



Rename the Bachelor of Science in "Embedded Systems and Internet of Things" to "Cyber-Physical Systems Engineering" (Senate Document #22-23-11)

PRESENTED BY SEC: Piotr Swistak, Chair, Senate Programs, Curricula, and Courses Committee; Senate: Elizabeth Beise, Associate Provost for Academic Planning and Programs

REVIEW DATES SEC – October 17, 2022 | SENATE – November 2, 2022

VOTING METHOD In a single vote

RELEVANT POLICY/DOCUMENT

NECESSARY APPROVALS Senate, President, USM Chancellor, and the Maryland Higher Education Commission

ISSUE

The A. James Clark School of Engineering’s Department of Electrical and Computer Engineering proposes to change the name of its Bachelor of Science in "Embedded Systems and Internet of Things" to "Cyber-Physical Systems Engineering". The program, which was established in 2019 and is offered at the Universities at Shady Grove, provides students with an understanding of both the hardware and software elements that go into design, development, and use of devices that link to the internet or other communication networks. The need to change the name has arisen from a requirement from the engineering accreditation agency, ABET, to include the word “engineering,” in all engineering program titles. The department is also using this occasion to change the name to a less verbose name that better conveys the broad nature of this program of study.

The proposal was approved by the Senate Programs, Curricula, and Courses committee on October 7, 2022.

RECOMMENDATION(S)

The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this name change.

COMMITTEE WORK

The committee considered this proposal at its meeting on October 7, 2022. Mel Gomez, from the Department of Electrical and Computer Engineering, presented the proposal and answered questions from the committee. The committee approved the proposal.

ALTERNATIVES

The Senate could decline to approve this new program title.

RISKS

If the Senate declines to approve this program title change, the current program will not adequately describe the breadth of the program, and it will also be out of compliance with its accreditation agency.

FINANCIAL IMPLICATIONS

There are no significant financial implications for program title changes.

660: CYBER-PHYSICAL SYSTEMS ENGINEERING

In Workflow

1. D-ENEE Curriculum Manager (kweiland@umd.edu; eirwin@umd.edu)
2. D-ENEE PCC Chair (adrian@umd.edu; kweiland@umd.edu; eirwin@umd.edu)
3. D-ENEE Chair (ednaw@umd.edu; josephj@umd.edu)
4. ENGR PCC Chair (mcbell@umd.edu; nroop@umd.edu; sash1@umd.edu)
5. ENGR Dean (kkiger@umd.edu; mcbell@umd.edu; nroop@umd.edu; sash1@umd.edu)
6. Academic Affairs Curriculum Manager (mcolson@umd.edu)
7. Senate PCC Chair (mcolson@umd.edu; pswistak@umd.edu)
8. University Senate Chair (mcolson@umd.edu)
9. President (mcolson@umd.edu)
10. Chancellor (mcolson@umd.edu)
11. MHEC (mcolson@umd.edu)
12. Provost Office (mcolson@umd.edu)
13. Undergraduate Catalog Manager (lyokoi@umd.edu; acruz130@umd.edu)

Approval Path

1. Mon, 28 Mar 2022 14:40:14 GMT
Kathryn Weiland (kweiland): Approved for D-ENEE Curriculum Manager
2. Mon, 28 Mar 2022 14:59:46 GMT
Adrianos Papamarcou (adrian): Approved for D-ENEE PCC Chair
3. Thu, 26 May 2022 18:30:00 GMT
Joseph JaJa (josephj): Approved for D-ENEE Chair
4. Fri, 10 Jun 2022 16:52:46 GMT
Mary Bell (mcbell): Rollback to Initiator
5. Mon, 12 Sep 2022 18:08:10 GMT
Kathryn Weiland (kweiland): Approved for D-ENEE Curriculum Manager
6. Mon, 12 Sep 2022 18:20:15 GMT
Adrianos Papamarcou (adrian): Approved for D-ENEE PCC Chair
7. Mon, 12 Sep 2022 20:23:12 GMT
Joseph JaJa (josephj): Approved for D-ENEE Chair
8. Wed, 14 Sep 2022 17:40:42 GMT
Mary Bell (mcbell): Approved for ENGR PCC Chair
9. Thu, 15 Sep 2022 12:02:10 GMT
Ken Kiger (kkiger): Approved for ENGR Dean
10. Fri, 30 Sep 2022 20:35:43 GMT
Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
11. Mon, 03 Oct 2022 14:01:16 GMT
Piotr Swistak (pswistak): Approved for Senate PCC Chair

History

1. Sep 13, 2019 by William Bryan (wbryan)
2. Oct 21, 2019 by William Bryan (wbryan)
3. May 13, 2021 by Mary Bell (mcbell)
4. Mar 7, 2022 by gckasten

Date Submitted: Mon, 12 Sep 2022 16:39:21 GMT

Viewing: 660 : Cyber-Physical Systems Engineering

Last approved: Mon, 07 Mar 2022 20:15:39 GMT

Last edit: Thu, 22 Sep 2022 17:47:26 GMT

Changes proposed by: Mary Bell (mcbell)

Proposed Action

Rename Program

Program Name

Cyber-Physical Systems Engineering

Program Status

Active

Effective Term

Fall 2022

Catalog Year

2022-2023

Program Level

Undergraduate Program

Program Type

Undergraduate Major

Delivery Method

On Campus

Departments

Department

Electrical and Computer Engineering

Colleges

College

The A. James Clark School of Engineering

Program/Major Code

07990

MHEC Inventory Program

Embedded Systems and Internet of Things

CIP Code

140999 - Computer Engineering, Other.

HEGIS

079900

Degree(s) Awarded

Degree Awarded

Bachelor of Science

Proposal Contact

Romel Gomez

Proposal Summary

Replace the program name from Bachelor of Science in Embedded Systems and Internet of Things to Bachelor of Science in Cyber-Physical Systems Engineering for accreditation consideration with ABET.

(PCC Log Number 22023)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Bachelor of Science in Cyber-Physical Systems Engineering will provide students with a solid foundation in key emerging technologies of the Internet of Things (IoT), the ability to integrate devices into complete IoT systems, and an understanding of how IoT fits within the wider context of information and communications technology, including data analytics and cloud computing. At the senior level, students will ultimately be able to specialize in one of the following tracks: Hardware, Computation, or Security track or pursue a General track option that provides a focus on courses from the other three tracks. It is expected that graduates will be in high demand in such occupational areas as hardware/software developers, computer systems analysts, network architects and administrators, information security analysts, information systems analysts and computer programs.

Catalog Program Requirements:

First & Second Year

Prior to being admitted to the Cyber-Physical Systems Engineering major, students should have completed the Engineering LEP gateway courses, basic math/science courses, lower-level General Education requirements, and at least 60 credits.

Course	Title	Credits
MATH140	Calculus I	4
MATH141	Calculus II	4
ENGL101	Academic Writing	3
CHEM135	General Chemistry for Engineers	3
PHYS161	General Physics: Mechanics and Particle Dynamics	3
PHYS260	General Physics: Vibration, Waves, Heat, Electricity and Magnetism	3
PHYS261	General Physics: Mechanics, Vibrations, Waves, Heat (Laboratory)	1
Programming Requirement ¹		2-4
ENES100	Introduction to Engineering Design	3
One of the following MATH2xx courses:		3-4
MATH246	Differential Equations for Scientists and Engineers	
MATH241	Calculus III	
MATH240	Introduction to Linear Algebra	
General Education Requirements/Additional Electives		28-31

¹ Embedded systems will accept any of the following programming courses or their equivalents:

- ENEE140
- CMSC131
- CMSC106
- Any introductory course in C, C++, Java, or Python (student must submit the course to ECE Department for Evaluation)

Junior & Senior Year at Shady Grove

Junior Year

First Semester	Credits	Second Semester	Credits
ENEB302		4 ENEB304	3
ENEB344		4 ENEB352	3
ENEB354		3 ENEB353	3
ENEB340		3 ENEB355	3
ENEB341		3 ENEB345	3
		17	15

Senior Year

First Semester	Credits	Second Semester	Credits
ENEB408 (ENEB408A Capstone Design I)		3 ENEB408 (ENEB408B Capstone Design II)	3
ENEB454		3 Senior Level Electives (based on track)	12
ENEB444		3	
ENEB346 (Linear Algebra for Machine Learning Applications)		3	

Professional Writing

3

15

15

Total Credits 62

Tracks

Hardware Track

Course	Title	Credits
Required Courses		
ENEB455	Advanced FPGA System Design using Verilog for Embedded Systems	3
Elective Courses		
Select three of the following:		
ENEB443	Hardware/Software Security for Embedded Systems	
ENEB451	Network Security	
ENEB452	Advanced Software for Connected Embedded Systems	
ENEB453	Web-Based Application Development	
ENEB456	Course ENEB456 Not Found (Machine Learning Tools)	
ENEB457	Foundations of Databases for Web Applications	
Total Credits		12

Computational Track

Course	Title	Credits
Required Courses		
ENEB456	Course ENEB456 Not Found (Machine Learning Tools)	3
Elective Courses		
Select three of the following:		
ENEB443	Hardware/Software Security for Embedded Systems	
ENEB451	Network Security	
ENEB452	Advanced Software for Connected Embedded Systems	
ENEB453	Web-Based Application Development (Web Based Application Development)	
ENEB455	Advanced FPGA System Design using Verilog for Embedded Systems	
ENEB457	Foundations of Databases for Web Applications	
Total Credits		12

Security Track

Course	Title	Credits
Required Courses		
ENEB451	Network Security	3
Elective Courses		
Select three of the following:		
ENEB443	Hardware/Software Security for Embedded Systems	
ENEB452	Advanced Software for Connected Embedded Systems	
ENEB453	Web-Based Application Development	
ENEB455	Advanced FPGA System Design using Verilog for Embedded Systems	
ENEB456	Course ENEB456 Not Found (Machine Learning Tools)	
ENEB457	Foundations of Databases for Web Applications (Foundations of Databases for Web Applications)	
Total Credits		12

General Track

The General Track offers a general focus of course content with classes from each of the three tracks. While there are no specific required or elective courses for this track, the General Track requires 12 credits, which is the same as the other three tracks. Consult with an advisor for details.

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

SAMPLE ACADEMIC PLAN

FIRST AND SECOND YEAR

Prior to being admitted to the Cyber-Physical Systems Engineering major, students should have completed the Engineering LEP gateway courses, basic math/science courses, lower-level General Education requirements, and at least 60 credits.

MATH140: Calculus I (4 credits)

MATH141: Calculus II (4 credits)

MATH2xx: Students may select one of the following courses:

- MATH246 Differential Equations (3 credits)
- MATH241 Calculus III (4 credits)
- MATH240 Linear Algebra (3 credits)

PHYS161: General Physics, Mechanics and Particles Dynamics (3 credits)

PHYS260/261: General Physics, Electrodynamics, Light, Relativity & Modern Physics (4 credits)

CHEM135: General Chemistry for Engineers (3 credits)

Programming Course Requirement (2-4 credits)

General Education Courses (23-31 credits)

JUNIOR YEAR – 1st Semester (17 credits)

ENEB302 Analog Circuits (4 credits)

ENEB340 Intermediate Programming Concepts and Applications for Embedded Systems (C/C++) (3 credits)

ENEB341 Introduction to Internet of Things (3 credits)

ENEB344 Digital Logic Design for Embedded Systems (4 credits)

ENEB354 Discrete Mathematics for Information Technology (3 credits)

JUNIOR YEAR – 2nd Semester (15 credits)

ENEB304 Microelectronics and Sensors (3 credits)

ENEB352 Introduction to Networks and Protocols (3 credits)

ENEB353 Computer Organization for Embedded Systems (3 credits)

ENEB355 Algorithms in Python (3 credits)

ENEB345 Probability & Statistical Inference (3 credits)

SENIOR YEAR – 1st Semester (15 credits)

ENEB408A Capstone Design Lab I (3 credits)

ENEB454 Embedded Systems (3 credits)

ENEB444 Operating Systems for Embedded Systems (3 credits)

ENEB346 Linear Algebra for Machine Learning Applications (3 credits)

ENGL3** Professional Writing (3 credits)

SENIOR YEAR – 2nd Semester (15 credits)

ENEE408B Capstone Design Lab II (3 credits)

ENEB4XX Senior General Electives (12 credits)

PROGRAM TRACKS

Students in the Cyber-Physical Systems Engineering major will have four available track options: General, Hardware, Computation & Security Tracks.

General Track: offers a general focus of course content with classes from each of the three tracks. There are no specific required or elective courses for this track.

Students in the Cyber-Physical Systems Engineering major will take 4 senior elective courses in the spring semester of their senior year. The specific elective course offerings will vary each spring semester. The general elective course sequence will be a combination of four of the following courses:

ENEB443 Hardware/Software Security for Embedded Systems

ENEB451 Network Security

ENEB452 Advanced Software for Connected Embedded Systems

ENEB453 Web-Based Application Development

ENEB455 Advanced FPGA System Design Using Verilog for Embedded Systems

ENEB456 Machine Learning Tools

ENEB457 Foundations of Databases for Web Applications

Hardware Track (12 credits): is focused primarily on the physical layer of devices, and concentrates on operations performed at the device level.

- Required Course:
 - ENEB455 Advanced FPGA System Design Using Verilog (3 credits)
- Elective Courses (must select 3 out of the following courses):
 - ENEB443 Hardware/Software Security for Embedded Systems (3 Credits)
 - ENEB451 Network Security (3 credits)
 - ENEB452 Advanced Software for Connected Embedded Systems (3 credits)
 - ENEB453 Web Based Application Development (3 credits)
 - ENEB456 Machine Learning Tools (3 credits)
 - ENEB457 Foundation of Databases for Web Applications (3 credits)

Computation Track (12 credits): focused at the modeling and software level, and specializes in data analytical methods and applications.

- Required Courses:
 - ENEB456 Machine Learning Tools (3 credits)
- Elective Courses (must select 3 out of the following courses):
 - ENEB443 Hardware/Software Security for Embedded Systems (3 Credits)
 - ENEB451 Network Security (3 credits)
 - ENEB452 Advanced Software for Embedded Systems-Connected Systems (3 credits)
 - ENEB453 Web Based Application Development (3 credits)
 - ENEB455 Advanced FPGA System Design Using Verilog for Embedded Systems (3 credits)
 - ENEB457 Foundation of Databases for Web Applications (3 credits)

Security Track (12 credits): focused on security issues within cyber-physical systems, and examines the hardware and software aspects of data integrity, corruption, and threats.

- Required Courses:
 - ENEB451 Network Security (3 credits)
- Elective Courses (must select 2 out of the following courses):
 - ENEB443 Hardware/Software Security for Embedded Systems (3 Credits)
 - ENEB452 Advanced Software for Embedded Systems-Connected Systems (3 credits)
 - ENEB453 Web Based Application Development (3 credits)
 - ENEB455 Advanced FPGA System Design Using Verilog (3 credits)
 - ENEB456 Machine Learning Tools (3 credits)
 - ENEB457 Foundation of Databases for Web Applications (3 credits)

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes

An ability to apply knowledge of computing, engineering, science, and mathematics to identify, analyze and solve complex engineering problems.

An ability to design, implement, and evaluate a computer-based system, process, component, or program that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

An ability to communicate effectively with a range of audiences.

An understanding of professional, ethical, legal, security, and social issues and responsibilities.

An ability to analyze the local and global impact of computing on individuals, organizations, and society.

An ability to function effectively on teams to accomplish a common goal.

An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

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

Program Modification Information

Impact on current students. It should be specifically acknowledged that students enrolled in the program prior to the effective date of any curriculum change may complete their program under the old requirements if they wish. The courses required must remain available, or suitable substitutions specifically designated.

There will be no impact to current students. The curriculum is unchanged.

Linked Programs

Indicate in the space below all programs to which this program is formally linked (e.g., approved combined bachelor's/master's programs, dual master's programs, or joint-programs with other universities). If the proposed modification will affect the linked program, provide as an attachment the new curriculum for each arrangement and provide supporting correspondence from the director of the linked program.

N/A

Renaming Program

Provide a rationale for renaming the program.

ABET accreditation requires the word "Engineering". The previous name is too verbose and narrowly focused. The new name is more concise and better conveys the broad nature of this program of study.

Reviewer Comments

Mary Bell (mcbell) (Fri, 10 Jun 2022 16:52:46 GMT): Rollback: A meeting with the ECE advisory board is required before proceeding.

Mary Bell (mcbell) (Wed, 14 Sep 2022 17:37:33 GMT): updated the reason for the proposal to add for accreditation issues.

Key: 660

Program Change Request

Date Submitted: 09/12/22 12:39 pm

Viewing: **660 : Cyber-Physical Systems**

Engineering ~~Embedded Systems and Internet of Things Major~~

Last approved: 03/07/22 3:15 pm

Last edit: 09/22/22 1:47 pm

Changes proposed by: Mary Bell (mcbell)

Catalog Pages Using this Program

- [Embedded Systems and Internet of Things Major](#)
- [,Embedded Systems and Internet of Things Major at Shady Grove](#)

Proposed Action Rename Program ~~Curriculum Change~~

Program Name

In Workflow

1. **D-ENEE Curriculum Manager**
2. **D-ENEE PCC Chair**
3. **D-ENEE Chair**
4. **ENGR PCC Chair**
5. **ENGR Dean**
6. **Academic Affairs Curriculum Manager**
7. **Senate PCC Chair**
8. **University Senate Chair**
9. President
10. Chancellor
11. MHEC
12. Provost Office
13. Undergraduate Catalog Manager

Approval Path

1. 03/28/22 10:40 am
Kathryn Weiland (kweiland):
Approved for D-ENEE Curriculum Manager
2. 03/28/22 10:59 am
Adrianos Papamarcou (adrian): Approved for D-ENEE PCC Chair
3. 05/26/22 2:30 pm
Joseph JaJa

- (josephj): Approved for D-ENEE Chair
4. 06/10/22 12:52 pm
Mary Bell (mcbell):
Rollback to Initiator
 5. 09/12/22 2:08 pm
Kathryn Weiland (kweiland):
Approved for D-ENEE Curriculum Manager
 6. 09/12/22 2:20 pm
Adrianos Papamarcou (adrian): Approved for D-ENEE PCC Chair
 7. 09/12/22 4:23 pm
Joseph JaJa (josephj): Approved for D-ENEE Chair
 8. 09/14/22 1:40 pm
Mary Bell (mcbell):
Approved for ENGR PCC Chair
 9. 09/15/22 8:02 am
Ken Kiger (kkiger):
Approved for ENGR Dean
 10. 09/30/22 4:35 pm
Michael Colson (mcolson):
Approved for Academic Affairs Curriculum Manager
 11. 10/03/22 10:01 am
Piotr Swistak (pswistak):
Approved for Senate PCC Chair

History

1. Sep 13, 2019 by William Bryan (wbryan)
2. Oct 21, 2019 by William Bryan (wbryan)
3. May 13, 2021 by Mary Bell (mcbell)
4. Mar 7, 2022 by gckasten

Cyber-Physical Systems Engineering ~~Embedded Systems and Internet of Things Major~~

Program Status	Active		
Effective Term	Fall 2022		
Catalog Year	2022-2023		
Program Level	Undergraduate Program		
Program Type	Undergraduate Major		
Delivery Method	On Campus		
Departments	<table border="1"> <thead> <tr> <th>Department</th> </tr> </thead> <tbody> <tr> <td>Electrical and Computer Engineering</td> </tr> </tbody> </table>	Department	Electrical and Computer Engineering
Department			
Electrical and Computer Engineering			
Colleges	<table border="1"> <thead> <tr> <th>College</th> </tr> </thead> <tbody> <tr> <td>The A. James Clark School of Engineering</td> </tr> </tbody> </table>	College	The A. James Clark School of Engineering
College			
The A. James Clark School of Engineering			
Program/Major Code	07990		
MHEC Inventory Program	Embedded Systems and Internet of Things		
CIP Code	140999 - Computer Engineering, Other.		
HEGIS	079900		
MHEC Recognized Area(s) of Concentration			

Degree(s) Awarded

Degree Awarded
Bachelor of Science

If other, new
degree award:

Proposal Contact

[Rommel Gomez](#) ~~Dr.Mel Gomez & Ms.Glenn Kasten-Sportes~~

Proposal Summary

~~As a new undergraduate program, the ESIOT program requires adjustments for the first 2 cohorts to conform to the ABET assessment guidelines, while maintaining the 62 credit limit. Two math courses, ENEB345: Probability & Statistical Inference, and ENEB346: Linear Algebra for Machine Learning Applications, have been added as required courses for ABET accreditation purposes. Replace Similarly, changes in the program name from Bachelor required courses and electives in the tracks, as well as the addition of Science in Embedded Systems and Internet of Things a general track option, are intended to Bachelor of Science in Cyber-Physical Systems Engineering for accreditation consideration with ABET. add flexibility to the program while maintaining the core educational objectives.~~

(PCC Log Number 22023 ~~21080~~)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Bachelor of Science in Cyber-Physical Embedded Systems Engineering and Internet of Things will provide students with a solid foundation in key emerging technologies of the Internet of Things (IoT), the ability to integrate devices into complete IoT systems, and an understanding of how IoT fits within the wider context of information and communications technology, including data analytics and cloud computing. At the senior level, students will ultimately be able to specialize in one of the following tracks: Hardware, Computation, or Security track or pursue a General track option that provides a focus on courses from the other three tracks. It is expected that graduates will be in high demand in such occupational areas as hardware/software developers, computer systems analysts, network architects and administrators, information security analysts, information systems analysts and computer programs.

Catalog Program Requirements:

First & Second Year

Prior to being admitted to the Cyber-Physical Embedded Systems Engineering and Internet of Things major, students should have completed the Engineering Engineering LEP gateway courses, basic math/science courses, lower-level General Education requirements, and at least 60 credits.

Course	Title	Credits
MATH140	Calculus I	4
MATH141	Calculus II	4
ENGL101	Academic Writing	3
CHEM135	General Chemistry for Engineers	3
PHYS161	General Physics: Mechanics and Particle Dynamics	3
PHYS260	General Physics: Vibration, Waves, Heat, Electricity and Magnetism	3
PHYS261	General Physics: Mechanics, Vibrations, Waves, Heat (Laboratory)	1
Programming Requirement ¹		2-4
ENES100	Introduction to Engineering Design	3
One of the following MATH2xx courses:		3-4
MATH246	Differential Equations for Scientists and Engineers	
MATH241	Calculus III	
MATH240	Introduction to Linear Algebra	

General Education Requirements/Additional Electives 28-31
¹

Embedded systems will accept any of the following programming courses or their equivalents:

- [ENEE140](#)
- [CMSC131](#)
- [CMSC106](#)

Any introductory course in C, C++, Java, or Python (student must submit the course to ECE Department for Evaluation)

Junior & Senior Year at Shady Grove

Junior Year

First Semester	Credits	Second Semester	Credits
ENEB302	4	ENEB304	3
ENEB344	4	ENEB352	3
ENEB354	3	ENEB353	3
ENEB340	3	ENEB355	3
ENEB341	3	ENEB345	3
	17		15

Senior Year

First Semester	Credits	Second Semester	Credits
ENEB408 (ENEB408A Capstone Design I)	3	ENEB408 (ENEB408B Capstone Design II)	3

Junior Year

First Semester	Credits	Second Semester	Credits
ENE454	3	Senior Level Electives (based on track)	12
ENE444	3		
ENE346 (Linear Algebra for Machine Learning Applications)	3		
Professional Writing	3		
	15		15
Total Credits 62			

Tracks

Hardware Track

Course	Title	Credits
Required Courses		
ENE455	Advanced FPGA System Design using Verilog for Embedded Systems	3
Elective Courses		
9		
Select three of the following:		
ENE443	Hardware/Software Security for Embedded Systems	
ENE451	Network Security	
ENE452	Advanced Software for Connected Embedded Systems	
ENE453	Web-Based Application Development	
ENE456	Course ENE456 Not Found (Machine Learning Tools)	
ENE457	Foundations of Databases for Web Applications	
Total Credits		12

Computational Track

Course	Title	Credits
Required Courses		
ENE456	Course ENE456 Not Found (Machine Learning Tools)	3
Elective Courses		
9		
Select three of the following:		
ENE443	Hardware/Software Security for Embedded Systems	
ENE451	Network Security	
ENE452	Advanced Software for Connected Embedded Systems	
ENE453	Web-Based Application Development (Web Based Application Development)	
ENE455	Advanced FPGA System Design using Verilog for Embedded Systems	
ENE457	Foundations of Databases for Web Applications	
Total Credits		12

Security Track

Course	Title	Credits
Required Courses		
ENE451	Network Security	3
Elective Courses		
Select three of the following:		
ENE443	Hardware/Software Security for Embedded Systems	
ENE452	Advanced Software for Connected Embedded Systems	
ENE453	Web-Based Application Development	
ENE455	Advanced FPGA System Design using Verilog for Embedded Systems	
ENE456	Course ENE456 Not Found (Machine Learning Tools)	
ENE457	Foundations of Databases for Web Applications (Foundations of Databases for Web Applications)	
Total Credits		12

General Track

The General Track offers a general focus of course content with classes from each of the three tracks. While there are no specific required or elective courses for this track, the General Track requires 12 credits, which is the same as the other three tracks. Consult with an advisor for details.

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

SAMPLE ACADEMIC PLAN

FIRST AND SECOND YEAR

Prior to being admitted to the [Cyber-Physical Systems Engineering Embedded System](#) major, students should have completed the [Engineering Engineering](#) LEP gateway courses, basic math/science courses, lower-level General Education requirements, and at least 60 credits.

MATH140: Calculus I (4 credits)

MATH141: Calculus II (4 credits)

MATH2xx: Students may select one of the following courses:

MATH246 Differential Equations (3 credits)

MATH241 Calculus III (4 credits)

MATH240 Linear Algebra (3 credits)

PHYS161: General Physics, Mechanics and Particles Dynamics (3 credits)

PHYS260/261: General Physics, Electrodynamics, Light, Relativity & Modern Physics (4 credits)

CHEM135: General Chemistry for Engineers (3 credits)

Programming Course Requirement (2-4 credits)

General Education Courses (23-31 credits)

JUNIOR YEAR – 1st Semester (17 credits)

ENE302 Analog Circuits (4 credits)

ENEB340 Intermediate Programming Concepts and Applications for Embedded Systems (C/C++) (3 credits)

ENEB341 Introduction to Internet of Things (3 credits)

ENEB344 Digital Logic Design for Embedded Systems (4 credits)

ENEB354 Discrete Mathematics for Information Technology (3 credits)

JUNIOR YEAR – 2nd Semester (15 credits)

ENEB304 Microelectronics and Sensors (3 credits)

ENEB352 Introduction to Networks and Protocols (3 credits)

ENEB353 Computer Organization for Embedded Systems (3 credits)

ENEB355 Algorithms in Python (3 credits)

ENEB345 Probability & Statistical Inference (3 credits)

SENIOR YEAR – 1st Semester (15 credits)

ENEB408A Capstone Design Lab I (3 credits)

ENEB454 Embedded Systems (3 credits)

ENEB444 Operating Systems for Embedded Systems (3 credits)

ENEB346 Linear Algebra for Machine Learning Applications (3 credits)

ENGL3** Professional Writing (3 credits)

SENIOR YEAR – 2nd Semester (15 credits)

ENEE408B Capstone Design Lab II (3 credits)

ENEB4XX Senior General Electives (12 credits)

PROGRAM TRACKS

Students in the [Cyber-Physical Systems Engineering](#) ~~ESIOF~~ major will have four available track options: General, Hardware, Computation & Security Tracks.

General Track: offers a general focus of course content with classes from each of the three tracks. There are no specific required or elective courses for this track.

Students in the [Cyber-Physical Embedded Systems Engineering](#) major will take 4 senior elective courses in the spring semester of their senior year. The specific elective course offerings will vary each spring semester. The general elective course sequence will be a combination of four of the following courses:

ENEB443 Hardware/Software Security for Embedded Systems

ENEB451 Network Security

ENEB452 Advanced Software for Connected Embedded Systems

ENEB453 Web-Based Application Development

ENEB455 Advanced FPGA System Design Using Verilog for Embedded Systems

ENEB456 Machine Learning Tools

ENEB457 Foundations of Databases for Web Applications

Hardware Track (12 credits): is focused primarily on the physical layer of devices, and concentrates on operations performed at the device level.

Required Course:

ENEB455 Advanced FPGA System Design Using Verilog (3 credits)

Elective Courses (must select 3 out of the following courses):

ENEB443 Hardware/Software Security for Embedded Systems (3 Credits)

ENEB451 Network Security (3 credits)

ENEB452 Advanced Software for Connected Embedded Systems (3 credits)

ENE452 Advanced Software for Connected Embedded Systems (3 credits)

ENE453 Web Based Application Development (3 credits)

ENE456 Machine Learning Tools (3 credits)

ENE457 Foundation of Databases for Web Applications (3 credits)

Computation Track (12 credits): focused at the modeling and software level, and specializes in data analytical methods and applications.

Required Courses:

ENE456 Machine Learning Tools (3 credits)

Elective Courses (must select 3 out of the following courses):

ENE443 Hardware/Software Security for Embedded Systems (3 Credits)

ENE451 Network Security (3 credits)

ENE452 Advanced Software for Embedded Systems-Connected Systems (3 credits)

ENE453 Web Based Application Development (3 credits)

ENE455 Advanced FPGA System Design Using Verilog for Embedded Systems (3 credits)

ENE457 Foundation of Databases for Web Applications (3 credits)

Security Track (12 credits): focused on security issues within cyber-physical systems, and examines the hardware and software aspects of data integrity, corruption, and threats.

Required Courses:

ENE451 Network Security (3 credits)

Elective Courses (must select 2 out of the following courses):

ENE443 Hardware/Software Security for Embedded Systems (3 Credits)

ENE452 Advanced Software for Embedded Systems-Connected Systems (3 credits)

ENE453 Web Based Application Development (3 credits)

ENE455 Advanced FPGA System Design Using Verilog (3 credits)

ENE456 Machine Learning Tools (3 credits)

ENE457 Foundation of Databases for Web Applications (3 credits)

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes

An ability to apply knowledge of computing, engineering, science, and mathematics to identify, analyze and solve complex engineering problems.

An ability to design, implement, and evaluate a computer-based system, process, component, or program that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

An ability to communicate effectively with a range of audiences.

An understanding of professional, ethical, legal, security, and social issues and responsibilities.

An ability to analyze the local and global impact of computing on individuals, organizations, and society.

An ability to function effectively on teams to accomplish a common goal.

Learning Outcomes

An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

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

Program Modification Information

Impact on current students. It should be specifically acknowledged that students enrolled in the program prior to the effective date of any curriculum change may complete their program under the old requirements if they wish. The courses required must remain available, or suitable substitutions specifically designated.

There will be no impact to current students. The curriculum is unchanged. ~~The proposed changes for this program will not negatively impact the students, but will rather work in their favor. The current students have not been able to choose a track due to limited resources and availability of courses. Instead, students are pursuing pre-selected courses that do not fit into one specific track. With the change to the general track option, current students will have less confusion about the tracks and how they fit into them and their uAchieve audits will match their accurate progress in the program.~~

Linked Programs

Indicate in the space below all programs to which this program is formally linked (e.g., approved combined bachelor's/master's programs, dual master's programs, or joint-programs with other universities). If the proposed modification will affect the linked program, provide as an attachment the new curriculum for each arrangement and provide supporting correspondence from the director of the linked program.

N/A

Renaming Program

Provide a rationale for renaming the program.

ABET accreditation requires the word "Engineering". The previous name is too verbose and narrowly focused. The new name is more concise and better conveys the broad nature of this program of study.

Supporting Documents

Attachments

[ESIOT Sample Four Semester Plan_F21.pdf](#)

Administrative
Documents

Reviewer

Comments

Mary Bell (mcbell) (06/10/22 12:52 pm): Rollback: A meeting with the ECE advisory board is required before proceeding.

Mary Bell (mcbell) (09/14/22 1:37 pm): updated the reason for the proposal to add for accreditation issues.

Key: 660