

## 6. KLESSE COLLEGE OF ENGINEERING AND INTEGRATED DESIGN

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The Klesse College of Engineering and Integrated Design (KCEID) houses the Department of Biomedical Engineering and Chemical Engineering, the Department of Electrical and Computer Engineering, the Department of Mechanical Engineering, the School of Architecture and Planning, and the School of Civil & Environmental Engineering, and Construction Management.

KCEID programs and experiences prepare students for the modern workforce by training them to take a holistic view to design. KCEID faculty are a diverse group of scholars and practitioners. Among them are well-recognized educators, scholars, and designers who have achieved national and international recognition for their research, publications, and professional practices. KCEID has excellent laboratory facilities where students receive hands-on instruction from faculty. Computer-aided design (CAD) facilities, including state-of-the-art workstations, are routinely used in all programs.

The Department of Biomedical Engineering and Chemical Engineering offers a Bachelor of Science degree in Biomedical Engineering (BME) and a Bachelor of Science degree in Chemical Engineering (CME).

The Department of Electrical and Computer Engineering (ECE) offers a Bachelor of Science degree in Computer Engineering (CPE) and a Bachelor of Science degree in Electrical Engineering (EE). ECE also houses the certificate program in Artificial Intelligence.

The Department of Mechanical Engineering (ME) offers a Bachelor of Science degree in Mechanical Engineering and four certificate programs in: (1) Aerospace Engineering, (2) Heating, Ventilation, and Air-Conditioning, (3) Industrial and Manufacturing Engineering, and (4) Oil/Gas.

The School of Architecture and Planning (SAP) offers a Bachelor of Science degree in Architecture and a Bachelor of Science degree in Interior Design. SAP offerings also include undergraduate courses in Urban and Regional Planning and a certificate program in Design Communication and Fabrication.

The School of Civil & Environmental Engineering, and Construction Management offers a Bachelor of Science degree in Civil Engineering and a Bachelor of Science degree in Construction Science and Management.

In addition, KCEID offers certificates in Engineering Projects in Community Service (EPICS) and Data Center Design.

KCEID programs in Biomedical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, and Mechanical Engineering are accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org>). Chemical Engineering is a newly established program and will seek accreditation following graduation of their first class per ABET policy. The Construction Science and Management degree is accredited by the American Council for Construction Education (ACCE (<https://www.acce-hq.org/>)).

### Signature Experience Requirement

All undergraduate students in KCEID are required to participate in an approved signature experience opportunity as a condition of graduation. The signature experience requirement will engage students in educational opportunities that allow them to gain real-world experience in their field of study. Students must complete one experience in one of the following four experiential learning categories: **internship**, **research**, **study abroad** programs, and **service-learning (INTERESTS)**. A description of each category is provided below.

**Internship:** A short-term, supervised period of activities carried out in an organization closely related to a student's field of study. Internships provide students the opportunity to put their skills into practice and explore career interests. Internships are full-time or part-time, credit or non-credit, and occur during the fall, spring, or summer semesters. Students may conduct internships in the private, public, and non-profit sectors. To earn academic credit for an internship, students must identify an opportunity that meets the conditions set by each Department/School and obtain approval. Co-op approval forms are available at KCEID's website (<https://ceid.utsa.edu/future-undergraduate/#forms>). The Student Success Center (SSC) serves as the central point of contact for industry professionals to connect with students regarding internship opportunities. Students can visit the SSC website (<https://ceid.utsa.edu/ssc/>) to identify available internship opportunities.

**Research:** Participation in activities that promote academic inquiry and scientific discovery in a field closely related to a student's major of study. Examples of research activities include laboratory work, design research, literature review, data collection, data analysis, field assessment, code development, among others. Research studies can be conducted in the student's home department or school, UTSA laboratories and studios, national laboratories, academic institutions, non-profit, applied research and development organizations, and research centers. Students must conduct research under the direction of a qualified supervisor and complete all appropriate training before engaging in research. Several KCEID programs offer research courses that satisfy technical elective requirements. The Office of Undergraduate Research (O.U.R) supports undergraduate students' participation in research activities by identifying opportunities. Students can visit the OUR website (<https://provost.utsa.edu/undergraduate-research/>) to search for research opportunities throughout the nation. In addition, research-track professors, schools, departments, KCEID Institutes and Centers, and the SSC offer students several research opportunities. Students and supervisors are encouraged to present their research findings in professional meetings and scientific publications.

**Study Abroad Programs:** International experiences expand students' worldview and provide them access to peculiar sites to obtain valuable knowledge relevant to their major. Architecture and Interior Design students have an international studies requirement in their respective curricula that is fulfilled via programming in Urbino, Italy. In addition, Architecture, Civil Engineering, Construction Science and Management, and Interior Design students can participate in a semester program in Urbino, Italy, that allows them to fulfill curriculum requirements while abroad. Students must consult their academic advisors to prepare a plan to complete prerequisite requirements for Urbino course offerings. Students must also be advised as to options by major as there may specific requirements/constraints thereto. KCEID also offers faculty-led summer programs that permit students to earn UTSA course credits in international settings. KCEID study abroad opportunities are advertised by organizing departments or schools and the SSC. UTSA Study Abroad (<https://global.utsa.edu/education-abroad/>) provides students several

international opportunities, including exchange programs and programs through affiliated institutions. Students must consult their plans with their Academic Advisors and determine how credits completed abroad may apply to their UTSA degree.

**Service Learning:** An experiential learning opportunity that allows students to offer solutions to problems and issues of public concern by applying the knowledge gained in the classroom. KCEID offers service-learning design and design-build programs in which students partner with local and global community organizations to address human, community, and environmental needs. KCEID's Engineering Projects in Community Service (EPICS) offers students the opportunity to work in multidisciplinary teams on long-term engineering-based design projects. EPICS courses are open to students from all disciplines; each student contributes expertise in his/her academic field. Each team consists of a mix of first-year, sophomores, juniors, and seniors. Students should consult their Academic Advisors on how to fulfill program requirements while enrolling in service-learning courses. Students can also participate in service-learning experiences through service-oriented organizations, such as Engineering without Borders, which assist less fortunate communities throughout the world. To satisfy the signature experience requirement, students must complete a community project and not simply enroll in an organization. Students can access the SSC website to identify the list of student organizations that have been granted a service-oriented designation. The Center of Architectural Engagement and Center for Civic Engagement website (<https://cce.utsa.edu/>) hosts several service-learning initiatives that can be used to fulfill the Signature Experience requirement.

Students may choose to meet their signature experience requirement in one of two ways which are further described below:

- A. completing a KCEID course associated with an INTERESTS category with a grade of C- or better, or
- B. successfully participating in an approved co-curricular experience.

Students must review their program of study requirements as some programs within KCEID have experiences embedded in their curriculum that can be applied to satisfy the College signature experience requirement. Students enrolled in Architecture and Interior Design programs must participate in an international signature experience. Students in the Construction Science and Management program must complete a required internship before graduation.

## A. Signature Experience Courses

Students who opt to satisfy the experience requirement through a designated INTERESTS course are highly encouraged to choose a course that allows them to simultaneously fulfill the signature experience requirement and a core-curriculum requirement, a technical elective requirement within their program of study, or a certificate program requirement. The following courses have been approved to satisfy the College Experience Requirement.

### 1. Internship

- ARC 4333 Practicum/Internship
- BME 3033 Biomedical Engineering Internship
- CME 4803 Chemical Engineering Internship
- CSM 4933 Summer Internship
- EGR 3303 Engineering Co-op

- EGR 3353 EPICS Engineering Co-op
- IDE 4333 Practicum/Internship

### 2. Research

- ARC 4913 Independent Study<sup>1</sup>
- IDE 4913 Independent Study<sup>1</sup>
- BME 3043 Biomedical Engineering Research
- CME 4913 Independent Study<sup>1</sup>
- CME 4703 Chemical Engineering Research
- CE 4913 Independent Study<sup>1</sup>
- CSM 4913 Independent Study<sup>1</sup>
- CPE 4913 Independent Study<sup>1</sup>
- EE 4913 Independent Study<sup>1</sup>
- ME 4913 Independent Study<sup>1</sup>
- EGR 4993 Honors Research

<sup>1</sup> To satisfy the signature experience requirement, instructors must indicate that independent studies are research-oriented.

### 3. Study Abroad Programs

- Urbino program courses in Architecture: ARC 4816 International Studies Studio, ARC 4833 International Studies Drawing Seminar, and ARC 4843 International Studies History Seminar
- Urbino program courses in Interior Design: IDE 4816 International Studies Studio, IDE 4833 International Studies Drawing Seminar, and IDE 4843 International Studies History Seminar
- The study abroad/ Urbino program section of CE 4813 Civil Engineering Design
- The study abroad/ Urbino program section of CSM 4713 Construction Capstone

### 4. Service Learning

Students should complete one of the following EPICS course sequence:

- EGR 1351 First Year Participation in Engineering Projects in Community Service (EPICS) + EGR 1352 First Year Participation in Engineering Projects in Community Service (EPICS)
- EGR 2351 Sophomore Participation in Engineering Projects in Community Service (EPICS)+ EGR 2352 Sophomore Participation in Engineering Projects in Community Service (EPICS)
- EGR 3351 Junior Participation in Engineering Projects in Community Service (EPICS) + EGR 3352 Junior Participation in Engineering Projects in Community Service (EPICS)
- EGR 4351 Senior Participation in Engineering Projects in Community Service (EPICS) + EGR 4352 Senior Participation in Engineering Projects in Community Service (EPICS)

Students enrolled in these courses must also enroll in the corresponding EID zero-credit hour course from the options listed below. These courses are graded on a pass/fail basis. Passing is contingent upon uploading documentation relevant to the experience at a specified link and completing surveys throughout the semester to report activities conducted during the experience.

#### EID 3100. Signature Experience Internship. (0-0) 0 Credit Hours.

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential learning internship opportunity in which students conduct supervised professional activities in an organization closely related to their field of study. May be repeated when topics vary.

**EID 3200. Signature Experience Research. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential learning research opportunity in the student's field of study. Students must conduct research under the direction of a qualified supervisor and complete all appropriate training before engaging in research activities. May be repeated when topics vary.

**EID 3300. Signature Experience Study Abroad. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An international experiential opportunity that allows students to obtain valuable knowledge relevant to their field of study by providing them access to peculiar sites. May be repeated when topics vary.

**EID 3400. Signature Experience Service Learning. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential service-learning opportunity in which students offer solutions to problems and issues of public concern by applying the knowledge gained in the classroom. May be repeated when topics vary.

**B. Signature Experience Co-Curricular Activities**

A list of pre-approved experiences will be updated each semester at the college website before each registration period. Students interested in fulfilling the signature experience requirement through an alternative experience must obtain approval from the School Director or Department Chair of their program of study and the Associate Dean of Undergraduate Programs before committing to the experience. The experience approval application form is available on the KCEID website (<https://ceid.utsa.edu/future-undergraduate/#forms>). The petitioners must provide supplementary documentation demonstrating that the experience meets one of the INTERESTS category descriptions and requires a time commitment of at least 100 hours.

All students must complete a Signature Experience Requirement form during the registration period corresponding to the semester in which the experience will be completed. In the form, students must indicate the signature experience in which they would like to participate. Approved students must enroll in the zero credit hour EID course (EID 3100, EID 3200, EID 3300, or EID 3400) associated with the category of the experience. These courses are graded on a pass/fail basis. Passing is contingent upon uploading documentation relevant to the experience at a specified link and completing surveys throughout the semester to report activities conducted during the experience.

Waivers will be granted only under exceptional circumstances and only considered a year before graduation. Students must submit a written request explaining the exceptional circumstances and include supporting documentation. Waivers to departments or school experiences will not exempt students from KCEID's signature experience requirement.

**Degree Requirements Common to All Engineering Programs**

During their first semester, students should specify their interest in a specific engineering program by selecting biomedical, chemical, civil, computer, electrical, or mechanical engineering as a major. Undecided engineering students should select a major closest to their area of interest (refer to the program descriptions). Students may obtain additional information about each program from their academic advisor or a faculty advisor in the appropriate department or school.

Students must satisfy the University's Core Curriculum and ABET accreditation requirements. Recommended degree plans and current ABET requirements may be obtained from the specific engineering

programs. All students admitted to the KCEID must complete at least 42 semester credit hours from their required major courses at UTSA before graduation.

Course requirements common to all engineering degree programs follow.

**I. Core Curriculum requirements**

Students seeking a Bachelor of Science degree in any engineering field must fulfill University Core Curriculum requirements in the same manner as other students at UTSA.

MAT 1214 Calculus I, PHY 1943 Physics for Scientists and Engineers I, and PHY 1963 Physics for Scientists and Engineers II (also listed under section II, General Engineering requirements) may be used to satisfy the Core Curriculum requirements for Mathematics and Life and Physical Sciences.

**II. General Engineering requirements**

All degree-seeking candidates in engineering must complete the following:

CHE 1103	General Chemistry I	3
EGR 2323	Applied Engineering Analysis I	3
MAT 1214	Calculus I	4
MAT 1224 or EGR 1324	Calculus II Calculus II for Engineers	4
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	4
<b>Total Credit Hours</b>		<b>22</b>

**Gateway Courses**

Students pursuing an engineering degree must successfully complete Gateway Courses with a grade of "C-" or better in no more than two attempts. If the student does not successfully complete a Gateway Course in two attempts, then the student is required to change their major.

For the purpose of this policy, dropping a course with a grade of "W" or taking an equivalent course at another institution of higher education counts as an attempt at taking the course.

**Three-Attempt Limit**

Students pursuing an engineering degree must successfully complete all science, engineering, and math courses for their program with a grade of "C-" or better in no more than three attempts. A student unable to achieve the "C-" Grade Rule within three enrollments (attempts) shall be required to change their major.

For the purpose of this policy, dropping a course with a grade of "W" or taking an equivalent course at another institution of higher education counts as an attempt at taking the course.

**Engineering Honors**

The Engineering Honors distinction provides the opportunity for experiential and advanced study under close faculty supervision to those admitted into the Engineering Honors Program (EHP). Selection for the

honors designation is based on the student's academic performance and recommendation by a faculty member in the student's major discipline.

## Program Admission

To be eligible for the program, students must have a minimum UTSA grade point average of 3.25 and a minimum grade point average of 3.25 in their major at UTSA. These minimum averages must be maintained by the student to receive approval from the College Honors Committee. Admission to the Engineering Honors Program is competitive.

### Engineering Honors Program Admission Criteria for Freshman

Applicants entering UTSA from high school may be directly admitted to the Engineering Honors Program if they meet the following requirements:

- meet all UTSA and KCEID admission requirements,
- rank in the top 25 percent of their high school class, and
- earn a score of 1280 or higher on the new SAT or a composite score of 27 or higher on the ACT.

### Engineering Honors Program Admission Criteria for Transfer and Current UTSA Engineering Students

Transfer applicants and applicants who are current UTSA engineering students may be admitted to the Engineering Honors Program if they meet the following requirements:

- have completed 12 UTSA semester credit hours,
- have a cumulative UTSA GPA of 3.5, and
- have credit for at least one Co-Curricular Signature Experience.

Students who are admitted to the Honors College Program have direct admission to the Engineering Honors Program but must complete the Engineering Honors Program acknowledgment form in order to participate in the program. The application forms and deadlines will be available on the KCEID website.

## Program Requirements

The Engineering Honors Program requires its member to meet academic and experiential learning requirements in order to graduate with the Engineering Honors designation. Students must meet a minimum of 9 hours through any combination of:

- Any Engineering Practice in Community Service (EPICS) courses
- Signature Experience designated courses
- EGR 4993 Honors Research for 3 semester credit hours in their last year of study which may be repeated once for credit and may be approved as a technical elective with department agreement.

## Grand Challenge Scholars Program

The Grand Challenge Scholars Program (GCSP) prepares selected degree-seeking students at UTSA with a combined educational and professional development opportunity to meet the most demanding engineering problems as articulated through the National Academy of Engineering (NAE) Grand Challenges. (<http://www.engineeringchallenges.org/challenges.aspx>)

## Program Admission

Students from all disciplines are eligible and encouraged to participate in the program. The application forms and deadlines will be available on the program's website (<https://ceid.utsa.edu/grand-challenges-scholars-program/>). Applicants must prepare a portfolio plan that includes the following:

- A preliminary proposal outlining the specific grand challenge of interest to be addressed.
- Proposed plan of course-based and extracurricular activities linked to five competencies: talent, multidisciplinary, viable business/entrepreneurship, multicultural, and social. Students should access the KCEID website to identify courses and extracurricular activities that can be used to satisfy each of the five competencies.
- A letter of recommendation from a UTSA academic or research professional who agrees to serve as the GCSP mentor.

Upper-division students that have completed elements of the GCSP prior to admission will also have the opportunity to apply them following a portfolio review by the GCSP committee. A GCSP committee will review the applications and notify students of their selection status.

## Program Requirements

To graduate as a GCSP scholar, students must:

- Maintain good academic standing
- Present findings at a research event once per year
- Complete one of the following courses during the first year of admission to the program:
  - EGR 1351 First Year Participation in Engineering Projects in Community Service (EPICS),
  - EGR 2351 Sophomore Participation in Engineering Projects in Community Service (EPICS),
  - EGR 3351 Junior Participation in Engineering Projects in Community Service (EPICS)
  - EGR 4351 Senior Participation in Engineering Projects in Community Service (EPICS)
- Complete one of the following courses during the last year of the program:
  - EGR 4352 Senior Participation in Engineering Projects in Community Service (EPICS),
  - EGR 4362 Senior EPICS Design I,
  - EGR 4363 Senior EPICS Design I,
  - EGR 4373 Senior EPICS Design II
- Satisfy the five competencies through designated courses or extracurricular activities as outlined on the program's website (<https://engineering.utsa.edu/>).

## Cooperative Education in Engineering Program

The Cooperative Education in Engineering Program formally integrates University studies with institutionally supervised work experiences at cooperating organizations. Students participating in this program alternate periods of study at the University with periods of employment in industry. This combination of experiences enhances the student's knowledge, personal development, and preparation for a professional career. Participants register at the University each semester. During the work periods, students register for the 3-semester-credit-hour EGR 3303 Engineering Co-op course. At the end of each work period, students submit reports covering the period. These reports are the basis of the student's grades in the course. The cooperative education work periods also provide students with a source of income to help pay for their college expenses.

To qualify for the Cooperative Education in Engineering Program, a student must have declared an engineering major and have a minimum cumulative grade point average of 2.50 and a minimum grade point average of 2.50 in their KCEID courses. Students are advised that many co-op employers require cumulative grade point averages higher than 2.50, and some require a minimum cumulative grade point average of 3.0. Transfer students may participate in the program after completing at least one semester at UTSA.

For more information and to apply to the Cooperative Education in Engineering Program, students should contact their Undergraduate Advisor of Record (UGAR).

## Laptop Program

The laptop program requires that students entering KCEID programs have their own laptop (notebook) computers and required software. The computer should be upgradeable in order to be of productive use for the duration of the academic program. The laptop specifications may vary per academic program. For further and specific information concerning laptop requirements for each program, please see the KCEID hardware recommendations website (<https://ceid.utsa.edu/students/computer-requirements/>).

- Certificate in Engineering Projects in Community Service (EPICS) (p. 5)
- Certificate in Data Center Design (p. 5)

## Certificate in Engineering Projects in Community Service (EPICS)

The Certificate in Engineering Projects in Community Service (EPICS) will prepare degree seeking students at UTSA with a national award winning social, civic, entrepreneurship program. In the 15 hour certificate, teams design, build, and maintain systems to solve engineering-based problems for the community, non-profits, schools, and other service organizations. This program certifies to employers that participants aren't waiting to graduate to solve social problems; they have already engaged them while in college. The EPICS program at UTSA will be housed in the Klesse College of Engineering and Integrated Design but EPICS and honors section courses will be open to all undergraduates.

Students will engage in the design process from start to finish with an emphasis on sustainability as they deliver products to clients. EPICS are multi-year, and often decade long ventures, with students encouraged to work on a project for at least one year. The course structure proposed has

a 1 credit hour introduction and a 2 credit continuation each year tied to the service based project and offered at freshman, sophomore, junior and senior levels.

## Certificate Requirements

Students will be required to complete a minimum of 15 semester credit hours for the certificate, credits may be repeated if engaged in different course sections tied to each project. Students may register for either 1 or 2 hours of credit but will be required to take on a higher-level role if registering for 2 hours of credit in a semester. The EPICS program will also encourage the use of a co-op internship at the host partner business if available. The EPICS co-op may be substituted for technical elective credit with permission of the department. Courses must be taken at their level of current status; freshman may take EPICS courses if between 0-29 hours, sophomores at 30-59, juniors at 60-89, and seniors at or above 90 hours. Certificates will be awarded upon completion of the 15 approved hours, and with a GPA of 2.0 or above.

Code	Title	Credit Hours
<b>Freshman Students</b>		
EGR 1351	First Year Participation in Engineering Projects in Community Service (EPICS)	1
EGR 1352	First Year Participation in Engineering Projects in Community Service (EPICS)	2
<b>Sophomore Students</b>		
EGR 2351	Sophomore Participation in Engineering Projects in Community Service (EPICS)	1
EGR 2352	Sophomore Participation in Engineering Projects in Community Service (EPICS)	2
<b>Junior Students</b>		
EGR 3351	Junior Participation in Engineering Projects in Community Service (EPICS)	1
EGR 3352	Junior Participation in Engineering Projects in Community Service (EPICS)	2
EGR 3353	EPICS Engineering Co-op	3
<b>Senior Students</b>		
EGR 4351	Senior Participation in Engineering Projects in Community Service (EPICS)	1
EGR 4352	Senior Participation in Engineering Projects in Community Service (EPICS)	2

Senior engineering students may be allowed to register for interdisciplinary senior design proportional to the hours in their home program of: Biomedical, Chemical, Civil, Computer, Electrical or Mechanical Engineering provided they meet the prerequisites of their respective senior design class, with permission of the department and with prior engagement with EPICS projects. Students enrolled in EPICS senior design will be tasked with a significant leadership role of juniors, sophomores and freshmen.

EGR 4362	Senior EPICS Design I	2
EGR 4363	Senior EPICS Design I	3
EGR 4373	Senior EPICS Design II	3

## Certificate in Data Center Design

The certificate program in Data Center Design is designed so that students in mechanical, civil, and electrical engineering disciplines will take all the required courses in their disciplines, then, take additional courses from other majors (options A, B and C shown below). For

instance, in order to be certified, a mechanical engineering student not only has to satisfy the mechanical engineering degree requirements, but also needs to complete courses in option A, shown below. All students must satisfy the prerequisites for courses in the option before registering for courses. Regardless of the option, all participating students must complete a 3 semester credit hour data center design project. The following exhibits the description of the project:

#### **EGR 4953 Special Studies in Engineering** **Overview of Data Center Design and Operation**

The goal of this course is to provide the student with a broad overview of the application of technical course material and to utilize that knowledge in completion of an approved data center project. The scope of the project encompasses all of the requisite phases in planning for a system deployment into a data center. The phases are: planning, requirement analysis, facility design and installation, system deployment, check out and transitioning to operations. Students should propose the projects, an advisor will be assigned (either from UTSA or industry), and the project will be evaluated as the principal element of the student's grade. Additionally, the course will include field trips to data centers, and guest lecturers to be provided. Some examples of the lecture topics include: Information Technology set up considerations, PSC management and systems monitoring, fire protection/detection at room and cabinet level, future power projections for servers and high performance computers, future cooling applications, physical security measures, etc. Successful course completion includes completing a class project and project presentation.

### **Option A. Mechanical Engineering Students**

Requires 15 semester credit hours in addition to the B.S. in Mechanical Engineering degree requirements. Mechanical Engineering students pursuing a certificate in Data Center Design must complete the following courses:

Code	Title	Credit Hours
CE 3113	Structural Analysis	3
CE 3213	Reinforced Concrete Design	3
EE 3413	Analysis and Design of Control Systems	3
EE 4953	Special Studies in Electrical and Computer Engineering (Power Electronics)	3
EGR 4953	Special Studies in Engineering (Overview of Data Center Design and Operation)	3
<b>Total Credit Hours</b>		<b>15</b>

### **Option B. Civil Engineering Students**

Requires 21 semester credit hours in addition to the B.S. in Civil Engineering degree requirements. Civil Engineering students pursuing a certificate in Data Center Design must complete the following courses:

Code	Title	Credit Hours
EE 2213	Electric Circuits and Electronics	3
EE 3413	Analysis and Design of Control Systems	3
EE 4953	Special Studies in Electrical and Computer Engineering (Power Electronics)	3
EGR 4953	Special Studies in Engineering (Overview of Data Center Design and Operation)	3
ME 3293	Thermodynamics I	3

ME 4293	Thermodynamics II	3
ME 4313	Heat Transfer	3
<b>Total Credit Hours</b>		<b>21</b>

### **Option C. Electrical Engineering Students**

Requires 18 semester credit hours in addition to the B.S. in Electrical Engineering degree requirements. Electrical Engineering students pursuing a certificate in Data Center Design must complete the following courses:

Code	Title	Credit Hours
EE 4953	Special Studies in Electrical and Computer Engineering (Power Electronics)	3
EGR 4953	Special Studies in Engineering (Overview of Data Center Design and Operation)	3
ME 3293	Thermodynamics I	3
ME 3663	Fluid Mechanics	3
ME 4293	Thermodynamics II	3
ME 4313	Heat Transfer	3
<b>Total Credit Hours</b>		<b>18</b>

### **Engineering (EGR) Courses**

#### **EGR 1003. Engineering Design and Problem Solving. (3-0) 3 Credit Hours.**

This course will introduce students to the scope of engineering, foundations of engineering science, and engineering design. Engineering fundamentals and design methods are addressed through rigorous design challenges and reverse engineering and redesign modules. The modules are designed so that students learn specific engineering content as they solve engineering problems in multiple contexts. This course is restricted to students in the Engineer Your World program. Course Fees: LRE1 \$25; STSE \$30.

#### **EGR 1313. Calculus with Engineering Applications. (3-2) 3 Credit Hours.**

Prerequisite: Completion of precalculus or satisfactory performance on a placement examination. The first of a two-part integrated physics and calculus course. Calculus topics include an introduction to the concepts of limit, continuity, and derivative, mean value theorem, and applications of derivatives such as velocity and acceleration; introduction to the Riemann integral and the fundamental theorem of calculus. Physics topics include an introduction to vectors, force and Newton's Laws of Physics. Classes meet weekly for three hours of lecture and two hours of problem solving tutorials. Course Fees: LRE1 \$25; STSE \$30.

#### **EGR 1324. Calculus II for Engineers. (4-0) 4 Credit Hours. (TCCN = MATH 2414)**

Prerequisite: MAT 1214. Methods of integration, applications of the integral, sequences, series, and Taylor expansions. Calculus topics are combined with physics applications including an introduction to vectors, parametric equations, gradients, and Newton's Laws of Physics. (Credit cannot be earned for both EGR 1324 and MAT 1224.) Course Fees: LRE1 \$25; STSE \$40.

**EGR 1343. The Impact of Modern Technologies on Society. (3-0) 3 Credit Hours.**

Prerequisites: Basic background in high school mathematics and physical sciences. This course is designed to inform students of the social impact of modern technologies. The course explores the issues faced by society as technology becomes an integral part of human life. The course prepares students to think critically, practically, creatively and responsively about technological and sociological challenges, and encourages them to examine solutions of their own. The course also explores and discusses the socio-technological interplay. May be applied toward the core curriculum requirement in Social and Behavioral Sciences. Course Fees: LRC1 \$12; LRE1 \$25; STSE \$30; DL01 \$75.

**EGR 1351. First Year Participation in Engineering Projects in Community Service (EPICS). (1-2) 1 Credit Hour.**

Engineering Projects in Community Service (EPICS) courses create a vertical project track under which students work in multidisciplinary teams on long-term engineering-based design projects. Projects of at least one-year in duration are intended to solve real problems that are defined in consultation with "customers" from not-for-profit community and education organizations. EPICS courses are open to students from all disciplines; each student contributes expertise in his/her academic discipline. Each team consists of a mix of first year, sophomores, juniors, and seniors. Students are encouraged to participate in an EPICS project team for two or more semesters. First year students gain insight into the specific project, and more generally, into the design and development process. They attend planning and reporting meetings with the customer and are expected attend all team meetings. Under the mentorship of the team's sophomores, juniors, and seniors they perform and report upon tasks consistent with their level of discipline expertise. May be repeated for credit. Course Fees: LRE1 \$25; STSE \$10; DL01 \$25.

**EGR 1352. First Year Participation in Engineering Projects in Community Service (EPICS). (2-2) 2 Credit Hours.**

Prerequisite: Permission of instructor required. Continuation of Engineering Projects in Community Service (EPICS). Participants gain insight into the specific project, and more generally, into the design and development process. They attend planning and reporting meetings with the customer and are expected to attend all team meetings. Working with the team's sophomores, juniors, and seniors, they perform and report upon tasks consistent with their level of discipline expertise. EPICS 1352 is offered for two credits and is intended for students who have exhibited significant achievement in EGR 1351 and desire the level of responsibility that is appropriate for two credits. May be repeated for credit. Course Fees: LRE1 \$25; STSE \$20.

**EGR 1403. Technical Communication. (3-0) 3 Credit Hours.**

Prerequisite: WRC 1013. Oral, written, graphical and visual communication; technical instructions; design project with presentation; teamwork; and personal responsibility. May be applied toward the Core Curriculum requirement in the Component Area Option. Course Fees: LRC1 \$12; LRE1 \$25; STSE \$30; DL01 \$75.

**EGR 2103. Statics. (3-0) 3 Credit Hours. (TCCN = ENGR 2301)**

Prerequisites: PHY 1943, and completion of or concurrent enrollment in MAT 1224. Vector analysis of force systems applied to particles and rigid bodies and free body diagrams. Engineering applications of equilibrium; of moments, internal forces, and friction; and of centroids, centers of gravity, and moments of inertia. Generally offered: Fall, Spring, Summer. Course Fees: LRE1 \$25; STSE \$30; DL01 \$75.

**EGR 2213. Statics and Dynamics. (3-0) 3 Credit Hours.**

Prerequisites: MAT 1224 and PHY 1943. Force, moment, equilibrium, centroids and moments of inertia, kinematics, and kinetics of particles. Not open to students in Civil or Mechanical Engineering. May not be substituted for EGR 2103. Generally offered: Fall, Spring, Summer. Course Fees: LRE1 \$25; STSE \$30.

**EGR 2323. Applied Engineering Analysis I. (3-1) 3 Credit Hours.**

Prerequisite: MAT 1224 or EGR 1324. Application of mathematical principles to the analysis of engineering problems using linear algebra and ordinary differential equations (ODE's). Topics include: mathematical modeling of engineering problems; separable ODE's; first-, second-, and higher-order linear constant coefficient ODE's; characteristic equation of an ODE; non-homogeneous equations; Laplace transforms; shifting theorems; convolution; solution of an ODE via Laplace transform; matrix addition and multiplication; solution of a linear system of equations via Gauss elimination and Cramer's rule; rank, determinant, and inverse of a matrix; eigenvalues and eigenvectors; existence and uniqueness of solutions; solution to system of ODE's by diagonalization. One hour of problem solving recitation. Generally offered: Fall, Spring, Summer. Course Fees: LRE1 \$25; STSE \$30; DL01 \$75.

**EGR 2351. Sophomore Participation in Engineering Projects in Community Service (EPICS). (1-2) 1 Credit Hour.**

Continuation of Engineering Projects in Community Service (EPICS). Sophomores gain insight into the specific project, and, more generally, into the design and development process. They attend planning and reporting meetings with the customer and are expected attend all team meetings. Under the mentorship of the team's juniors and seniors, they perform and report upon tasks consistent with their level of discipline expertise. May be repeated for credit. Course Fees: LRE1 \$25; STSE \$10.

**EGR 2352. Sophomore Participation in Engineering Projects in Community Service (EPICS). (2-2) 2 Credit Hours.**

Continuation of Engineering Projects in Community Service (EPICS). Sophomores gain insight into the specific project, and, more generally, into the design and development process. They attend planning and reporting meetings with the customer and are expected attend all team meetings. Under the mentorship of the team's juniors and seniors they perform and report upon tasks consistent with their level of discipline expertise. May be repeated for credit. Course Fees: LRE1 \$25; STSE \$20.

**EGR 2513. Dynamics. (3-0) 3 Credit Hours. (TCCN = ENGR 2302)**

Prerequisites: MAT 1224 and EGR 2103. Kinetics of particles and plane rigid bodies, work and energy, impulse and momentum, equations of motion and engineering applications. Generally offered: Fall, Spring, Summer. Course Fees: LRE1 \$25; STSE \$30; DL01 \$75.

**EGR 3303. Engineering Co-op. (0-0) 3 Credit Hours.**

Prerequisite: Acceptance into the Cooperative Education in Engineering Program. Designed for students participating in Cooperative Education in Engineering Program. Problems related to students' work assignments during their work for co-op employers. No more than 3 semester credit hours of Engineering Co-op may apply to a bachelor's degree. To apply 3 semester credit hours of Engineering Co-op as a technical elective toward a degree in engineering, a student must petition and get approval of a faculty supervisor prior to co-op activities. (Formerly EGR 3301. Credit cannot be earned for both EGR 3303 and EGR 3301.) Differential Tuition: \$165.

**EGR 3323. Applied Engineering Analysis II. (3-1) 3 Credit Hours.**

Prerequisite: EGR 2323. Application of mathematical principles to the analysis of engineering problems using vector differential and integral calculus, partial differential equations, and Fourier series; complex variables; discrete mathematics; and use of software tools. One hour of problem solving recitation. Generally offered: Fall, Spring, Summer. Differential Tuition: \$165. Course fee: DL01 \$75.

**EGR 3351. Junior Participation in Engineering Projects in Community Service (EPICS). (1-2) 1 Credit Hour.**

Prerequisite: Upper-division standing. Continuation of Engineering Projects in Community Service (EPICS). The responsibilities of juniors include working with the seniors in the planning and organization of the project, contributing to the design process, problem solving by contributing expertise from their discipline, meeting with the customer, and the mentorship of sophomores and freshmen. The EPICS procedures manual provides information on expected relative workload for students. May be repeated for credit. Differential Tuition: \$55.

**EGR 3352. Junior Participation in Engineering Projects in Community Service (EPICS). (2-2) 2 Credit Hours.**

Prerequisites: Upper-division standing and permission of instructor required. Continuation of Engineering Projects in Community Service (EPICS). The responsibilities of juniors include working with the seniors in the planning and organization of the project, contributing to the design process, problem solving by contributing expertise from their discipline, meeting with the customer, and the mentorship of sophomores and freshmen. The EPICS procedures manual provides information on expected relative workload for students. May be repeated for credit. Differential Tuition: \$110.

**EGR 3353. EPICS Engineering Co-op. (0-0) 3 Credit Hours.**

Prerequisite: Acceptance into the Cooperative Education in Engineering Program and permission of instructor required. Designed for students participating in EPICS Cooperative Education in Engineering Program. Problems related to students' work assignments during their work for co-op employers. No more than 3 semester credit hours of Engineering Co-op may apply to a bachelor's degree. To apply 3 semester credit hours of Engineering Co-op as a technical elective toward a degree in engineering, a student must petition and get approval of a faculty supervisor prior to co-op activities. Differential Tuition: \$165.

**EGR 3713. Engineering Economic Analysis. (3-0) 3 Credit Hours.**

Prerequisites: ECO 2013 or ECO 2023, and MAT 1224. Time-value of money concepts; techniques for economic evaluation of engineering alternatives; depreciation and taxes; inflation and market rates; contracting practices; funding public projects and related public policy issues. Generally offered: Fall, Spring. Differential Tuition: \$165. Course fee: DL01 \$75.

**EGR 4351. Senior Participation in Engineering Projects in Community Service (EPICS). (1-2) 1 Credit Hour.**

Prerequisite: Upper-division standing. Continuation of Engineering Projects in Community Service (EPICS). Seniors are responsible for the management tasks of planning and organizing their team project activity. They are expected to contribute expertise from their discipline to the design of the team's projects throughout most of the design process phases of problem identification, specification development, design, production, and deployment. Seniors will also meet with the customer and mentor the freshman, sophomores, and juniors. The EPICS procedures manual provides information on expected relative workload for students. May be repeated for credit. Differential Tuition: \$55.

**EGR 4352. Senior Participation in Engineering Projects in Community Service (EPICS). (2-2) 2 Credit Hours.**

Prerequisites: Upper-division standing and permission of instructor required. Continuation of Engineering Projects in Community Service (EPICS). Seniors are responsible for the management tasks of planning and organizing their team project activity. They are expected to contribute expertise from their discipline to the design of the team's projects throughout most of the design process phases of problem identification, specification development, design, production, and deployment. Seniors will also meet with the customer and mentor the freshman, sophomores and juniors. The EPICS procedures manual provides information on expected relative workload for students. May be repeated for credit. Differential Tuition: \$110.

**EGR 4362. Senior EPICS Design I. (1-4) 2 Credit Hours.**

Prerequisite: Permission of instructor required. Continuation of Engineering Projects in Community Service (EPICS). Seniors using EGR 4363 to fulfill capstone or design requirements where approved for their major may be required to satisfy additional course requirements specified by their degree program. The EPICS procedures manual provides information on expected relative workload for students. Seniors are responsible for the management tasks of planning and organizing their team project activity. They are expected to contribute expertise from their discipline to the design of the team's projects throughout most of the design process phases of problem identification, specification development, design, production, and deployment. Seniors will also meet with the customer and mentor the first year, sophomores and juniors. May be repeated for credit. Differential Tuition: \$110.

**EGR 4363. Senior EPICS Design I. (1-6) 3 Credit Hours.**

Prerequisite: Permission of instructor required. Continuation of Engineering Projects in Community Service (EPICS). Seniors using EGR 4363 to fulfill capstone or design requirements where approved for their major may be required to satisfy additional course requirements specified by their degree program. The EPICS procedures manual provides information on expected relative workload for students. Seniors are responsible for the management tasks of planning and organizing their team project activity. They are expected to contribute expertise from their discipline to the design of the team's projects throughout most of the design process phases of problem identification, specification development, design, production, and deployment. Seniors will also meet with the customer and mentor the first year, sophomores and juniors. May be repeated for credit. Differential Tuition: \$165.

**EGR 4373. Senior EPICS Design II. (1-6) 3 Credit Hours.**

Prerequisite: EGR 4362 or EGR 4363, and permission of instructor. Continuation of EPICS courses. Seniors using EGR 4363 to fulfill capstone or design requirements where approved for their major may be required to satisfy additional course requirements specified by their degree program. The EPICS procedures manual provides information on expected relative workload for students. Seniors are responsible for the management tasks of planning and organizing their team project activity. They are expected to contribute expertise from their discipline to the design of the team's projects throughout most of the design process phases of problem identification, specification development, design, production, and deployment. Seniors will also meet with the customer and mentor the first year, sophomores, and juniors. May be repeated for credit. Differential Tuition: \$165.

**EGR 4501. Engineering Ethics and Leadership. (1-0) 1 Credit Hour.**

Prerequisites: EGR 2323 and Upper-division standing. A study of professional engineering ethics including the history of ethical thinking, codes and professionalism, and problem-solving techniques. The connection of engineering ethics to emerging environmental, social, and governance ESG issues. Leadership is introduced using the Student Leadership Challenge to provide fundamental principles of leadership. The course will include case studies, guest speakers, and experiential learning to reinforce the topics. Differential Tuition: \$55.

**EGR 4953. Special Studies in Engineering. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Differential Tuition: \$165. Course fee: DL01 \$75.

**EGR 4993. Honors Research. (0-0) 3 Credit Hours.**

Prerequisite: Enrollment limited to candidates for college honors during their last two semesters; approval by the College Honors Committee. Supervised research and preparation of an honors thesis. May be repeated once with approval. Differential Tuition: \$165.

## **Engineering and Integrated Design (EID) Courses**

**EID 3100. Signature Experience Internship. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential learning internship opportunity in which students conduct supervised professional activities in an organization closely related to their field of study. May be repeated when topics vary.

**EID 3200. Signature Experience Research. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential learning research opportunity in the student's field of study. Students must conduct research under the direction of a qualified supervisor and complete all appropriate training before engaging in research activities. May be repeated when topics vary.

**EID 3300. Signature Experience Study Abroad. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An international experiential opportunity that allows students to obtain valuable knowledge relevant to their field of study by providing them access to peculiar sites. May be repeated when topics vary.

**EID 3400. Signature Experience Service Learning. (0-0) 0 Credit Hours.**

Prerequisite: Co-enrollment in a linked course or consent of department chair. An experiential service-learning opportunity in which students offer solutions to problems and issues of public concern by applying the knowledge gained in the classroom. May be repeated when topics vary.