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.

https://et.iupui.edu/departments/mat/programs/mt/grad/phdmt

Graduate Programs in Music Therapy
The **Master of Science in Music Therapy (M.S.M.Th.)** program is 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.

https://et.iupui.edu/departments/mat/programs/mth/grad/msmth/

The **Doctor of Philosophy in Music Therapy** is a research-oriented degree. The degree is designed to prepare board-certified music therapists for independent academic/research careers enabling them to explore the bast ways music influences health and well-being. The principal objectives of this doctoral program are to train music therapists who will conduct research examining current music therapy practice and pedagogy; explore opportunities to optimize music therapy practice and pedagory; and apply new understanding to clinical practice and education the overarching goals and learning outcomes of the PhD in Music Therapy are guided by the American Music Therapy Association advanced professional competencies. The program is available on campus and online.

A total of 90 credit hours is required for the degree, of which up to 30 credit hours may be transferred from a student's post-baccalaureate degree of study, as approved by the graduate advisory committee.

The 90 credit hours for the Ph.D. are distributed among the following 6 content areas:

- Advanced music therapy competencies - 18 credit hours
- Other Studies in Music - 9 credit hours
- Declared minor area - 12 credit hours
- Life Sciences - 6 credit hours
- Electives - 12 credit hours
- Research Credits/Dissertation - 33 credit hours

https://et.iupui.edu/departments/mat/programs/mth/grad/phd/

Master of Science in Cybersecurity and Trusted Systems The objective of this program is to prepare students to enter the workforce in the rapidly advancing field of cybersecurity and to address the security challenges and risks that industry encounters daily. The M.S. in Cybersecurity and Trusted Systems provides the student the opportunity to develop foundational knowledge and the necessary cybersecurity skill set to prepare for engineering/information technology careers.

The M.S. in Cybersecurity and Trusted Systems program is designed so that graduates holding a B.S. 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.

Successful graduates of the program earn a Master of Science (M.S.) in Cybersecurity and Trusted Systems awarded by Purdue University.

The curriculum consists of a total of 30 credit hours as follows:

- Primary Cybersecurity Courses (9 credit hours)
- Foundational Cybersecurity Courses (9 credit hours)
- Elective Cybersecurity Courses (6 credit hours)
- Elective Courses (6 credit hours)

For more information visit our website at https://et.iupui.edu/departments/cigt/programs/cit/grad/cybersecurity/ or contact Computer and Information Technology at (317) 274-9705 or vial email: cit@iupui.edu.

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

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

Certificate in Engineering Leadership

Earning the Certificate in Engineering Leadership (CEL) at IUPUI will provide students with strong preparation in engineering leadership knowledge and skills. This Purdue certificate will supplement an already-earned bachelor's degree from a variety of science, technology, engineering, and mathematics (STEM).

https://etiupui.edu/departments/tlc/programs/ols/grad/cert-eng-leader

Graduate Certificate in Human Resource Development

Earning the Human Resource Development (HRD) Graduate Certificate will provide students with strong preparation in the foundations of HRD, including related skill development. This certificate will supplement an already-earned bachelor's degree from a variety of disciplines and can be earned by itself or in conjunction with another graduate degree.

https://et.iupui.edu/departments/tlc/programs/ols/grad/cert-hrd

Graduate Certificate in Project Management

Earning the Project Management (PM) Certificate at IUPUI will provide you with strong preparation in the foundations of project management knowledge and skills. This certificate will supplement an already-earned bachelor's degree from a variety of disciplines and can be earned by itself or in conjunction with another graduate degree.

https://et.iupui.edu/deppartments/tlc/programs/ols/grad/cert-pm-grad

For more information about the Technology graduate programs visit: https://et.iupui.edu/departments/mstech/

Master of Science and Master of Science in Engineering

Digital Signal Processing Certificate

This is a 12-credit hour (4 courses) Graduate Certificate in Digital Signal Processing trains engineers to become in trained in Digital Signal Processing (DSP) techniques and methodologies that have been widely employed in many application areas, ranging from consumer electronics to space exploration to medicine. With the advances in microelectronics and high-speed microprocessors/ microcontrollers/DSP processors. Many complex DSP algorithms for solving real-world application problems can be implemented in real-time in a cost-effective manner. Examples are high-performance telecommunication and networking, video/audio/data communications, control of complex systems, medical imaging, etc. This certificate program is designed to help practicing engineers become knowledgeable about the area of digital signal processing. The certificate the student earns serves as evidence that they have achieved a significant level of expertise in digital signal processing.

The certificate requires selection of at least two courses in the required area and the remaining two courses in the elective area.

Required Courses:

- ECE 53800: Digital Signal Processing I
- ECE 60000: Random Variables and Signals

Electives (choose two courses):

- ECE 53600: Introduction to computational Intelligence
- ECE 53700: Multimedia Applications
- ECE 54400: Digital Communications
- ECE 55900: MOS VLSI Design
- ECE 58000: Optimization Methods for Systems and Control
- ECE 59500: Topics - Multimedia and Mobile Computing
- ECE 59500: Topics - Advanced Digital Signal Processors
- ECE 60200: Lumped System Theory
- ECE 60800: Computational Models and Methods
- ECE 62600: Adaptive Signal Processing
- ECE 62900: Introduction to Neural Networks
- ECE 63700: Digital Image Processing I
- ECE 64500: Estimation Theory
- ECE 64800: Digital Signal Processing II
- MA 51100: Linear Algebra with Applications

(Note either ECE 60200 or ECE 60800 can be applied to the certificate, but not both)

Form more information regarding course requirements, application process, and certificate completion requirements, contact ecegrad@iupui.edu.

Hybrid Electric Vehicle Technology Certificate

This is a 12-credit hours (4 courses), Graduate ECE Certificate in Hybrid Electric Vehicle Technology. Development of the next generation of fuel-efficient and environmentally-responsible advanced electric drive vehicles is one of the nation's top priorities. The State of Indiana plays a major role in the design, development, and manufacturing of these types of vehicles, such as electric vehicle (EV), hybrid electric vehicle (HEV) or plugin hybrid electric vehicles (PHEV), or their components. This is a very technically intensive and competitive field that requires multidisciplinary approaches. Expertise in the HEV technology will greatly needed to meet the demands in the hybrid vehicle sector of the automotive industry.

This certificate program is designed to address industry's increased needs for engineers having expertise in EV/ HEV/PHEV. It will prepare today's engineers to be competitive in taking on the new challenges facing the industry so that the companies in automotive sector can compete globally.

The certificate requires selection of at least two courses in the primary area and the remaining two courses in the related area.

Primary courses:

- ME 50105: Hybrid and Electric Transportation
- ECE 59500: Advanced Hybrid and Electric Vehicle Systems and Control

HEVTC Program:

- ME 59700: Dynamics and Simulation of Hybrid-electric vehicles
- ME 59700: Energy Storage Devices and Systems
- ME 50104: Powertrain Integration
- ECE 61000: Energy Conversion (required for students in ECE)

Related Courses:

- ME 50400: Automotive Control
- ME 59700: Renewable Energy and Fuel Cells
- ECE 59500: Automotive Control (dual listed with ME 50400, cannot be taken with ME 50400)
- ECE 59500 Introduction to Smart Grid Theory and Implementation
- ECE 58000: Optimization Methods for Systems and Control

For more information regarding course requirements, application process, and certificate completion requirements, please contact us: ecegrad@iupui.edu.

Power and Energy Processing Certificate

This is a 12-credit hour (4 courses) Graduate Certificate in Power and Energy Processing. This certificate program addresses the power industry increased needs for engineers with power and energy processing expertise. It will prepare engineers to the challenges faced by the power industry with a multidisciplinary approach. It will also expose students for state-of-the-art academic topics

for those who are interested in advanced degrees such as Masters and PhD.

The certificate is a Purdue School of Engineering and Technology certificate, only offered at IUPUI. Upon completion of all requirements, the certificate will be reflected on the transcript.

This certificate program addresses industry's increased needs for engineers with power and energy expertise. It will prepare engineers to face the challenges of the power and electronics industry.

The specific learning outcomes, skills, and competencies students will learn after completing the certificate program are the ability to describe, model, control and simulate the main elements of the current and future electrical power grid, which includes but not limited to: magnetic energy conversion devices, power electronics, and energy storage devices.

At least three courses from the major list of classes and at most one course from minor list of classes as described below:

Major courses:

- ECE 42700: Power Electronics
- ECE 52702: Advanced Power Electronics Converters
- ECE 53200: Computational Methods for Power System Analysis
- ECE 51501: Smart Grid
- ECE 61000: Energy Conversion

Minor courses:

- ME 50104: Powertrain Integration
- ME 57500: Theory and Design of Control Systems
- ME 59700: Energy Storage Devices and Systems
- ECE 60200: Lumped System Theory

For more information regarding course requirements, application process, and certificate completion requirement, please contact ecegrad@iupui.edu.

Certificates

In addition to graduate degree programs, the Department of Electrical and Computer Engineering also offers graduate certificate programs in the following areas:

- Graduate Certificate in Digital Signal Processing
- Graduate Certificate in Hybrid Electric Vehicle Technology
- Graduate Certificate in Power and Energy Processing

In addition to graduate degree programs, the Department Mechanical and Energy Engineering 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 Engineering Design Innovation
- Graduate Certificate in Hybrid Electric Vehicle Technology
- Graduate Certificate in Systems Engineering

In addition to graduate degree programs, the Department of Technology, Leadership and Communication also offers graduate certificate programs in the following areas:

- Graduate Certificate in Engineering Leadership
- Graduate Certificate in Human Resource Development
- Graduate Certificate in Project Management

Computer-Aided Mechanical Engineering Certificate

This is a 12-credit hour (4 course) Graduate Certificate in Computer-Aided Mechanical Engineering. This graduate certificate program in computer-aided mechanical engineering is designed specifically to train engineers to become professionally certified in the computer-aided mechanical engineering field without formally pursuing a graduate degree. It will provide a set of integrated courses on the fundamentals of finite element analysis and CAD/CAM and enable students completing the certificate program to understand the theoretical foundations of modeling and analysis of various mechanical components and to conduct performance analysis.

The program's emphasis will be on fundamentals of analysis and design, which will be supplemented by learning commercially available computer codes such as ProEngineer, Ansys, StarCD,Patran, andAbaqus.

GPA requirements:

- Successful completion of the certificate requires at least a B average over all courses counting toward the certificate.
- Minimum grade acceptable is C. Courses with a grade of C- or less must be retaken to count toward the certificate.
- All requirements for the certificate must be completed within three years of admission.

There are two specialty areas. You may select one of the two following specialties:

- Computations of Mechanical Systems
- Computations of Fluid and Thermal Systems

Required courses:

There are two required and two elective courses for each specialty area.

- ME 55100: Finite Element Analysis
- ME 54600: CAD/CAM: Theory and Applications

Computations of Mechanical Systems specialty courses (choose 2):

- ME 55000: Advanced Stress Analysis
- ME 55200: Advanced Applications of the Finite Element Method
- ME 56100: Optimum Design: Theory and Practice
- ME 56300: Mechanical Vibrations
- ME 56900: Mechanical Behavior of Materials
- ME 55800: Composite Materials
- ME 59700: Advanced Mechanical Engineering ProjectsI

Computations of Fluid and Thermal Systems specialty courses (choose 2):

- ME 50500: Intermediate Heat Transfer
- ME 50900: Intermediate Fluid Mechanics
- ME 52500: Combustion
- ME 55200: Advanced Applications of the Finite Element Method
- ME 58100: Numerical Heat Transfer and Fluid Flow
- ME 59700: Advanced Mechanical Engineering Projects I
- ME 61400: Computational Fluid Dynamics

For more information regarding course requirements, application process, and certificate completion requirements, please go to this website: https://et.iupui.edu/departments/mee/programs/me/grad/certificates/

Energy Management and Assessment Certificate

This is a 12-credit hour (4 courses) Graduate Certificate in Energy Management and assessment. This certificate program is designed to address industry's increased needs for engineers who have expertise in energy management and efficiency. It will prepare today's engineers to be competitive in taking on the new challenges of energy efficiency facing industry. The purpose of this new graduate-certificate program in mechanical engineering is to enable engineers to become certified in energy assessment without formally pursuing a graduate degree.

GPA requirements:

- Successful completion of the certificate requires at least a B average over all courses counting toward the certificate.
- Courses with a grade of C-or less must be taken again to count toward the certificate. The minimum grade that will be accepted in any single course is C. For transfer credits, only the courses taken that result in a grade of B or better may be transferred for this certificate program.

Required courses:

- ME 50101: Industrial Energy Assessment: Tools and Applications
- ME 50102: Energy Assessment of Industrial Processes
- ME 50103: Energy Management Principles
- ME 59700: Assessment Projects

This certificate is a Purdue University certificate that would appear on a student's transcript upon completion.

For more information regarding course requirements, application process, and certificate completion requirements, please go to this website: https://et.iupui.edu/departments/mee/programs/me/grad/certificates/

Systems Engineering Certificate

This is a 12-credit hour (4 courses) Graduate Certificate in Systems Engineering. This certificate program is designed to address industry's increased needs for engineers who have expertise in Systems Engineering. It will prepare today's engineers to be competitive in taking on the new challenges facing the industry so that our companies can compete globally.

GPA requirements:

- Successful completion of the certificate requires at least a B average over all courses counting toward the certificate
- Courses with a grade of C- or less must be taken again to count toward the certificate. The minimum grade that will be accepted in any single course is C. For transfer credits, only the courses taken that result in a grade of B or better may be transferred for this certificate program.

This certificate requires selection of at least two courses in the required area and the remaining two courses in the elective area.

Required courses:

- ME 59700: Introduction to Systems Engineering Principles
- ME 59700: Systems and Specialty Engineering

Electives (choose two courses):

- ME 57500: Theory and Design of Control Systems
- ME 58100: Numerical Methods in Mechanical Engineering
- ME 59700: Advanced Mechanical Engineering Projects I
- ME 59700: Design Optimization Methods
- ECE 51500: Software Engineering Methodology
- ECE 53600: Introduction to Computational Intelligence
- ECE 56500: Computer Architecture
- ECE 58000: Optimization Methods for Systems and Control
- ECE 60200: Lumped System Theory
- ECE 68000: Modern Automatic Control
- STAT 51100: Statistical Methods I
- STAT 51200: Applied Regression Analysis
- STAT 51400: Designs of Experiments

This certificate is a Purdue University certificate that would appear on a student's transcript upon completion.

For more information regarding course requirements, application process, and certificate completion requirements, please go to this website: https://et.iupui.edu/departments/mee/programs/me/grad/certificates/.

Hybrid Electric Vehicle Technology Certificate

This is a 12-credit hours (4 courses), Graduate ECE Certificate in Hybrid Electric Vehicle Technology. Development of the next generation of fuel-efficient and environmentally-responsible advanced electric drive

vehicles is one of the nation's top priorities. The State of Indiana plays a major role in the design, development, and manufacturing of these types of vehicles, such as electric vehicle (EV), hybrid electric vehicle (HEV) or plugin hybrid electric vehicles (PHEV), or their components. This is a very technically intensive and competitive field that requires multidisciplinary approaches. Expertise in the HEV technology will greatly needed to meet the demands in the hybrid vehicle sector of the automotive industry.

This certificate program is designed to address industry's increased needs for engineers having expertise in EV/HEV/PHEV. It will prepare today's engineers to be competitive in taking on the new challenges facing the industry so that the companies in automotive sector can compete globally.

The certificate requires selection of at least two courses in the primary area and the remaining two courses in the related area.

Primary courses:

- ME 50105: Hybrid and Electric Transportation
- ECE 59500: Advanced Hybrid and Electric Vehicle Systems and Control

HEVTC Program:

- ME 59700: Dynamics and Simulation of Hybrid-electric vehicles
- ME 59700: Energy Storage Devices and Systems
- ME 50104: Powertrain Integration
- ECE 61000: Energy Conversion (required for students in ECE)

Related Courses:

- ME 50400: Automotive Control
- ME 59700: Renewable Energy and Fuel Cells
- ECE 59500: Automotive Control (dual listed with ME 50400, cannot be taken with ME 50400)
- ECE 59500 Introduction to Smart Grid Theory and Implementation
- ECE 58000: Optimization Methods for Systems and Control

For more information regarding course requirements, application process, and certificate completion requirements, please go to this website: https://et.iupui.edu/departments/mee/programs/me/grad/certificates.

Certificate in Engineering Leadership

Earning the Certificate in Engineering Leadership (CEL) at IUPUI will provide students with strong preparation in engineering leadership knowledge and skills. This Purdue certificate will supplement an already-earned bachelor's degree from a variety of science, technology, engineering, and mathematics (STEM) fields and can be earned by itself or in conjunction with another relevant graduate degree.

The CEL Certificate curriculum includes four required graduate courses and one elective graduate course for 15 credit hours in this post-baccalaureate credential.

- OLS 58200 - Leadership & Organizational Change.
- OLS 57100 - Advanced Project Management in Technology.
- TCM 51000 - Effective workplace Technical Communication.
- ME 55401 - Design for Intellectual Property Protection and Commercialization.
- Advisor-approved Elective

For more information, please go to: https://et.iupui.edu/departments/tlc/programs/ols/grad/cert-eng-leader

Certificate in Human Resource Development

Earning the Human Resource Development (HRD) Graduate Certificate will provide students with strong preparation in the foundations of HRD, including related skill development. This certificate will supplement an already-earned bachelor's degree from a variety of disciplines and can be earned by itself or in conjunction with another graduate degree.

The HRD Certificate curriculum includes three required graduate courses and one elective graduate course for 12 credit hours.

- OLS 51500 - Foundations of Human Resource Development.
- OLS 57400 - Managerial Training and Development.
- OLS 58200 - Leadership and Organizational Change.
- Advisor-approved Elective

For more information, please go to: https://et.iupui.edu/departments/tlc/programs/ols/grad/cert-hrd

Project Management Certificate

Earning the Project Management (PM) Certificate at IUPUI will provide students with strong preparation in the foundations of project management knowledge and relevant skills. This certificate will supplement an already-earned bachelor's degree from a variety of disciplines or in conjunction with another graduate degree.

The PM Certificate curriculum includes four required graduate courses and one advisor approved elective graduate course for 15 credit hours for this post-baccalaureate credential.

- OLS 57100 - Advanced Project Management in Technology or INFO-B 505 Informatics Project Management.
- OLS 57200 - Integration of Project Management for Leaders.
- OLS 58200 - Leadership and Organizational Change or SPEA-V 513 Managing Change and Organizational Development.
- TCM 51000 - Effective Workplace Technical Communication or TCM 54000 Managing Document Quality.
- Advisor-approved Elective

For more information, please go to: https://et.iupui.edu/departments/tlc/programs/ols/grad/cert-pm-grad

Engineering Design Innovation Certificate

This certificate program is designed to address industry's increased needs for engineers who can develop new and innovative technologies. It will prepare today's engineers to be competitive in taking on the new challenges.

The purpose of this graduate-certificate program in mechanical engineering is to enable engineers to become more innovative in the design of engineering systems without formally pursuing a graduate degree. The certificate will provide a core set of courses on origami based design, optimal mechatronics system design, and environmental pollution control. The projects assigned in these courses are based on new ideas which will be solved during the semester using studio based methodology. Students completing this certificate will be able to contribute the knowledge gained to serve the respective companies more effectively

Total requirements: 12 credit hours.

To earn a certificate, the students admitted to this certificate program are required to complete twelve credit hours of graduate courses. There are courses in the primary and related areas. The certificate requires selection of at least two courses in the primary area (6 credit hours) and the rest in related area.

Primary Area Courses:

- ME 58901: Optimal Design of Mechatronic Systems: Robots and interactive Structures
- ME 57301: Air Pollution and Emission Control
- ME 59700: Design of Complex and Origami Structures
- ME 60601: Optimal Design of Complex Mechanical Systems

Related Area Courses:

- ME 57201: Analysis and Design of Robotic Manipulators
- ME 50601: Design Optimization Methods
- ME 52601: Integrated Nanosystems Processes and Devices
- ME 54600: CAD/CAM Theory and Application

This certificate is a Purdue University certificate that would appear on a student's transcript upon completion.

For more information regarding course requirements, application process, and certificate completion requirements, please go to this website: https://et.iupui.edu/departments/mee/programs/me/grad/certificates/cert-edi

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 2, Lab 2.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 to 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 2, 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 infrastructure. Autodesk Revit will be the software presented.

ART 15500 Residential Construction (3 cr.) P: ART 11700 and ART 12000 Class 2, Lab 2. Wood frame construction through a semester project requiring planning, preliminary, and working drawings. Outside lab assignments are required.

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 2 Lab 2. 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 2. 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.) P: By Permission. A variety of courses may be offered to support student interest in architectural or design topics, or to support independent study options as needed.

ART 32300 3D Architectural Modeling II (3 cr.) P: ART 22200 and ART 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 35503 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 Architech Technology (3 cr.) P: By Permission. A variety of courses may be offered to support student interest in architectural or design topics, or to support independent study options as needed.

Artificial Intelligence

AIE 10000 Introduction to Artificial Intelligence (3 cr.) Class 3. This course presents current real-world applications of AI with multiple case studies. Students learn the history of AI and how its coming pervasiveness could impact the future. Topics include heuristic search, machine learning, automated decision making, and interaction with the physical world. Programming-based assignments enable students to learn AI techniques.

AIE 20000 Introductory Data Science (3 cr.) P: CSCI 23000 or CSCI 24000 or ECE 29500 or (ECE 26100 and ECE 26300) or consent of instructor; minimum grade of C- required in prerequisite course. This course will provide an introduction to data science and the R software language. Topics include data manipulation, analysis, modeling and visualization. Relevant concepts in statistics, mathematics and computer science will be covered within the course. Students will gain experience analyzing real-world datasets from science, government and industry.

AIE 30000 Introductory to Artificial Intelligence-Human Computer Focus (3 cr.) Course in Development. Class 3

AIE 40000 Recent Trends in AI (3 cr.) Course in Development. Class 3

AIE 40000 Recent Trends in AI (3 cr.) Course in Development. Class 3

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 22201 Introductory Biomeasurements (3 cr.) P: ENGR 29700, PHYS 25100. C: BME 22400, MATH 26600. The foundations of basic circuit theory are introduced including voltage-current characteristics of resistive and reactive elements. Ohm's and Kirchhoff's Laws, equivalent sources, transformations and superposition, transient response, instantaneous and average power, AC impedance, dynamic response of first and second order systems.

BME 22400 Biomeasurements Lab (1 cr.) P: ENGR 29700, PHYS 25100. C: BME 22201, MATH 26600. Laboratory exercises will reinforce the foundations of basic circuit theory. Electronic instruments are used in the context of biomedical signal measurement and processing and include the use of oscilloscopes, function generators, transducers, electrodes, biopotential amplifiers and digital data collection and analysis. Laboratory exercises utilize industrially relevant instruments for measurement and acquisition of time varying signals arising from electronic and bioelectric sources.

BME 24100 Fundamentals of Biomechanics (4 cr.) P: PHYS 15200. This course combines didactic lecture and laboratory and will introduce the student to the principles of biomechanics in the context of the musculoskeletal system. Topics include: fundamental concepts of mechanics, force systems and couples (including muscle and joint forces), free body diagrams, stress analysis and failure of materials (including analysis of bone strength), mechanical behavior of soft tissues, dynamics of particles and rigid bodies (including analysis of gait), and impluse (including analysis of injury).

BME 24101 Introductory Biomechanics (3 cr.) P: PHYS 15200. This course uses didactic lecture material to introduce students to the principles of mechanics and how these concepts apply to musculoskeletal tissues.

BME 24300 Biomechanics Lab (1 cr.) P: PHYS 15200. C: BME 24101. This course uses laboratory experiments to introduce students to the principles of mechanics and how these concepts apply to musculoskeletal tissues.

BME 29500 Selected Topics in Biomedical Engineering (1-4 cr.) P: PHYS 15200. C: BME 24101. Specialized topic areas for which there are no specific courses, workshops, or individual study plans, but having sufficient student interest to justify the formalized teaching of a course.

BME 30200 Professional Development & Design in BME (2 cr.) P: Junior level standing in BME. This course explores design, career, and professional topics in Biomedical Engineering. To prepare students for capstone and engineering practice, students will engage in case study design encompassing conceptualization, requirements generation and system design. Essential design elements such as user need, ideation, constraints, regulatory, and documentation will be reviewed and applied. Additional career and professional topics include resume writing, interviewing, and professional conduct; post-graduate education and lifelong learning; and industrial, clinical, and research opportunities in Biomedical Engineering.

BME 32200 Probability and Statistics 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 22201 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 of MATLAB.

BME 35200 Cell & Tissue Mechanics (3 cr.) P: BME 24101, CHEM-C 106. C: BIOL-K 324. This course will explore 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 Cell & Tissue Lab (1 cr.) C: BME 35200. This course develops quantitative biomechanical methods to analyze cell/tissue behavior and properties to solve biomechanical engineering problems. Topics include: bioviscoelasticity, failure, filament dynamics, membrane dynamics, biofluid dynamics, cellular dynamics, and tissue dynamics.

BME 38100 Implantable Materials and Biological Response (3 cr.) P: BME 24101 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 Implantable Materials Lab (1 cr.) C: BME 38100. Supplements 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 38800 Applied Biomaterials (3 cr.) P: CHEM-C 106. This course covers foundational knowledge in the fields of materials science and engineering. Emphasis is placed on the materials that used in biomedical applications and the relationship between material properties and the performance of these biomaterials.

BME 39500 Selected Topics in Biomedical Engineering (1-4 cr.) Specialized topic areas for which there are no specific courses, workshops, or individual study plans, but having sufficient student interest to justify the formalized teaching of a course.

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 applies systems theory and explores feedforward and feedback control in the context of physiological systems. Control, frequency response, and linear systems concepts are applied to action potential generation, motor control, heart rate regulation, and other physiological processes.

BME 41101 Quantitative Physiology in BME (4 cr.) P: BME 33100 with a grade of C- or higher. 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. Control, frequency response, and linear systems concepts are applied to action potential generation, motor control, heart rate regulation, and other physiological processes. Approximately a third of the course will be devoted to physiological systems, as 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.) C: BME 35200. 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 engineering principles in mass and other transport processes in biological systems. Topics covered include diffusion, convection, reaction

kinetics, transport in porous and fluid mediums, etc. Mathematical models of transport are developed and applied to biomedical problems and physiological systems such as the kidney/renal and oxygen/arterial systems.

BME 49100 Biomedical Engineering Design I (3 cr.) P: Senior level 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 49101 Biomedical Engineering Design (2 cr.) P: Senior level standing in program. 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: BME 49101. This course continues the design experience from BME 49101 with verification, validation, and re-design of student projects. Regulatory and ethical design constraints will be discussed.

BME 49500 Selected Topics in Biomedical Engineering (1-4 cr.) Specialized topic areas for which there are no specific courses, workshops, or individual study plans, but having sufficient student interest to justify the formalized teaching of a course.

BME 49600 Biomedical Engineering Design Projects (1-3 cr.) P: Permission of Department. Individual research projects to be approved by the supervising faculty member before registering for the course. An approved written report is required.

BME 49700 Directed Readings - Biomedical Engineering (1-3 cr.) P: Permission of department. Individualized reading course supervised by an appropriate faculty. Approval for each reading course must be obtained from the department prior to registration.

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 52600 Cardiac Electrophysiology (3 cr.) P: Permission of instructor. This course will introduce the basic principles of cardiac-generated bioelectricity as measured at cellular, extra cellular and body surfaces. The generation, detection and classification of abnormal cardiac rhythms will be emphasized Clinical and engineering principles of relevant electro-therapies will also be studied including cardiac pacemakers, defibrillators and ablation therapies involving cardiac mapping and a variety of ablative energy sources. Modern signal processing methods as applied to electrocardiography will also be presented.

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.g. 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 decidedly analytical and engineering viewpoint. Students should have successfully completed courses in elementary analog electronic circuits and ordinary differential equations, and should be prepared to solve related homework problems using any available software programming tools (e.g. Matlab, Maple, Visual C, Visual Basic, etc.) Basic knowledge of biological sciences is required as the course is best suited for participants who have completed a first year undergraduate course in Chemistry and/or Biology. To be successful in this course students should have successfully completed courses in engineering, physics, elementary analog electronic circuits, ordinary differential equations, and should be prepared to solve related homework problems using any available software

programming tools (e.g. Matlab, Maple, Visual C, Visual Basic, etc.) Students must have had at least a first year undergraduate course in Chemistry and/or Biology.
Considerable independent responsibility must be maintained to ensure a timely completion of all laboratory projects and examinations.

BME 54400 Musculoskeletal Biology and Mechanics (3 cr.) P: Permission of instructor required.
This course will cover topics relevant to skeletal tissues (bone, tendon, ligament, cartilage and meniscus, muscle) including 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.
Students will gain a working understanding of tissue biology and physiology and mechanical principles governing tissue formation, maintenance, adaptation and failure.

BME 54500 Orthopaedic Tissue Mechanics (3 cr.) P: Permission of instructor. Orthopaedic tissues, such as bone, cartilage, tendon, and ligament, serve functions that are largely mechanical in nature and that are critical for our health. This course is structured around classical topics in mechanics of materials and their applications in biomechanics and musculoskeletal tissues.

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 the 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 discovery, development, clinical trials, 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 students (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 69500 Advanced 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 an advanced 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.

BME 69900 Research PhD Thesis (1-9 cr.) P: Permission of instructor required. Research Ph.D. Thesis.

Candidate

CAND 99100 Candidate (0 cr.)

Computer and Information Technology

CIT 10600 Using a Personal Computer (3 cr.) 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.) 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 15000 Introduction to Cybersecurity (3 cr.) This course will Demystify Cybersecurity. In this experiential course, students will be immersed in a real-world cyber environment to solve cybersecurity problems using science and art. Contemporary issues and experience how the scientific process unfolds to make such contributions. In particular, students will study cybersecurity topics through capture the flag games,

minimal lectures, and student collaborations. Students will learn to deal with cyber threats through a variety of collaborative, experiential activities including passwork hacking, malware, mobile, and networked devices.
The course will introduce students to the variety of cybersecurity careers available in business, healthcare, non-profit, and government. This course is open to all students no matter what their background.

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 28404. 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: 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: CIT 21400 and (CIT 14000 or CIT 21500). 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: or C: CIT 21200 and CIT 21400. This course will provide students with the knowledge and techniques of introductory web programming.

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: (CIT 14000 or CIT 21500) and P: or C: CIT 21400. 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 21500, or CIT 24200, or CIT 27000) and (MATH 15400 or MATH 15900). 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 30900 Cybersecurity and Network Programming (3 cr.) P: CIT 14000, CIT 20300, and CIT 20700. This course teaches students skills necessary to develop programs and scripts to solve cybersecurity and networking problems such as automating manual tasks, parsing data, and data analysis. Students gain hands-on experience, combining the theory and practice of relevant tools, techniques, and programming technologies used in daily real-world cybersecurity and networking profession.

CIT 31200 Advanced Web Site Design (3 cr.) P: CIT 21200 and P: or C: CIT 21500. 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. 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 31400 NoSQL Database Design (3 cr.) P: CIT 21400 and (CIT 24200 or CIT 27000). This course will cover the design and implementation of NoSQL database. Students will manage database structures; understand basic NoSQL data-management concepts; create and manipulate NoSQL database objects using scripts; model logical data requirements using entity-oriented techniques; transform a logical data model into a database structure.

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 34700 Advanced ASP.Net Programming (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 and (MATH 15400 or MATH 15900). 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. 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. 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 and (MATH 15400 or MATH 15900). 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 40400 Offensive Security (3 cr.) P: CIT 29900 and CIT 40600. This course teaches students the skills necessary to perform offensive security and understand vulnerabilities within systems. Students gain hands-on experience, combining the theory and practice of relevant tools, and techniques used in the day to day real-world cybersecurity and networking profession.

CIT 40600 Advanced Network Security (3 cr.) P: CIT 20300 and (MATH 15400 or MATH 15900). 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 40700 Fundamentals of Intelligent Agents (3 cr.) P: CIT 21300, CIT 21400, and CIT 300-level Programming Language. This course covers the concepts, applications, and theories of operations of Intelligent Agent Technology. An Intelligent Agent is a software program that uses communication protocols to exchange information for automatic problem solving. Students will perform an in-depth analysis of an Intelligent Agent for a specific application and construct a prototype of it.

CIT 41100 Native iOS 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 Data-Driven Cloud Applications (3 cr.) P: Any CIT 200 level programming language, CIT 21300, CIT 21400 and P or C: CIT 32000. This course will introduce students to a number of concepts related to the development and deployment of structured datasets and data-driven applications using a variety of computing services. Projects will include (but are not limited to) consumption of available data into an application, the transfer of large datasets to an appropriate cloud service, development of an interface to allow thirdparty access to datasets, and the creation of one or more software applications that meet user needs and utilize custom datasets.

CIT 41300 Advanced Mobile Application Development (3 cr.) P: CIT 31300. Students will rapidly develop data-driven mobile applications that are deployed to Android and iOS devices that use geolocation.

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 impacted 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 41800 Native Android Application Development (3 cr.) P: CIT 21300, and (CIT 21500 or CIT 24200 or CIT 27000). This advanced programming course gives student hands-on experience developing applications for Google mobile computing devices running the Android operating system. Student will build data-driven and location-aware applications using object-oriented software design patterns common to mobile application development. A variety of data storage and remote datasource-driven applications will be introduced.

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 42100 Big Data Analytics (3 cr.) P: CIT 31400 and CIT 32000 and CIT 38800. This course will cover both the fundamentals and concepts of data analytics. The focus is on emerging advanced data analytics techniques and their applications to practical problems for different disciplines, such as IT, health care, and economics. Machine learning algorithms and distributed computing environments will be explored.

CIT 42200 Business Intelligence (3 cr.) P: CIT 30400. Business Intelligence (BI) has become vital in the way organizations store, analyze, and use their data. Leaders across all levels and departments are craving to have information at their fingertips that will allow them to make decisions more accurately and efficiently. This course will review the various applications and technologies used for collecting, storing, and analyzing information that allow for better decision making. Students will be guided through the BI life cycle of requirements gathering, project management (agile), ETL (extract, transform, load), data warehousing, application development, implementation, and product support. Students will take a hands-on approach using publicly available data sources to build their own BI platform to gain better insight into the various phases and complexities involved in analytic systems.

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 34700), P: or C: CIT 41200. 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. 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 30400 and (CIT 31300, CIT 34700, or CIT 38800). 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 and will work through the full life cycle of the development of a software application. A project-based learning approach is used in this course.

CIT 45100 IT Security Risk Assessment (3 cr.) P: CIT 40600. 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 30400. 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, administration, 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 50100 Data-Driven Cloud Computing Applications (3 cr.) P: Any programming course equivalent to 300-level programming, any relational database course equivalent to 200-level database course, and introductory web development course. This course introduces students to data hosted in cloud platforms and provides the opportunity to develop applications that read and write to those sources. Projects include transferring data to the cloud, development of a user interface, and development of software applications that meet user needs and utilize custom datasets.

CIT 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. Students will learn not only basic statistics but also the research process by designing, conducting, and analyzing the data for a small empirical research project using real-world data.

CIT 51101 iOS Mobile Application Development (3 cr.) P: Any programming course equivalent to 300-level programming. Any relational database course equivalent to 200-level database course. This advanced programming course teaches students to create data-driven, location-aware mobile applications for the iOS platform. Students will learn common mobile app design patterns and will integrate cloud computing services into their applications.

CIT 51102 Android Mobile Application Development (3 cr.) P: Any programming course equivalent to 300-level programming. Any relational database course equivalent to 200-level database course. This advanced programming course teaches students to create data-driven, location-aware mobile applications for the Android platform. Students will learn common mobile app design patterns and will integrate cloud computing services into their applications.

CIT 51600 Database Security (3 cr.) P: Graduate Status, CIT 21400 or basic database background and SQL language. 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 52600 Applied Data Analytics (3 cr.) P: CIT 50700. Measurement and Evaluation in Industry and Technology or equivalent, Basic knowledge about computing architecture, and programming in one of the major programming languages. This course will cover both the fundamentals and the concepts of the data analytics cycle and the advancement data analytics techniques. The focus is on emerging advanced data analytics techniques and their applications to practical problems for different disciplines, such as IT, health care, and economics. Both advanced supervised learning and unsupervised learning algorithms will be explored along with data visualization techniques. Students will apply these advanced techniques in labs and a research project to resolve an applied research problem and identify scientific findings by using public data sets. A research project report is required at the end of the course and the quality of the research report is expected to align with the requirements of IEEE or ACM international conferences.

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 54600 Mobile Computing and Applications Technologies (3 cr.) P: Java Programming (CIT 27000). This course aims to provide in-depth coverage of mobile computing concepts and technologies. Fundamentals and state of the art developments, such as location and context-based service, cognitive radio and dynamic spectrum access, and security and privacy in mobile networks, will be included. Course will involve readings and discussion of classic and new papers on emerging topics in mobile computing research. The goal of the course is to provide a solid technological and research foundation in the area of mobile computing. In addition, hands-on experience in applying the technology to practice is a critical element.

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 55510 Network Security (3 cr.) P: Graduate Status. Basic network security course (CIT 35600 or CIT 40200 or equivalent). 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 course. Many emerging challenges and solutions in network security architectures, multilevel systems, and security management and monitoring will also be included.

CIT 56200 Mobile and Network Forensics (3 cr.) P: Graduate Status. This course deals with the forensics process of mobile and network forensics and cyber-crime scene analysis. The various laws and regulations dealing with computer forensic analysis will be discussed. Students will analyze and synthesize the collection, preservation, analysis, and presentation of mobile and network evidence. Students will analyze evidence to the emerging international standards for computer forensic analysis, as well as utilize a formal methodology for conducting mobile and digital forensic investigations and conduct research in the emerging areas of mobile and network forensics commensurate with graduate education.

CIT 56500 Teaching Computer Programming and Applications (3 cr.) Participants explore best methods for teaching secondary computer programming and computer applications. Additionally, participants learn to integrate other subjects with computer programming and applications.

CIT 57800 Advanced Topics in Data Management (3 cr.) P: TECH 50700 and CIT 52600 and Basic knowledge about computing architecture, and programming in JAVA. This is an advanced data management course. The topics might change each term it offers. The objective of this course is to cover most emerging topics for data management and explore the cutting-edge technologies in data science. "Big data" is an emerging term to demonstrate the large volume and diversity of data that are generated by different applications every second. "Big data" is exposed to new techniques about how to efficiently store the data, manage the data, analyze the data, and integrate the data. In this course, topics to be discussed include but not limited to emerging data storage and management techniques for large-scale data sets, cloud based data mining tools for analyzing large-scale data collections, information retrieval over large-scale data collections and related data security and privacy issues. The class will also focus on research, evaluate and design data management infrastructure for real-world application domains, such as health care, online marketing, social network analysis and so on.

CIT 58100 Topics in Computer Information Technology (1-6 cr.) Advanced study of technical and professional topics relating to computer and information technology. Emphasis is on the cutting-edge technologies and new developments relating to advanced technologies.

Computer Graphics Technology

CGT 10100 Introduction to Computer Graphics Technology (3 cr.) 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.) 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.) 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.) 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.) 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 20200 Motion and Video I (3 cr.) 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, keyframing, and design principles. Students will also learn basics in client relationship and business etiquette. Initial projects will focus on commercial creation and the utilization of typography as it relates to storytelling.

CGT 20400 An Introduction to Themed Attraction Design (3 cr.) An introduction to immersive attraction; including the consideration of operations, graphics, engineering, technology and design. Students will apply their knowledge in narration and graphic principles to concept projects in immersive spaces.

CGT 21100 Raster Imaging for Computer Graphics (3 cr.) 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.) 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. 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 25100 Principles of Creative Design (3 cr.) 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 31300 Digital Painting I for Computer Graphics (3 cr.) 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.) P: CGT 20200. 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 31700 Planning and Communicating Themed Attraction Design (3 cr.) P: CGT 20400. Building on students' knowledge of narrative creation and design, students will learn about the fundamentals of operations, graphics, engineering, technology and design to create theme-based immersive attractions. This course will focus on design concepts, technical design, management and creation of immersive experiences.

CGT 31800 Animation Preproduction (3 cr.) This course introduces students to industry standard practices of preproduction for animation, and demonstrates how these processes relate to the creation of large-scale graphics productions.

CGT 32800 Business of Themed Entertainment (3 cr.) This course provides an insider's look at the skills needed to succeed in the themed entertainment industry as well as provide an overview of the experience economy. Students will get an insider understanding of the project process, working with outside vendors, team communication, common constraints and budgeting.

CGT 34000 Digital Lighting and Rendering for Computer Animation (3 cr.) P: CGT 11600 and have a good working knowledge of 3D modeling and basic animation techniques. 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 24100. 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: Have experience in 3D modeling and animation techniques. 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 Multimedia Authoring I (3 cr.) P: CGT 25100. 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 Dynamic Content Development I (3 cr.) P: CGT 25100. A course focusing on the development of dynamic content and applications to facilitate information distribution. 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 interactive multimedia products that utilize database management systems, file systems, and XML to provide a method for visualizing and manipulating that data. Significant time is spent on intermediate to advanced programming and scripting.

CGT 36700 Previsualization of Themed Entertainment (3 cr.) This course provides an overview of themed entertainment development from concept to previsualization and communication. Students will have the opportunity to take initial concepts for themed experiences and visualize them to communicate to multiple external audiences.

CGT 40200 Motion and Video II (3 cr.) P: CGT 31400, CGT 34600. 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 40300 Digital Painting II for Computer Graphics (3 cr.) P: CGT 31300. This is an advanced course in digital painting techniques for graphical visualization and communication. Emphasis is placed upon larger, more complex digital painting works through industry standard digital preproduction and production practices. Significance is placed upon visual development and professional criticism.

CGT 40400 Self Promotion for Computer Graphics (3 cr.) P: Senior Standing. This course has been designed to introduce students to the professional practice of branding oneself as commonly used in industry. Students will learn how to critique their own work, and the work being done by peers in the industry.

CGT 40700 Current & Future Trends in Themed Attraction Design (3 cr.) P: CGT 31700. Students will learn about current trends in immersive attractions. Current technologies will be explored that can be used to enhance the narrative in a themed immersive space. Students will explore technologies, narrative techniques and integration of engineering.

CGT 41100 Contemporary Problems and Applications in Computer Graphics (3 cr.) P: Senior standing. Groups will learn 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 41600 Senior Design Project (3 cr.) 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 24100. 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 Visual Effects in Film and Animation (3 cr.) P: CGT 24100. 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 Digital Post Production (3 cr.) P: CGT 24100. 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 Authoring II (3 cr.) P: CGT 35100. This course focuses on the development of applications that manipulate media assets. Significant time is spent on intermediate to advanced programming and scripting as well as the synchronization of aural and graphical components. Students are required to plan, design, and implement a major project, and a final presentation is required.

CGT 45600 Dynamic Content Development II (3 cr.) P: CGT 35600. This course presents the advanced technologies available for use on the World Wide Web and within corporate intranet environments. Emphasis and discussion is focused on the advantages and disadvantages of these technologies as well as on implementation to create unique solutions for business and industry. Strategies for planning, development, and implementation will be discussed and demonstrated. Significant time is spent on advanced programming and scripting as well as manipulation and visualization of data from various sources, including robust database management systems. Students are required to plan, design, and implement a major project.

CGT 49900 Select Topics in Computer Graphics (1-3 cr.) Variable topic class. Hours and subject matter to

be arranged by staff. Course may be repeated for up to 9 credit hours.

Construction Management

CMGT 11000 Introduction to Construction Management (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.

CMGT 12000 Materials and Methods (3 cr.) P: CMGT 11000. 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.

CMGT 15000 Surveying (3 cr.) P: MATH 15300. C: MATH 15400. Class 2, Lab 2. 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.

CMGT 21000 Quantity Take-off (3 cr.) P: CMGT 12000 and MATH 15400. Class 2, Lab 2. A study of methods to estimate quantities of materials required in construction. Practice in making quantity surveys.

CMGT 25000 Mechanical and Electrical Systems (3 cr.) P: CMGT 12000 and MATH 15400. Methods for design, construction and inspection of mechanical 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-conditioning) and plumbing work.

CMGT 26000 Statics (3 cr.) P: CMGT 12000 and MATH 15400. Class 3. Forces acting on bodies at rest, including coplanar, concurrent, and nonconcurrent systems. Includes centroids, moments of inertia, and friction.

CMGT 31000 Cost Estimating (3 cr.) P: CMGT 21000. Class 2, Lab 2. 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.

CMGT 32000 Scheduling and Project Control (3 cr.) P: CMGT 31000. Class 2, Lab 2. 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.

CMGT 33000 Contract Administration and Specifications (3 cr.) P: CMGT 31000. 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.

CMGT 35000 Materials Testing (2 cr.) P: CMGT 26000. C: CMGT 36000. Class 1, Lab 2. 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.

CMGT 36000 Strength of Materials (3 cr.) P: CMGT 26000. C: CMGT 35000. 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 statically indeterminate beam analysis.

CMGT 37000 Temporary Structures in Construction (3 cr.) P: CMGT 35000 and CMGT 36000. Class 2, Lab 3. Preparation of structural construction drawings for buildings, bridges, roads, and topographic drawings.

CMGT 38000 Infrastructure Planning, Engineering, and Economics (3 cr.) P: CMGT 35000 and CMGT 36000. Class 3. Introduction to the planning and analysis of infrastructure projects focusing on the prioritization, stewardship, management, and decision-making roles in a public works agency. This course covers municipal infrastructure system, infrastructure alternatives, financial and economic analyses, environmental and social impact assessment, uncertainty and risk-benefit analysis, sustainability, and public-private partnerships.

CMGT 39000 Construction Experience III (1 cr.) P: CMGT 21000, TCM 22000 and TCM 34000. 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.

CMGT 41000 Equipment and Field Operations (3 cr.) P: CMGT 31000. Class 3. Study of types and uses of construction equipment and machinery in relation to diverse field operations. Analysis of equipment productivity and costs.

CMGT 42000 Safety and Inspection (3 cr.) P: CMGT 33000. 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.

CMGT 43000 Jobsite Management (3 cr.) P: CMGT 31000 and CMGT 32000. C: CMGT 44000. 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.

CMGT 44000 Project Management Capstone (3 cr.) P: CMGT 32000, CMGT 41000 and CMGT 42000. C: CMGT 43000. 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.

CMGT 45000 Structural Systems and Analysis (3 cr.) P: CMGT 35000 and CMGT 36000. 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.

CMGT 46000 Soils and Foundations (3 cr.) P: CMGT 35000 and CMGT 36000. Class 2, Lab 2. 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.

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, MATH 26100, and PHYS 25100. 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.) P: Completion of all freshman engineering requirements. 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.) P: ENGR 19700 within previous 2 semesters. 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 29500 Selected Topics in Electrical and Computer Engineering I (0-4 cr.) Variable topic and experimental courses appropriate at the sophomore level, as approved by the ECE Curriculum Committee at IUPUI.

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 31500 Fundamentals of Electrical Energy Engineering (3 cr.) P: ECE 20400. Class 3. Resistive circuit analysis with controlled sources. Sinusoidal frequency response, filters and Bode plots. Complex power in AC circuits, ideal transformers and three-phase power. Power electronic circuits including diodes, transistor switches, rectifiers and AC-DC converters. Magnetic circuits, magnetic materials and B-H curves. Transformer equivalent circuit models. No credit will be given for ECE majors.

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 37200 Principles of Software Design (3 cr.) P: CSCI 24000. Recommended CSCI 36200. Class 3. This course is designed to teach students best practices in designing and implementing object-oriented systems of high quality. To accomplish this task, we start with an overview of software design patterns and their role in developing high-quality software. We then begin

surveying different design-level software design patterns, such as the Bridge, Strategy, Wrapper Facade, and Visitor software design patterns. Next, we touch on software design patterns for building distributed systems. Finally, we finish the course by surveying Software anti-patterns, which are common design mistakes that negatively impact system quality, such as degrading performance as the system scales in size and complexity. Students will have the opportunity to apply learned techniques on several programming projects throughout the semester.

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 39501 Selected Topics in Electrical and Computer Engineering II (0-4 cr.) Variable topic and experimental courses appropriate at the junior level, as approved by the ECE Curriculum Committee at IUPUI.

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: ECE 36200, and CSCI 36200 or ECE 35900. 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 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 43201 Elementary Power Systems Engineering (3 cr.) P: ECE 32100 or A- or higher in ECE 20100. 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 45500 Integrated Circuit Engineering (3 cr.) P: ECE 25500. Class 3 Analysis, design and fabrication of silicon bipolar and MOSFET monolithic integrated circuits. Consideration of amplifier circuit design, and fabrication techniques with circuit simulation. Integrated operational amplifiers with difference amplifiers, current sources, active loads, and voltage references. Design of IC analog circuit building blocks.

ECE 46100 Software Engineering (3 cr.) P: CSCI 24000 and ECE 37200. 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 30200. 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 or ECE 35900. 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 in the engineering degree program 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 49500 Selected Topics in Electrical and Computer Engineering (1-4 cr.) Engineering topics.

ECE 49600 Electrical and Computer Engineering Projects (1-3 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 51501 Smart Grid (3 cr.) P: Graduate Standing, or senior standing in the degree program and ECE 30100. This course analyzes the history of the U.S. power grid and the basic concepts on the current electric power system. The main challenges on the transition of the traditional power system with unidirectional power flow to the new and complex system.

ECE 52301 Nanosystems Principles (3 cr.) P: Graduate standing, or senior standing and ECE 25500 in an engineering or science degree program, or consent of instructor. 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.

ECE 52601 Integrated Nanosystems Processes and Devices (3 cr.) P: ECE 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-scale 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.

ECE 52702 Advanced Power Electronics Converters (3 cr.) P: Graduate standing, or senior standing and 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) cascade, 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: Senior standing in the degree program and 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, or senior standing in the degree program and ECE 30100 and ECE 36200. 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 53401 Embedded Autonomous Systems in Automotive Platforms (3 cr.) P: Graduate Standing, or senior standing in the degree program and ECE 30100, ECE 30200, and ECE 36200. A treatment of embedded and autonomous systems: motor control, image vision, sensors, security, nural networks, SLAM, machine and deep learning, protocols, standards, and implementation using multiprocessors, multicores, ISP, Bluebox, and APEX.

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: Senior standing in the degree program and ECE 30100, ECE 30200, and ECE 36200, 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 senior standing in the degree program and ECE 30200. 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: Senior standing in the degree program and 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, groups 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: Senior standing in the degree program and 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: Senior standing in the degree program and ECE 30100. 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.

ECE 55400 Electronic Instrumentation and Control Circuits (3 cr.) P: Senior standing in the degree program and 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: Senior standing in the degree program and ECE 30100 and ECE 42100, 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.

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: Senior standing in the degree program and ECE 30200 and ECE 36200, or 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: Senior standing in the degree program and 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 56601 Real-time Operating Systems and Application (3 cr.) P: Senior standing in the degree program and ECE 36200, 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 56810 Design with Embedded and Digital Signal Processors (3 cr.) P: Senior standing in the degree program and ECE 36200, or graduate standing. Class 3. This course provides an overview of the architectures, design considerations. Features and applications of embedded processors with digital signal processing capabilities, single-core and multi-core digital signal processors (DSPs). The course emphasizes design consideration for embedded and DSP-based real-time systems. Different applications such as internet of things, Voice over IP, wearable devices, medical instrumentation, machine to machine, smart homes and wireless systems will be considered.

ECE 56900 Introduction to Robotic Systems (3 cr.) P: Senior standing in the degree program and 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: Senior standing in the degree program and ECE 35900 or CSCI 36200, 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: Senior standing in the degree program and consent of advisor, or Graduate standing. 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: Senior standing in the degree program and consent of Advisor, 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 (1-3 cr.) Formal classroom or individualized instruction on topics of current interest.

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 62900 Intro to Neural Networks (3 cr.) Class 3. An introduction to basic concepts in the design, analysis, and application for computational neural networks. Topics include highly parallel fine grain architectural models such as the Boltzmann machine, Rosenblatt's

Perception, Hopfields' neural nets, backpropogation, and their associated learning algorithms. Proposed architectures and related simulation techniques are discussed. Applications to signal/image processing and recognition, optimization, and controls are examined.

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 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 69311 Advanced Internship (1-3 cr.) Graduate-level internship based course, in an off-campus internship position. Internship must be in the area of Electrical & Computer Engineering. Individual Internship must be preapproved by the supervising ECE faculty member before the student can register for the course. A written report must be submitted and approved by the faculty before credit is accepted. This course cannot be used to satisfy the minimum course requirements for the Master's or Ph.D. degrees.

ECE 69401 ECE Graduate Seminar (0 cr.) Seminar presentations by ECE faculty, staff and others from academia and industry. The presentations introduce students to a wide variety of current topics relevant to the technical, educational and career aspects of electrical and computer engineering. Graduate standing required. This course cannot be used to satisfy the Ph.D. seminar requirements.

ECE 69409 ECE PhD Residency Course (0 cr.) This course is for ECE PhD students who are required to be enrolled at Purdue West Lafayette for their PhD program although research instruction and all related activities occur at the IUPUI campus.

ECE 69401 ECE Graduate Seminar (0 cr.) Seminar presentations by ECE faculty, staff and others from academia and industry. The presentations introduce students to a wide variety of current topics relevant to the technical, educational and career aspects of electrical and computer engineering. Graduate standing required. This course cannot be used to satisfy the Ph.D. seminar requirements.

ECE 69500 Advanced Topics in Electrical & Computer Engineering (1-3 cr.) Formal classroom or individualized instruction on advanced topics of current interest.

ECE 69600 Advanced Electrical Engineering Projects (1-4 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.

ECE 69900 Research (PhD) (1-18 cr.) Research for PhD thesis.

Electrical and Computer Engineering Technology

ECET 10700 Introduction to Circuit Analysis (4 cr.) P: MATH 15300. Voltage, current, resistance, Ohm's law, Kirchhoff's current and voltage laws, resistance combinations, and Thevenin's, Norton's and superposition theorems are studied and applied. DC and AC circuits are studied and utilized, with basic AC terminology described. ideal RC coupling and filter circuits and RC switching circuits are introduced. Fundamentals analog circuits with ideal or near-ideal electronic devices are utilized in the lecture and laboratory to enhance the understanding of basic circuit laws and theorems.

ECET 10900 Digital Fundamentals (3 cr.) P: MATH 11100 or higher. 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. 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. A continuation of ECET 10900. 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. Capacitors, inductors, switching circuits, transformers, rectifiers, linear regulators, dependent sources, operational amplifiers, BJT- & MOSFET-based small-signal amplifiers, waveform generation, and programmable analog devices are studied. Circuit fundamentals such as Kirchhoff's laws are utilized in analysis and design of circuits.

ECET 16400 Applied Object-oriented Programming (3 cr.) P: or C: MATH 15300. 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 18103 Circuit Analysis I (4 cr.) P: TECH 10500 with a grade of C or better: P: or C: MATH 15400. Introduction to circuit analysis with emphasis on direct current applications. Topics include: voltage, current, resistance, Ohm's law, Kirchhoff's current and voltage laws, resistance combinations and Thevenin's, Norton's and superposition theorems are studied and applied. DC circuits are studied and utilized, with basic AC terminology described.

ECET 20700 AC Electronics Circuit Analysis (4 cr.) P: ECET 15700 and MATH 15400. AC circuits, including the j operator, phasors, reactance, and impedance are studied. 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. Computer aided analysis of circuits is used.

ECET 20900 Introduction to Microcontrollers (4 cr.) P: ECET 10900 and P or C: ECET 16400. This course is an introduction to microprocessor hardware and software, focusing on embedded control applications. Interconnections of components, peripheral devices, bus timing relationships, structured C-language programming, debugging, input/output techniques, and use of PC based software development tools are studied.

ECET 23110 Electrical Machines (3 cr.) P: ECET 10900 and ECET 15700; P or C: PHYS 21800. 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. 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 24103 Electronic Devices & Circuits (4 cr.) P: ECET 18103 with grade of C or better and MATH 15400. Introduction to analysis and design of electronic devices and circuits. Topics include: diodes, rectifiers, bipolar junction transistors, field effect transistors, operational amplifiers, active filters, slew rate, linear and switching power supplied.

ECET 24703 Circuit Analysis II (4 cr.) P: ECET 18103 with grade of C or better and MATH 22100. A study of ac sources and electrical circuits with complex calculations in form of the phasor, introduction to impedance, admittance and frequency-dependent values in rectangular and polar forms, the concept of apparent-active-reactive power, circuit network theorems, first-order and second-order systems, resonance, filters, frequency responses, Operational amplifiers, and active filters.

ECET 28404 Contemporary Communication systems (4 cr.) P: ECET 10700 and ECET 16400. An introductory course in communication that introduces and evaluates basic concepts and principles of contemporary communication systems. The hardware and software issues in contemporary communications are studied. Emphasis is given on experiential experience in the signals and systems used in contemporary communications, such as types of signals and systems, use of communication devices and media, choice of networking topologies, protocols, and platforms.

ECET 30200 Introduction to Control Systems (4 cr.) P: ECET 23120. The first course in industrial controls is applications oriented and includes on-off type open- and closed-loop control systems, and analog-based systems. Major topics include relay and programmable controller-based systems.

ECET 30700 Analog Network Signal Processing (4 cr.) P: ECET 20700 and MATH 22200. This is an advanced course in network analysis that stresses network theorems and solutions of time-domain and frequency-domain problems. Transform circuit and signal analysis using Laplace and Fourier techniques are developed, culmination in active filter design applications. Software techniques such as MATLAB and LABVIEWTM, are employed to solve mathematical problems.

ECET 30903 Advanced Embedded Microcontrollers (3 cr.) P: ECET 20900. This course emphasizing advanced applications of embedded microcontrollers, included are microcontroller architecture, use of advanced programmable counter/timer arrays, interrupts, multi-tasking, analog interfaces, hardware abstraction and their peripherals.

ECET 33100 Generation and Transmission of Electrical Power (4 cr.) P: ECET 23110. 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 33400 Embedded-Cross-Platform Interface and Communication (3 cr.) P: ECET 16400, or CIT 26200 or CIT 27000. Project-oriented, hands-on study of embedded communication protocols, advanced OOP targeted for hand-held devices and low power embedded systems interface. A PC based OS with cross-platform development environments designing system solutions targeted for device platforms and interfacing with microcontroller systems. Topics include microcontrollers, SoC, various OS platforms, RTOS, Embedded IoT protocols.

ECET 35100 Instrumentation Applications for Technology (3 or 4 cr.) P: MATH 22100 and ECET 10700 or ECET 11600. 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. A study of the architecture, instruction set, and hardware and software development tools associated with a fixed-point general-purpose DSP VLSI processor. Fundamental principles associated with the processing of discrete-time signals are also introduced along with the implementation of some common applications such as waveform generation, audio effects, FIR and IIR digital filtering, and DFT- and FFT-based spectral analysis.

ECET 36000 CIM in Electronics Manufacturing (4 cr.) P: ECET 20700 and ECET 20900. Manufacture and assembly of printed circuit boards, board layout, soldering and test. Emphasis is on high volume, state-of-the-art manufacturing processes, including surface mount technology (SMT). Laboratory projects include CAD circuit board layout, automatic assembly equipment, thermal characteristics of circuit boards, process design and SPC techniques.

ECET 37100 Automation, Instrumentation, and Process Control (3 or 4 cr.) P: ECET 23120. 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 23110. A study of the design and operation of electric distribution systems including estimated demand, 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 (NEC). Both new facilities and additions to existing facilities are included.

ECET 38404 Fundamentals of Contemporary Signal Processing (4 cr.) P: ECET 28404 and MATH 22100; P or C: MATH 22200. Fundamentals of processing techniques applied to signals and systems in both time and frequency domains are studied. Both continuous-time and discrete-time linear systems are introduced. Analysis methods such as: Fourier series, Fourier transform, bilateral Laplace transform, difference equations, discrete-Time Fourier transform, bilateral Z-Transform are introduced. Common applications such as wave form generation, FIR and IIR digital filtering, DFT and FFT based spectral analysis and filtering are covered. Use of software tools is emphasized throughout the course.

ECET 41700 Advanced Digital Systems Design with VHDL (4 cr.) 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 16400 and ECET 20900. Real-time, PC-based operating systems. Programming Graphical User for control applications using an object-oriented language. Embedded PC hardware, busses, and peripheral programming. Writing device drivers.

ECET 45703 Applied Power Electronics (3 cr.) P: ECET 20700. Introduction to analysis and design of power electronic devices and topologies. Topics include: power electronic devices, ac-dc, ac-ac, dc-dc, and dc-ac converters, harmonics and power quality, introduction to d-q transformation.

ECET 48300 Network Fundamentals with Microcontrollers (4 cr.) P: ECET 20900. 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 28404. 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. 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.) Hours and subject matter to be arranged by staff.

Energy Engineering

EEN 22001 Fundamentals of Energy Materials (3 cr.) P: CHEM C105. C: ME 20000, 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 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 33001 Modeling & Measurements of Dynamic Systems (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 40600 HVAC Design (3 cr.) P: ME 31002 or EEN 31000. C: ME 31401. The fundamentals required to design and analyze HVAC systems used in buildings. This includes the fundamentals of the thermodynamics of HVAC systems & buildings, the thermodynamics of moist air (psychrometrics), calculating building heating/cooling loads, application of HVAC equipment to buildings, HVAC component analysis, and energy reduction strategies. Application to real building designs.

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.

Facilities Management

FMGT 51000 Introduction to Facilities Planning and Management (3 cr.) An overview of the planning process for facilities is covered including: space planning; facilities layout; engineering systems integration; site selection; compliance with ADA requirements; sustainability; and LEED certification. Additionally, topics related to organizational concepts and management of the facility will be discussed including: management functions; how facility management fits into the organization structure; professional conduct and certification of facility professionals; outsourcing and contracts; and risk management.

FMGT 51500 Introduction to Facilities Engineering Systems (3 cr.) This course introduces and examines the design criteria, operation, safety, maintenance, testing and assessment of building engineering systems. The inter-relationships of fire protection, HVAC/R, electrical distribution, plumbing, lighting, acoustics, telecommunication and energy management are examined.

FMGT 52000 Energy Management for Buildings (3 cr.) P: FMGT 51000 or equivalent. 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.

FMGT 52500 Management of IT, Telecommunications, and Video Infrastructure (3 cr.) P: FMGT 51500 or equivalent. This course is the study telecommunications and IT technology, including voice, data, and video. Topics include digital communications, standards and protocols, Ethernet, local and wide area networks, fiber optics, voice, and network video technologies.

FMGT 53000 Facilities Contract Management (3 cr.) P: FMGT 51000 or equivalent. This course will teach you the basics of contracts. The purpose of the course is not to teach you how to write contracts (that is what lawyers do). Instead, you will learn key principles of contract law so that you can better understand how an agreement is made and what terms become part of that agreement. Knowledge from this course will help the facility manager navigate the contractual process, from negotiating terms to dealing with potential disputes. Areas of focus will include real estate contracts, negotiations, managing risks and disputes, and the uniform commercial code. An emphasis will also be placed on contracts related to construction projects.

FMGT 53500 Quality and Productivity in Industry and Technology (3 cr.) P: IET 15000 or equivalent. This course exams the process optimization utilizing contemporary quality and systems engineering methodologies, specifically Six Sigma, Lean, Toyota Production System (TPS) and Constraint Management. Direct application of principles to an industry field project is required. This course covers optimization and management of production, service and transactional processes.

FMGT 54000 Facilities Maintenance and Operation (3 cr.) P: FMGT 51500 or equivalent. Topics of this course include: infrastructure management; maintenance influence on life-cycle cost; preventive and predictive maintenance programs; maintenance management software tools; and interaction with trade craftsmen.

FMGT 54500 Financial Aspects of Facilities Management (3 cr.) P: FMGT 53000 or equivalent . Financial analysis and reporting, concepts and methods of accounting, budgeting and evaluation of projects are examined. The role of the facility manager in corporate earnings and valuations is covered and financial aspects of managing a facility over its life-cycle are examined.

FMGT 55500 Healthcare Facilities Management (3 cr.) This course will provide an overview of hospital layout and associated building elements along with code compliance and functionality. Discussion includes operating rooms, medical/surgical units, OB/labor and delivery, radiology/ MRI/CT/emergency department, electrical systems, plumbing systems, medical gas systems, HVAC, fire protection, telecommunications/network and maintenance/ regulatory requirements.

FMGT 56000 Emergency Management for Facilities Personnel (3 cr.) This course encompasses a broad survey of emergency management topics relevant to facility managers and related personnel. Issues such as mitigation, preparedness, response and recovery, planning, risk assessment, life-safety and regulations, natural disasters and terrorism will be discussed, and opportunities for personalized planning through applied exercises will be utilized to provide enhanced understanding to the students.

FMGT 59800 Facilities Management Capstone (3 cr.) P: Final semester of study. Independent study of a special problem under the guidance of a member of the staff.

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 12500 First Year Seminar for Engineering Majors (1 cr.) This course offers new and prospective engineering majors strategies for success in college. Students work with an instructional team to develop the necessary skills to successfully transition to the university environment.

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)

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 29500 Transition to Engineering Profession (1 cr.) This course offers engineering students strategies for success in college. Co-taught by an Academic Advisor and a Career Advisor, students will develop the necessary skills to successfully transition to IUPUI and start planning for their career after graduation. This course is for transfer students with 17+ transfer credits, military veterans, or students who are 23 or older.

TECH 29500 Transition to Technology Profession (1 cr.) This course offers technology students strategies for success in college. Co-taught by an Academic Advisor and a Career Advisor, students will develop the necessary skills to successfully transition to IUPUI and start planning for their career after graduation. This course is for transfer students with 17+ transfer credits, military veterans, or students who are 23 or older.

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 curvefitttting, 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 31000 Seminar for Technology Transfer Students (3 cr.) A seminar and bridge course for Transfer Single Articulation Pathway Associate Degree graduates in EET and MET to prepare them for success in junior and senior technical classes.

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 discussed. Networking failures will be discussed. HIPAA

data recovery requirements will be studied and actual HIPAA violations will be discussed.

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.) 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 26500 Healthcare Devices and Systems (3 cr.) P: HETM 22500, HETM 24000 and ECET 15700 (C or better). C: HETM 32000. Students have 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 introduction to imaging modalities.

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. 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 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 26500. 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 26500. 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 26500 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.

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 15500. 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. C: INTR 22500 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: ART 21000 and 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 and MATH 15400. C: INTR 22500. 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.) P: Senior Standing. 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.

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 Portfolio (3 cr.) P: Senior Standing. An instructor mentored course which requires students to develop resume, portfolio, and website materials suitable for interviewing for entry-level professional practice.

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, EEN 22501, CHEM-C 105 and ME 22501. .
First and second laws, entropy, reversible and irreversible processes, properties of pure substances. Application to engineering problems. ***ME and EEN students require a grade of C- or better.**

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 26201 Design, Ethics and Entrepreneurship (2 cr.) P: ENGR 19600. C: COMM-R 110, ENG-W 131, ENGR 29700, ME 27000, 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 students require a grade of C- or better.**

ME 27200 Mechanics of Materials (3 cr.) P: ME 27000 and EEN 24000 for EEN students.
Analysis of stress and strain; equations of equilibrium and compatibility; stress/strain laws; extension, torsion, and bending of bars; membrane theory of pressure vessels; elastic stability; selected topics. Laboratory experiments include testing of mechanical properties and failure analysis. ***ME students require a grade of C- or better.**

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 laments, and other engineering systems. ***ME students require a grade of C- or better.**

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 31002 Fundamentals of Fluid Mechanics (3 cr.) P: MATH 26600, ME 20000 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 students require a grade of C- or better.**

ME 31401 Fundamentals of Heat and Mass Transfer (3 cr.) P: EEN 31000 or ME 31002. 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 designed as an overview of economics with a focus on how it relates to the practice of engineering. Topics include interest formulas, rate of return, life cost analysis, depreciation, taxes and cash flow.

ME 33000 Modeling and Analysis of Dynamic Systems (3 cr.) P: ECE 20400 and MATH 26600. C: ME 27400 and ENGR 29700.
Introduction to dynamic engineering systems; electrical, mechanical, fluid, and thermal components; linear system response; Fourier series and Laplace transform. ***ME students require a grade of C- or better.**

ME 34001 Instrumentation and Measurement Systems (2 cr.) P: ME 33000. 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.
Kinematic 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. Static

and dynamic balancing. Design documentation report writing and communication. ***ME students require a grade of C- or better.**

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 40600 Robust Design, Standards and Contemporary Issues (1 cr.) P: ME 37200 or (ME 27200 & EEN 34500). C: ME 34400 The role of standards, robust design and lifelong learning in engineering design. Application to contemporary issues.

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 44100 Design for IP Protection (3 cr.) P: (ME 26201 and ME 25001) or (EEN 26201 and EEN 25001) or BME 24101 or ECE 27000. Introducing topics of intellectual property such as copyright, trademark, and trade-secret in engineering design. Develop design solutions based on structured innovation. Convert innovative solutions into protectable inventions. Learn about infringement concepts with regards to engineering design. Reviewing patents. Creating patentable projects. Preparing patent applications.

ME 44200 Design for Patentability (3 cr.) P: (ME 26201 and ME 25001) or (EEN 26201 and EEN 25001) or BME 24101 or ECE 27000. Introducing advanced topics of patent law including restriction practice, pre-appeal briefs, full appeal briefs, patentability reports, novelty, obviousness, and patentable subject matter. Discussing how to transform non-patentable inventions into patentable invention. Creating patentable projects. Preparing and filing patent applications.

ME 44300 IP Rights for Engineers (3 cr.) P: (ME 26201 and ME 25001) or (EEN 26201 and EEN 25001) or BME 24101 or ECE 27000. Introducing transactional IP concepts including licensing considerations for patents, trademarks, and copyrights, valuating IP including strength of patents and patent applications and trademarks, understanding role of open source in IP, and supporting litigation effort. Discussing how to transform non-patentable inventions into patentable invention. Creating patentable projects. Preparing and filing patent applications.

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.) C: ME 34001 and ME 42501. 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 20000. Class 3. The 0th, 1st, 2nd, and 3rd Law of Thermodynamics and their applications in thermodynamic systems; Macroscopic thermodynamics and physics behind concepts on energy, entropy and the Laws; Availability concept and analysis for open and closed systems; Legendre transformation and its application; Real gas concept and its state equation; Thermodynamic properties of pure fluids and mixtures also if time permitted.

ME 50101 Energy Assessment of Industrial Processes (3 cr.) P: Graduate Standing or Instructor Consent. The course describes a systematic approach for improving energy efficiency in the manufacturing sector.

The manufacturing equipment and processes will be analyzed in terms of energy consumption improvement.

It provides the technical foundation for students on assessing industrial processes to identify energy efficiency opportunities in industrial, electrical, motor drive, compressed air, process heating, process cooling, lighting, space conditioning, combined heat and power systems.

The course consists of three parts: (1) fundamentals of energy assessment, (2) understanding of industrial processes in terms of energy consumption and energy efficiency, and (3) the energy assessment of industrial processes.

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 50500 Intermediate Heat Transfer (3 cr.) P: ME 31401. Class 3. Heat and mass transfer by diffusion in one-dimensional, two-dimensional, transient, periodic, and phase change systems. Convective heat transfer for external and internal flows. Similarity and integral solution methods. Heat, mass, and momentum analogies. Turbulence. Buoyancy-driven flows. Convection with phase change. Radiation exchange between surfaces and radiation transfer in absorbing-emitting media. Multimode heat transfer problems.

ME 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 31002 or EEN 31000. Class 3. 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 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: ME 29500/EEN 22000 and/or permission of instructor. The basic concepts and components of primary and rechargeable batteries; Faraday's Law; electrode process and kinetics; electric double layer; electroanalytical techniques; battery standard, operation, and other considerations; materials for Li-ion batteries; next generation high energy rechargeable lithium batteries; batteries for electric vehicles and hybrid electric vehicles; and battery for the electrodes, electrolytes, temperature range and operation of different types 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 26201 or EEN 26201, 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 54800 Fuel Cell Science & Engineering (3 cr.) P: CHEM-C106, PHYS 25100, ECE 20200 or ECE 20400, ME 20000. This course is designed as the introduction to fuel cell science and engineering for both graduate and undergraduate students (senior). The course is 3 credit hours (3 credits for lecture). It is intended for students in the mechanical and electrical engineering, materials science and chemistry. The course will cover the fundamentals of the fuel cell science; emphasis will be placed on the fuel cell reactions, charge and mass transport in fuel cells, water transport management, and materials development in the fuel cells, fuel cell system designs and integrations. the current state-of-the-art fuel cell technology will be introduced as well as the current technical challenges on the development of fuel cells. Codes and standards for safe handling of fuel cells will also be emphasized.

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 26201 or EEN 26201 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 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: ME 27400 or EEN 24000, ME 37200 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 or EEN 24000, ME 33000 or EEN 33001. 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.

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 48200 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 57301 Air Pollution and Emission Control (3 cr.) P: Graduate standing or instructor's consent. This course is designed to integrate the real-world problem solving experience into the course curriculum through project/lab environment. Students will study the air pollution sources and fundamental mechanisms of their impact on the environment and human health, and how automotive emission can be measured and controlled. In particular, measurement of particulate emission deposited in a diesel particulate filter will be studied. here the students will have a chance to optimally design the

sensor components. The course topics are chosen in this context so that they align with the local industry/lab well. Topics in emission control technologies, including sensors, control mechanisms, remedial systems will be taught and combined into the course projects that students will complete over the course of a semester.

ME 58100 Numerical Methods in Mechanical Engineering (3 cr.) P: ME 31401 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 59100 Mechanical Engineering Projects (1-3 cr.) Individual Advanced Study in various fields of Mechanical Engineering. May be repeated for up to 6 credit hours. Students must consult MEE Faculty for permission to enroll in this Project Based Course.

ME 59700 Selected Topics in Mechanical Engineering (Variable Title) (3 cr.) Various courses offered on an experimental basis.

ME 59800 Mechanical Engineering Graduate Seminar (0 cr.) ME Graduate Seminar course is a zero (0) credit hour course; however, students will be graded on attendance etc. Enrollment in ME Graduate Seminar ME 59800 in the appropriate semester(s) is necessary for our department funded Graduate and Professional students.

ME 60101 Computational Modeling of Turbulence (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. Force systems, resultants and equilibrium, trusses, frames, beams, and shear and movements in beams are studied.

MET 20400 Production Drawing (3 cr.) P: TECH 10500 and MET 10400 or TECH 10400. Class: 2, Lab: 2. Preparation of working drawings from layouts, functional dimensioning, assembly drawings, detailing of machine elements, applying fits, limits and tolerances to dimensions for interchangeable manufacture.

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). 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 (3 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, MET 21300 and PHYS 21800. Class 3. The methods developed in statics, dynamics, and strength of materials applied to the selection of basic machine components. The fundamental principles required to select the individual elements that compose a machine are developed. Selected course topics are included as computer exercises..

MET 22000 Heat and Power (3 cr.) P: MET 22100 and 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.

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.) 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: 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: MET 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 Mechanical Design/Drafting (3 cr.) P: CGT 11000 or TECH 10400, or MET 10400 or Consent of Instructor. 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) An overview of structures, properties and applications of metals, polymers, ceramics, and composite materials is presented. Problem-solving skills are developed in material selection, evaluation, measurement, and testing. Laboratory activities include testing various properties of different materials, and selection of materials for engineering applications.

MET 35000 Applied Fluid Mechanics (3 cr.) P: MET 11100 and MET 22000. Class 3. The fundamentals of fluid mechanics, including properties of fluids; pressure; hydrostatics, and dynamics of fluid flow; kinematics and dynamics of fluid flow; friction losses 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 Projects in Mechanical Design (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: MET 22000 and MET 32000. 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: MET 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 Engineering Ttechnology students. Class 2, Lab 2. Directed work on individual projects for senior Mechanical Engineering 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 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 29701 Computer Modeling for Motorsports (2 cr.) P: None An Introductory course detailing methods for designing & modeling motorsports components using computer aided design (CAD) software.

MSTE 29800 Programming & Computer Modeling for Motorsports (2 cr.) P: MSTE 27200 & admission to MSTE program. 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 introduced 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 Instructor. This is a directed study course for students wishing to pursue additional motorsports studies under the direction of a faculty advisor.

MSTE 31201 Business of Motorsports (4 cr.) P: MSTE 27200 and ENG W131. This course covers the unique aspects of the motorsports industry, especially race teams, including organizations, budgeting, marketing, & sponsorships through an examination of literature & guest speakers.

MSTE 31700 Motorsports Practicum II (1 cr.) P: 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 professional motorsports organization.

MSTE 32000 Motorsports Design I (3 cr.) P: MSTE 35000, MSTE 47200 or permission of instructor. 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.

MSTE 33001 Data Acquisition in Motorsports I (2 cr.) C: ECE 20400 This course introduces students to motorsports data acquisition systems and the associated

hardware and software that are comprised therein. A hands-on lab component is included in the class where in students learn how to specify a motorsports data system, understand vehicle network communication and build a motorsport industry standard data acquisition wiring harness.

MSTE 33100 Race Engineering (3 cr.) P: MSTE 33001 and MSTE 47200. This course explores the application of vehicle dynamics principles to motorsport vehicles. Students will utilize engineering software tools to develop motorsport engineering workbooks for vehicle performance analysis. Driver performance analysis and race strategy topics are introduced to provide the student with the full fundamentals of race engineering.

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 29701. 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, 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 12 of the 12 skills outlined in the Course Objectives.

MSTE 41800 Advanced Motorsports Practicum (1 cr.) P: Permission of Instructor. 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.) P: ME 20000. 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: ME 27000 and ME 27400. This course develops students understanding in the mathematical model development of the motorsports vehicle. Students will utilize these models to understand how key vehicle parameters influence vehicle performance in the longitudinal and lateral direction.

MSTE 48200 Motorsports Aerodynamics (3 cr.) P: ME 31002 and MSTE 35000. 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 cr.) P: MSTE 27000 and ENG-W 131 and Permission of Instructor. This is a special topics course for students wishing to pursue advanced studies under the direction of a faculty advisor.

MSTE 57200 Vehicle Dynamics (3 cr.) P: Graduate standing or MSTE 21000 and ME 27000. Vehicle dynamics is the study of behavior of vehicles in motion. The study is one of the most important activities in the Vehicle design and development cycle to design vehicles which drive well and are comfortable to ride in. The course focuses on the development of advanced mathematical engineering models that represent the behavior of automotive vehicles and vehicle subsystems. Topical emphasis is focused on rectilinear performance, steady state handling behavior, tire models and suspension models.

MSTE 57400 Advanced Vehicle Dynamics (3 cr.) P: MSTE 57200. An investigation into advanced topics in the field of vehicle dynamics. This course covers the principles and applications of vehicle handling dynamics from an advanced perspective in depth. The methods required to analyze and optimize vehicle handling dynamics are presented, including tire compound dynamics, vehicle planar dynamics, vehicle roll dynamics, full vehicle dynamics, and in-wheel motor vehicle dynamics. The provided vehicle dynamic model is capable of investigating drift, sliding, and other over-limit vehicle maneuvers. This is an ideal course for postgraduate and research students and engineers in motorsports, mechanical, automotive, transportation, and ground vehicle engineering.

MSTE 57800 Composite Materials for Automotive Applications (3 cr.) This course focuses on Development of Low-Cost Carbon Fiber for Automotive Applications, Mechanical Properties of Advanced Composites, Automotive Composite Structures for Crashworthiness, Crashworthiness Analysis of Composite, Hybrid Structures

Consisting of Sheet Metal and Fiber Reinforced Plastics for Structural Automotive and Design Solutions to Improve Crash-Box Impact Efficiency for Racing Applications.

MSTE 57900 Design and Analysis of Materials and Structures in Lightweight Vehicles (3 cr.) P: Graduate standing or ME 27200. The materials for the construction of automobiles are changing from mostly low carbon steels to a combination of steels, light alloys, such as aluminum and magnesium alloys, and polymer matrix composites. Many of these materials are already used in today's vehicles, albeit in smaller volumes. Future vehicles, which will have to be much lighter in weight for improved fuel economy and reduced environmental pollution, will contain much larger volumes of these materials. The selection of materials will not only be influenced by their weight reduction potential, but also by factors such as safety, durability, processing, joining, recycling and cost. This course focuses on materials, their properties,processing technology and design and materials selection issues pertinent to designing lightweight vehicles. it will provide first-hand knowledge and experience of working with these advanced materials. it starts with a broad review of the materials scenario and design considerations for lightweight automotive structures. it is then divided into two major parts: materials, and design and manufacturing. The materials part contain topics on advanced steels, aluminum alloys, magnesium alloys and polymer matrix composites. it will provide information on material properties, processing characteristics and application examples. The design and manufacturing part contains information on manufacturing processes for light alloys, joining, crashworthiness considerations, recycling and life-cycle issues.

MSTE 58200 Motorsports Aerodynamics (3 cr.) P: Graduate standing or ME 20000, 31000 and MSTE 35000. A study and adaptation of fluid flow and aerodynamics as applied to motorsports design and performance optimization. This course is designed to reinforce student's understanding of aerodynamics as it pertains to a race car. This course breaks down the differences between actual air flow while driving/racing versus air flow within a wind tunnel, and how these flows are different. It discusses how to evaluate those flows, and determine if they need to be improved. it discusses ways to improve the aero on race cars.

MSTE 58400 Advanced Motorsports Aerodynamics (3 cr.) P: MSTE 58200. This advanced course is designed to adapt the secrets of the rapidly developing field of high-speed vehicle design. From F1 to Indy Car, advanced drag simulation and Sedan racing, this course provides clear advanced explanations for students and engineers who want to improve their design skills and to interpret how their favorite race cars aerodynamics is designed. it differentiates how aerodynamics win races, why downforce is more important than streamlining and drag reduction, designing wings and venturis, plus wind tunnel designs and more. Appraises the development process of advanced motorsports aerodynamics engineering. Extensive use of CFD in the development of race ar aerodynamics.

MSTE 59200 Motorsports Simulations (3 cr.) P: Graduate standing or MSTE 29800 and MSTE 47200. A course on mathematical modeling and computer simulation of mechanical systems offering a complete tool for modeling and simulation of integrated and complex systems for use within automotive and motorsports applications. Complex multi-disciplinary systems modeling and analysis problems will be solved, using a modeling and simulation environment for complex systems analysis such as Dymola's Modelica simulation technology. Dymola is a complete environment for model creation, testing, simulation and post-processing. Equal emphasis is placed on model development and simulation via Dymola GUI interface. Models range from simple spring-mass-damper system to whole vehicle models will be covered.

MSTE 59700 Selected Topics in Motorsports Engineering (1-3 cr.) Topics of contemporary importance or of special interest that are outside the scope of the standard graduate curriculum can be offered temporarily under the selected topics category until the course receives a permanent number.

MSTE 59800 Motorsports Engineering Projects (1-3 cr.) Individual research projects of contemporary importance or of special interest that are outside the scope of the standard graduate curriculum can be studied under the Motorsports Engineering Projects course.

MSTE 59900 Motorsports Advanced Internship (1-3 cr.) Graduate-level based course, in an off-campus internship position.

MSTE 69800 Research MS Thesis (1-6 cr.) Research credit for students in thesis option.

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 107 Music Technology Fundamentals (3 cr.) Course serves as an introduction to concepts and functions of software/hardware technologies common to contemporary music composition, performance, and audio engineering. Areas to be covered include analog/digital signal flow, basics of a digital audio workstation software, elements of a studio listening environment, utilizing audio files and MISI data, and analog/digital hardware for sound and data input/output.

MUS-A 130 Music Theory and History I (3 cr.) P: MUS-Z111 (minimum grade of B) or placement test. This course covers fundamental concepts of music theory, style, and historical contexts. Investigate music, from major historical precedents to contemporary aesthetics. Topics include acoustic sound principles and proficiency with pitch, rhythm, and harmony in varied stylistic and cultural genres.

MUS-A 131 Aural Skills (2 cr.) P: MUS-Z 111 (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: MUS-A 107 (minimum grade of B) or placement test. 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 II (3 cr.) P: MUS-A 130 (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 (3 cr.) P: MUS-A 130 (minimum grade of C) and MUS-A 132 (minimum grade of C). 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-A 132 (minimum grade of C) or department consent. 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, Digital Audio Workstations, microphones, studio design and setup, signal flow and routing, mixing, and mastering.

MUS-A 200 Music Technology (Applied) (1-2 cr.) P: Consent of Instructor. Music Majors only. This course consists of private lessons, 30 minutes (1 cr) or 50 minutes (2 cr) each week, focused on developing musical and accurate performance practices with music technology as the primary instrument.

MUS-A 209 DiEnsemble (Destructive/Inventive Systems Ensemble (1 cr.) P: Departmental consent required. This ensemble uses improvisatory hardware and software hacking techniques as an approach to music making. By finding novel solutions to musical performance problems, students cultivate an attitude of creative freedom. Students experiment with improvisation, circuit-bending and destructive/creative instrument design while crafting a performance of live works.

MUS-A 214 Music and Sound for Games (3 cr.) P: MUS-A 132 or Permission of Instructor. Creation and implementation of music, sound effects, and dialogue assets into standard game engine software. Students compose scores and audio effects and learn basic scripting and coding applications used to build audio and music assets with digital audio workstations, middleware, and game design.

MUS-A 231 Musicianship Skills 3 (2 cr.) P: MUS-A 132 (minimum grade of C). In this course students will focus on developing a) practical and aural skills in technical listening with respect to quantitative audio features, b) fundamental theoretical understanding of common audio effects, c) vocabulary and communication skills for the discussion of sound quality, and d) an understanding of audio components and signal flow.

MUS-A 232 Music Technology Lab III (3 cr.) P: MUS-A 142 (minimum grade of C). A232 provides learning and hands-on experience of audio circuits and related technologies used in music technology. The curriculum builds upon introductory-level content oa MUS-A 142 by investigating fundamentals music engineering principles and evaluation techniques. These advanced studies fulfill core concepts, requisite knowledge, and techniques employed throughout all MAT music technology courses.

MUS-A 235 Electro-Acoustic Ensemble (1 cr.) A student ensemble for acquiring musical and technological skills 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.

MUS-A 240 Music Theory and History IV (3 cr.) P: MUS-A 140 (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 WW II.

MUS-A 241 Ear Training for Music Technology (2 cr.) P: MUS-A 231 (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.

MUS-A 242 Music Technology Lab IV (3 cr.) P: MUS-A 142 (minimum grade of C). This course introduces fundamental aspects of integrating musical performance with visual communication through two primary methods of audience delivery, recorded content and live experience. Topics include video production, graphic design, technical A/V setup, signal flow, digital/analog interface, DMX, lighting design, composition, post production, and generative graphics.

MUS-A 307 Autonomous Music Systems (3 cr.) P: MUS-A 142 or instructor approval. This course introduces intersections of music and A.I. course topics, combining machine learning, artificial intelligence, data management, and automation with musical concepts of modes, harmonies, rhythms, dynamics, and style practice. Students will build musical working digital systems via computer programming environments, culminating in autonomously generated music for live performance.

MUS-A 308 Applied Acoustics (3 cr.) P: MUS-A 142 or instructor approval. This course will cover various topics of acoustics relevant to technical applications for the arts, music technology, and physical spaces. These subject

areas include fundamentals of waves and acoustics, acoustic metrics, wave interactions, modal analysis, architectural acoustics, and noise control methods.

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 Technology and other engineering and technology faculty at IUPUI, researchers from local and national academia, representatives 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 505 Applied Acoustics (3 cr.) the one-semester long graduate course will cover various topics of acoustics, relevant to technical applications for the arts, music technology, and physical spaces. These subject areas include fundamentals of waves and acoustics, acoustic metrics, wave interactions, modal analysis, architectural acoustics, and noise control methods.

MUS-A 540 Music Engineering Technology (3 cr.) This course provides a technical approach of engineering concepts of music technology. Topics include digital audio concepts, audio signal processing, synthesis, and electroacoustic design of audio devices, while utilizing programming. Students will develop a quantitative understanding of music engineering methods and investigate current technologies and their effects on music technologists.

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. Music 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. Music 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. Music 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. Music 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. Music 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-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.

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.) This course is intended as an introduction to popular guitar styles and techniques by building rudimentary guitar playing skills: basic open and bar chords, learning how to read tabs and music, and learning basic finger style. No previous experience is required.

MUS-L 102 Intermediate Guitar Class (2 cr.) P: MUS-L 101 or instructor approval. 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 influences 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.

MUS-L 200 Guitar (1-2 cr.) P: Consent of instructor. Music 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/C: MUS-L 153. Observation of professional music therapy sessions in a variety of settings with client populations of varying needs.

MUS-L 254 Music Therapy Practicum I (1 cr.) P: MUS-L 253 and MUS-X 298. Students work with a board-certified music therapist providing services with music therapy clients in the community. Field experiences focus on the establishment of rapport and application of music experiences in clinical settings. Includes at least one clinical hour and attendance at a weekly seminar. May be repeated.

MUS-L 340 Music Therapy in Health Care (3 cr.) P: L153.
Study of music therapy methods and materials commonly used in assessment and treatment with adults and children in healthcare settings. Emphasis is placed on bio-psycho-social-spiritual issues of patients in healthcare. Discussion of healthcare access and healthcare disparities are explored, and how to address those issues as they affect music therapy clinical practice.

MUS-L 353 Music Therapy Practicum II (1 cr.) P: MUS-L 254. Students will work with a board-certified music therapist to provide services with music therapy clients. Students co-lead and/or lead clinical sessions focused on the implementation of music therapy assessments. Includes clinical hours and attendance at weekly seminar. 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: MUS-L 353. Students work with a board-certified music therapist to provide services with music therapy clients with an emphasis on the process of assessment, treatment, and evaluation. Includes at least two clinical hours per week and attendance at a weekly seminar. May be repeated.

MUS-L 370 Clinical Reasoning in Music Therapy (3 cr.) P: MUS-L 153. Introduction to the concepts and practice of critical thinking, clinical reasoning, and clinical judgment within the field of music therapy. The 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 health.

MUS-L 410 Administrative and Professional Issues in Music Therapy (2 cr.) P: MUS-L 340 and MUS-L 420. Study of government and professional guidelines that influence music therapy services and documentation practice. Includes development of administrative skills such as proposal writing, public relations, budgeting, staff relationships, interviewing, program development, conflict resolution and professional standards and ethics. Emphasis is placed on government relations and issues of advocacy.

MUS-L 415 Music Therapy Technology Lab (2 cr.) P: MUS-A 132. Application of previously gained knowledge of music technology (hardware and software) to the field of music therapy. The course includes exploration o current technologies used in music therapy settings and issues of cyber security related to technology in healthcare.

MUS-L 418 Psychology of Music (3 cr.) An in-depth study of the psychological foundations of music behavior including human response to music, music preference and ability; psychoacoustical parameters; and an exploration of the question, "Why are humans musical?" Overview of music psychology research, and the scientific method, and research techniques. Offered online.

MUS-L 419 Introduction to Music Therapy Research Methods (3 cr.) P: L418. Overview and implementation of research methods, statistics and techniques applied to psychology of music principles. Includes research ethics training and the completion of experimental project related to psychology of music or musical behaviors.

MUS-L 420 Clinical Processes in Music Therapy (3 cr.) P: Consent of instructor. Overview of the music therapy treatment process. Special emphasis placed the treatment process within behavioral health settings. This course includes an in-depth exploration and discussion of cultural competence and social justice within the context of music therapy assessment, treatment planning, treatment implementation, evaluation, and discharge.

MUS-L 421 Music Therapy Practicum IV (1 cr.) P: MUS-L 353 and consent of instructor. Students work with a board-certified music therapist to provide services with clients focusing on the process of treatment from assessment through evaluation and the development of therapeutic self. Involves clinical hours and attendance at weekly seminar. May be repeated.

MUS-L 422 Theoretical Foundations of Music Therapy (3 cr.) P: MUS-L420. Study of music therapy theory, including underlying philosophies, imported and indigenous schools of thought, and related methods of clinical practice. Students will develop a personal philosophy of music therapy.

MUS-L 424 Music Therapy Internship (2 cr.) P: Consent of director of music therapy. All previous course work must be complete before beginning the internship. A six-month internship completed under the supervision of a Board-Certified Music Therapist at an AMTA approved clinical site or an affiliated site after the completion of degree course work. This course must be completed within two years of all academic work. Liability insurance required.

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.) P: MUS-A 132 (minimum grade of C). 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 232 (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 knowledge and appreciation of the broad genre of computer music, as well as practical understanding of fundamental techniques used in digital signal processing (DSP). Essays written by pioneering composers, theorists and philosophers in the field 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 a practical understanding of fundamental techniques used in digital signal processing (DSP). In addition, this course will offer examples of 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 Clinical Improvisation (3 cr.) P: MUS-L 153 and MUS-U 410. Introduce 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 exploration 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 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 development 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 expertise and accomplishment of the creator.

MUS-N 512 Foundations of Sound Production (3 cr.) P: Consent of instructor. This course explores how musical sound is produced. Fundamentals of the physics of sound will provide the technical foundation to explore musical applications. The course will cover the varying families of musical instruments, tuning and temperament, and human hearing while also introducing aspects of audio programming to reinforce theoretical concepts.

MUS-N 513 Principles of Music Technology (3 cr.) Explores underlying technologies of systems within the music and media field from a computational perspective by utilizing software programming tools and techniques to create and build interactive systems within these domains. The Max programming environment is the current format for application designs in the course.

MUS-N 514 Music Technology Methods (3 cr.) P: Consent of instructor. This course is designed to provide a functional, conceptual, and philosophical overview of graduate level music technology. Students will evaluate and analyze software, hardware, and related technology applications. Additionally, students will compare and critique these concepts and tools as they relate to the field of music technology.

MUS-N 515 Multimedia Design Application in the Arts (3 cr.) P: Consent of instructor. Addresses the usability and human factor principles of multimedia digital product design in the arts. Topics include cognitive frameworks, design patterns, user research, usability evaluation, and performance analysis. Students will apply the various cognitive theories and design principles in the creation software applications to be employed in the arts.

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 the project.

MUS-N 518 Music and Arts Technology Directed MS Project (3 cr.) P: Consent of instructor. A music and arts technology-focused project commensurate with the course load. Instructor and student will work together to develop a multi-layered project. Requirements include project research and/or development of project, final report, and presentation.

MUS-N 519 Digital Sound Design for Multimedia I (3 cr.) P: 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-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. Through the study of the past, the class will develop rationales for new and emerging technologies that relate to the expression of music today and looking towards the future.

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 526 Synthesizers and Controllers (3 cr.) Synthesizers and Controllers addresses underlying principles of analog and digital synthesizer technology. Topics covered include voltage control, additive synthesis, FM, wavetables, and MIDI. The course will also examine various types of controller technology frequently used in computer music creation and performance.

MUS-N 527 Advanced Digital Music Systems (3 cr.) Music Systems addresses underlying principles of digital audio processing, together with related control systems for live music performance, production, and installations. They will work with software to create music scenarios of their own design. Students will also program music software and will design a large-scale music system.

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 and as therapy. Student explore multiple schools of philosophical thought related to the concepts of health, wellness, being human, and values in the therapeutic process.

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. The focus of this course is the evidence-based application of music in medical settings to facilitate symptom relief and improve the health and well-being of clients. Students will critique the scientific, theoretical, and empirical basis for music interventions.

MUS-N 533 Advanced Clinical Techniques in Music Therapy (3 cr.) P: Consent of instructor. This course is designed to develop advanced level protocol delivery and data collection skills. Students will develop and carry out music therapy protocol and provide a written theoretical rationale and critique of the protocol's effectiveness. This class serves as a graduate clinical practicum. Students will engage in weekly supervision.

MUS-N 534 Introduction to Arts Based Research (3 cr.) An overview of Arts Based Research (ABR) methodologies including a critical look at the history of ABR and the many indigenous ways of knowing that preceded (and exist alongside) its creation, as well as distinguishing ABR from other forms of arts informed qualitative work.

MUS-N 600 Thesis in Music Therapy (1-6 cr.) Research thesis for M.S. in Music Therapy and M.S. in Music Technology.

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. Music 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. Music 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. Music 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. Music 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. Introduction to using therapeutic and recreational music interventions with individuals who have special needs. Includes development of skills in music conducting, planning and adapting music protocols for specific goals, sequencing and leading music experiences, and structuring experiences to facilitate participant success. Emphasis placed on music in special education, and music therapy with children and adults with developmental disabilities.

MUS-U 410 Creative Arts, Health & Wellness (2 cr.) P or C: MUS-L 153 and MUS-L 253. Overview of the use of creative arts and action-oriented experiences throughout the lifespan. Involves the study of creativity and applications designed to facilitate healthy living practices, wellness, and personal growth from a humanistic perspective. Body mechanics and healthy movement are emphasized.

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. Music 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. Muisc 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. Music 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. Music 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: or C: L253. Application to the IUPUI Music Therapy Practicum Program, permission of the director of music therapy, successful completion of a background check. A written application and oral examination of observation techniques, clinical music therapy skills, functional music, and accompaniment skills.

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.) Performance of various jazz style practices, to include improvisation and varied ensemble instrumentations.

MUS-X 398 Upper Level Music Therapy Practicum Exam (0 cr.) C: MUS-L 353. Skills check designed to assure that students are musically prepared to begin.

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.) 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 students with 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 132 (minimum grade of C) and MUS-A 140 (minimum grade of C). 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 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 29801 Leadership Seminar I for ET Student Leaders (0-1 cr.) New student peer leaders in Engineering and Technology will receive training to facilitate a mentoring relationship, lab, and/or recitation class within the School of Engineering and Technology's formal mentoring and PLTL programs. Selected topics focus on leadership styles, group dynamics, facilitation techniques, collaborative learning techniques, redirecting strategies, and student motivation.

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, thrive 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 business 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 35100 Innovation & Entrepreneurship (3 cr.) An in-depth study of innovation in existing organizations, as well

as entrepreneurship in start-up businesses, franchises, family-owned firms, and other business formats.

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 bargaining, 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 39801 Leadership Seminar II for ET Student Leaders (0-1 crs. cr.) This course introduces ET student peer leaders to the knowledge, attitudes and inner resources needed to be an effective leader. Students will utilize their first hand experiences to obtain the techniques needed to improve their leadership skills.

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 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 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 49100 Internship Program (3 cr.) P: OLS major, senior standing, OLS 48700, and consent of instructor. A practicum designed to combine University study with work experience directly related to the student's plan of study.

OLS 49801 Leadership Seminar III for ET Student Leaders (0-1 crs cr.) The content of this course focuses on applying mentoring, leadership, and facilitation skills for student leaders. Students registering for this course have completed OLS 29801 and OLS 39801. Student leaders will demonstrate their skills for leading and managing groups through completing a special project that enhances the ET PLTL/Mentoring programs.

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 50701 Quantitative Analysis and Analytics for Leaders (3 cr.) P: Graduate Standing. This course emphasizes the use of statistical analysis in critical decision-making. Specifically, the course focuses on selecting data and running appropriate statistical analyses, synthesizing findings based upon the analyses, making decisions based upon the findings, and using multiple modes to present the data, the findings, and recommendation(s) for action.

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 51600 Diversity, Equity, and Inclusion for Organizational Leaders (3 cr.) P: Graduate Standing. This course will assist stduents in identifying and understanding diversity, equity, and inclusion issues in the workplace. Students will engage with various theories and concepts related to workplace and societal diversity, equity, and inclusion and apply them to organizational settings.

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 Business & 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 57200 Integration of Project Management for Leaders (3 cr.) P: Graduate Standing. This course emphasizes critical analysis, synthesis, and evaluation of theories and application of project management knowledge and skills, leadership, communication, and stakeholder engagement. Students integrate theoretical and applied skills in planning, distributing, and managing communication; analyzing and interpreting project organization in context; and applying best practices in team management.

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 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 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 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.

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 50500 Preparing for Career Transitions: Creating an E-Portfolio (3 cr.) The purpose of the course is to help graduate students to reflect on their work and to present evidence of their knowledge, skills, and professional attributes to prospective employers. Abilities to reflect and present apply throughout one's career in rapidly changing workplace contexts. In this course, students will learn about the role of e-portfolios in presenting work to prospective employers, reflect on their goals and abilities, and learn principles of effective e-portfolio design.

TCM 51000 Effective Workplace Technical Communication (3 cr.) This course explores and applies principles of professional technical communication in industrial, technological, and business settings, with emphasis on adapting to organizational audiences, selective and organizing ideas, managing communication projects, and communicating clearly and effectively.

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 54000 Advanced Managing Document Quality. (3-4 cr.) Students examine and apply principles of creating a technical or professional publication from start to finish. Students also explore and practice publication quality management issues such as planning, researching audience and content, designing the publication, drafting, obtaining reviews, conducting usability testing, and negotiating within organizational cultures.

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.

TCM 56000 Engineering Communication in Academic Contexts (3 cr.) Develop reading, writing, and speaking skills for academic success as an engineering, science, or technology graduate student. Students analyze the structure, claims, and evidence of written documents and oral presentations. Students simulate these presentations and write similar documents to gain practical experience for successful writing and speaking in academic contexts.

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.