
# Department of Computer Science and Engineering Undergraduate Studies Handbook

2023-2024

Academic Year

(Revised on 5/23/2023)

# CSE Department
# Contact Information

| Title | Name | Contact Information |
|---|---|---|
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# Contents

# 1 Advising Information

## 1.1 Introduction

This document provides a guide to the policies and procedures for undergraduate studies in the Department of Computer Science and Engineering at the University of Notre Dame (herein after Department). It serves both to elaborate items such as contact information and advising roles, curricular requirements and options for majors, minors and concentrations, and to summarize certain information of frequent interest to students. It supplements two University of Notre Dame undergraduate policy documents: 1) the Undergraduate Academic Code and 2) the Bulletin of Information.

Nothing herein is to be interpreted as contrary to the regulations of the Undergraduate Affairs and Programs. Circumstances will arise that either have not been included or will require a decision on the part of the Department. The advisor is always the first person to contact if a question should arise. If a problem cannot be resolved, then the Director of Undergraduate Studies (DUS) or the Department Chairman should be approached. Modifications to the department undergraduate program regulations are approved from time to time by the CSE Undergraduate Studies Committee and are made known by publishing a new version of the Undergraduate Studies Handbook.

## 1.2 CSE Web Page

The Undergraduate webpage is the best resource for:

- Standard major planning: degree requirements for CS and CPEG programs
- Courses satisfying minor and concentration requirements
- CSE student groups and organizations

## 1.3 The Undergraduate Academic Program Administrator

Mrs. Dian Wordinger can help if you need:

- CSE course registration overrides
- Clarification and confirmation of information on the CSE Web Page
- Graduation Progress System (GPS) adjustments pertaining to CSE major requirements

## 1.4 The Academic Advisor

Advisors Leonor Wangensteen and Cindy Cubillo can help if you have questions about:

- 4-year Academic Plans and Non-standard major planning
- Adding and dropping courses
- Switching majors, or adding programs, minors and concentrations
- University and College degree requirements
- Transfer student advising
- Connections to academic and other campus resources

## 1.5 The Director of Undergraduate Studies

Prof. Ramzi Bualuan is the best resource for specifics about the CS or CPEG majors:

- Study Abroad planning and course approvals
- Dual degree program approvals
- Course substitutions
- Research credit approvals
- Advice on transfer credits for courses taken at another institution
- Graduate fellowship opportunities
- What, if anything, can be double-counted for various types of requirements
- CPT/OPT issues

## 1.6 The Associate Dean for Advising and Academic Affairs

Associate Dean Mike Ryan can help if you have:

- Issues related to academic probation, dismissal, and readmission
- Course withdrawal after drop date
- Leaves of absence from the University
- Course overload approval (19+ credit hours/semester)
- S/U grading approval
- Part-time status approvals

## 1.7 Faculty Advisors

They are the best resource for general, “big picture” discussions:

- Student and department expectations for the college experience
- Discernment: is CS or CPEG the right major?
- Choosing CSE electives
- Choosing engineering minors and CSE concentrations
- Research opportunities in CSE
- Career aspirations
- Graduate school aspirations

## 1.8 Other Resources

Registrar's Office (transcripts, enrollment verification, registration information, university calendars)

Path Class Search and NOVO Browse Classes on InsideND are the best resources for:

- Course offerings and descriptions
- Course attributes, which indicate what requirements a course satisfies, e.g., CPTE - CPEG Technical Elective, WRIT – Writing Intensive core requirement, etc.

The Graduation Progress System (GPS) on InsideND:

- The GPS degree audit report is a guide when planning progress towards completion of degree. Your academic advisor or the Office of the Registrar may be contacted for assistance in interpreting the report.

The Meruelo Family Center for Career Development is the best resource for:

- Opportunities available at specific companies
- Mock interviews, Scheduling interviews, Resume preparation, and more
- Chris Washko serves as Assistant Director, Engineering Careers

University Health Services

University Student Affairs

Office of Community Standards

# 2 CSE Undergraduate Curriculum

## 2.1 Why Study Computer Science (CS) or Computer Engineering (CPEG) at Notre Dame?

Graduates of our undergraduate programs are highly sought after by top companies – our placement rate has been at or near 100% for many years.

Our graduates take up careers in the computing industry, the finance industry, large engineering companies, startup companies, consulting firms, medical informatics companies, and government. Others enter doctoral programs at leading universities. Still others pursue startup opportunities, contributing to the burgeoning innovation culture surrounding computer science and engineering.

Our programs do not assume that you come to Notre Dame with any previous experience in programming. You can become an expert software engineer through your time and experience at Notre Dame.

## 2.2 Program Outcomes

Graduates of the Computer Science and Computer Engineering programs will achieve the following objectives:

(1) They will be technically qualified for practice in the profession; they will demonstrate the ability to specify, design, and implement software and/or hardware-software systems to meet customer requirements or to advance the state of the art; the ability to employ modern computer languages, environments, and platforms in such tasks; and the ability to apply knowledge of science and mathematics to such tasks;

(2) they will be effective technical communicators, orally and in writing, and effective team members capable of working effectively in groups on computing problems;

(3) they will be ethical professionals, capable of evaluating personal and professional choices in terms of codes of ethics and ethical theories and understanding the impact of their decisions on themselves, their professions, and on society;

(4) they will be successful as graduates, either through professional employment in the private or public sector, or as students in graduate study. They will also be able to employ life-long learning tools and techniques to maintain their currency in the field.

## 2.3 Program Descriptions

### We offer two undergraduate degrees

The Computer Science Bachelor of Science Program is accredited by the Computing Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Program Criteria for Computer Science and Similarly Named Computing Programs. The Computer Engineering Bachelor of Science Program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Program Criteria for Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Programs.

The difference between the Computer Science and Computer Engineering degrees are quite significant in terms of the required set of core courses. Because the Computer Engineering and Computer Science programs are identical through the fourth semester, a switch from one program to the other is very easy to make until the beginning of the fifth semester.

### Program in Computer Science

The Program in Computer Science focuses on the application of computers to real problems, especially in the design, development, and use of software. The program is designed to foster an understanding of the key properties of algorithms (the mathematical statements of how problems are to be solved), and how to recognize and design good algorithms to solve real problems in efficient fashions. The program also includes developing the ability to engineer large, efficient, portable, and scalable pieces of software that implement good algorithms in ways that are useful to the end users, and to do so in ways that use modern software development tools and techniques.

Computer Science Curriculum

CSE Course Map (CS and CPEG)

### Program in Computer Engineering

The Program in Computer Engineering focuses on understanding the basic nature of the electronic devices that go into the creation of modern computers and on the detailed architecture and organization of such systems, both within the central processing unit and in how larger systems are assembled. Modern design tools and techniques are introduced very early in the program and used throughout to design, analyze, and prototype real digital computing systems. All computer engineering students are required to enroll in at least one of a prescribed set of design courses before graduation.

Computer Engineering Curriculum

CSE Course Map (CS and CPEG)

## 2.4 Curricular Planning

It is recommended that all CSE majors initiate a 4-year graduation plan by the end of their first year. This curricular plan should be reviewed by academic advisors or Directors of Undergraduate Studies (DUS). before the start of each new semester to ensure the student is on track to graduate on time. Planning resources include the CSE Department website, the Bulletin of Information, this CSE Undergraduate Handbook, and Grade History and the Graduation Progress System (GPS), which are both found on Inside ND.

#### Curriculum Planning Tools

For now, it is recommended to use Google Sheets when building a 4-year graduation plan, so that it may be more easily shared with advisors and DUS. Some students find it helpful to color code each type of requirement (core, college, major, and any additional courses). Additional planning tools will be shared with students as they are developed.

## 2.5 Other programs

#### B.A. in Computer Science

The Bachelor of Arts in computer science allows you to pursue a broad liberal arts education while building a strong foundation in computer science. Housed in the College of Arts and Letters, the program involves significant coursework in the College of Engineering's Department of Computer Science and Engineering. Incoming students should speak with their first-year advisor to plan courses to prepare for the major. All students interested in participating in the major should plan to apply for entry to the major during the spring of their first year. See more info at https://altech.nd.edu

**Reilly Program 5-year EG/AL Dual Degree**

The five-year dual degree program between the College of Arts and Letters and the College of Engineering enables the student to acquire degrees from both colleges. This combination program, instituted in 1952, offers students the advantages of both a liberal and a technical education. The student completing one of these combination programs has a background in the humanities and social sciences as well as a degree from one of the programs offered by the College of Engineering. Advisors for the program are available for consultation about the advisability of entering the program and about meeting the particular needs of each student pursuing this program. Qualified students are eligible to receive modest scholarship support from the John J. Reilly Endowed Scholarship program during their third, fourth, and fifth years of study. The decision to enter the program ideally should be made prior to beginning the sophomore year, although students can also enter the program at a later stage. See more info at https://reilly.nd.edu/undergraduate/dual-degree and in the Bulletin of Information.

**Dual Degree with the College of Science**

The five-year dual degree program between the College of Science and the College of Engineering enables the student to acquire degrees from both colleges—the bachelor of science from the College of Science and the bachelor of science degree in a chosen program of the College of Engineering. This combination program, instituted in 2013, offers students the advantages of the liberal arts aspects of natural science and mathematics education coupled with a strong technical education. Because a student may enter the program from either college, both colleges have agreed to a certain degree of flexibility in allowing students to meet degree requirements. See more info in the Bulletin of Information.

**Dual Degree with the Mendoza College of Business**

The five-year dual degree program between the Mendoza College of Business and the College of Engineering enables the student to earn the bachelor of science in a chosen field of the College of Engineering and the master of business administration. This program, instituted in 1991, offers students the opportunity to better integrate study in engineering and in management. The student completing this program has a background in the management sciences, as well as the first professional degree in one of the fields of engineering. See more info at https://mendoza.nd.edu/graduate-programs/mba-engineering-dual-degree/ and in the Bulletin of Information.

## 2.6 CS Course Plan for Class of 2024

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours:18)** | | | **Spring Semester (Credit Hours:18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours:17.5)** | | | **Spring Semester (Credit Hours:17.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 4 |
| CSE 20110 | Discrete Mathematics | 3 | CSE 20289 | Systems Programming | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours:16)** | | | **Spring Semester (Credit Hours:15)** | | |
| | CSE Elective | 3 | CSE 30151 | Theory of Computing | 3 |
| | CSE Elective | 3 | CSE 30332 | Programming Paradigms | 3 |
| | Technical Elective | 3 | CSE 30341 | Operating Systems | 3 |
| CSE 30321 | Computer Architecture | 4 | ACMS 30440 | Probability and Statistics | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours:15)** | | | **Spring Semester (Credit Hours:12)** | | |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | Technical Elective | 3 | CSE 40175 | Ethical and Social Issues | 3 |
| CSE 40113 | Algorithms | 3 | | Core Curriculum Course | 3 |
| | Free Elective | 3 | | Total Credit Hours | 129 |

## 2.7 CPEG Course Plan for Class of 2024

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours: 18)** | | | **Spring Semester (Credit Hours: 18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours: 17.5)** | | | **Spring Semester (Credit Hours: 17.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 4 |
| CSE 20110 | Discrete Mathematics | 3 | CSE 20289 | Systems Programming | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours: 16)** | | | **Spring Semester (Credit Hours: 15)** | | |
| | CSE Elective | 3 | CSE 30341 | Operating Systems | 3 |
| | Free Elective | 3 | ACMS 30440 | Probability and Statistics | 3 |
| EE 20100, 21100 | Intro to Electrical Engineering | 3 | EE 20221 | Signal and Information Systems | 3 |
| CSE 30321 | Computer Architecture | 4 | EE 20241 | Electronic Devices & Systems | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours: 16)** | | | **Spring Semester (Credit Hours: 12)** | | |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | Free Elective | 3 | CSE 40175 | Ethical and Social Issues | 3 |
| CSE 40522 | CPEG Capstone Design | 4 | | Core Curriculum Course | 3 |
| EE 30122 | System Theory and Applications | 3 | | Total credit hours | 130 |

## 2.8 CS Course Plan for Class of 2025

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours:18)** | | | **Spring Semester (Credit Hours:18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours:17.5)** | | | **Spring Semester (Credit Hours:17.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 4 |
| CSE 20110 | Discrete Mathematics | 3 | CSE 20289 | Systems Programming | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours:16)** | | | **Spring Semester (Credit Hours:15)** | | |
| | CSE Elective | 3 | CSE 30151 | Theory of Computing | 3 |
| | CSE Elective | 3 | CSE 30332 | Programming Paradigms | 3 |
| | Technical Elective | 3 | CSE 30341 | Operating Systems | 3 |
| CSE 30321 | Computer Architecture | 4 | ACMS 30440 | Probability and Statistics | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours:15)** | | | **Spring Semester (Credit Hours:12)** | | |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | Technical Elective | 3 | CSE 40175 | Ethical and Social Issues | 3 |
| CSE 40113 | Algorithms | 3 | | Core Curriculum Course | 3 |
| | Free Elective | 3 | | Total credit hours | 129 |

## 2.9 CPEG Course Plan for Class of 2025

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours: 18)** | | | **Spring Semester (Credit Hours: 18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric (or WRIT) | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours: 17.5)** | | | **Spring Semester (Credit Hours: 17.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 4 |
| CSE 20110 | Discrete Mathematics | 3 | EE 20223 (spring only) | Intro to Electric Circuits | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours: 16)** | | | **Spring Semester (Credit Hours: 15)** | | |
| CSE 20289 | Systems Programming | 3 | CSE 30341 | Operating Systems | 3 |
| | Free Elective | 3 | ACMS 30440 | Probability and Statistics | 3 |
| CSE 30342 (fall only) | Digital Integrated Circuits | 3 | | CSE Elective | 3 |
| CSE 30321 | Computer Architecture | 4 | CSE 30353 (spring only) | Signal Processing Fundamentals | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours: 13)** | | | **Spring Semester (Credit Hours: 12)** | | |
| CSE 40522 (fall only) | CPEG Capstone Design | 4 | CSE 40175 | Ethical and Social Issues | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | Core Curriculum Course | 3 |
| | | | | Total credit hours | 127 |

## 2.10 CS Course Plan for Class of 2026 and Beyond

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours:18)** | | | **Spring Semester (Credit Hours:18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design (WRIT*) | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric* | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric* | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours:17.5)** | | | **Spring Semester (Credit Hours:16.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 3 |
| CSE 20110 | Discrete Mathematics | 3 | CSE 20289 | Systems Programming | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours:15)** | | | **Spring Semester (Credit Hours:15)** | | |
| | CSE Elective | 3 | CSE 30151 | Theory of Computing | 3 |
| | CSE Elective | 3 | CSE 30332 | Programming Paradigms | 3 |
| | Technical Elective | 3 | CSE 30341 | Operating Systems | 3 |
| CSE 30321 | Computer Architecture | 3 | ACMS 30440 | Probability and Statistics | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours:15)** | | | **Spring Semester (Credit Hours:12)** | | |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | Technical Elective | 3 | CSE 40175 | Ethical and Social Issues | 3 |
| CSE 40113 | Algorithms | 3 | | Core Curriculum Course | 3 |
| | Free Elective | 3 | | Total credit hours | 127 |

* *Students who have AP credit for Writing and Rhetoric still owe a Writing Intensive course (WRIT attribute). Beginning fall 2023, EG 10117 has a WRIT attribute and will satisfy the WRIT requirement.*

**CS Program Requirements for Class of 2026 and Beyond**

To earn the BS CS, students must complete the following requirements

1. *Completion of University Core Curriculum requirements **(26 credits)**.* Note the Liberal Arts 1, 2 and 3 requirements will be covered by courses required by the College of Engineering and the Department of Computer Science Engineering. Also note that the University Seminars can double count as another core requirement.

2. *Completion of the College of Engineering requirements **(22 credits)***. Students must complete the following courses:
    - EG 10117 – Engineering Design (3 credits)
    - EG 10118 – Engineering Programming (3 credits)
    - MATH 10550 – Calculus I (4 credits)
    - MATH 10560 – Calculus II (4 credits)
    - CHEM 10171/11171 – Introduction to Chemical Principles (4 credits)
    - PHYS 10310 – General Physics I (4 credits)

    Additional College of Engineering degree requirements are covered by courses required by the Department of Computer Science and Engineering.

3. *Completion of the Computer Science (CS) degree requirements.*
    a. *CS mathematics and science requirement **(14 credits)***. In addition to the College of Engineering mathematics and science requirements, students must also complete the following courses:
        - MATH 20550 – Calculus III (3.5 credits)
        - MATH 20580 – Introduction to Linear Algebra and Differential Equations (3.5 credits)
        - ACMS 30440 – Probability and Statistics (3 credits)
        - PHYS 10320 – General Physics II (4 credits)

    b. *CS Core requirement (**35 credits**).* Students must complete the following courses:
        - CSE 20321 – Fundamentals of Computing (4 credits)
        - CSE 20110 – Discrete Math (3 credits)
        - CSE 20312 – Data Structures (4 credits)
        - CSE 20221 – Logic Design (3 credits)
        - CSE 20289 – Systems Programming (3 credits)
        - CSE 30321 – Computer Architecture (3 credits)
        - CSE 30141 – Theory of Computing (3 credits)
        - CSE 30332 – Programming Paradigms (3 credits)
        - CSE 30341 – Operating Systems (3 credits)
        - CSE 40113 – Algorithms (3 credits)
        - CSE 40175 – Ethics and Social Issues (3 credits)

    c. *CSE Electives (**18 credits**).* Students must complete 18 additional credits of CSE elective course. Students have a choice from 30+ courses offered by the departments of Computer Science Engineering and Electrical Engineering. (Up to

9 of the aforementioned elective credits may be fulfilled by courses offered by the Department of Electrical Engineering)

d. *Technical Electives (**9 credits**).* Students must complete 9 additional credits of technical elective courses. Students can choose from numerous courses offered by the College of Engineering and the College of Science.
e. *Free Electives (**3 credits**).* Students must complete 3 additional credits of elective courses. Students can choose from courses offered by University of Notre Dame.

4. *Earn a minimum of 127 hours of course credit.* Note that if multiple requirements are met using one course, additional coursework might be required to ensure the student achieves the 127 minimum required total credits.

## 2.11 CPEG Course Plan for Class of 2026 and Beyond

| First Year | | | | | |
|---|---|---|---|---|---|
| **Fall Semester (Credit Hours: 18)** | | | **Spring Semester (Credit Hours: 18)** | | |
| MATH 10550 | Calculus I | 4 | MATH 10560 | Calculus II | 4 |
| CHEM 10171 | Intro to Chemical Principles | 4 | | Technical Elective | 3 |
| EG 10117 | Engineering Design* | 3 | EG 10118 | Engineering Computing | 3 |
| | Core Curriculum Course | 3 | PHYS 10310 | Engineering Physics I | 4 |
| USEM or WR 13100 | University Seminar or Writing & Rhetoric* | 3 | USEM or WR 13100 | University Seminar or Writing & Rhetoric* | 3 |
| FYS 10101 | Moreau First Year Experience | 1 | FYS 10102 | Moreau First Year Experience | 1 |
| **Sophomore Year** | | | | | |
| **Fall Semester (Credit Hours: 17.5)** | | | **Spring Semester (Credit Hours: 16.5)** | | |
| MATH 20550 | Calculus III | 3.5 | MATH 20580 | Intro to Linear Algebra and Differential Equations | 3.5 |
| PHYS 10320 | Engineering Physics II | 4 | CSE 20221 | Logic Design | 3 |
| CSE 20110 | Discrete Mathematics | 3 | EE 20223 (spring only) | Intro to Electric Circuits | 3 |
| CSE 20311 | Fundamentals of Computing | 4 | CSE 20312 | Data Structures | 4 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Junior Year** | | | | | |
| **Fall Semester (Credit Hours: 15)** | | | **Spring Semester (Credit Hours: 15)** | | |
| CSE 20289 | Systems Programming | 3 | CSE 30341 | Operating Systems | 3 |
| | Free Elective | 3 | ACMS 30440 | Probability and Statistics | 3 |
| CSE 30342 (fall only) | Digital Integrated Circuits | 3 | | CSE Elective | 3 |
| CSE 30321 | Computer Architecture | 3 | CSE 30353 (spring only) | Signal Processing Fundamentals | 3 |
| | Core Curriculum Course | 3 | | Core Curriculum Course | 3 |
| **Senior Year** | | | | | |
| **Fall Semester (Credit Hours: 13)** | | | **Spring Semester (Credit Hours: 12)** | | |
| CSE 40522 (fall only) | CPEG Capstone Design | 4 | CSE 40175 | Ethical and Social Issues | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | CSE Elective | 3 |
| | CSE Elective | 3 | | Core Curriculum Course | 3 |
| | | | | Total credit hours | 125 |

* *Students who have AP credit for Writing and Rhetoric still owe a Writing Intensive course (WRIT attribute). Beginning fall 2023, EG 10117 has a WRIT attribute and will satisfy the WRIT requirement.*

**CPEG Program Requirements for Class of 2026 and Beyond**

To earn the BS CPEG, students must complete the following requirements

1. *Completion of University Core Curriculum requirements **(26 credits)***. Note the Liberal Arts 1, 2 and 3 requirements will be covered by courses required by the College of Engineering and the Department of Computer Science Engineering. Also note that the University Seminars can double count as another core requirement.

2. *Completion of the College of Engineering requirements **(22 credits)***. Students must complete the following courses:
   - EG 10117 – Engineering Design (3 credits)
   - EG 10118 – Engineering Programming (3 credits)
   - MATH 10550 – Calculus I (4 credits)
   - MATH 10560 – Calculus II (4 credits)
   - CHEM 10171/11171 – Introduction to Chemical Principles (4 credits)
   - PHYS 10310 – General Physics I (4 credits)

   Additional College of Engineering degree requirements are covered by courses required by the Department of Computer Science and Engineering.

3. *Completion of the Computer Engineering (CPEG) degree requirements.*
   a. *CPEG mathematics and science requirement **(14 credits)***. In addition to the College of Engineering mathematics and science requirements, students must also complete the following courses:
      - MATH 20550 – Calculus III (3.5 credits)
      - MATH 20580 – Introduction to Linear Algebra and Differential Equations (3.5 credits)
      - ACMS 30440 – Probability and Statistics (3 credits)
      - PHYS 10320 – General Physics II (4 credits)

   b. *CPEG Core requirement (**39 credits**).* Students must complete the following courses:
      - CSE 20321 – Fundamentals of Computing (4 credits)
      - CSE 20110 – Discrete Math (3 credits)
      - CSE 20312 – Data Structures (4 credits)
      - CSE 20221 – Logic Design (3 credits)
      - EE 20223 – Intro to Electric Circuits (new course) (3 credits)
      - CSE 30342 – Digital Integrated Circuits (new course) (3 credits)
      - CSE 30321 – Computer Architecture (3 credits)
      - CSE 20289 – Systems Programming (3 credits)
      - CSE 30341 – Operating Systems (3 credits)
      - CSE 30353 – Signal Processing Fundamentals (new course) (3 credits)
      - CSE 40522 – CPEG Capstone Design (4 credits)
      - CSE 40175 – Ethics and Social Issues (3 credits)

   c. *CSE Electives (**18 credits**).* Students must complete 18 additional credits of CSE elective course. Students have a choice from 30+ courses offered by the

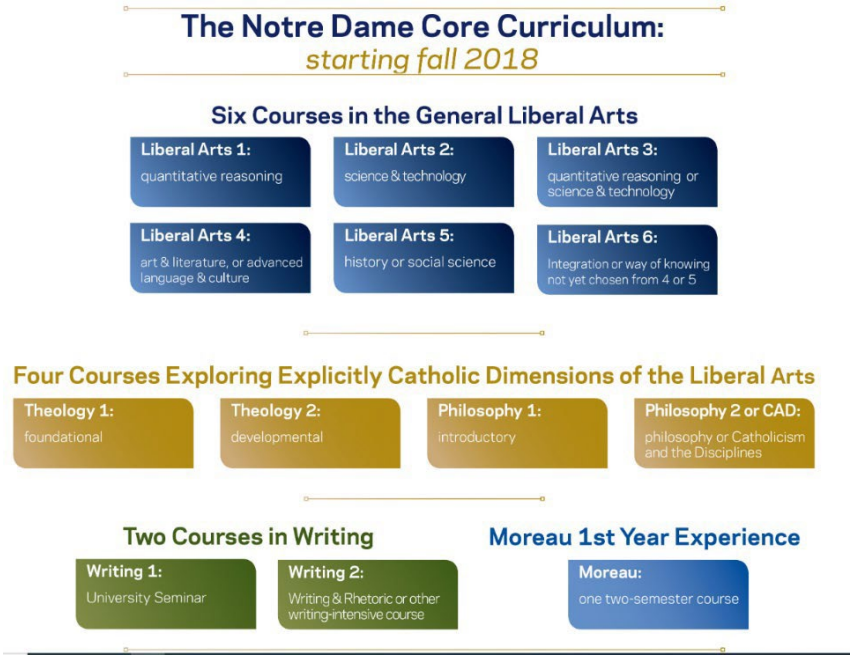
departments of Computer Science Engineering and Electrical Engineering. (Up to 9 of the aforementioned elective credits may be fulfilled by courses offered by the Department of Electrical Engineering)

d. *Technical Electives (**3 credits**).* Students must complete 3 additional credits of technical elective courses. Students can choose from numerous courses offered by the College of Engineering and the College of Science.
e. *Free Electives (**3 credits**).* Students must complete 3 additional credits of elective courses. Students can choose from courses offered by University of Notre Dame.

4. *Earn a minimum of 125 hours of course credit.* Note that if multiple requirements are met using one course, additional coursework might be required to ensure the student achieves the 125 minimum required total credits.

## 2.12 The Notre Dame Core Curriculum

Central to undergraduate education at the University of Notre Dame is the core curriculum, a set of requirements that apply to all students, regardless of major. While the approach to the core will necessarily evolve over time, the goal is always the same: to provide students with a common foundation in learning that will make a unique contribution to their intellectual and personal development as well as their lives after Notre Dame. See full description at https://corecurriculum.nd.edu/




**Six Courses in the General Liberal Arts**

- Liberal Arts 1: Quantitative Reasoning
- Liberal Arts 2: Science & Technology
- Liberal Arts 3: Quantitative Reasoning or Science & Technology
- Liberal Arts 4: Art & Literature, or Advanced Language & Culture
- Liberal Arts 5: History or Social Science
- Liberal Arts 6: Integration or Way of Knowing not yet chosen from 4 or 5

**Four Courses Exploring Explicitly Catholic Dimensions of the Liberal Arts**

- Theology 1: Foundational
- Theology 2: Developmental
- Philosophy 1: Introductory
- Philosophy 2 or CAD: Philosophy elective or Catholicism and the Disciplines

**Two Courses in Writing**

- Writing 1: University Seminar[1]
- Writing 2: Writing & Rhetoric or Other Writing-Intensive Course[2]

**Moreau First Year Experience**

- Moreau: One two-semester course

*1 A University Seminar (USEM) course may be double-counted to fulfill both the USEM requirement and one of the other university core requirements.*

*2 Students who have AP credit for Writing and Rhetoric still owe a Writing Intensive core (WRIT attribute). Beginning fall 2023, EG 10117 has a WRIT attribute.*

# 3 CSE and Technical Electives

## 3.1 CSE Electives

A CSE elective includes any CSE and EE 30000 level and above course that are not requirements of the major. Special requests for CSE Electives should be brought to brought to the Director of Undergraduate Studies.

To find these, go to class search (classsearch.nd.edu) and select the subject *CSE - Computer Science and Engr* or *EE – Electrical Engineering.* Students should make sure to read through registration restrictions for each course including pre-requisites, enrollment level limitations, and special approvals by department or instructor.

## 3.2 Technical Electives

One 10000-20000 level technical elective (ie: EE 10200, CE 10115, CHEM 10172) is accepted if taken as a First-Year student. Otherwise, technical electives are usually non-freshman course in engineering or science at the 30000 and above level, or some selective courses from other departments, provided that the content does not mostly overlap with one of your other courses.

Technical electives can be taken anytime, not necessarily during the semester indicated on the curriculum schedule. Special requests for technical electives should be brought to the Director of Undergraduate Studies.

**Engineering and science departments**

Engineering:

AME - aerospace and mechanical engineering

CE - civil engineering

CBE - chemical and biomolecular engineering

CSE - computer science and engineering

EE - electrical engineering

EG - non-departmental engineering

Science:

ACMS-applied & comp math and stats

BIOS- biological sciences

CHEM- chemistry

MATH-mathematics

PHYS-physics

SC-non-departmental sciences

**Other departments, subject to approval**

ARCH (Architecture)

DESN (Design)

CDT (Comp & Digital Technology)

FTT (Film, Television, & Theater)

MUS (Music)

One ROTC 40000 course

STV (Science/Technology/Values)

TEC (Technology Ethics)

## 3.3 Free Electives

A free elective can include any graded course that is not already counting towards University / College / Major requirements. Free electives can double count towards minors, 2nd majors, 2nd degrees, and the ROTC programs.

## 3.4 Medical School

Engineering is the fifth most common major for Notre Dame Students applying to medical school. The Center for Health Sciences Advising can provide you with advice on choosing courses as an engineering student planning to attend medical school.

Most medical schools require applicants to have taken the MCAT (Medical College Admission Test), and to have completed:

- One year of Biology (Recommend BIOS 10171/11173: Biological Sciences I and lab, BIOS 10172/11174: Biological Sciences II and lab)
- Two years of Chemistry (10171, 10172, 20273, 20274 with labs)
- One year of Physics
- Biochemistry

Many schools recommend courses in:

- Writing intensive courses
- Psychology and Sociology/Anthropology

Note that some medical schools (e.g. Harvard) require the biology courses to be taken in college (not satisfied by AP credits). If you have AP credit, you must take higher level biology courses with lab components. There are similar restrictions on AP chemistry and physics. Other schools accept credits awarded through AP testing (at Notre Dame this usually requires a score of 5). If you are interested in a specific medical school you should verify their policy on AP credits early in the program.

Hence, in addition to the CSE degree requirements, students must take additional courses. In addition to the courses, the Notre Dame preprofessional programs generally require a 1 credit lab component with each course. Students with an interest in preparing for medical school should consult with personnel in the Center for Health Sciences Advising for curricular planning advice, as they have prepared course plans for engineering students interested in medical school.

For CSE majors, only ONE 10000-20000 level science course may be used to satisfy a General Technical Elective requirement. All other Technical Electives must be at the 30000+ level. Students should consult with the Director of Undergraduate Studies for approval of any General Technical Electives that are not currently listed in GPS.

## 3.5 ROTC

ROTC courses can count toward satisfying engineering degree requirements as follows:

**Navy ROTC**

An NCSI 40000 level course can be applied to satisfy a University core requirement where the course has the necessary attribute or has been approved to meet the requirement. For example, NSCI 40402 has the WKSP attribute assigned and so it may count as the second philosophy and a technical elective course. A second NSCI 40000 level course can be used to satisfy either the HISTORY or SOCIAL SCIENCE (not both) requirement.

**Army ROTC**

An MSL 40000 level course can be used to satisfy either the HISTORY or SOCIAL SCIENCE (not both) requirement. A second MSL 40000 level course can be used to satisfy a technical elective requirement. For engineering majors with free electives, other MSL graded courses (usually 30000-level) can be used to satisfy free electives.

**Air Force ROTC**

An AS 40000 level course can be used to satisfy either the HISTORY or SOCIAL SCIENCE (not both) requirement. An AS 40000 level course can be used to satisfy a technical elective requirement. For engineering majors with free electives, other AS graded courses (usually 30000-level) can be used to satisfy free electives.

# 4 Study Abroad

Students who study abroad in the academic year generally do it during the fifth or sixth semester; a few go for the entire junior year. Below are the requirements to participate in the programs. Any student who is not behind in the program is eligible to participate. However, in certain cases students must register for the correct courses during their sophomore year to attend the program, and if they do not do so, then they are not eligible to attend.

## 4.1 Academic Year Program Locations

If a student needs to take CSE courses abroad, these locations may work for them:

- London (UK) - Spring semester only
- Dublin (Ireland) - UCD and DCU
- Hong Kong (China) - HKUST and HKU
- Perth (Australia)
- St. Andrews (Scotland)
- Singapore
- Alcoy (Spain) – students need to have the equivalent of 2 semesters of college-level Spanish (Beginning I/II) by the time they go abroad to Alcoy, or test out of that level via AP/SAT II/IB credit. If a student has not taken a Spanish class at Notre Dame, they can request a meeting with the DUS in the Spanish department who can submit the language reference on their behalf.

If a student does not need to take a course in their major during their semester abroad, they are welcome to study in any program that interests them.

Students with program specific questions should schedule an appointment with the Notre Dame International Study Abroad Team. Each location has a specific program director, which you can find at https://studyabroad.nd.edu/programs/program-advising/

For additional information on a specific program, please speak with your adviser or the DUS and visit the Notre Dame International Study Abroad website: **https://international.nd.edu/education-abroad/study-abroad/**.

## 4.2 Summer Study Abroad Programs

International Programs offered by the College of Engineering feature courses taught by Notre Dame faculty, so you can enjoy time abroad and still graduate in four years. Most engineering students choose to go abroad the summer after their first or second year (leaving later years open for internships).

The **College of Engineering** offers summer programs in:

- Alcoy (Spain)
- London (England)
- Dublin (Ireland)
- Kitakyushu (Japan)
- Rome (Italy)
- Berlin (Germany)

Other summer programs offered through Notre Dame International Study Abroad

# 5 Minors

The College of Engineering offers seven minors, open to all University students who have taken the appropriate pre-requisite courses for upper-level engineering and science courses.

A student seeking an engineering degree is allowed to count a course to satisfy a university requirement, a college/major requirement, and one additional program requirement (dual degree, supplementary major, minor, etc). Note that if multiple requirements are met using one course, additional coursework might be required to ensure the student achieves the minimum required total credits to earn the CS and CPEG engineering degrees.

Because multi counting exceptions pertain to the degree and may affect a student's ability to graduate, students should consult with their advisor or DUS to ensure that they will continue to meet graduation requirements.

The department who manages the minor should be consulted for the rules. Students in other colleges should consult their own program department for similar restrictions.

- Bioengineering
- Computational Engineering
- Energy Engineering
- Energy Studies
- Engineering Corporate Practice
- Environmental Earth Sciences
- Resiliency and Sustainability of Engineering Systems

## 5.1 Bioengineering (MBIE)

This minor, offered by the Department of Aerospace and Mechanical Engineering and the Department of Chemical and Biomolecular Engineering, comprises a six-course sequence that teaches students how to use the tools of engineering analysis with the fundamentals of the engineering and life sciences, to enliven the understanding of living organisms, medical treatments and biochemical pathways and to provide quantitative predictions and insight towards the design of medical and biological devices and processes.

***Introduction requirement:***
Students select one of five foundational courses that are suitable for students with interests in differing areas of bioengineering. Some of these courses are at the senior elective level, and may build on previous courses. Others at the sophomore level, and provide an introduction to a field. The Foundations course can be taken at any point in the undergraduate curriculum.

***Concentration area requirements:***
Students complete the minor requirements with any course in the college that has the BIOE attribute. Students are advised to pursue course sequences that are thematic, either from a single department or in a topic area that spans departments. However, there are no restrictions on specific course groupings.

***Biological Sciences Requirements:***
Students should complete the standard two semester introductory sequence in biology. These two courses are prerequisites for every biological science class offered at Notre Dame. They provide a solid grounding for students in biological sciences, covering the essential concepts of evolution, basic physiology, gene transcription and translation, proteins and signaling molecules, and progressing to ecosystems. The courses cover multi-organism systems, which is relevant for students interested in environmental engineering and epidemiology.

***Non-engineering Majors:***
The college council also approved awarding the minor to students in the college of science, and the demand from students in chemistry and biochemistry has been particularly strong. Students outside the college of engineering are expected to complete a minimum of two semesters of physics and three semesters of mathematics, including at least Calculus I and II. They must also meet the prerequisites for any engineering courses they plan to take as part of the minor, which generally includes a course in differential equations.

***AP Credits and Double Counted Credits:***
Credit for BIOS 10171 and BIOS 10172 could be satisfied for students who receive a 5 on the AP biology exam, consistent with Notre Dame Policy: https://firstyear.nd.edu/academics/advanced-placement-credit/ap-exam-credit/.

***Course Requirements***
Biological Sciences:

- BIOS 10171 Biology I: Big Questions (3 credits)
- BIOS 10172 Biology II: Molecules to Ecosystems (3 credits)

Engineering Courses:

1. One foundational course
   - AME 40571/60571 Structural Aspects of Biomaterials
   - AME 40572/60572 Introduction to Biomechanics
   - AME/CBE 30386 Introduction to Bioengineering
   - CBE 30357 Biotransport
   - EE 40331 Biomedical Device Design
   - EE 40432 Systems Biology
2. Any three additional courses with the BIOE course designator

***Study Abroad***

Students wishing to study abroad may complete these requirements based on equivalent or similar course work offered in the London, Dublin, or Perth programs. Courses that have equivalent Notre Dame Course numbers assigned by the office of International Studies or the respective departments will be accepted automatically. Please contact Professor Glen Niebur (gniebur@nd.edu) in advance to discuss possible courses.

## 5.2 Computational Engineering (MCOM)

This minor, offered by the Department of Aerospace and Mechanical Engineering, recognizes the importance of computational tools in all disciplines of engineering and gives students exposure to the fundamentals of programming and numerical methods, experience and skills in computer usage, and knowledge of applications from a range of different areas. The Computational Engineering Minor will provide the students with a solid grounding in the application of computational methods to various engineering problems such as fluid mechanics, structural analysis, elasticity, optimization, etc. With a fundamental understanding of the problems being solved and the numerical methods used to determine solutions, students are prepared to properly interpret the results, recognize the limitations of the methods employed, etc.

The Minor requires completion of 15 credits of coursework, more fully described below.

One of the following courses must be taken to fulfill the requirements for the minor:

- AME 40532 Computational Fluid Dynamics
- AME 40541/60541 Finite Element Methods
- CE 60130 Finite Elements in Engineering

Any of the following courses may be taken in order to fulfill the requirements for the Computational Engineering Minor:

- ACMS 20210 Scientific Computing[3]
- ACMS 20220 Scientific Computing Python[3]
- ACMS 40212 Advanced Scientific Computing
- ACMS 40390 Numerical Analysis [or Math 40390][4]
- ACMS 40395 Numerical Linear Algebra
- ACMS 40630 Nonlinear Dynamical Systems
- ACMS 40730 Mathematical/Computational Modeling
- ACMS 40760 Introduction to Stochastic Modeling
- ACMS 50550 Functional Analysis
- ACMS 50051 Numerical PDE Techniques for Scientists and Engineers I [or PHYS 50051]
- ACMS 50052 Numerical PDE Techniques for Scientists and Engineers II
- ACMS 60395 Numerical Linear Algebra
- ACMS 60612 Advanced Scientific Computing
- ACMS 60690 Numerical Analysis I[4]
- ACMS 60790 Numerical Analysis II
- AME 20214 Introduction to Engineering Computing[3]
- AME 40510 Introduction to Numerical Methods[5]
- AME 40532 Computational Fluid Dynamics
- AME 40541/60541 Finite Element Methods
- AME 50559 Statistical Computing Methods for Scientists and Engineers
- AME 60614 Numerical Methods
- AME 60620 Multiscale Modeling
- AME 60649 Molecular Level Modeling for Engineering Applications
- CBE 20258 Computational Methods in Chemical Engineering[5]
- CBE 40455 Process Operations
- CE 30125 Computational Methods [or CSE 30125]
- CE 40140 Applied/Computational Probability for Engineers; Uncertainty Quantification and Propagation

*3 Only one of these courses will be counted*

*4 Only one of these courses will be counted*

*5 Only one of these courses will be counted*

- CE 60130 Finite Elements in Engineering [or CSE 60130, or ACMS 60590]
- CE 60263 Finite Element Methods in Structural Mechanics
- CSE 20189 Basic UNIX for Engineers
- CSE 20232 C/C++ Programming
- CSE 40113 Design/Analysis of Algorithms
- CSE 40166 Computer Graphics
- CSE 40171 Introduction to Artificial Intelligence
- CSE 40431 Programming Languages
- CSE 40755 Parallel Computing
- MATH 30720 Discrete Fourier and Wavelet Transforms
- MATH 50510 Computer Programming/ Problem Solving
- PHYS 30421 Scientific Programming

## 5.3 Energy Engineering (MENE)

This minor, offered by the Department of Aerospace and Mechanical Engineering, recognizes that Energy is an important subject of current interest that involves many engineering and non-engineering disciplines, and enables students to develop a stronger background in and to prepare better for professional jobs or higher studies in the area. This minor differs from the Energy Studies minor as described below in that it focuses on the technical aspects of energy and requires courses concentrated in engineering and science.

Energy is clearly of pressing national and international concern, the fact of which is evidenced by recognition by Notre Dame in the creation of the Center for Sustainable Energy. The factual details of the nature of the technological energy needs facing society and the manner in which academia, and Notre Dame in particular, are addressing them were the focus of a recent article in the Signatures Magazine and include the following subjects:

- Blackouts, the stability of the power grid and other reliability issues in energy distribution;
- Energy efficiency and policy;
- The politics of power;
- Sources of energy and the related environmental concerns;
- Carbon dioxide capture and storage;
- Nuclear energy and the associated difficulties;
- Clean coal technology, and;
- Biofuels

The Energy Engineering Minor parallels the institutional commitment reflected in the creation of the Center for Sustainable Energy at the undergraduate level by providing undergraduates with the educational background necessary to confront this important technological issue of the current time.

The Minor requires completion of five courses, more fully described below.

The following courses may be taken in order to fulfil the requirements for the Energy Engineering Minor:

- AME 20231 Thermodynamics
- AME 40401 Energy, Technology and Policy

- AME 40431 Gas Turbines and Propulsion
- AME 40472 Electrical and Hybrid Vehicles
- AME 40530 Wind Turbine Performance, Control and Design
- AME 47431 Special Studies: Designing Energy-Efficient Buildings
- AME 50531 Intermediate Thermodynamics
- AME 40532 Computational Fluid Dynamics
- AME 50535 Energy Systems
- AME 50539 Photovoltaic System Design for Engineers
- AME 53631 Molecular Thermodynamics
- AME 40634/60634 Intermediate Heat Transfer
- AME 60636 Fundamentals of Combustion
- AME 60638 Turbine Engine Components
- CBE 20256 Chemical Engineering Thermodynamics
- CBE 40425 Energy, Economics, and Environment
- CBE 40435 Electrochemical Energy and Storage
- CBE 40498 Energy and Climate
- EE 30372 Electric Machinery and Power Systems
- EE 47010 Alternative Energy Devices and Materials
- EE 40472 Electrical and Hybrid Vehicles
- EE 47015 Electric Vehicles and the Power Grid
- PHYS 30461 Thermal Physics

Only one of these courses will be counted

## 5.4 Energy Studies (MENS)

The **Energy Studies Minor** is open to undergraduate students in all majors and colleges at the University of Notre Dame. This minor prepares students to become successful leaders who understand the complexities of the world's energy challenges, joining an energy network that extends far beyond campus. Students may draw from both technical and non-technical resources to learn how to help move our country and the world toward a more sustainable energy future.

The minor requires:

- ENER 20052 Concepts of Energy and the Environment
- ENER 20202 The Business of Energy
- Capstone The required capstone credit may be earned in one semester, ENER 37001, or through two half-credit seminar-style classes over two semesters, ENER 37003 and 37004. A pre-approved energy experience rounds out the minor by senior year.
- Select 9 credits of energy-related elective courses from a pre-approved list of technical and non-technical courses. Additional courses, including from study abroad programs, may be used with pre-approval.

The ESM Academic Advisor is Peter C. Burns, The Henry J. Massman Professor of Civil and Environmental Engineering and Earth Sciences and Director of ND Energy. If you have questions for Prof. Burns or would like more information about the ESM, contact Anne Berges Pillai, Education and Outreach Associate Program Director, at 574-631-9106 or apillai@nd.edu.

## 5.5 Engineering Corporate Practice (MECP)

The College of Engineering collaborates with the Mendoza College of Business and the College of Arts and Letters to offer this unique experience that prepares you for your future career while exploring topics at the intersection of engineering and business.

The Minor in Engineering Corporate Practice (MECP) is open to all engineering undergraduates.

**Required coursework**

- College of Engineering:
    - EG40421 or EG4442 (Integrated Engineering and Business Fundamentals - 3 credits)
    - EG40422 (Advanced Integrated Engineering and Business Concepts - 3 credits)
- College of Art and Letters:
    - Economics Course (AP credit does not satisfy this requirement - 3 credits)
        - Microeconomics (If no AP ECON credits)
        - Macroeconomics (If AP Micro credits)
        - Intermediate Micro Theory (If AP Micro and Macro credits)
- Mendoza, College of Business (must take Accounting or Finance plus one other course - 6 credits total):*
    - BAEG 20100 / BASC 20100 / BAAL 20100 / ACCT 20100 (Foundations of Accounting)
    - BAEG 20150 / BASC 20150 / BAAL 20150 / FIN 20150 (Foundations of Finance)
    - BAEG/MGTO 30500 Intro to Entrepreneurship
    - BAEG/MGTO 30510 Social Entrepreneurship
    - BAEG/MGTO 41500 Idea Discovery Lab
    - BAEG/MARK 20100 Foundations of Marketing

*Only 1 Mendoza course may be taken in a given semester. BAEG 20100 or BAEG 20150 must be included to complete the minor. You must register for the BAEG designated sections.

**For additional questions, please contact:**

Professor Mike Kitz (Michael.P.Kitz.1@nd.edu)

Professor Todd Taylor (Ttaylo24@nd.edu).

## 5.6 Environmental Earth Sciences (MEES)

The courses you need to take are listed in the table below.

| Course No. | Course Name | Credit |
|---|---|---|
| CE 20110 | Planet Earth | 4 |
| CE 20520 | Environmental Mineralogy | 4 |
| CE 45200 or CE 45300 | Field Trip 1 | 1 |
| | EVES Elective | 4 |
| | EVES Elective | 3 |
| | Total | 16 |

EVES Elective courses include the following courses. If applicable, appropriate pre-requisites must be taken for entry into elective courses.

- CE 20300 Global Change, Water & Energy
- CE 20320 Envir. Aquatic Chemistry
- CE 30500 Surficial Processes
- CE 30530 Sedimentation & Stratigraphy
- CE 30540 Petrology of Earth Materials (4 credits)
- CE 30560 Dynamic Earth
- CE 40300 Geochemistry
- CE 40320 Envir. & Aquatic Chem
- CE 40360 Geomicrobiology
- CE 40381 Envir. Isotope Geochem
- CE 40382 Actinide Chemistry
- CE 45200 Spring Field Trip (1 credit)
- CE 45300 Fall Field Trip (1 credit)
- CE 60310 Organic Geochemistry

## 5.7 Resiliency and Sustainability of Engineering Systems (MRSE)

The Resiliency and Sustainability of Engineering Systems minor is open to students from all disciplines (i.e., not just limited to students in the College of Engineering) who can satisfy the pre-requisites for CE10700 (see below). The minor includes two required courses, three elective courses, and a capstone experience. The two required courses are:

- CE10700 Sustainable Development in a Changing World (Required)
  Spans a broad range of topics on the environmental consequences of engineering systems in sustainable development.
- CE30720 Resiliency of Engineering Systems (Required)
  Focuses on engineering for mitigation and resiliency, also emphasizing communication skills so that graduates are equipped to work with city planners, policymakers and the public.

The three elective courses will be selected in collaboration with the Director of the Minor. Options to fulfill this requirement span multiple departments and include pre-approved courses from departments such as Political Science, Psychology, Philosophy, Laws, Economics, and Sociology. Courses will be from at least two different departments. At least two of the elective courses will be at the advanced undergraduate level (i.e., junior or senior). In addition, at least one of the three elective courses will be outside the College of Engineering.

In addition to coursework, students will be required to complete a 1-credit capstone experience. The goal is for the student to obtain hands-on experience with resiliency and sustainability issues focusing on implementation in a real-world setting, such as a related research position or an internship with a governmental body, regulatory agency, environmental advocacy group, or other organization. Proposed by the student, each capstone experience will be approved by the Director of the Minor. Projects will vary among students, and it is expected that each experience will allow the student to pursue a topic of particular interest to him/her in much more depth than a single course might allow. Each experience will be accompanied by a Capstone Thesis Report that will be due no later than the spring semester of the senior year.

# 6 CSE Concentrations

The Department of Computer Science and Engineering offers Concentrations in several areas. Each Concentration is designed to offer a structured set of elective courses around an organized theme. Most of those courses are CSE electives, while some of them are technical electives, and they would all count towards requirements of a CS or a CPEG degree. In those cases where a student has a choice for an elective requirement, the elective selection must be approved by the Director of Undergraduate Studies.

Note that the current curricula for the CS and CPEG programs for the class of 2015 and beyond have the following elective requirements:

CS requirements: 5 CSE electives, 2 technical electives, 1 free elective

CPEG requirements: 4 CSE electives, 2 free electives

Upon a student's successful completion of a CS/CPEG program with a chosen Concentration, the Concentration will appear on the student's transcript.

The Concentrations that are currently available in CSE for CS or CPEG majors are:

- BioInformatics and Computational Biology Concentration
- Cloud Computing Concentration
- Cyber Security Concentration
- Mobile Computing Concentration
- Media Computing Concentration
- (note that the IT Leadership concentration has been discontinued; interested students are encouraged to look into the Engineering Minor in Corporate Practice)

## 6.1 BioInformatics and Computational Biology Concentration

concentration code: CBCB

This program is designed to offer a sequence of elective courses to CS/CPEG* students who are interested in the field of Bioinformatics. The set of courses listed below will satisfy five CSE electives and two technical electives that are part of the requirements for a CS degree.

**CSE electives:**

1. CSE 40532: Bioinformatics Computing

   OR CSE 40884: Complex Networks

   OR CSE40817: Healthcare Analytics

2. CSE 30246: Database Concepts

3. #3-5. CSE 40xxx: Three CSE electives in advanced data processing/analysis, chosen either from (1) or the following: Distributed Computing (CSE40771), Parallel Computing (CSE40755), Cloud Computing (CSE40772), Data Mining (CSE40647), Advanced Databases (CSE40746), Software Engineering (any); Natural Language Processing (CSE40657), or Undergraduate Research

**Technical Electives:**

1. Students are highly encouraged to take Undergraduate Research to work on real biological/biochemical data as a tech elective but this is not required
2. Students with this concentration may take any of the classes below as a tech elective per an agreement with BIOS if they choose:

- BIOS 20201: Biological Sciences I
- BIOS 20250: Classical and Molecular Genetics
- BIOS 40577/60577: Topics in Genetics/Molecular Bio (with permission)

* CPEG students would use one of the CSE requirements above, and one of the technical ones, as their two free electives

## 6.2 Cloud Computing Concentration

concentration code: CCLO

This program is designed to offer a sequence of elective courses to CS/CPEG students who are interested in the field of cloud computing and other large scale software systems.

The student must take four courses from the following list:

- CSE 30264 Computer Networks
- CSE 30246 Database Concepts
- CSE 40232 Software Engineering
- CSE 40613 Web Applications
- CSE 40755 Parallel Computing
- CSE 40771 Distributed Systems
- CSE 40822 Cloud Computing
- CSE 40833 Parallel Algorithms and Programming

and take at least one semester of Undergraduate Research, involving a faculty-supervised project in the area of cloud computing:

CSE 48901 Undergraduate Research

## 6.3 Cybersecurity Concentration

concentration code: CCYS

This program is designed to offer a sequence of elective courses to CS/CPEG students who are interested in the field of computer security.

The student must take:

- CSE 40567 Computer Security
- CSE 30264 Computer Networks
- CSE 40647 Data Science (Course project oriented at security)

Finally, the student must take two additional courses from the following list:

- CSE 40232 Software Engineering
- CSE 40746 Advanced Databases
- CSE 40622 Cryptography
- CSE 40367 Computer Forensics
- CSE 40333 Mobile Application Projects
- CSE 48901 Undergraduate Research (Security-oriented topic)

A total of five courses are necessary to satisfy the concentration. Three are required, two may be selected from the second list.

## 6.4 Mobile Computing Concentration

concentration code: CMBL

This program is designed to offer a sequence of elective courses to CS/CPEG students who are interested in the field of mobile computing and communications.

The student must take the following two courses:

- CSE30264 Computer Networks
- CSE40814 Mobile Computing

In addition, the student must take three courses from the following list:

- CSE 30246 Database Concepts
- CSE 40333 Mobile Application Development
- CSE 40416 System Interface Design
- CSE 40424 Human Computer Interaction
- CSE 40633 Advanced Mobile Application Development
- CSE 40943 Autonomous Mobile Robots
- CSE 48901 Undergraduate Research (can be taken twice)

Undergraduate Research (CSE48901) must focus on a topic in the area of mobile computing or wireless networks and must be taken for a minimum of three credit hours to count as a full course. Six credit hours of undergraduate research count as two of the three elective courses. Due to frequent changes in course offerings, students interested in this concentration are encouraged to contact one of the faculty members listed below to obtain approval to count a course not listed above towards the concentration requirements.

Note that CPEG students pursuing this concentration will have to take a course load that exceeds their minimum credit requirements for their degree.

## 6.5 Media Computing Concentration

concentration code: CMED

This program is designed to offer a sequence of elective courses to CS/CPEG students who are interested in the field of Media Computing / Graphics / Animation.

The set of courses listed below will satisfy three of the CSE electives that are part of the requirements for a CS or CPEG degree.

CSE electives: 3 courses

- CSE 40166 Computer Graphics
- CSE 40655 Technical Concepts of Visual Effects
- CSE 48901 Undergraduate Research

Technical/Free electives: 2 courses

- DESN 20200: ID: Rapid Visualizations (formerly DESN 21200: Visual Dialog/Design Drawing)
- AND, upon approval, one (1) more course in any of: DESN or ARST or FTT

# 7 Undergraduate Research and Projects

## 7.1 Undergraduate Research and Engineering Projects

Most students benefit greatly from becoming involved in research projects and participating in the Department's research activities. CSE students may do research for either course credit or as a paid research aide. Please note: students cannot receive credit and be paid for the same research position.

### Finding a Research Advisor

To find suitable supervisors and research topics, students should talk to their instructors and academic advisors to find out about on-going research in the Department.

Students can explore the departmental website and the faculty websites for more detailed information on their research. Individual faculty members should be contacted directly to see if they have openings for undergraduate research aides.

Every fall semester, the College of Engineering hosts an Undergraduate Engineering Fair to showcase engineering research opportunities, projects, and labs.

### Research as a Paid Position

The supervising faculty member will determine if the research can be done as a paid position. Once this decision is made, the student should come the Department office and complete the necessary employment paperwork with CSE Undergraduate Academic Program Administrator.

### Research and Projects for Credit

CSE 28901/48901 are the variable credit Undergraduate Research courses.

> The permission of the faculty supervising the research is required to register for CSE 28901/48901. The research supervisor should email the CSE Undergraduate Academic Program Administrator, including the number of credit hours (1-3) for which the student should be enrolled.
>
> A maximum of 3 credits of CSE research can count toward CSE elective credits and another 3 credits of CSE or any other engineering and science department research can count as general technical elective credits. Students taking research from a non-CSE faculty member should sign up for the research course from that department.

CSE 20600/30660/40600 CSE Service Projects

> Course Description: Engineering projects in community service. For more information on how to become involved in CSE Service Projects, students should directly contact the professor on record.

EG 30010 Community Project Leadership

> Course Description: A practicum in project leadership and project management. Learn about relationship and task elements of using your engineering skills to execute complex real world challenges in the city. Learn about effective team building, learn to use design thinking, learn to plan your work and work your plan. Connect your STEM problem solving skills to helping people who need your help for a better quality of life.

EG 35101 Engineering Innovation Projects

> Course Description: In this course, students from different majors will work in teams on projects that develop innovative solutions to real-world problems that come from industry, government, and not-for-profit organizations. All projects will contain substantial technical engineering content, with many projects employing multidisciplinary concepts. Students will have the opportunity to select their preferred projects from a list of available projects in a given semester and then be assigned to teams. The course may be taken for 1 or 2 credits (or 3 by special permission), and taken repeatedly so that credits can be accumulated and

count towards a Technical Elective for any Engineering degree. Each student is expected to spend approximately 3 hours per week on the course per credit earned for semester-long projects (shorter projects may require a few more hours per week). All project teams will participate in a common orientation that includes topics such as project management and team leadership, but otherwise will meet at times convenient to the teams and their industry/community partners.

## Summer Research Experience for Undergrads (REUs)

Approximately 300 undergraduate students from around the world participate in research at Notre Dame in the summer. All students doing research in the summer must be registered for a course in the summer and complete the ND Roll Call process. Current Notre Dame students must get department approval in order to register through insideND. More info at https://summersession.nd.edu/programs/reu

## iTREDS Program

Interdisciplinary Traineeship for Socially Responsible and Engaged Data Scientists (iTREDS) program trains undergraduate students at the University of Notre Dame and Saint Mary's College in data science through a lens of social responsibility and community engagement, including rigor and responsibility, ethics, society, and policy.

Through the 15-credit program, iTREDS scholars develop an in-depth data science background as well as communication, critical thinking, teamwork, and other skills necessary for professional development. The program also includes experiential learning opportunities, via a capstone project and summer internship, in which students learn how to effectively engage with stakeholders, understand their needs, assess societal impact, and incorporate utility and value. More info at https://lucyinstitute.nd.edu/education/itreds-program

**Eligibility:**

- Notre Dame sophomores in the Department of Computer Science and Engineering
- Notre Dame sophomores pursuing a Data Science Minor
- St. Mary's sophomores who will have completed a calculus course and Introduction to Programming (CPSC 207) prior to beginning the program.
- To join the two-year program, students must apply their sophomore year to participate as a junior.

# 8 Student Organizations and Activities

## 8.1 Professional and Honors Societies

### 8.1.1 Engineering Leadership Council

The Engineering Leadership Council of Notre Dame exists as a student government body within the College of Engineering which supports all CoE clubs via working with the Dean's Office. ELC members are provided with excellent leadership development opportunities while serving the CoE student body with professional development and community outreach. More info contact elc@nd.edu or visit https://elc.nd.edu/

### 8.1.2 Women in Engineering

Notre Dame Women in Engineering encourages women to pursue engineering as an exciting and fulfilling educational and career choice. We bring together women at all levels — undergraduate, graduate, faculty, and alumni — to create a community of support and opportunities for women to thrive.

The Society of Women Engineers (SWE) gives support, guidance and recognition to women engineers and engineering students. Today, SWE is a nationally recognized professional, educational, non-profit, service organization. Its student section membership includes graduate and undergraduate female and male engineers. More info at https://engineering.nd.edu/student-experience/women-in-engineering/

### 8.1.3 ELITE Engineers

ELITE (Enhancing Leadership through Intentional and Transformational Experiences) engineers is a program designed to help students develop their identity as engineers and support their success inside and outside of the classroom. Programming offered through the program is centered around the pillars of career/professional development, academic excellence, community building, and wellness. Although open to anyone, this program may be of special interest to first gen and/or students from underrepresented backgrounds in STEM. Click here to join the mailing list.

### 8.1.4 Society of Hispanic Professional Engineers (SHPE)

The purpose of this student chapter is to: 1. Increase the number of underrepresented students in the fields of science, technology, engineering, and mathematics (STEM) at the University of Notre Dame. 2. Promote the advancement of underrepresented STEM students in employment and education. 3. Improve the retention of underrepresented students enrolled in STEM majors. 4. Provide a forum for the exchange of information pertinent to underrepresented STEM students enrolled at the University of Notre Dame. 5. Develop a working network with local schools to encourage pre-college, underrepresented students to enter the STEM fields. 6. Promote professional advancement for underrepresented STEM students by fostering cooperation among industry, government, academic, and professional leaders to improve educational and employment opportunities. 7. Provide counseling and financial assistance to underrepresented students in STEM. For more information, please contact us at shpe@nd.edu

### 8.1.5 National Society of Black Engineers (NSBE)

Founded in 1975, The National Society of Black Engineers has strived to increase the number of culturally responsible Black Engineers who excel academically, succeed professionally, and positively impact the community. The objective of the National Society of Black Engineers shall be to stimulate and develop student interest in engineering; to strive to increase the number of students studying engineering at both the undergraduate and graduate levels; and to endeavor in the advancement of the ethnic minority engineer in professional industry. For more information, please contact nsbe@nd.edu

### 8.1.6 TAU BETA PI

In 1960, the Indiana Gamma Chapter of Tau Beta Pi was installed at Notre Dame to foster a spirit of liberal culture in the engineering college and to recognize those who have conferred honor upon Notre Dame by distinguished scholarship and exemplary character as undergraduates in engineering or by their attainment as alumni in the field of engineering. Seniors in the top fifth of their class and juniors in the top eighth of their class are eligible for election under rigid standards of scholarship, character, leadership, and service. More info at https://sites.google.com/a/nd.edu/tbp/home

### 8.1.7 Eta Kappa Nu, Sigma Chapter

The purpose of Eta Kappa Nu is to bring closer together those students at the University of Notre Dame who excel at computer and electrical engineering while showing leadership and exemplary character. For more information, please contact us at hkn@nd.edu

### 8.1.8 Engineers Without Borders (EWB)

Engineers Without Borders - Notre Dame strives to live out the mission of EWB-USA: "EWB-USA builds a better world through engineering projects that empower communities to meet their basic human needs." In accordance with the mission of Engineers Without Borders-USA, EWB-ND strives to bring necessary changes to international communities in order to improve the quality of living. EWB-ND works with the community to implement and maintain the given project. More info at https://ewbnotredame.weebly.com/the-team.html

## 8.2 CSE Related Clubs

### 8.2.1 Notre Dame Computer Club

The University of Notre Dame Computer Club is a student chapter of the Association for Computing Machinery. The purpose of this club is to facilitate the needs and interests of the computer science and engineering students on campus as well as anybody with an interest in the subject matter. More info at https://www3.nd.edu/~cseclub/

### 8.2.2 Notre Dame Linux Users Group

The mission of the Linux Users Group of Notre Dame (NDLUG) is to promote the use and awareness of open source projects, including but not limited to Linux. We aim to provide a welcoming community for any and all open source enthusiasts and help promote the Hacker Ethic, whose tenets are central to the open source environment. More info at https://ndlug.org/

### 8.2.3 CS for Good

CS for Good is a student club focused on the intersection of computing and social good. The purpose of CS for Good shall be to use computing technology as a tool to create a positive social impact and a culture of social engagement. CS for Good will work toward its goals by: A. creating infrastructure for student teams to work on computing projects for community partners in need, B. organizing events to encourage the use of computing technology for good, such as thematic hackathons or speaker events with exemplary individuals, and C. engaging in outreach events to help South Bend residents. For more information, please email us at cs4good@nd.edu or visit http://sites.nd.edu/cs4good/

### 8.2.4 Women in Computer Science (WICS)

Women In CS (WICS) is a social and professional club for all women in Computer Science and Computer Engineering at the University of Notre Dame. We use this group to host events, build community and share valuable resources related to careers, academics and opportunities. More info at https://sites.google.com/nd.edu/ndwics/home