

## **COMPUTER ENGINEERING MINOR (21 – 24 CREDITS)**

### **A. Mission**

The minor in computer engineering provides an **opportunity to gain a more in-depth knowledge of computing technology, programming digital hardware**, interfacing digital hardware, machine learning, microcontrollers and microprocessors, robotics, as well as digital signal and image processing. Students who are already enrolled in an ECE major may not enroll in this program.

### **B. Learning Outcomes & Assessment**

1. Upon completion of this program students should be able to:

- Identify, formulate, and solve complex engineering problems by applying principles of engineering, computer science, and mathematics
- Apply engineering design to produce solutions that meet specified needs
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

2. Assessment of this program will follow our bi-yearly assessment, evaluation and continuous improvement cycle that is done for the ECE major. It will be first assessed in Fall 2023.

### **C. Curriculum Outline**

## **COMPUTER ENGINEERING MINOR (21 – 24 CREDITS)**

### **A. Core Requirements (15-16 credits)**

- ECE 375 – Microprocessor Systems Credit: 4
- ECE 475 – Computer Architecture Credit: 4

Select one of the following:

- CSC 212 – Principles of Programming Credit: 3
- ECE 270- C/C++ Programming Language Credit: 4

Select one of the following:

- CSC 222 - Computer Organization and Programming Credit: 4
- ECE 271- Digital Systems Credit: 4

### **B. Elective Requirements (6 - 8 credits)**

- CSC 241 - Abstract Data Types and Programming Methodology Credit: 3
- CSC 322 – Systems Programming Credit: 3
- CSC 344 – Programming Languages Credit: 3
- CSC 445 – Computer Networking Credit: 3
- ECE 335 – Digital Signal Processing Credit: 4
- ECE 388 - Humanoid Robotics Credit: 3
- ECE 433 – Introduction to Digital Imaging Credit: 3
- ECE 465 – Introduction to Robotics Credit: 4
- ECE 470 – Machine Learning Credit: 4
- ECE 472 - Advanced Digital Systems Credit: 4
- ECE 499 - Independent Study Credit: 3

Note: Some courses may have pre-requisites.

#### D. Enrollment

- What is the projected enrollment when the program begins?  
4 – 8 students in the first year of the minor
- What is the projected enrollment after five years?  
12-24 students
- How were these projections determined

We receive between 4 and 8 requests from Computer Science students who take our ECE271 – Digital Systems course every year for a Computer Engineering minor. We approximate that it will take 3 years to complete the minor resulting in 12-24 students enrolled in the minor at any one time after the minor is mature. This reflects 4-8 students taking courses at each level at any given time.

#### E. Faculty

##### Director of Computer Engineering Minor – Marianne

##### Hromalik A. Core Requirements (15-16 credits)

- CSC212 – Principles of Programming - **every semester CS Faculty (please see attached support letter)**
- ECE 270 - C/C++ Programming Language – **Mustafa Ayad, Brian Haynes (adjunct), Marianne Hromalik (once/ twice per year - rotated as part of normal workload)**
- ECE271/CSC222 – Digital Systems/ Computer Organization and Programming **Mustafa Ayad, Mario Bkassiny, Ildar Sabarinov, Marianne Hromalik, Sungeun Kim (every semester rotated as part of normal workload)**
- ECE 375 – Microprocessor Systems – **Mustafa Ayad, New Faculty Hire for Fall 2022, (every semester, rotated as part of normal workload)**
- ECE475 – Computer Architecture - **Marianne Hromalik, (every semester or as needed, part of normal workload)**

##### B. Elective Requirements (6 - 8 credits)

- CSC 241 - Abstract Data Types and Programming Methodology – 3cr **every semester CS Faculty (please see attached support letter)**
- CSC 322 – Systems Programming – **every semester CS Faculty (please see attached support letter)**
- ECE 335 – Digital Signal Processing - **Marianne Hromalik (ECE elective rotation)**
- ECE 388 - Humanoid Robotics – **Mustafa Ayad, New Faculty hire (ECE elective rotation)**
- ECE 433 – Introduction to Digital Imaging - **Sungeun Kim (ECE elective rotation)**
- ECE 465 – Introduction to Robotics - **Mustafa Ayad, New Faculty hire (ECE elective rotation – once per year)**
- ECE 470 – Machine Learning – **Mustafa Ayad, New Faculty hire, Marianne Hromalik (ECE elective rotation)**

- CSC445 – Computer Networking – **CS Faculty (once per year)**
- CSC344 – Programming Languages– **every semester CS Faculty (please see attached support letter)**
- ECE 472 - Advanced Digital Systems – **Marianne Hromalik (ECE elective rotation)**
- ECE 499 - Independent Study – **Any ECE or CS faculty**

We typically (when fully staffed) run 2 -3 electives each semester meaning that each elective runs once every 3 or 4 semesters.

#### F. Advisement

All minor students will be assigned an academic advisor in the ECE department. These students will be shared across all our faculty as is the norm in our ECE major.

#### G. Resources

| Expenditures               |                     | Start-up            | When the program begins | After five years   |
|----------------------------|---------------------|---------------------|-------------------------|--------------------|
| Personnel                  | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Library                    | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Equipment                  | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Laboratories               | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Supplies & Expenses (OTPS) | <i>Reallocation</i> | \$1200 <sup>1</sup> | \$200 <sup>2</sup>      | \$200 <sup>2</sup> |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Capital Expenditures       | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Other                      | <i>Reallocation</i> | \$0                 | \$0                     | \$0                |
|                            | <i>New funds</i>    | \$0                 | \$0                     | \$0                |
| Grand Total                |                     | \$1200              | \$200                   | \$200              |

<sup>1</sup>Extra start-up costs are for digital boards for labs which will support 6 extra lab groups (12 students).

<sup>2</sup>Extra OTPS expenses are for extra components, tools and consumables in labs for the duration of the program.