From:	Smith, Randy
To:	Anderson, Betty Lise; Shanker, Balasubramaniam
Cc:	Andridge, Rebecca; Reed, Katie; Smith, Randy; Orr, James; Duffy, Lisa; Quinzon-Bonello, Rosario; Tomasko, David
Subject:	Proposal to establish a 1b Undergraduate Certificate and Minor in Signal Processing
Date:	Friday, May 19, 2023 2:40:21 PM
Attachments:	image001.png

Betty Lise and Shanker:

The proposal from the Department of Electrical and Computer Engineering to establish a 1b Undergraduate Certificate and Minor in Signal Processing was reviewed by the Council on Academic Affairs at its meeting on May 16, 2023, and electronically approved by the Council on May 19, 2023. Thank you for attending the meeting to respond to questions/comments.

No additional level of internal approval is necessary. This action will be included in the Council's next Annual Activities Report to the University Senate (July 2023).

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 Rebecca Andridge.1 or me.

I wish you success with this important program development.

Randy

THE OHIO STATE UNIVERSITY

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Memo

To: Randy Smith, Vice Provost for Academic Programs
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: February 24, 2023

Re: UG Embedded Certificate in Signal Processing

On February 3, 2023, the College of Engineering Committee for Academic Affairs voted unanimously to approve the UG Embedded Certificate in Signal Processing proposal submitted by the Department of Electrical and Computer Engineering.

If you require additional information, feel free to contact me.

Yours sincerely,

Rosario Quinzon-Bonello

Rosie Quinzon-Bonello

Proposal for an Undergraduate Embedded Certificate in Signal Processing

November 19, 2022

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:

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

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	

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: Engr 1182.01, 1182.02, 1182.03, 1282.01H, 1282.02H, 1282.03H, 1282.04H, or 1186, 1187 and 1188 concurrent; and Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260; and CPHR 2.00 or above.

Proposed changes: 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: CSE 1222, 2221, Engr 1222, 1281.01H, or 1281.02H; and Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260; and Engr 1182.01, 1182.02, 1182.03, 1282.01H, 1282.02H, 1282.03H, 1282.04H, or 1186, 1187, and 1188 concurrent, or major in CIS or CIS-PRE; and CPHR 2.00 or above.

Proposed changes: CSE 1222, 2221, Engr 1222, 1281.01H, or 1281.02H; and Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260, or CHEM 1210 or 1250.

Offered every semester

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

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

Proposed changes: Prereq: 2060. 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.

A. 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: Remove ECE 3090 prereq to allow other majors to take it.
Offered every spring.

B. Length of program compared to similar programs

We are not aware of any similar programs.

C. 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

D. Transfer Credits

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

E. Arranged/Individual Study Courses

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

F. Overlap

A maximum of 6 credit hours of the major may overlap[FS1] with the credits required for the academic certificate.

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.

If demand increases for the labs, we will need more GTAs to run the additional sections. Six GTAs have been promised by the College of Engineering from the Intel funds.

IV. Justifiable expenses

A. Additional Faculty

We currently have enough faculty with the appropriate expertise to offer the certificate. If we are able to hire someone in the image processing area, we could strengthen this program by reviving ECE 5460 Image Processing, which has always had a very high demand but the person who taught it left OSU.

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.