MAJOR DESCRIPTION & FLOWCHART

AS OF DECEMBER, 2022

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ENGINEERING

(Starting from academic year 2022-2023)

Description

Engineering is a distinctive career path at Fulbright University Vietnam, a liberal arts university. By integrating well-designed general education and a rigorous engineering curriculum, the Human-centered Engineering program at this university can be easily distinguished from those at other universities in Vietnam. In their typical jobs, engineers apply creatively the principles of science, technology, engineering, and math (STEM) to design, build, maintain, improve and even invent things to address critical human needs. Such designs and improvements include structures, machines, devices, systems, materials and processes that may have become part and parcel of our everyday life. Over the past few decades, industries have developed and undergone a radical technological transformation. The adoption of new technologies is shifting the frontier between the tasks performed by humans and those performed by machines and algorithms, increasing the demand for new job roles and skillsets. In addition, increasingly complex problems that human beings are facing often require multidisciplinary, human-centered and transformative approaches. In particular, there has been strong evidence that future great engineers need the liberal arts to develop the required emerging skill sets such as critical thinking and analysis, active life-long learning, complex problem-solving, self-management, working with people, management and communication of activities. Traditional engineering education programs in the world and those in other universities in Vietnam, however, focus heavily on specialized STEM-related knowledge and skills. They often play much less attention to students' development of knowledge, skills and mindset that could only be obtained under the umbrella of liberal arts through Arts, Humanities, and Social Sciences courses, new pedagogical approaches and extra-curricular activities. On the contrary, at Fulbright University Vietnam, the Engineering curriculum has been designed based on a student-centered, multidisciplinary, project-based, future-fit approach. The Engineering major courses are designed and developed to provide students with broad knowledge in a variety of specializations, including Electrical Engineering, Computer Engineering, Mechanical Engineering, Control Theory (Robotics) and Entrepreneurship. The sequence of courses on each of these Engineering specializations range from Foundation level (i.e., 100-level) through Intermediate level (i.e., 200-level) to Advanced level (i.e., 300-level). The Advanced-level courses and two-semester Capstone projects provide students with deep knowledge and a chance to apply what they have learned into real-world problems. In addition, students are required to complete a well-balanced set of courses in Mathematics, Natural Sciences, Arts, Humanities, and Social Sciences in order to be awarded a bachelor's degree in Engineering. Although students will be required to take half of the minimum number of credits for graduation in Engineering, they will have a certain degree of freedom of choosing Engineering elective courses to pursue their interest of study with Engineering. After graduation, Engineering students may choose different career options such as starting-up their own companies, working in industry or enrolling into post-graduate programs.

Learning Outcomes

Developed based on the whole-person educational framework of Fulbright University Vietnam and for seeking Accreditation Board for Engineering and Technology (ABET) accreditation, Engineering curriculum aims at supporting the development of graduates who will have:

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

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

Degree Requirements

A Bachelor's degree in Engineering is awarded upon the successful completion of

- 5 Core courses (20 credits) and 8 Exploratory courses (32 credits), of which up to two Exploratory courses (8 credits) can be counted towards the major.
- Fulbright Seminar (4 credits, optional) and Experiential Learning (4 – 12 credits).
- 9 Engineering major courses (36 credits).
- of which at least 3 courses are at the 300-level or Advanced level (12 credits).
- 6 Mathematics or Basic Science courses (24 credits).
- of which at least 3 Mathematics courses (12 credits).
- 1 Programming course (4 credits).
- 1 Scholar Development (in the form of internship) (4 credits).
- Capstone I OR an additional Engineering course (4 credits).
- Capstone II OR an additional 300-level Engineering course (4 credits).

Sample Student Journey

Year 1	Year 2	Year 3	Year 4
Core Courses Exploratory Courses Foundation/ Intermediate Engineering* Programming Foundation**	Core Courses Exploratory Courses Foundation/ Intermediate Engineering* Mathematics** Basic Science**	Foundation/ Intermediate Engineering Advanced Engineering (300-level) Mathematics Basic Science Scholar Development (Internship) Elective	Engineering Advanced (300-level) Mathematics/Basic Science Capstone I OR Foundation/Intermediate/Advanced Engineering Capstone II OR Advanced Engineering Electives

*Note: * can be counted toward the Exploratory category 3 requirement*

*Note: ** can be counted toward the Exploratory category 4 requirement*

Major Outline

Students will take core courses and exploratory to establish a broad and solid foundation in the first two years at Fulbright University Vietnam. Upon taking the engineering core course "Design and Systems Thinking," all students have been exposed to understanding the users' needs, defining engineering problems, and ideating potential solutions before gaining some hands-on experience creating, making and testing a physical product. Students interested in exploring further can take several Foundation Engineering courses, which are designed specifically to bridge engineering practice, mathematics, and basic sciences. In general, these courses only require the core engineering course as the prerequisite, if any, making them accessible to undetermined-major students to pursue courses of interest. Once the students declare their major or minor in Engineering, they will gain more specialized knowledge and skills by taking more Engineering Foundation courses and Engineering Advanced courses. As part of a human-centered approach that aims to determine human-centric problems and then apply innovative engineering solutions, the students will be encouraged to take Elective courses in Arts, Humanities, Social Sciences, and Entrepreneurship. In some specialized Engineering courses, they will have the opportunities to practice the learned knowledge and skill in devising more complicated systems, components, or processes to meet the target users' desired needs and required technical specifications with constraints. The students will be given certain flexibility in choosing their engineering pathway.

Sample Engineering Foundation/Intermediate Courses

- *Computer Modeling and Simulation (100-level, Foundation)*

  The real world consists of many complex systems, such as physical, biological and social systems. Those systems are composed of many parts that have their own behaviors and interact with each other to form the integrated behaviors as a whole. Computer modeling and simulation can assist us to better understand, design, create and/or evaluate such complex systems. In this course, we will learn and practice some of the most common approaches in developing mathematical models of such systems and then implement the models in Python to simulate the systems computationally to make it possible to investigate their behaviors and quantitative performance in well-designed scenarios. The students are encouraged to work in groups on term projects of which the topics may be a mechanical system, a natural process or a disease's transmission in a certain area.

- *Engineering Exploration: Sink or Swim (100-level, Foundation)*

  The project-based course guides students to perform engineering analysis through real-world examples. Describing physical systems with mathematical models can speed up the engineering design process as well as enhance the overall quality of the final products. Throughout three major projects (pop-pop engine boat, mouse trap car, and ninja robot), students will apply quantitative engineering analysis to model the dynamics of different systems based on classical physics and thus inform their design decisions. Students will have opportunities to verify their design and prediction in end-of-project competitions.

- *Electronic Devices and Circuits (200-level, Intermediate)*

  The course provides basic knowledge about Electronics, from passive to active devices, from fundamental to intermediate level circuits. Simulation tools will be used in conjunction with theory, so that student can quickly adopt theory leant into circuit simulation. The simulation result then is applied to real circuit implementation in class projects for hands-on experience and training. Circuit types includes filters, transistor-based amplifier, op-amp based amplifier, voltage source, current source, instrumentation amplifier. Practical building blocks of real circuits like transistor switch, solid-state relay, electromechanical relay, rectifier, direct current (DC)-DC converter, low drop-out (LDO) regulators, battery charger, protection circuit will be analyzed with focus on key parameters that engineer should consider while building an electronics circuit. Students are expected to build and measure their own working printed circuit board (PCB) as assignments.

- *Signals, Systems and Control (200-level, Intermediate)*

Signals are everywhere. By definition, a signal is any observable change in quantity over space or time. It could help observers to obtain information about a phenomenon. In nature, signals can be actions done by organisms to alert other organisms or sounds or motions by animals to alert other animals of danger or food. Advances in technology have improved the capabilities of human beings to identify, analyze and even synthesize diverse information sources such as audio (speech, acoustics, music), image (photos, videos, multimedia, medical scans), medical signals (heart rate, blood pressure, brain activity) and remote sensing data (geophysical, sensing, radar). In principle, signals could be represented as data values or abstractly as mathematical expressions. A system converts or manipulates an input signal into an output signal. Examples of systems are face recognition, video streaming, cellular phones, and smart homes. In this course, students will learn to use mathematical theory and computer simulation to develop models, to analyze and to manipulate signals and systems that vary in continuous-time and discrete time. Specifically, the course covers representation of signals and systems, systems properties, conversion between continuous-time and discrete-time, Laplace, Fourier and z-transforms, transfer functions, frequency responses, convolution, stability, feedback and control systems. Students will gain hands-on experience on how to process various types of signals and to analyze and design systems by computer simulation using MATLAB or a similar software package.

- *Mechanical Design (200-level, Intermediate)*

  The course covers principles and techniques for creative design of mechanical machines with engineering specifications and user requirements. From designing with a solid modeling computer aided design (CAD) package, students will then take into consideration different factors (actuators, mechanism, drivetrain, materials, manufacturing processes, and so on) that influence the machine's lifetime. Students are expected to learn the fundamental knowledge including strength of material, kinematics analytical method, fluid mechanics, and heat transfer.

- *Computer Organization (200-level, Intermediate)*

Computing systems, such as mobile phones, laptops or personal computers, have been important parts of human beings' everyday life. For example, computer scientists, programmers and engineers use computing systems in many of their tasks. Understanding of what is going on beyond the statements in high-level programming languages such as Python, Java, and C/C++ will help computer scientists and programmers write more efficient code. Similarly, such understanding helps engineers interact better with their computing systems at the device or pin level. How are computing systems designed and implemented? In principle, computing systems often involve many layers of abstraction, from gates and circuits through machine and assembly code to software libraries and applications. This course introduces students to the abstract design and implementation of computer systems from the digital level in the hardware upwards to the interface between the hardware and the software. In particular, the course starts by revisiting the concept of bits and introducing arithmetic and logical operations on bits. Next, it takes the students from the building of logic gates based on the transistor as a switch, gated latches to more complex logic structures. The knowledge is then applied to implement memory and a finite state machine. From there, students study the instruction cycle that the central processing unit (CPU) of a computer follows. As an example, students study a particular computer that can capture the important structures of a modern computer, while simple enough to facilitate complete understanding and hands-on programming experiences. Students also explore decisions and tradeoffs involved in the design and implementation. Applied projects and/or lab assignments might include the design and simulation of a CPU, and the tools used to program low-level systems.

- *Sensors, Measurement and Analysis (200-level, Intermediate)*

  This course cultivates the process of experimental investigations in the context of engineering systems. Students will work both individually and in teams to investigate the measurement of fundamental properties of the physical world like temperature, pressure, and sound intensity to design and fabricate simple electronic sensors that allow them to measure these properties in an engineering application. Furthermore, students will work on the collection and analysis of the data produced from these sensors to

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evaluate the performance of their devices and to understand real-world phenomena as the objects of designed experimental investigation.

- *Integrated Engineering Project (200-level, Intermediate)*

  This course provides students with significant engineering experience that allows future engineering majors to work on a project that develops and tests an integrated system of mechanical, electronic, and software components. Students will learn to do component design and testing as well as integration design and debugging. Team projects will be subjected to cost and time constraints that require students to develop project management and teamwork skills, and become familiarized with realistic component sourcing, contracting, and delivery processes that exist in the industry.

- *Intelligent robot studio: From theory to practice (200-level, Intermediate)*

  Robots have been a part of our daily life for decades with numerous applications ranging from home automation and medical assistance to smart factories and space exploration. The aim of this course is to develop an understanding of the basic concepts of robotics, focusing on the construction and programming of autonomous mobile robots. The course uses a studio-based approach that tightly combines instruction in theory with practical implementation. After a review of recent developments in robotics, students are introduced to fundamental concepts related to robot mechanics, kinematics, sensor systems, and motion control. They are then introduced to high-level concepts related to robot intelligence such as path planning, localization, and map building. Students are also taught essential concepts and skills of programming. Both the robotic concepts and programming skills are reinforced as they work in a supervised, hands-on, team-based project. In this project, students work in teams to apply the conceptual knowledge and skills that they have acquired to the task of building and programming a robot in hands-on sessions. Students develop their project in the framework of the engineering design process—from the analysis of requirements and initial design to implementation and testing. The course concludes with a contest designed for the robots developed by students.

- *Product Development (200-level, Intermediate)*

  The course is designed to develop students' product mindset and deeper understanding of what it takes to bring a product from idea, to launch, to future iteration. The students will begin by defining the problem a product will solve as they map the customer's journey and articulate user personas. They will have the opportunity to learn important facets of product road-mapping decisions and prototyping through several product management activities, including how to partner with designers and developers to create codeless prototypes. The focus then moves to measuring progress against objectives and presenting product learning to stakeholder. The student will apply these skills to build a minimal viable product version and collect user feedback before bringing the product to market. Although the examples of developing hardware and complicated systems may be used as illustration during class, most of the product development will focus on delivering a digital product (software, web page, etc.), This course is developed and will be delivered under the partnership with Mobile Service Joint Stock Company (M_Service), the owner of MoMo, one e-wallet in Vietnam.

- *Computer Vision (300-level, Advanced)*

  Computer vision is gaining its applications from facial recognition, human pose tracking, and interactive entertainment to medical imaging and autonomous vehicles. This course provides students with fundamental concepts in computer vision including image formation, camera modelling, feature extraction, motion estimation and tracking, and classification. It also introduces basic methods for applications such as camera calibration, depth recovery from stereo, and action recognition. Students will then apply them to practical projects related to human motion detection and autonomous vehicles with the use of embedded computers.

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Other Sample Engineering Courses

- Physics of Smart Devices (100-level, Foundation)
- Digital Communications (200-level, Intermediate)
- Real-time Digital Signal Processing (300-level, Advanced)
- Project Management (300-level, Advanced)
- Artificial Intelligence for Robotics (300-level, Advanced)
- Mechanical Systems: Design and Analysis (300-level, Advanced)
- Human-Computer Interaction (300-level, Advanced)
- Wireless Communication La (300-level, Advanced).
- Multimedia Processing (300-level, Advanced) .

Sample Programming Courses

- Computer Science 1 (Foundation)
- Computer Science 2 (Intermediate).

Sample Mathematics Courses

- Calculus
- Linear Algebra
- Discrete Mathematics
- Differential Equations
- Introduction to Data Analysis
- Probability
- Multivariate Calculus
- Stochastic Calculus

Sample Basic Science Courses

- Introductory Biology
- Environmental Sciences
- Sustainable Development: Science and Industries
- Physics for Light-based Technology

- Matter
- Physics of Smart Devices
- Cell Biology
- Energy in Daily Life
- Introduction to Bioinformatics
- Organic Chemistry
- Materials that Shape Our World
- Algae.

Requirements for Declaring the Engineering Major and Minor

To formally declare Engineering as your major, you must complete core course Design and Systems Thinking, one Programming Foundation course, two Mathematics or Basic Science courses, and two Engineering Foundation/Intermediate courses. To formally declare the Engineering minor, you must complete core course Design and Systems Thinking, one Programming Foundation course, one Mathematics or Basic Science course, and one Engineering Foundation/Intermediate course.

Graduation with Honors Requirements

- Students must complete Capstone I and Capstone II
- The Capstone must be graded Honors

Minor Requirements

A Bachelor's degree with minor in Engineering is awarded following the successful completion of

- 6 Engineering major courses (*24 credits*)
  - of which at least 2 courses are at the 300 level (*8 credits*)
- 3 Mathematics or Basic Science courses (*12 credits*)
  - of which at least 2 Mathematics courses (*8 credits*)
- 1 Programming course (*4 credits*).

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MATHEMATICS & BASIC SCIENCE COURSES

Sample Mathematics Courses (at least 3 required)

- Calculus
- Linear Algebra
- Discrete Mathematics
- Differential Equations
- Introduction to Data Analysis
- Probability
- Multivariate Calculus
- Stochastic Calculus

Sample Basic Science Courses

- Introductory Biology
- Environmental Sciences
- Sustainable Development: Science and Industries
- Physics for Light-based Technology
- Matter
- Physics of Smart Devices
- Cell Biology
- Introduction to Bioinformatics
- Organic Chemistry
- Materials that Shape Out Our World
- Algae

ENGINEERING ADVANCED COURSES (300-Level)

Sample Elective Courses

- Digital Signal Processing
- Computer Vision
- Project Management
- Artificial Intelligent for Robots
- Mechanical Systems: Design and Analysis
- Human-Computer Interaction
- Introduction to Embedded Systems
- Wireless Communication Systems
- Multimedia Processing

Flowchart

1. Programming Foundation *(1 required)*
2. Mathematics or Basic Science Courses *(6 required)*
3. Engineering Foundation OR Intermediate Courses *(2 required)*
4. Engineering Advanced Courses *(3 required)*
5. Scholar Development *(1 required)*
6. Capstone I or Engineering Course (any level) *(1 required)*
7. Capstone II or Engineering Course (300- level) *(1 required)*

PROGRAMMING FOUNDATION COURSES

- Computer Science 1 (Foundation)
- Computer Science 2 (Intermediate)

ENGINEERING INTERMEDIATE COURSES (200-Level)

Sample Intermediate Courses

- Computer Organization
- Sensors, Measurement and Analysis
- Integrated Engineering Project
- Intelligent Robot Studio: From Theory to Practice
- Product Development
- Fundamental of Mechanical Design
- Principles of Digital Communications
- Virtual Design

ENGINEERING FOUNDATION COURSES (100-level)

Sample Foundation Courses

- Computer Modeling and Simulation
- Engineering Exploration: Sink or Swim
- Signals, Systems and Controls
- Electronic Devices and Circuits

ENGINEERING MINOR

(10 courses)

- Programming Foundation *(1 required)*
- Mathematics or Basic Science - at least two of which are Mathematics *(3 required)*
- Engineering courses - at least two of which are at 300-level *(6 required)*