From:	Smith, Randy
To:	Anderson, Betty Lise
Cc:	Leite, Fabio; Reed, Katie; Smith, Randy; Duffy, Lisa; Hunt, Ryan; Shanker, Balasubramaniam; Quinzon-Bonello, Rosario; Tomasko, David
Subject:	Proposal to revise the UG Minor and Embedded Certificate in Signal Processing
Date:	Sunday, February 25, 2024 9:08:41 AM
Attachments:	image001.png

Betty Lise:

The proposal from the Department of Electrical and Computer Engineering to revise the undergraduate minor and embedded certificate in Signal Processing was approved by the Council on Academic Affairs at its meeting on February 21, 2024. Thank you for attending the meeting to respond to questions/comments.

This action will be included in the Council's next Annual Activities Report to the University Senate (July 2024).

The Council asks that the Department return in two-years to give information on the impact of these changes to students (enrollment, time to graduation, completion rates). This can be presented as an informational items rather than a formal proposal.

The Office of the University Registrar will work you with any implementation issues.

Please keep a copy of this message for your file on the proposal and I will do the same for the file in the Office of Academic Affairs.

If you have any questions please contact the Chair of the Council, Professor Fábio Leite. (11), or me.

Randy

THE OHIO STATE UNIVERSITY

W. Randy Smith, Ph.D.
Vice Provost for Academic Programs
Office of Academic Affairs
University Square South, 15 E. 15th Avenue, Columbus, OH 43201
614-292-5881 Office
smith.70@osu.edu
Assisted by:
Katie Reed
Executive Assistant
(614) 292-5672
reed.901@osu.edu

THE OHIO STATE UNIVERSITY

College of Engineering

Undergraduate Education & Student Services

122 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210-1278

614-292-2651 Phone
614-292-9379 Fax

engineering.osu.edu

Memo

To: Randy Smith, Vice Provost for Academic Programs
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: January 11, 2024
Re: Program Change Proposal to both the UG Minor and Embedded Certificate in **Signal Processing** submitted by the Department of Electrical and Computer Engineering

---

On January 10, 2024, The College of Engineering Committee for Academic Affairs approved the program changes to both the UG Minor and Embedded Certificate in Signal Processing.

A summary of the changes is on page 2. Whilst one program is a minor and the other an embedded certificate, they are of the same content, so they have been presented in one document. Track Changes has been selected so that reviewers can view and compare what has been revised.

Yours sincerely,

Rosie Quinzon-Bonello

October 12, 2023

To: **Boyd Panton, CCAA Chair**

RE: **Changes to Undergraduate Minor and Embedded Certificate in Signal Processing**

In this document you will find changes to our Electrical and Computer Engineering undergraduate minor and undergraduate embedded certificate in Signal Processing.

Embedded UG Certificate in Signal Processing

- Added an additional elective
- Prerequisites for ECE 2060 have changed to "none"
- Updated current prerequisites to reflect recent and proposed changes
- Increase overlap hours to 100%
- Added exclusion between minor and certificate

Minor in Signal Processing

- Added an additional elective
- Prerequisites for ECE 2060 have changed to "none"
- Updated current prerequisites to reflect recent and proposed changes
- Added exclusion between minor and certificate
- Added language about overlap with undergraduate degree.
    - Explanation that this minor is not available to ECE students in the Electrical Engineering Program but possible to obtain for Computer Engineering Program of Study students.

You will find these changes on the following page numbers:

Certificates/Minors	**Page Numbers**
Undergraduate Minor in Signal Processing	3-6
Undergraduate Embedded Certificate in Signal Processing	7-12

If you have any further questions, please feel free to contact me at Anderson.67@osu.edu

Best Regards

Dr. Bette Lise Anderson

Proposal for Undergraduate Minor in Signal Processing
Revision Sept 18 2023

Betty Lise Anderson, Department of Electrical and Computer Engineering

Motivation

Analyzing and synthesizing complex electrical signals such as sound, images, and measurements are useful skills for anyone in the sciences.

Target audience

Undergraduates in engineering, math, physical sciences. These students will likely have the necessary math and physics courses to go directly into the courses in this minor.

Timing

Desired start up is Autumn 2023.

Coursework

Completion of the minor requires a minimum of 15 credit hours. The required courses are ECE 2020 Introduction to Analog Circuits and Systems, ECE 2060 Introduction to Digital Logic, ECE 2050 Introduction to Discrete Time Signals and Systems, ECE 3050 Signals and Systems. Student may choose the fifth course as one of : ECE 5206 Medical Imaging and Processing, ECE 5200 Introduction to Signal Processing or ECE 5460 Image Processing.

Required:

ECE 2020 Introduction to Analog Circuits and Systems (3 credits)

Prereq: Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260, or CHEM 1210 or 1250.

Offered every semester

ECE 2060 Introduction to Digital Logic (3 credits)

Prereq: None.

Offered every semester

ECE 2050 Introduction to Discrete Time Signals and Systems (3 credits)

Prereq: 2000, or 2060, or 2061 and 2067; and CSE 1222. Prereq or concur: Math 2174 or 2568.

Proposed changes: 2060, or 2061 and 2067; and enrollment in ECE major and CSE 1222, or enrollment in other major and CSE 1222, CSE 2221, ENGR 1222, ENGRE 1281.01H, or ENGR1281.01H. Prereq or concur: Math 2174 or 2568.

Offered every semester.

ECE 3050 Signals and Systems (3 credits)

Prereq: 2020, 2050, and 2060; or 2100; and Math 2568; and prereq or concur Math 2415; and enrollment in ECE or EngPhysics major.
Proposed changes: Prereq: 2060. Prereq or concur: Math 2174 or 2568.
Offered every semester.

Pick one:

ECE 5200 Introduction to Digital Signal Processing (3 credits)

Prereq: 3050, and Stat 3470 or Math 4530; or Grad standing.
Offered every spring.

ECE 5206 Medical Imaging and Processing (3 credits)

Prereq: 3050 (352). Prereq or concur: 3090 or 582, or Grad standing in ECE, BiomedE, or Biophys.
Proposed changes: Prereq or concur: 3906 or permission of instructor, and 3050; or Grad standing in ECE, BiomedE, or Biophys.
Offered every spring.

ECE 5460 Image Processing (3 credits)

Prereq: 5200 (600), and Stat 3470 (427) or Math 530; or Grad standing in Engineering, Biological Sciences, Statistics, Bioinformatics, or Math and Physical Sciences.

Semesters of offering

Number	Title	Even Aut	Odd Spr	Odd Aut	Even Spr
2020	**Introduction to Analog Circuits and Systems**	X	X	X	X
2060	**Introduction to Digital Logic**	X	X	X	X
2050	**Introduction to Discrete Time Signals and Systems**	X	X	X	X
3050	**Signals and Systems**	X	X	X	X
5200	**Introduction to Digital Signal Processing**		X		X
5206	**Medical Imaging and Processing**		X		X
5460	**Image Processing**	X		X	

Resources required

All courses listed above exist and are already offered

Admission requirements

Minimum GPA of 1.7 (C-) to apply. Initially admitted to the university as part of an Associates or Bachelors Degree program.

Completion requirements

Minimum GPA of 2.0 in the minor courses. Only grades of C- or better may be counted toward the minor.

Pass/Nonpass Courses

No courses graded Pass/Non-Pass may be applied to the minor.

Transfer Credits

At least half of the credits counting toward the minor must be earned in regular OSU coursework.

Overlap with the major and additional minors

The minor must be in a different subject from the major (as identified by the registrar's official listing of approved majors)

Each minor completed must contain a minimum of 12 credit hours distinct from the major and/or additional minors (i.e., if a minor requires more than 12 credit hours, a student is permitted to overlap those credit hours beyond 12 with the major or with another minor)." the major.

Thus, this minor is not available to ECE students in the Electrical Engineering Program of Study (EES), because more than half of the required courses for the minor are also required for their major. EES students wishing to document proficiency in signal processing may take the Embedded Undergraduate Certificate in Signal Processing. For ECE students in the Computer Engineering Program of Study (CES), it is possible to take 12 distinct hours by taking ECE 3050 plus all three electives. CES students wishing to document proficiency in signal processing may prefer to the Embedded Undergraduate Certificate in Signal Processing.

Overlap with the GE

A student is permitted to overlap up to 6 credit hours between the GE and a minor.

Electrical and Computer Engineering Students

Not available to ECE students

Exclusions

A student receiving the Certificate in Signal Processing may not also receive the Minor in Signal Processing.

Outcomes

Upon completion of the Minor in Signal Processing, learners will be better prepared to:

1) Be competent with linear systems as approximate models of physical systems
2) Master Fourier series, Fourier transform, and discrete-time Fourier transform
3) Master the fundamentals of sampling and reconstruction

Proposal for an Undergraduate Embedded Certificate in Signal Processing: Revision September 18, 2023

Betty Lise Anderson, Department of Electrical and Computer Engineering

I. Program definition

A. Title of program

Undergraduate Embedded Certificate in Signal Processing

B. Certificate Category and Justification

Analyzing and synthesizing complex electrical signals such as sound, images, and measurements are useful skills for anyone in the sciences.

C. Purpose of program

1. This certificate can be completed by undergraduates currently pursuing BS degrees at Ohio State.
2. Method of delivery will be primarily in-person, in accordance with current offering of the courses in the certificate Additionally, there is a required laboratory component.

D. Methods of delivery

The courses are primarily offered in-person currently.

E. Timing

Desired start up is Autumn 2023.

F. Goals

The goal is to provide a mechanism for undergraduate students in engineering, math, and the physical sciences to acquire basic competency in signal processing, in addition to their major degree outside electrical engineering. This certificate is not available to ECE students

G. Outcomes

Upon completion of the academic certificate in Semiconductor Devices, learners will be better prepared to:

4) Be competent with linear systems as approximate models of physical systems
5) Master Fourier series, Fourier transform, and discrete-time Fourier transform
6) Master the fundamentals of sampling and reconstruction

H. Minimum requirements

A minimum GPA of 2.0 in the certificate courses is required for completion. Only grades of C- or better may be counted toward the certificate.

Completion of the certificate requires a minimum of 15 credit hours.

I. Methods of delivery

Number	Title	Online	In-Person	In-person or online
2020	**Introduction to Analog Circuits and Systems**		X	
2060	**Introduction to Digital Logic**		X	
2050	**Introduction to Discrete Time Signals and Systems**		X	
3050	**Signals and Systems**		X	
5200	**Introduction to Digital Signal Processing**		X	
5206	**Medical Imaging and Processing**		X	
5460	**Image Processing**		X	

J. MOU with ODEE

Not required.

K. List of required and elective courses

1. Required:

ECE 2020 Introduction to Analog Circuits and Systems (3 credits)

Prereq: Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260, or CHEM 1210 or 1250.
Offered every semester

ECE 2060 Introduction to Digital Logic (3 credits)

Prereq: None.
Offered every semester

ECE 2050 Introduction to Discrete Time Signals and Systems (3 credits)

Prereq: 2000, or 2060, or 2061 and 2067; and CSE 1222. Prereq or concur: Math 2174 or 2568.
Proposed changes: 2060, or 2061 and 2067; and enrollment in ECE major and CSE 1222, or enrollment in other major and CSE 1222, CSE 2221, ENGR 1222, ENGRE 1281.01H, or ENGR1281.01H. Prereq or concur: Math 2174 or 2568.
Offered every semester.

ECE 3050 Signals and Systems (3 credits)

Prereq: 2020, 2050, and 2060; or 2100; and Math 2568; and prereq or concur Math 2415; and enrollment in ECE or EngPhysics major.
Proposed changes: Prereq: 2060. Prereq or concur: Math 2174 or 2568.
Offered every semester.

2. Pick at least one:

ECE 5200 Introduction to Digital Signal Processing (3 credits)

Prereq: 3050, and Stat 3470 or Math 4530; or Grad standing.
Offered every spring.

ECE 5206 Medical Imaging and Processing (3 credits)

Prereq: 3050 (352). Prereq or concur: 3090 or 582, or Grad standing in ECE, BiomedE, or Biophys.
Proposed changes: *:* Prereq or concur: 3906 or permission of instructor, and 3050; or Grad standing in ECE, BiomedE, or Biophys.

ECE 5460 Image Processing (3 credits)

Prereq: 5200 (600), and Stat 3470 (427) or Math 530; or Grad standing in Engineering, Biological Sciences, Statistics, Bioinformatics, or Math and Physical Sciences.

L. Length of program compared to similar programs

We are not aware of any similar programs.

M. Semesters of offering

Number	Title	Even Aut	Odd Spr	Odd Aut	Even Spr
2020	**Introduction to Analog Circuits and Systems**	X	X	X	X
2060	**Introduction to Digital Logic**	X	X	X	X
2050	**Introduction to Discrete Time Signals and Systems**	X	X	X	X
3050	**Signals and Systems**	X	X	X	X
5200	**Introduction to Digital Signal Processing**		X		X
5206	**Medical Imaging and Processing**		X		X
5460	**Image Processing**	X		X	

N. Transfer Credits

All courses in the Certificate must be taken at Ohio State.

O. Arranged/Individual Study Courses

Arranged individual study courses may not be applied to the certificate.

P. Overlap

All of the courses in the certificate may be counted toward the undergraduate degree.

Q. Exclusions

A student receiving the Certificate in Signal Processing may not also receive the Minor in Signal Processing.

II. Enrollment

A. Projected enrollment

We have no experience with these certificates, so we can only guess at the number of students who might be interested, potentially 5 per year

1. Will there be problems if too many students enroll in the certificate program?

It is unlikely, but the courses 2020, 2050, 2060, and 3050 are offered every semester and sections can be made larger if needed, although the first three have labs which could become bottlenecks if this certificate proves insanely popular. Given that it's 15 credits, we don't think it will happen.

2. Will there be problems if too few students enroll in the certificate program?

No.

B. Opportunities for graduates

Graduates working in the physical sciences and engineering will be more employable with the addition of this skill set.

C. Admission requirements

A minimum GPA of 1.7 (C-) to apply. Initially admitted to the university as part of an Associates or Bachelors Degree program. An embedded certificate program is "declared" in a similar path to majors.

III. Sufficient resources

A. Adequacy and availability of facilities and staff

All courses listed above exist and are already offered. They run on the schedule listed under Section I.M.

B. Projected resource needs and plans to meet those needs

The certificate can run and serve students immediately.

IV. Justifiable expenses

A. Additional Faculty

We currently have enough faculty with the appropriate expertise to offer the certificate.

B. Course additions or deletions

No new courses are needed at this time.

C. Necessary budget adjustments

We can run the certificate with existing resources.

D. Available and anticipated funding

None.

V. Adequate demand

A. Evidence of sufficient demand by students faculty, general public, and/or business

We have met with the Biomedical Engineering Department about potential ECE minors that might interest their students. They suggested that Signal Processing would be the primary topic of interest.

B. Duration of demand (long/short term)

To be determined. Since no additional resources are required to run this certificate, we can try it and see.

C. Ability of other programs to meet demand

Signal Processing is a well-known sub-discipline in electrical engineering. Although it is used in other fields, to master the topics requires fundamental ECE knowledge in analog and digital circuits and systems.

VI. Competitiveness with other institutions: limited overlap within the University

A. Overlap with other programs or departments

None.

B. Duplication of effort by other areas in the University, another university or another school

Universities including Purdue, University of Massachusetts, and Arizona State offer Graduate and Professional Certificates in signal processing, but not undergraduate.

C. Similar programs at other universities in Ohio, or in the United States, and their levels of success

No similar programs exist as far as we know.