

New Proposal

Date Submitted: 03/21/24 11:33 am

Viewing: : **Semiconductor Engineering**
Minor, UG

Last edit: 03/25/24 3:44 pm

Changes proposed by: Ashley Hallock

In Workflow

1. U Program Review
2. 1227 Head
3. KP Committee Chair
4. KP Dean
5. University Librarian
6. COTE Programs
7. Provost
8. Senate EPC
9. Senate
10. U Senate Conf
11. Board of Trustees
12. IBHE
13. HLC
14. DMI

Approval Path

1. 03/21/24 11:38 am
Emily Stuby (eastuby):
Approved for U Program Review
2. 03/21/24 11:39 am
Ashley Hallock (ahallock):
Approved for 1227 Head
3. 03/21/24 12:05 pm
Ashley Hallock (ahallock):
Approved for KP Committee Chair
4. 03/21/24 12:06 pm
Cindy Pruitt (cpruitt):
Approved for KP

- Dean
- 5. 03/21/24 12:09 pm
Claire Stewart (clairest):
Approved for University Librarian
- 6. 03/21/24 1:25 pm
Suzanne Lee (suzannel):
Approved for COTE Programs
- 7. 03/21/24 1:43 pm
Brooke Newell (bsnewell):
Approved for Provost

Proposal Type

Proposal Type:
Minor (ex. European Union Studies)

Administration Details

Official Program Name	Semiconductor Engineering Minor, UG	
Diploma Title	Minor in Semiconductor Engineering	
Sponsor College	Grainger College of Engineering	
Sponsor Department	Engineering Administration	
Sponsor Name	Jonathan Makela	
Sponsor Email	jmakela@illinois.edu	
College Contact	Ashley Hallock	College Contact Email
	ahallock@illinois.edu	
College Budget Officer	Tessa Hile	
College Budget Officer Email	tmhile@illinois.edu	

List the role for rollbacks (which role will edit the proposal on questions from EPC, e.g., Dept Head or Initiator) and/or any additional stakeholders. Purpose: List here who will do the editing work if proposal needs rolled back. And any other stakeholders.

Does this program have inter-departmental administration?

No

Proposal Title

Effective Catalog Term Fall 2024

Proposal Title (either Establish/Revise/Eliminate the Degree Name in Program Name in the College of XXXX, i.e., Establish the Bachelor of Science in Entomology in the College of Liberals Art and Sciences, include the Graduate College for Grad Programs)

Establish the Undergraduate Minor in Semiconductor Engineering in the Grainger College of Engineering

Does this proposal have any related proposals that will also be revised during the next 6 weeks? Consider Majors, Minors, Concentrations & Joint Programs in your department. Please know that this information is used administratively to move related proposals through workflow efficiently. Example: If you are revising the BS proposal and one related concentration within the next 6 weeks, "This BS proposal (key 567) is related to the Concentration A proposal (key 145)."

Program Justification

Provide a brief justification of the program, including highlights of the program objectives, and the careers, occupations, or further educational opportunities for which the program will prepare graduates, when appropriate.

The resurgence of semiconductor manufacturing as a vital and strategic sector of the US economy has motivated a concerted effort to reorganize the related educational opportunities on campus, drawing from the significant strengths in The Grainger College of Engineering. The proposed Minor in Semiconductor Engineering aims to provide a comprehensive introduction to semiconductors with many possible pathways for specialization, leading to a variety of professional opportunities for science and engineering majors.

The field of semiconductors is inherently broad and interdisciplinary, with key curricular components distributed among multiple engineering departments. We believe it is most appropriate to establish the proposed minor in The Grainger College of Engineering rather than in a specific department, to realize a cooperative framework with a holistic approach that maximizes the educational options. Many students will be able to fulfill a majority of the requirements of the minor within their choice of technical elective courses for their major program of study.

The main objective of the minor is to delineate a clear trajectory for students to acquire the competencies needed to emerge as future leaders in the semiconductor industry and in academia. The curriculum of the minor begins with the choice of three foundational courses from a selection of core topics, ranging from physical theory to device fabrication and to applications, providing a solid background to build upon for the final selection of advanced electives. Students will be able to pursue both breadth and depth, made possible by our unparalleled portfolio of courses, distributed across the following departments: Electrical and Computer Engineering; Material Science and Engineering; Mechanical Science and Engineering; Nuclear, Plasma and Radiological Engineering; Industrial and Enterprise Systems Engineering; Physics.

Strong connections with the semiconductor industry, engaged with our engineering centers and laboratories, will be leveraged to enrich the students' experience and to cultivate targeted opportunities for relevant internships and projects to complement academics. This will reinforce the pipeline for professional employment which is projected to expand with the ongoing investments by the government toward the development of a resilient and self-sufficient semiconductor manufacturing network. Completion of the Minor in Semiconductor Engineering will provide important credentials to make our students even more competitive as the interest for careers in this field is likely to grow nationwide with the buildup of manufacturing capacity. At the same time, students interested in research will be well prepared to pursue graduate studies and contribute to the new discoveries necessary to sustain innovation and move the semiconductor field even further.

Please include how the proposed minor requires some depth in the subject, but not as extensive as the major.

The Minor in Semiconductor Engineering is being proposed to provide a learning opportunity for students interested in gaining a more holistic view of the semiconductor industry than typical while pursuing one of the existing engineering undergraduate degree programs currently available in The Grainger College of Engineering. The semiconductor industry relies on scientists and engineers having a broad swath of knowledge that spans multiple departments. The Minor in Semiconductor Engineering brings together courses from across different academic departments to provide students with additional breadth and depth in the field that they would not be able to obtain through completion of their respective majors alone.

Instructional Resources

Will there be any reduction in other course offerings, programs or concentrations by your department as a result of this new program/proposed change?

No

Does this new program/proposed change result in the replacement of another program?

No

Does the program include other courses/subjects outside of the sponsoring department impacted by the creation/revision of this program?

Yes

Courses outside
of the sponsoring
department/interdisciplinary
departments

ECE 444 - IC Device Theory & Fabrication
ECE 443 - LEDs and Solar Cells
ECE 340 - Semiconductor Electronics
ECE 304 - Photonic Devices
ECE 441 - Physcs & Modeling Semicond Dev
ECE 442 - Silicon Photonics
ECE 460 - Optical Imaging
ECE 481 - Nanotechnology
ECE 488 - Compound Semicond & Devices
ECE 495 - Photonic Device Laboratory
IE 330 - Industrial Quality Control
IE 361 - Production Planning & Control
IE 360 - Facilities Planning and Design
IE 412 - OR Models for Mfg Systems
IE 431 - Design for Six Sigma
SE 411 - Reliability Engineering
MSE 304 - Electronic Properties of Matls
MSE 460 - Electronic Materials I
MSE 461 - Electronic Materials II

MSE 485 - Atomic Scale Simulations
MSE 487 - Materials for Nanotechnology
MSE 488 - Optical Materials
ME 487 - MEMS-NEMS Theory & Fabrication
ME 432 - Fundamentals of Photovoltaics
ME 453 - Data Sci in Mfg Quality Cntrl
NPRE 429 - Plasma Engineering
NPRE 321 - Intro to Plasmas & Application
NPRE 423 - Plasma Laboratory
PHYS 370 - Intro to Quant Info and Comp
PHYS 402 - Light
PHYS 404 - Electronic Circuits
PHYS 427 - Thermal & Statistical Physics
PHYS 460 - Condensed Matter Physics
PHYS 486 - Quantum Physics I
PHYS 487 - Quantum Physics II
ME 455 - Micromanufacturing Process & Automation

Please attach any [ECE Endorsement of minor.pdf](#)
letters of [Physics Endorsement of minor - August 3 2023.pdf](#)
support/acknowledgement [NPRE Endorsement of minor June 2023.pdf](#)
for any [MechSE Endorsement of minor _amj\[1\].pdf](#)
Instructional [MatSE Endorsement of Minor.pdf](#)
Resources [ISE Endorsement of minor.pdf](#)
consider faculty,
students, and/or
other impacted
units as
appropriate.

Program Regulation and Assessment

Plan to Assess and Improve Student Learning

Illinois Administrative Code: 1050.30(b)(1)(D) Provision is made for guidance and counseling of students, evaluations of student performance, continuous monitoring of progress of students toward their degree objectives and appropriate academic record keeping.

List the program's student learning outcomes. Each outcome should identify what students are expected to know and/or be able to do upon completing this program.

Semiconductor Engineering is a broad field which encompasses many areas of science and technology. Correspondingly, there are many possible directions in industry and research which share the same fundamentals but branch out into an extraordinarily diverse range of applications. The intention of the proposed minor is not to provide a one-size-fits-all solution, but to support a wide range of educational choices and channelize larger numbers of engineering undergraduates into advanced courses to develop expertise in diverse areas of semiconductor design, manufacturing, and applications in order to meet the growing demands and expectations from the semiconductor industry.

As such, students earning the Minor in Semiconductor Engineering will have:

- a holistic view of the semiconductor industry from both a technical point of view and in the global societal context and how different engineering disciplines contribute to the field;
- a rigorous foundation and broad competency in the field of semiconductors based on an understanding of the underlying physics, material properties, and manufacturability of semiconductor devices; and
- a depth of knowledge in one area of semiconductor design, manufacturing, or applications to prepare them to meet the growing demands and expectations from the semiconductor industry.

As a whole, students completing the minor will be able to speak the same "language" of semiconductors, while carrying with them specific breadth and depth as selected according to individual interests. Such diversity of backgrounds within the same general area is very desirable for employment in industry or participation in research groups.

Describe how, when, and where these learning outcomes will be assessed.

Describe here:

Each course to be selected as a part of the minor has its own unique set of learning objectives, desired educational outcomes, and assessment protocols established for ABET accreditation (see below).

Student outcomes will also be evaluated in terms of enrollment in graduate education or attainment of employment in the semiconductor industry. This information will be obtained from standard campus resources with this information (e.g., the Illini Success first destinations survey).

Identify faculty expectations for students' achievement of each of the stated student learning outcomes. What score, rating, or level of expertise will signify that students have met each outcome? Provide rating rubrics as necessary.

Faculty assessment of student attainment of learning objectives will primarily be assessed through satisfactory completion of the individual courses needed to earn the minor, as represented by their final course grades. In addition, a faculty committee, with representation from the six departments offering courses in the minor, will provide regular (semesterly) oversight of the minor.

Explain the process that will be implemented to ensure that assessment results are used to improve student learning.

The engineering departments (except Physics) providing coursework for this minor are all ABET accredited. For that accreditation, the departments each have a continuous improvement process developed which will be leveraged to ensure that the individual courses and overall learning objectives for the minor are being assessed and that those assessments are used to improve student learning. This already-existing framework will be augmented by a faculty advisory committee for the minor, consisting of one faculty member from each department providing courses for the minor. This committee will oversee the requirements of the minor, including any revisions that need to be made as a result of the assessments conducted.

Program

[Semiconductor Minor Program Description Requirements Jan2024.docx](#)

Description and

Requirements

Attach Documents

Is the career/profession for graduates of this program regulated by the State of Illinois?

No

Program of Study

Baccalaureate degree requires at least 120 semester credit hours or 180 quarter credit hours and at least 40 semester credit hours (60 quarter credit hours) in upper division courses" (source: <https://www.ibhe.org/assets/files/PublicAdminRules2017.pdf>). For proposals for new bachelor's degrees, if this minimum is not explicitly met by specifically-required 300- and/or 400-level courses, please provide information on how the upper-division hours requirement will be satisfied.

An undergraduate minor should consist of at least 16 - and no more than 21 hours - of course work, with at least 6 hours of 300- or 400- level courses. Except for clearly remedial offerings, prerequisite courses within the sponsoring unit count towards the total; prerequisite courses outside the sponsoring unit do not count toward this total. The unit sponsoring the minor and that unit's college may set educationally necessary prerequisites for eligibility for the minor within these constraints. Does this proposal meet these criteria?

Yes

Attach Program of Study-related information such as sample sequences (for undergraduate programs) or college-level forms.

Catalog Page Text - Overview Tab

Description of program for the catalog page. This is not official content, it is used to help build the new catalog page for the program. Can be edited in the catalog by the college or department.

Students may fulfill the requirements for a Minor in Semiconductor Engineering by completing the following course sequence with a minimum of 16 credit hours. At least six hours of coursework for the minor should be advanced (300-level or 400-level courses) and must be distinct from credit earned for the student's major or another minor. A minimum of two courses should be 400-level.

Students may apply up to 3 credit hours of independent study towards the "semiconductor elective courses" requirement of the minor, to enable them to pursue advanced topics under the guidance of a faculty member. Topics for the independent study must be approved by the minor's faculty oversight committee in order to apply towards the minor requirements. Students can contact the program advisor to learn how to get an independent study course approved.

Statement for
Programs of
Study Catalog

Course List

Code	Title	Hours
Semiconductor Core Courses. Select 9 hours from list below.		9
<u>ECE 340</u>	Semiconductor Electronics	
or <u>MSE 304</u>	Electronic Properties of Matls	
<u>IE 330</u>	Industrial Quality Control	
or <u>IE 361</u>	Production Planning & Control	
<u>ECE 444</u>	IC Device Theory & Fabrication	
or <u>ME 487</u>	MEMS-NEMS Theory & Fabrication	
<u>MSE 460</u>	Electronic Materials I	
<u>NPRE 429</u>	Plasma Engineering	
<u>ME 432</u>	Fundamentals of Photovoltaics	
or <u>ECE 443</u>	LEDs and Solar Cells	
Semiconductor Elective courses. Select 7 hours from list below.		7
<u>ECE 304</u>	Photonic Devices	
<u>ECE 441</u>	Physcs & Modeling Semicond Dev	
<u>ECE 442</u>	Silicon Photonics	
<u>ECE 460</u>	Optical Imaging	
<u>ECE 481</u>	Nanotechnology	
<u>ECE 488</u>	Compound Semicond & Devices	
<u>ECE 495</u>	Photonic Device Laboratory	
<u>IE 360</u>	Facilities Planning and Design	
<u>IE 412</u>	OR Models for Mfg Systems	
<u>IE 431</u>	Design for Six Sigma	
<u>SE 411</u>	Reliability Engineering	
<u>MSE 461</u>	Electronic Materials II	
<u>MSE 485</u>	Atomic Scale Simulations	
<u>MSE 487</u>	Materials for Nanotechnology	
<u>MSE 488</u>	Optical Materials	
<u>ME 453</u>	Data Science in Manufacturing Quality Control	
<u>ME 455</u>	Micromanufacturing Process & Automation	
<u>NPRE 321</u>	Introduction to Plasmas and Applications	

Code	Title	Hours
NPRE 423	Plasma Laboratory	
PHYS 370	Introduction to Quantum Information and Computing	
PHYS 402	Light	
PHYS 404	Electronic Circuits	
PHYS 427	Thermal & Statistical Physics	
PHYS 460	Condensed Matter Physics	
PHYS 486	Quantum Physics I	
PHYS 487	Quantum Physics II	
Independent Study - Students may apply up to 3 credit hours towards this requirement, once approved.		
Total Hours		16

Program Features

Academic Level Undergraduate

Is this minor?

An interdisciplinary study focusing on a single theme

Is This a Teacher Certification Program?

No

Will specialized accreditation be sought for this program?

No

Other than certification via the students' degree audits, is there any additional planned mechanism to award/honor successful completion of the minor?

No

Delivery Method

This program is available:

On Campus - Students are required to be on campus, they may take some online courses.

Enrollment

Will the department limit enrollment to the minor?

No

Describe how the department will monitor the admission to/enrollment in the minor.

The process to declare a minor in The Grainger College of Engineering is described at <https://advising.grainger.illinois.edu/degree-programs/minors>. As a college-level minor, interested students will meet with a college advisor to discuss the program ahead of declaring the minor.

Are there any prerequisites for the proposed minor?

No

Number of Students in Program (estimate)

Year One Estimate

20

5th Year Estimate (or when
fully implemented)

100

Budget

Will the program or revision require staffing (faculty, advisors, etc.)
beyond what is currently available?

No

Additional Budget
Information

Attach File(s)

Financial Resources

How does the unit intend to financially support this proposal?

The minor is comprised of courses already regularly offered by the participating departments. There is not additional cost with course delivery.

There will be some impact on college-level advising, which will be responsible for advising students interested in pursuing the minor. Current staffing is expected to be able to absorb the expected number of students interested in pursuing the minor.

Will the unit need to seek campus or other external resources?

No

Attach letters of
support

Library Resources

Describe your proposal's impact on the University Library's resources, collections, and services. If necessary please consult with the appropriate disciplinary specialist within the University Library.

This proposal does not include significant topics that Grainger Library does not currently support, particularly as noted by the utilization of existing courses. After consultation with the Grainger Librarians (Monica Carroll and Sarah Park), we believe that the current resources are sufficient to meet the needs of this program. The early notification will also allow any necessary resource co-location to occur at the Library's discretion.

EP Documentation

EP Control

EP.24.086

Number

Attach [ep24086_email to and response from sponsor_20240325.pdf](#)

Rollback/Approval

Notices

This proposal No

requires HLC

inquiry

DMI Documentation

Attach Final

Approval Notices

Banner/Codebook

Name

Program Code:

Minor Code	Conc Code	Degree Code	Major Code
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Senate Approval

Date

Senate

Conference

Approval Date

BOT Approval

Date

IBHE Approval

Date

HLC Approval

Date

DOE Approval

Date

Effective Date:

Attached

Document

Justification for

this request

Program Reviewer

Comments

Brooke Newell (bsnewell) (09/18/23 11:27 am): Rollback: Email sent to Ashley

Brooke Newell (bsnewell) (09/19/23 12:56 pm): Rollback: Rollback per request

Brooke Newell (bsnewell) (02/28/24 11:13 am): Rollback: Per discussion with Ashley.

Barbara Lehman (bjlehman) (03/21/24 9:21 am): Rollback: rollback per sponsor request. See attached email.

Cindy Pruitt (cpruitt) (03/21/24 9:37 am): Rollback: Per the sponsor's request.

Claire Stewart (clairest) (03/21/24 11:25 am): Rollback: Per Ashley Hallock's request on 3/21/2024



COLLEGE OF ENGINEERING

Department of Electrical & Computer Engineering
2120 Electrical and Computer Engineering Building, MC-702
306 N. Wright St.
Urbana, IL 61801-2991

Bruce Hajek
Department Head

Date: July 1, 2023

From: Prof. Bruce Hajek *Bruce Hajek*
Head, Department of Electrical and Computer Engineering
To: Whom it may concern
Subject: GCOE Minor in Semiconductor Engineering

I write to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. I realize that the creation of the minor will place some burden on the College staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the CGOE staff should be provisioned to handle such burden. The Minor will also create some load on our departmental undergraduate advising.

I acknowledge that the course(s) controlled by my department:

- ECE 298 An introductory one hour course on semiconductor engineering
- ECE 340 Semiconductor devices
- ECE 443 LEDS and Solar Cells
- ECE 444 Theory and Fabrication of Integrated Circuits
- ECE 304 Photonic Devices
- ECE 441 Physics and Modeling of Semiconductor Devices
- ECE 442 Silicon Photonics
- ECE 460 Optical Imaging
- ECE 481 Nanotechnology
- ECE 305 Quantum Systems I
- ECE 488 Compound Semiconductors and Devices
- ECE 495 Photonic Device Laboratory

are included in the options for the Minor. My department will do it's best to make these courses available for students in the minor.

I agree that my department will be responsible in the coming years to provide one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor. This committee will be responsible for maintaining and updating the Minor as the courses and student needs evolve, with approval of the GCOE Executive Committee.

August 3rd, 2023

From: Prof. Matthias Grosse Perdekamp
Head Department of Physics

To: Whom it may concern
Subject: GCOE Minor in Semiconductor Engineering

I write to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. I realize that the creation of the minor will place some burden on the College staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the CGOE staff should be provisioned to handle such burden. The Minor will also create some load on our departmental undergraduate advising.

I acknowledge that the course(s) controlled by my department:

PHYS 370 Quantum information and quantum computing
PHYS 402 Light
PHYS 404 Electronic Circuits
PHYS 427 Thermal and Statistical Physics
PHYS 460 Condensed Matter Physics
PHYS 486 Quantum Physics I
PHYS 487 Quantum Physics II

are included in the options for the Minor. Physics will make these courses available for students in the minor.

I agree that my department will appoint one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor. This committee will be responsible for maintaining and updating the minor as courses and student needs evolve, with the approval of the GCOE Executive Committee.

With Kind Regards,





UNIVERSITY OF
ILLINOIS
URBANA - CHAMPAIGN

The Grainger College of Engineering

Department of Nuclear, Plasma, & Radiological Engineering
Suite 100 Talbot Laboratory, MC-234
104 S. Wright St.
Urbana, IL 61801

Date: June 21, 2023

From: Prof. Rizwan Uddin, Head *Rizwan Uddin*
Department of Nuclear, Plasma & Radiological Engineering

To: Whom it may concern

Subject: GCOE Minor in Semiconductor Engineering

I write to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. I realize that the creation of the minor will place some burden on the College staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the GCOE staff should be provisioned to handle such burden. The Minor will also create some load on our departmental undergraduate advising.

I acknowledge that the course(s) controlled by my department:

NPRE 429 Plasma Engineering
NPRE 321 Introduction to Plasmas
NPRE 423 Plasma Laboratory

are included in the options for the Minor. My department will do it's best to make these courses available for students in the minor.

I agree that my department will be responsible in the coming years to provide one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor. This committee will be responsible for maintaining and updating the Minor as the courses and student needs evolve, with approval of the GCOE Executive Committee.



August 2, 2023

From: Prof. Anthony M. Jacobi
Head, Department of Mechanical Science & Engineering

To: Whom it may concern

Subject: GCOE Minor in Semiconductor Engineering

I write to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. I realize that the creation of the minor will place some burden on the College staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the CGOE staff should be provisioned to handle such burden. The Minor will also create some load on our departmental undergraduate advising.

I acknowledge that the course(s) controlled by my department:

- ME 432 Fundamentals of Photovoltaics
- ME 453 Data Science in Manufacturing Quality Control
- ME 455 Micromanufacturing Process & Automation
- ME 485 MEMS Devices & Systems
- ME 487 MEMS-NEMS Theory & Fabrication
- ME 497* Independent Study (*max 3 cr, as approved, if in relevant topic area)
- ME 498 Nano-scale Fabrication & Characterization or
NanoMFG for Sustainable Energy

are included in the options for the Minor. My department will do its best to make these courses available for students in the minor.

I agree that my department will be responsible in the coming years to provide one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor and review of ME 497 relevance for usage towards minor requirements. This committee will be responsible for maintaining and updating the Minor as the courses and student needs evolve, with approval of the GCOE Executive Committee.

August 9, 2023

From: Prof. Nancy Sottos
Head, Department of Material Science & Engineering

To: Whom it may concern

Subject: GCOE Minor in Semiconductor Engineering

I write to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. I realize that the creation of the minor will place some burden on the College staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the CGOE staff should be provisioned to handle such burden. The Minor will also create some load on our departmental undergraduate advising.

I acknowledge that the course(s) controlled by my department:

MSE 304 Electronic Properties of Materials
MSE 460 Electronic Materials, Devices, and Processing 1
MSE 461 Electronic Materials II
MSE 485 Atomic Scale Simulations
MSE 487 Materials for Nanotechnology
MSE 488 Optical Materials

are included in the options for the Minor. My department will do its best to make these courses available for students in the minor.


I agree that my department will be responsible in the coming years to provide one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor. This committee will be responsible for maintaining and updating the Minor as the courses and student needs evolve, with approval of the GCOE Executive Committee.

Sincerely,



Nancy R. Sottos
*Department Head and Swanlund Endowed Chair
Department of Materials Science and Engineering
& The Beckman Institute at the University of Illinois*

TO: Bruce Hajek, ECE Department Head

FROM: Jeff Shamma, ISE Department Head 

DATE: July 26, 2023

SUBJECT: GCOE Minor in Semiconductor Engineering

This memo is to endorse the proposed Minor in Semiconductor Engineering to be administered by the Grainger College of Engineering. ISE realizes that the creation of the minor will place some burden on staff for enrollment and tracking of student progress towards the minor and for undergraduate advising. I agree the GCOE staff should be provisioned to handle such burden. The Minor will also create some load on ISE undergraduate advising.

ISE acknowledges that the following course controlled by my department are included in the options for the Minor:

IE 330	Industrial Quality Control
IE 361	Planning for Production
IE 360	Facility Planning and Design
IE 412	OR Models for Manufacturing Systems
IE 431	Design for Six Sigma
SE 411	Reliability Engineering

ISE will do its best to make these courses available for students in the minor.

ISE will be responsible in the coming years to provide one of its faculty members to serve on the GCOE standing committee for the oversight of the proposed minor. This committee will be responsible for maintaining and updating the Minor as the courses and student needs evolve, with approval of the GCOE Executive Committee.

Program Description and Requirements

At least 16 credit hours are required for the minor. At least six hours of coursework for the minor must be 400-level courses. As with any campus minor, at least six hours must be distinct from credit earned for the student's major or another minor.

Semiconductor engineering is a broad field which encompasses many areas of science and technology. The semiconductor industry relies on scientists and engineers having a broad swath of knowledge that spans multiple departments. Correspondingly, there are many possible directions in industry and research which share the same fundamentals but branch out into an extraordinarily diverse range of applications. The minor in semiconductor engineering brings together courses from across different academic departments to provide students with additional breadth and depth in the field that they would not be able to obtain through completion of their respective majors alone. Completion of the minor allows students to develop expertise in diverse areas of semiconductor design, manufacturing, and applications in order to meet the growing demands and expectations from the semiconductor industry.

Phase 1 – Core courses (9-11 credit hours)

The requirements for the minor include selection of three courses out of the following list, with highlights of the main learning outcomes. Six areas have been identified to provide a rigorous foundation and broader competency in the field of semiconductors. At the same time, technical directions can be explored in sufficient depth to develop interest for selection of elective courses.

- 1) ECE 340 "Semiconductor Devices" or MSE 304 "Electronic Properties of Materials".
ECE 340 introduces the basic theory of charge transport in semiconductors and the behavior of fundamental devices. In terms of learning outcomes, students learn how physics concepts can be applied to explain the microscopic operation of the building blocks needed to design functional devices. MSE 304 focuses on the fundamental behavior of materials which are used to fabricate semiconductor devices. The main learning outcome is to understand how the principles of quantum mechanics govern the unique properties of semiconductor materials which make realization of functional devices possible.
- 2) IE 330 "Industrial Quality Control" or IE 361 "Planning for Production".
The yield of acceptable semiconductor chips in a given fabrication process is of utmost importance. IE 330 gives a rigorous introduction to contemporary concepts and methods for quality and productivity design and improvement and discusses the leading approaches to quality management, methods for statistical process control, process capability analysis, and tolerance assessment. IE 361 focuses on the analysis and design of production systems, and the principles behind their management, operation, and maintenance, emphasizing the use of mathematical and computer models for effective planning. The learning objectives of these courses provide a unique component in the proposed minor, to prepare students interested in industrial management and entrepreneurship for the fast-changing production environment of semiconductor technology.

3) ECE 444 “Theory and Fabrication of Integrated Circuits” or ME 487 MEMS-NEMS Theory & Fabrication

ECE 444 is a comprehensive fabrication lab with the wide-ranging learning goal to provide a thorough understanding of the design and process technology of modern integrated circuits. It includes direct hands-on exposure to all aspects of processing technology, experience in the design of semiconductor device processes, and a clear understanding of the economic and technical trade-offs inherent in this industry. ME 487 is a similar course focusing on physical and chemical theory, design, and hands-on fabrication of micro- and nano-electromechanical systems (MEMS and NEMS); cleanroom fabrication theory, including general cleanroom safety, lithography, additive and subtractive processes, bulk and surface micromachining, deep reactive ion etching (DRIE), lithographic Galvanoförmung Abförmung (LIGA), packaging, scaling, actuators, and micro-nanofluids; fabrication of two take-home devices, such as piezoresistive sensors and microfluidic logic chips, that demonstrate advanced fabrication processing.

4) MSE 460 “Electronic Materials, Devices, and Processing I”.

This course introduces materials used in modern electronic and optoelectronic devices which have driven the innovation in the microelectronic industry. Students will be able to understand the operation of electronic devices and how their performance is limited by material properties. Comparative analysis of material properties imparts technical insight on how to choose the most appropriate materials and processing techniques for different applications.

5) NPRE 429 “Plasma Engineering”.

This course covers the basic principles and example plasma processes, which play an important role in material processing for microelectronics manufacturing and in other related technologies, ranging from lighting applications to displays.

6) ME 432 “Fundamentals of Photovoltaics” or ECE 443 “LEDs and Solar Cells”.

ME 432 develops the fundamental understanding of photovoltaic technologies for energy production. Students learn how solar cells operate, how they are fabricated and tested, applying fundamental physics and engineering analysis to assess the potential of different materials and technologies. ECE 443 explores energy conversion devices from fundamental to system-level emphasizing the role of quantum mechanical processes. Numerical simulation tools and hands-on characterization of modern devices, provide students with comprehensive working knowledge of the building blocks for the ongoing revolution in efficient lighting and green energy production.

The above are all existing courses in the respective engineering departments. Students enrolled in the engineering majors and in a number of science majors which already include the necessary mathematics and physics sequences, will be able to access these offerings, for the most part, without the need for additional prerequisite courses.

Phase 2 – Electives

Select additional courses from *Core courses*, above, and the list, below, to meet the 16-credit hour minimum. At least six hours taken for the minor must be distinct from credit earned for the student's major(s) or another minor. At least six hours taken for the minor must be 400-level coursework. In addition, students may apply up to 3 credit hours of independent study towards the advanced electives requirement of the minor, to enable them to pursue advanced topics under the guidance of a faculty member. Topics for the independent study must be approved by the minor's faculty oversight committee in order to apply towards the minor requirements.

ECE Courses

ECE 304	Photonic Devices
ECE 441	Physics and Modeling of Semiconductor Devices
ECE 442	Silicon Photonics
ECE 460	Optical Imaging
ECE 481	Nanotechnology
ECE 488	Compound Semiconductors and Devices
ECE 495	Photonic Device Laboratory

ISE courses

IE 360	Facility Planning and Design
IE 412	Operations Research Models for Manufacturing Systems
IE 431	Design for Six Sigma
SE 411	Reliability Engineering

MatSE courses

MSE 461	Electronic Materials II
MSE 485	Atomic Scale Simulations
MSE 487	Materials for Nanotechnology
MSE 488	Optical Materials

MechSE courses

ME 453	Data sciences and in manufacturing quality control
ME 455	Micromanufacturing Process & Automation
ME 485	MEMS Devices & Systems

NPRE courses

NPRE 321	Introduction to Plasmas
NPRE 423	Plasma Laboratory

Physics courses

PHYS 370	Quantum information and quantum computing
PHYS 402	Light
PHYS 404	Electronic Circuits
PHYS 427	Thermal and Statistical Physics

PHYS 460 Condensed Matter Physics
PHYS 486 Quantum Physics I
PHYS 487 Quantum Physics II

From: [Fagen-Ulmschneider, Wade A](#)
To: [Lehman, Barbara J](#)
Cc: [Miller, Nolan H](#)
Subject: Fw: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor
Date: Monday, March 25, 2024 1:26:43 PM
Attachments: [image001.png](#)
[image002.png](#)

Hi Barb,

Can you attach this sponsor communication below about advising to the proposal (<https://nextcourses.illinois.edu/programadmin/?key=1199>, EP 24.086).

Thanks!

- wade

--

Wade Fagen-Ulmschneider, Ph.D.

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From: Makela, Jonathan <jmakela@illinois.edu>

Sent: Monday, March 25, 2024 9:07 AM

To: Fagen-Ulmschneider, Wade A <waf@illinois.edu>; Hallock, Ashley <ahallock@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Hi Wade,

Thanks for the question. I hope to clarify, below.

As you know, we have a distributed advising model in the college with students being supported by a mixture of (department-specific) faculty and professional advisors at the department level in addition to professional advisors at the college level. We plan to have one or two college-level advisors serve as the primary contact for questions about the minor. We also expect many questions to be asked by students at the department level, which will be directed to the college advisors as needed. We have monthly meetings with departmental advisors which will help coordinate on this front. The college advisors will work with the faculty oversight committee (with representation from the departments offering courses in the minor) when it comes to questions about approving specific independent study projects to count towards the elective requirement or other detailed content-specific questions. Finally, the college advisors and records team will be responsible for certifying minor completion when it

is time for degree certifications.

Let me know if there is anything else you need to know on this.

Regards,
Jonathan

JONATHAN J. MAKELA

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From: Fagen-Ulmschneider, Wade A <waf@illinois.edu>

Date: Friday, March 22, 2024 at 6:43 PM

To: Makela, Jonathan <jmakela@illinois.edu>, Hallock, Ashley <ahallock@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Hi Jonathan, Ashley,

A subcommittee member noticed that three separate terms were used for advising and, as a college-wide minor instead of a department-led minor, there was a question about the specific advising plan.

Specifically, what is the relationship between the "program advisor" and "college advisor" or "college-level advisor?" Briefly, I wonder who (generally) will act as the point person for students interested in pursuing this minor.

Thanks,
- wade

--

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From: Makela, Jonathan <jmakela@illinois.edu>

Sent: Friday, March 22, 2024 8:27 AM

To: Fagen-Ulmschneider, Wade A <waf@illinois.edu>; Hallock, Ashley <ahallock@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Thanks, Wade. If you think I should be at the meeting on Monday, I can rearrange some things to make that happen, but if this is unlikely to require any further justification I am equally fine trusting the process and letting EPC discuss/vote without me there.

Regards,

Jonathan

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From: Fagen-Ulmschneider, Wade A <waf@illinois.edu>

Date: Thursday, March 21, 2024 at 4:57 PM

To: Hallock, Ashley <ahallock@illinois.edu>, Makela, Jonathan <jmakela@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering

Minor

Hi Ashley, Jonathan,

We've received the revision and asked the subcommittee to take a final look at it – thank you for the super-quick turn-around on it.

If there's no additional feedback from the subcommittee, we'll have it ready to present at the next EdPol meeting where we reach it in the agenda*. If any concerns come up, we'll seek additional feedback from you before voting on the proposal. If we think there are deeper discussions needed, we'd invite you to the meeting when we have it scheduled – but simple proposals like this rarely require the sponsor to attend unless they're interested. Specifically, your work in having all the sponsor letters and support for all departments involved in the course makes this very easy for us.

(*: Normally every meeting we cover the full agenda, but there's a chance that we may not make it through the full agenda on April 1 -- there's a major proposal early on the agenda that may take all meeting or may be very quick.)

Let me know if you have any questions – thank you again for the quick turnaround on replacing the 498 course!

Best,
- wade

--

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From: Hallock, Ashley <ahallock@illinois.edu>
Sent: Wednesday, March 20, 2024 9:03 AM
To: Fagen-Ulmschneider, Wade A <waf@illinois.edu>; Makela, Jonathan <jmakela@illinois.edu>
Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Yes, please roll that back and we can make that change.

-Ashley

From: Fagen-Ulmschneider, Wade A <waf@illinois.edu>
Sent: Tuesday, March 19, 2024 7:50 PM

To: Makela, Jonathan <jmakela@illinois.edu>

Cc: Hallock, Ashley <ahallock@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Hi Jonathan,

Thanks – so far, that's the only question that has come up from the subcommittee review.

@Ashley, I believe the EdPol will need to roll it back to make that change on your side? I can ask Barb to do that if it's needed.

Thanks,
- wade

--

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From: Makela, Jonathan <jmakela@illinois.edu>

Sent: Tuesday, March 19, 2024 2:58 PM

To: Fagen-Ulmschneider, Wade A <waf@illinois.edu>

Cc: Hallock, Ashley <ahallock@illinois.edu>

Subject: Re: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Hi Wade,

Good to hear from you and, yes, we should catch up some time!

Thanks for catching this. Inclusion of ME 498 was an oversight on our part. That was caught in the college-level review process but somehow we neglected to update that aspect of CIM-P. Essentially, ME 498 has now been approved as a permanent course, but at the 500-level and so it is not appropriate to keep it in the elective list of the minor. Since this was an elective course and there are many other choices for the students to take to satisfy that aspect of the minor, not including the course will have minimal impact.

I hope this explanation suffices. Ashley will make the necessary change in CIM-P. Let me know if there are any other questions or concerns that come up.

Regards,
Jonathan

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From: Fagen-Ulmschneider, Wade A <waf@illinois.edu>

Date: Monday, March 18, 2024 at 11:24 PM

To: Makela, Jonathan <jmakela@illinois.edu>

Cc: Hallock, Ashley <ahallock@illinois.edu>

Subject: Educational Policy (EdPol) Subcommittee Review - Semiconductor Engineering Minor

Hi Jonathan, (CC: Ashley)

(@Jonathan, hope you had a great spring break! It's been forever since we've crossed paths, I hope it happens again soon!)

Hello – I am one of the subcommittee chairs of the Senate Education Policy Committee (EdPol) and my subcommittee is doing the initial review of your proposals before presenting it to the full committee to vote on as part of the shared governance of the Urbana Senate.

Specifically, my subcommittee is looking at:

- EP 24.086: Semiconductor Engineering Minor (<https://nextcourses.illinois.edu/programadmin/?key=1199>)

Thank you for the excellent and detailed proposal -- the subcommittee and I were able to quickly understand how the minor is a college-wide minor that incorporates courses for many units. We received this just before the break and were already able to get several

subcommittee members' feedback. The subcommittee was thrilled to see the strong support you have from all the units and are excited to see students taking this minor in the near future.

There was one subcommittee question that I wanted to reach out to you as the sponsor to get more information:

In the Program of Study, one course listed is ME 498: Special Topics (Nanoscale Fabrication and Characterization). The subcommittee member noted that the Provost policy <https://provost.illinois.edu/policies/policies/courses/proposing-new-courses/> limits any special topics offerings of the same course to a maximum of three terms: "a specific topic may be offered a maximum of three times under a special topics listing; if there is an intention to offer the course past the third time, a proposal to establish it as a permanent course must be submitted through the CIM C system. Approval as a permanent course is necessary before the course can be offered again." Do you know what the plan is to address this course in future?

If any other questions or comments arise as the subcommittee reviews it, I'll continue to forward them to you. After a review by the subcommittee, we'll present it to the full EdPol committee as soon as possible for a vote by the full committee (possibly as early as this coming Monday, March 25 if everything's ready). I'll keep you posted.

Thanks!!
- wade

--

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