ISE Undergraduate Minor Options for Increased Depth in Select Areas

In this packet you will find four undergraduate minor options many Integrated Systems Engineering students pursue. Students within our program may choose to obtain any minor offered here at Ohio State, however the few highlighted within this packet enhance many of the topics covered within our Integrated Systems Engineering curriculum and fit cohesively into a successful 4-5 year undergraduate plan. Additionally, these minors allow students an opportunity to receive greater depth in the following options:

- General Business Minor
- Interdisciplinary Entrepreneurship Minor
- Design Minor
- Computer and Information Science Minor

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General Business Minor

Business Minor
The General Business Minor is designed to provide students in majors other than business with an understanding of the language and basic concepts of business. The minor consists of five courses, one each from the areas of accounting, finance, management and human resources, marketing, and operations management.

The General Business Minor does not have an application process. In order to graduate with a Business Minor, you must fulfill the guidelines listed in the curriculum requirements provided below. Upon completing the guidelines, a student need only list the Business Minor on their department graduation application. Students may request to have the business minor added to their degree audit at any time to track their progress in the minor. No approval from the Fisher College of Business is required.

Exclusions:
This minor is not open to students majoring in business or intending to major in business. Minor courses do not count toward a business degree and do not serve as prerequisites for further study in business.

Guidelines:
- Minimum C- for a course to be listed on the minor along with a 2.0 cumulative point-hour ratio required for the minor
- Course work graded Pass/Non-Pass cannot count on Minor

Below are specific Curriculum Requirements for the General Business Minor

Requirement 1. Before taking the minor courses, it is required that each student take the following courses:
- College Algebra (Math 1130 or 1148 or equivalent or higher)
- Microeconomics (Econ 2001.01 or equivalent)
- Basic Computing (CSE 1110 or higher)

*Engineering students will automatically fulfill the math and basic computing requirements, however they’ll still need to complete Econ 2001.01, which also counts as a social science general education requirement. When scheduling for ANY business minor course, students will need to contact their departmental advisor. Even though all prerequisites will have been met, the system will not allow you to
enroll yourself-an advisor will need to override you into ALL business minor courses. Please email your advisor with the exact course you’re hoping to add along with the exact section number will suffice.

**Requirement 2.** All five courses must be completed to satisfy minor requirements. Variations in the program are generally not permitted; any variations must be approved by the Associate Director of General Business Programs with the Fisher College of Business. The following five courses include:

- **AMIS 2000 (Foundations of Accounting and MIS) (3hrs)**
  - A survey of accounting for non-business students; financial statements and analysis; accounting for assets, liabilities and owner’ equity; and elements of managerial accounting

- **BUSFIN 3120 (Foundations of Finance) (3hrs) (prereq of AMIS 2000)**
  - A survey of topics in finance for non-business students including; discussion of investment, time value of money, financial markets, financial institutions, risk and return, corporate and international business

- **BUSMHR 3100 (Foundations of Management & Human Resources) (3hrs)**
  - A survey of topics in management and human resources for non-business students. The material includes a discussion of organizational behavior, human resource management and labor markets.

- **BUSMGT 3130 (Foundations of Operations Management) (3hrs)**
  - A survey of operations management for non-business students including discussion of operations management issues in both manufacturing and service organizations including management and purchasing.

- **BUSM&L 3150 (Foundations of Marketing) (3hrs)**
  - A survey of marketing for non-business students including discussion of marketing practice tools and concepts and their applications in profit and non-profit organizations.

**Requirement 3.** No more than 6 hours of transfer credit may be applied to any minor

**Requirement 4.** No grade below a C- will be permitted in courses comprising the minor; the minimum overall CPHR of the minor shall be 2.0.

**Requirement 5.** Courses taken on a Pass/Non-Pass basis may not be applied to the minor.

*Note that at most 6 of the credit hours fulfilled as part of Requirements 2 can be used as non-ISE technical electives.*
Interdisciplinary Entrepreneurship Minor

Entrepreneurship Minor

The Undergraduate Interdisciplinary Minor in Entrepreneurship is offered through a collaboration of Fisher, the College of Arts and Sciences, the College of Engineering, the College of Education and Human Ecology, and the College of Food, Agricultural and Environmental Services.

Designed for capturing the economic value in creative ideas for commercially viable products and services, this educational program enhances a student's understanding of entrepreneurship, encourages exploration into personal career opportunities through entrepreneurial studies, and develops specific competencies in the creation, growth, and leadership of entrepreneurial enterprises. The minor requires successful completion of a minimum of 15 hours and five courses.

The Entrepreneurship Minor does not have an application process. In order to graduate with an Entrepreneurship Minor, you must meet the guidelines listed in the curriculum requirements provided below. Upon completing the guidelines, a student need only list the Interdisciplinary Entrepreneurship Minor on their department graduation application. Students may request to have the Entrepreneurship Minor added to their degree audit at any time to track their progress in the minor. No approval from the Fisher College of Business is required.

Below are specific Curriculum Requirements for the Interdisciplinary Entrepreneurship Minor

Requirement 1. Students must complete the following courses:

- BUSMHR 2500 (Entrepreneurship) (3hrs) (approved for GEC, Social Science credit)
  - Examines the theoretical foundations of innovation and entrepreneurship including their influence on industry and market evolution.
- BUSMHR 3510.01 (New Venture Creation) (3hrs) (prereq of BUSMHR 2500)
  - Explores the process for creating new ventures; including ideation, evaluation of business opportunities, business planning and assembling business resources.

  OR

- BUSMHR 3510.02 (Creating Social Venture) (3hrs) (prereq of BUSMHR 2500)
  - Examines the creation of entrepreneurship ventures in the non-profit sector.
Requirement 2. The minor requires students to successfully complete at least three elective courses. It is recommended that students complete one elective from each of three content areas listed below.

Regardless, students will not be permitted to count more than two courses from any one content area for credit toward their minor. In addition, students are encouraged to take at least two electives outside their major areas of study.

**Content Area 1: Creativity, Innovation and Idea Generation**

- **BUSM&L 3241 (Introduction to Entrepreneurial Marketing)** (3hrs) (prereqs Econ 2001.01 or AEDEcon 2001 or equivalent, Math 1130 or equivalent)
  - Focuses on marketing concepts and methods of entrepreneurs leading growth-oriented companies
- **BUSMHR 3665 (Personal Creativity & Innovation)** (3hrs)
  - Explores how people, places and practices foster personal creativity. Develops student's ability to create innovative concepts for new products and services.
- **ISE 5682/ME 5682 (Fundamentals of Product Design)** (3hrs) (prereqs senior, graduate student or by permission)
  - Takes students through the product design process, from listening to the voice of the customer to idea generation and evaluation, system level design and system architecture, design for assembly and manufacturing and lean manufacturing.
- **PSYCH 2462 (The Psychology of Creativity)** (3hrs) (prereqs Psych 1100 or 1100H)
  - Examines the theories, definitions, processes and measurement of personal creativity.

**Content Area 2: Opportunity Evaluation and Venture Planning**

- **AEDEcon 3102 (Principles of Agribusiness Marketing)** (3hrs) (prereqs AEDEcon 2001.01, 2001(H), Econ 2001.01 or 2001(H))
  - Focuses on in-depth assessment of the marketing environment in specific food and natural resource industries and what it takes to successfully lead an entrepreneurial enterprise in these industries.
- **BUSFIN 3290 (Foundations of Entrepreneurial Financing)** (3hrs) (prereqs BUSFIN 3120 OR 3220)
  - Presents a dynamic two-part process in which companies invest in both real and human capital assets and then find the financial capital necessary to pay for those investments.
- **BUSMHR 5530 (Value Creation in Social Entrepreneurship)** (3hrs) (BUSMHR 2500 and Econ 2001.01)
  - Progressive social organizations are seeking to be more entrepreneurial in the manner in which they run their nonprofit businesses. This course is offered to honors students throughout the university. Content will include a group assignment where students will focus on completing a social enterprise project for a non-profit organization in Central Ohio.
- **BUSMHR 3542 (The Accelerator: Planning the Entrepreneurial Adventure)** (3hrs) (prereqs BUSMHR 2500)
  - Practicum experience for exploring personal entrepreneurship and creating new ventures.
Content Area 3: Leading High-Performance Ventures

AEDEcon 3160 (Human Resource Management in Small Businesses) (2hrs) (prereqs junior standing or by permission)
  - Study of characteristics of small businesses that make many of their human resource management problems unique, such as recruiting only in local labor markets in relative geographic isolation, limited alternatives for organizational structure and irregular coverage of labor laws.

BUSMHR 3541 (Global Innovation and Entrepreneurial Leadership) (3hrs) (prereqs BUSMHR 2500 and ECON 2001.01)
  - Field study projects to introduce students to venture capital, private equity, technology commercialization and new venture strategy.

BUSMHR 4520 (Leading High-Performance Ventures) (3hrs) (prereqs BUSMHR 2500 and ECON 2001.01)
  - Explores the key managerial practices and skills necessary to lead a successful growing business

CSC FFS 3270 (Families in Business) (3hrs) (prereqs sophomore standing or above)
  - Offers students the opportunity to explore family business topics, such as family dynamics, conflicts and relationships relative to the business; formation and growth, strategic management, professionalization and succession planning.

SOCIAL 3464 (Work, Employment and Society) (3hrs)
  - Provides an overview of social science knowledge about organizational functioning, labor force composition and human relations issues.

Requirement 3. Students intending to complete the Entrepreneurship Minor should review any prerequisites carefully and plan to take them early in their academic program plan.

*Note that at most 6 of the credit hours fulfilled as part of Requirements 2 can be used as non-ISE technical electives. Additionally, ISE 5682 can be double counted in the ISE technical electives.
Design Minor Program

Design Minor

In today’s society, every graduate entering a new career or profession will encounter a design problem or solution. A knowledge of the processes and strategies associated with design can influence a positive approach or decision in manufacturing, engineering, marketing, communications, education and many other fields.

This 18 semester credit hour minor has been crafted for students who want to gain a competitive edge through an understanding of the basics behind contemporary design situations and solutions.

No permissions or approval are required from the Design Department to pursue the Design Minor. In order to graduate with a Design Minor, you must fulfill the guidelines listed in the curriculum requirements provided below. Upon completing the guidelines, a student need only list the Design Minor on their department graduation application. Students may request to have the design minor added to their degree audit at any time to track their progress in the minor.

Guidelines

- Transfer credit is allowed however no more than one half of the credit hours required on the minor
- Overlap with General Education Courses is permitted
- Overlap with the Design Major is not allowed and the minor must be in a different subject than the major and the same courses cannot count on the minor as counted on the major.
- Minimum C- for a course to be listed on the minor along with a 2.0 cumulative point-hour ratio required for the minor
- Course work graded Pass/Non-Pass cannot count on Minor

Requirement 1. The minor consists of 18 credit hours and at least 9 credit hours must be in courses at the 3000 level or above.

Requirement 2. The following 9 credit hours are required:

DESIGN 3105 (Design Concepts for Non-Majors) (3hrs) *Approved ISE technical elective*
- A studio-based introduction to the design process; creative problem-solving process emphasizes divergent thinking skills through observation, abstraction, evaluation and communication.

DESIGN 3305 (Design Visualization for Non-Majors) (3hrs) *Approved ISE technical elective*
- Development of drawing skills to explore, observe, understand, record, analyze and communicate visual information.
Design 3505 (Typographic Design for Non-Majors) (3hrs)
- Introduction to the knowledge and skills of typographical design and its corresponding aesthetic, functional and technological applications and utilizations.

**Requirement 3.** Students must pick 9 credit hours from the following electives:

DESIGN 2700 (Introduction to Design Practice) (3hrs) (concurrently* 2110, 2120, 2310 & 2320)
- Introduction to theory, rationale, practice and societal impact of design; design process, critical issues, relationship to the environment. *Students may register without prereqs or core requisites.

DESIGN 2750 (Design History) (3hrs) (prereq minor in design)
- A history of design as affected by technology, science and cultural world view.

DESIGN 4405 (Design Media for Non-Majors) (3hrs) (prereq DESIGN 3105, 3305, and 3505)
- The application of electronic media technologies to design content
  - *Approved ISE technical elective*

DESIGN 4505 (3-D Visualization) (3hrs) (prereq DESIGN 3105, 3305, 3505)
- Concepts of 3D modeling, rendering and animation for visualizing design forms
  - *Approved ISE technical elective*

DESIGN 5405 (Web Communication) (3hrs) (prereqs DESIGN 3105, 3305, 3505)
- Electronic communication techniques related to the web and interactivity; web design and technology principles.
  - *Approved ISE technical elective*

DESIGN 5505 (Information Design) (3hrs) (prereqs DESIGN 3105, 3305, 3505)
- Design principles related to visualizing quantitative information, processes and systems.
  - *Approved ISE technical elective*

ENGINEERING GRAPHICS 1121 (Graphic Presentation) (2hrs)
- Presentation of three-dimensional subjects by precise graphics: orthographic, sectional, pictorial and introduction to computer graphics

ENGINEERING GRAPHICS 4410.01 (Computer Graphics Using AutoCad) (2hrs) (prereqs Engr. 1182, 1185 or 1282)
- An advanced course in graphics with emphasis on the application on computer generated graphics to the solution of engineering problems. AutoCad and Civil 3D to be used.

ENGINEERING GRAPHICS 4410.02 (Computer Graphics Using SolidWorks) (2hrs) (prereqs Engr 1121 or 1182 or 1185 or 1282)
- An advanced course in graphics with emphasis on the application on computer generated graphics to the solution of engineering problems. SolidWorks to be used.
INDUSTRIAL AND SYSTEMS ENGINEERING 3700 (Cognitive Engineering Systems) (3hrs) (prereqs junior standing, admission to the ISE major)
  - Human-centered design of cognitive tools and work systems. Human-computer interaction; decision making; human error; computer-supported distributed work; design of decision support systems.
  - *Approved to double count in ISE major and Design Minor*

MECHANICAL ENGINEERING 5680 (Computer aided Design and Manufacturing) (4hrs) (prereqs grad standing or permission of instructor)
  - Design of machine components, surfaces and assemblies using parametric and feature-based design principles and advanced design tools.

ISE 5682/MECHANICAL ENGINEERING 5682 (Fundamentals of Product Design Engineering) (4hrs) (prereqs senior or grad standing in engineering or permission of instructor)
  - Fundamentals of the product design process, from concept creation to final implementation, including product architecture and design for manufacture and assembly.
Minor in Computer and Information Science

Computer and Information Science Minor

Students who plan to major in another area but have a strong interest in computing may want to consider this minor as an option.

This minor consists of a minimum of 13 credit hours from the following three categories; Programming Fundamentals, CIS Core and Technical Electives. Three different tracks A, B, and C, are available for the fundamentals portion; each track consists of a 3 credit hour prerequisite course (which, being at the 1000-level, is not counted in the total hours for the minor), followed by a 3-4 credit hour course. The core consists of a 3 credit hour course followed by a one credit hour course (on professionalism and ethics in computing). The electives portion requires the students to take a minimum of 6 hours from a specified list of courses.

No permissions or approval are required from the Department of Computer Science & Engineering to pursue the CIS Minor. In order to graduate with a CIS Minor, you must fulfill the guidelines listed in the curriculum requirements provided below. Upon completing the guidelines, a student need only list the CIS on their department graduation application. Students may request to have the CIS added to their degree audit at any time to track their progress in the minor.

Guidelines

- CIS minors DO NOT get permanent computer accounts on the CSE machines and DO NOT receive priority scheduling in CSE courses. (Any students who wish to pursue a track similar to the CIS minor within ISE should consider the Data Analytics track as priority seating is GAURANTEED if granted permission into that highly competitive track. For more information regarding this, email the majors advisor, Kristen Arra at arra.7@osu.edu).
Requirement 1. Complete ONE of the following tracks:

Track A:
CSE 1211 (Computational Thinking in Context: Images, Animation and Games) (3hrs) followed by CSE 2221 (Software 1: Software Components) (4hrs) (prereqs CSE 1211 or 1212 or 1221 or 1222 or 1223 or ENGR 1281.01 and ENGR 1281.02(H) concurrent with MATH 1151 or 1161.01 or 1161.02)

Track B:
CSE 1222 (Programming in C++) (3hrs) (prereqs MATH 1151 or 1161, not open to students with credit in ENGR 1281.01 or 1282.02 followed by CSE 2122 (Data Structures Using C++) (3hrs) (prereq CSE 1222)

Track C:
CSE 1223 (Programming in Java) (3hrs) followed by CSE 2123 (Data Structures Using Java) (3hrs) (prereq CSE 1223)

Requirement 2. Complete the following core CIS courses:

CSE 2321 (Foundations I) (3hrs) (prereqs CSE 1232, 1233, 2221, and MATH 1151. Concurrently (for students with credit for 2221): CSE 2231
- Propositional and first-order logic; basic proof techniques; graphs, trees; analysis of algorithms; asymptotic analysis; recurrence relations
CSE 2501 (Social, Ethical and Professional Issues in Computing) (1hr) (prereqs CSE 1222, 1223, 2231 and 2321 and Gen Ed Writing Level 2)
- Social, ethical and professional issues facing computing professionals; ethical principles; discussion of case studies

Requirement 3. Choose a minimum of 6 credit hours from the following technical electives:
CSE 2231 (Software II: Software Development and Design) (4hrs) (prereq CSE 2221)
CSE 2331 (Foundations II: Data Structures and algorithms) (3hrs) (prereqs CSE 2231 and 2321 and STATS 3470
CSE 2421 (Systems I: Introduction to Low-Level Programming and Computer Organization) (4hrs) (prereqs CSE 1232, 1233, 2231 and 2321
CSE 3241 (Introduction to Database Systems) (3hrs) (prereqs CSE 2133 or 2231 or 2233 and 2321 or Math 2366