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 Semiconductor Devices
Date:	Friday, May 19, 2023 2:42:16 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 Semiconductor Devices 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.

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 Minor in Semiconductor Devices

On February 3, 2023, the College of Engineering Committee for Academic Affairs voted unanimously to approve the UG Minor in Semiconductor Devices 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

Undergraduate Minor in Semiconductor Devices

November 19, 2022

Betty Lise Anderson, Department of Electrical and Computer Engineering

Motivation

The reshoring of microelectronics manufacturing, and the anticipated opening of semiconductor fabrication lines in central Ohio by Intel and nationwide by several semiconductor companies is expected to stimulate much interest in students acquiring skills in semiconductor devices, device physics, fabrication, and electronics.

Target audience

Undergraduates in engineering, math, physical sciences. These students will likely have the necessary math and physics course 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 13 credit hours. Of these, ECE 3030 Semiconductor Electronic Devices (3 credits), is the gateway course, and required, although a similar course in another department may be approved by petition. (Special rules apply to ECE students; see below). ECE 5530 is also required. Additionally, at least one lab (either 5037 or 5537) is required; each is 4 credits. The remaining three credits can be chosen from a pick list.

Required:

ECE 3030 Semiconductor Device Physics (3 credits)

Current Prereqs: 2020, 2021, or 2100; and Physics 1251, 1261, or both 1240 and 1241; and Chem 1210, 1220, or 1250; and enrollment in ECE, MSE, or EngPhysics major. Prereq or concur: Math 2415 or 2174.

Proposed new prereqs: Physics 1251, 1261, or both 1240 and 1241; and Chem 1210, 1220, or 1250. Prereq or concur: Math 2415 or 2174. Offered every semester.

E**CE 5530 Fundamentals of Semiconductors for Microelectronics and Photonics** (3 credits)

Prereq: 3030, or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

Proposed changes: modify course topics to include more device physics and specifically silicon devices; course change request in progress

Pick at least one:

ECE 5037 Solid State Electronics and Photonics Laboratory (4 credits)

Proposed name change: Semiconductor Device Fabrication Lab
Current Prereqs: Prereq or concur: 3030, and acceptance in ECE, MSE or EngPhysics major; or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.
Proposed new prereqs: Prereq or concur: 3030; or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

ECE 5537 Semiconductor Device Characterization and Modeling Lab (4 credits)
Prereq: ECE 3030; or grad standing in Engineering or Physics.
This course is currently being piloted as ECE 5194.17, but the permanent number of 5537 has been applied for.

Additional courses (pick 1)

ECE 5031 Semiconductor Process Technology (3 credits)
Prereq: 3030, or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences. Offered every spring.

ECE 5033 Surfaces and Interfaces of Electronic Materials (3 credits)
Prereq: 3030, and Physics 1250 or 1250H; or Grad standing in Engineering, Biological Science, or Math and Physical Sciences. Offered odd springs

ECE 5131 Lasers (3 credits)
Prereq: 3010 and 3030 or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

ECE 5132 Photonics (3 credits)
Prereq: 3010 and 3030 or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

ECE 5244 Si and Wide Band Gap Power Devices (3 credits)
3030 or grad standing in engineering or physics.

ECE 5832 Photovoltaics and Energy Conversion (3 credits
Prereq: 3030, or Grad standing in Engr or Physics.

ECE 5833 Organic and Printed Flexible Electronics (3 credits)
Prereq: 3030, or permission of instructor for non-ECE majors; or Grad standing in engineering, biological sciences, or math and physical sciences.

Note: A student completing the minor must take at least one lab, but may choose another in addition as an elective.

Semesters of offering

Number	Title	Even Aut	Odd Spr	Odd Aut	Even Spr
3030	**Semiconductor Device Physics**	X	X	X	X
5530	**Fundamentals of Semiconductors for Microelectronics and Photonics**	X		X	
5037	**Semiconductor Device Fabrication Lab**	X		X	
5537	**Semiconductor Device Characterization and Modeling Lab***		X		X
5031	**Semiconductor Process Technology**		X		X
5033	**Surfaces and Interfaces of Electronic Materials**		X		
5131	**Lasers**			X	
5132	**Photonics**	X			
5244	**Si and Wide Band Gap Power Devices**	X		X	
5832	**Photovoltaics and Energy Conversion**			X	
5833	**Organic and Printed Flexible Electronics**		X		

*ECE 5537 is currently being piloted under ECE 5194.17; permanent number is being applied for.

Resources required

All courses listed above exist and are already offered, with two caveats:

1) ECE 5537 is currently running as a Group Studies; a permanent number is being applied for
2) ECE 5037 has not run for several years due to failing equipment. We have a new plan, however, to run ECE 5037 (fabrication laboratory) either in Dreese, or in Nanotech West, or in a combination of these facilities. We are seeking funds to upgrade the existing equipment in the 5037 lab, which already has dedicated space in the Dreese basement cleanroom (specialized environment needed to fabricate chips). If we can secure money for updated equipment, repairs to the air handlers, and staff to maintain the lab, we can re-open this course. Resources and facilities are being arranged to run the course, and to repair equipment. If, however, that doesn't happen soon, we can still offer the certificate with only the ECE 5537 laboratory course.

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.

Admission requirements

Minimum GPA of 1.7 (C-) to apply. Initially admitted to the university as part of and 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.

Independent Study, Satisfactory/Unsatisfactory courses

Up to three credit hours of xx93 or courses graded Satisfactory/Unsatisfactory may be counted toward 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

A maximum of 6 credit hours of the minor may overlap with the credits required for the major.

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

ECE has two programs of study, electrical engineering program of study (EES) and computer engineering program of study (CES).

EES students are required to complete three "domains" for their major, choosing two electives in one domain and one elective in each of two other domains. There are six domains. One of the domains is "solid state electronics and photonics." ECE students desiring to obtain this minor may take four courses from the list above, excepting ECE 3030, which is required of EES students. Of those electives, up to 6 credits from list above can count toward the solid state domain *and* the minor simultaneously. To complete the minor, the student must take ECE 5530, and either 5037 or 5537, and two additional electives from the list above.

CES students are not required to take ECE 3030 for their major. They must take 16 hours of technical electives, of which 9 must be from a list specific to computer engineers They may therefore take up to 7 hours of ECE technical electives outside that list, which may be solid state courses. Thus a CES student could count ECE 3030 and 5530 toward those six hours to degree *and* toward the minor simultaneously; they would need to take either the 5037 lab or the 5537 lab, and one additional solid state elective from the table above to complete the certificate.

Outcomes

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

1) Understand advanced semiconductor physics
2) Understand electronic and optical properties of semiconductors
3) Understand the principles of new electronics devices as new technologies develop.