

REQUEST TO ADD OR CHANGE A TRANSCRIPT-RECOGNIZED UNDERGRADUATE ACADEMIC MINOR AND/OR REQUEST FOR RECOGNITION ON THE UNIVERSITY TRANSCRIPTS¹

- 1. TYPE OF PROPOSAL:** ☒ New Transcript-Recognized Minor
☐ Change an Existing Transcript-Recognized Minor
☐ Delete a Transcript-Recognized Minor
- 2. THIS PROPOSAL INVOLVES*: (Please check all that apply)**
- | | | |
|---|--|---|
| <input checked="" type="checkbox"/> Courses in other colleges | <input type="checkbox"/> Courses in proposer's college that are frequently taken by students in other colleges | <input type="checkbox"/> Flags |
| <input type="checkbox"/> Course in the core curriculum | <input type="checkbox"/> Change in course sequencing for an existing program | <input type="checkbox"/> Courses that have to be added to the inventory |
| <input checked="" type="checkbox"/> Change in admission requirements (external or internal) | <input type="checkbox"/> Requirements not explicit in the catalog language (e.g., lists of acceptable courses maintained by department office) | |
- 3. SCOPE OF PROPOSED CHANGE:**
- a. Does this proposal impact other colleges/schools? Yes ☒ No ☐
If yes, then how?
Students from the College of Natural Science (Chemistry and Physics) will be eligible to receive a minor in Engineering. There will likely be a small increase in the number of students from the College of Natural Sciences taking courses in the Cockrell School of Engineering, but we expect that this will offset by a similarly small increase in the number of students from the Cockrell School of Engineering who are taking courses in the College of Natural Sciences.
- b. Do you anticipate a net change in the number of students in your college? Yes ☐ No ☒
If yes, how many more (or fewer) students do you expect?
- c. Do you anticipate a net increase (or decrease) in the number of students from outside of your college taking classes in your college? Yes ☐ No ☒
If yes, please indicate the number of students and/or class seats involved.
- d. Do you anticipate a net increase (or decrease) in the number of students from your college taking courses in other colleges? Yes ☐ No ☒
If yes, please indicate the number of students and/or class seats involved.

If 3 a, b, c, or d was answered with yes, please answer the following questions. If the proposal has potential budgetary impacts for another college/school, such as requiring new sections or a non-negligible increase in the number of seats offered, at least one contact must be at the college-level.

How many students do you expect to be impacted?

Impacted schools must be contacted and their response(s) included:

Person communicated with: David Vandebout

Date of communication: September 1, 2017

Response: Dr. Vandebout wanted to ensure that CNS staff would not be handling advising for the minor. It was confirmed that this would not be the case. CSE will do all the advising.

Person communicated with: Jack Ritchie, PHY Department Chair

Date of communication: November 7, 2017

Response: "With regards the proposed Engineering Minor in Materials Science, as Chair of the Physics Department, I approve of the proposal. I think it will be valuable and popular among students at UT Austin. Greg Sitz has kept me apprised of the progress of the proposal, and I can state that the Department has the seat capacity for the relevant Physics courses. Any change in load is unlikely to have an adverse impact on our program."

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Person communicated with: Dr. Graeme Henkelman/Dr. Simon Humphrey, CH

Date of communication: November 10, 2017

Response: Dr. Henkelman participated on the steering committee to form the minor and was instrumental in selecting the courses for the Chemistry majors. Dr. Humphrey plans to bring up the subject of the minor in the next departmental C&C committee meeting.

4. OFFICIAL NAME: Minor in Materials Science and Engineering

5. PROPOSED IMPLEMENTATION DATE:² Fall 2018

6. FIELD OF STUDY, CIP CODE (administrative unit awarding the certificate):³
Materials Engineering 14.1801

7. STATEMENT OF OBJECTIVE: The proposed Materials Science and Engineering (MS&E) minor is intended for students who wish to develop proficiencies in the interdisciplinary field of Materials Science and Engineering while pursuing a major in a related field. It is anticipated that the minor will prepare students for fields that cross traditional disciplinary boundaries and/or those who wish to prepare themselves for graduate school in Materials Science and Engineering or a related discipline.

The MS&E minor will initially be available to students from two colleges (Natural Sciences and the Cockrell School of Engineering) from four majors (Chemistry, Physics, Electrical Engineering and Mechanical Engineering). The MS&E minor may be extended to students in other majors and colleges at a later date. The current majors were chosen because they:

1. Offer clear areas of synergy and overlap with Materials Science and Engineering, so that required courses in the major will adequately prepare students for courses in the minor in MS&E
2. There are well-defined areas within the major discipline where Materials Science and Engineering concepts can be applied
3. There are potential advantages for students seeking employment who have a recognized minor in the discipline
4. The major can accommodate a Materials Science and Engineering Minor without extending time to graduation

8. ADMISSIONS REQUIREMENT (IF ANY):

- The minor must be completed in conjunction with an undergraduate degree in one of the four supported majors—Chemistry, Physics, Electrical Engineering, and Mechanical Engineering
- Students must have completed M 408C, M 408D, M427J, CH 301, PHY 303K and PHY 303L, or equivalent and all with a grade of C- or higher
- Students must have completed thirty hours or more and have not taken more than sixty hours and will be encouraged to apply online at the earliest possible date; deadlines will be March 1 for fall or summer and October 1 for spring.
- Applicants will be reviewed by the MS&E faculty advisor and decisions will be made in time for fall and spring admissions.

9. NUMBER OF STUDENTS EXPECTED TO RECEIVE THE TRANSCRIPT-RECOGNIZED MINOR EACH SEMESTER: Twenty

10. ANTICIPATED ENROLLMENT CAPACITY? 100

11. NUMBER OF HOURS REQUIRED FOR COMPLETION:⁴ Fifteen

12. COMPOSITION OF THE MINOR FACULTY COMMITTEE (INCLUDING THE COMMITTEE CHAIR):⁵

| Name of Faculty Member | College/Department | Title at UT Austin | Highest Degree and Awarding Institution |
|------------------------|--------------------|--------------------|---|
|------------------------|--------------------|--------------------|---|

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| | | | |
|---|--|-------------------------------------|-------------------------------------|
| Desiderio Kovar (Chair) | CSE/Mechanical Eng. | Professor | Ph.D., UC Berkeley |
| Graeme Henkelman | CNS/Chemistry | Professor | Ph.D., Univ. of Washington |
| Gregory Sitz Edward Yu | CNS/Physics CSE/Electrical & Computer Eng. | Professor Professor | Ph.D., Stanford Ph.D., Cal. Tech |
| Brian Korgel | CSE/Chem. Eng. | Professor | Ph.D., UCLA |
| Nathaniel Lynd | CSE/Chem. Eng. | Assistant Prof. | Ph.D., Univ. of Minnesota |
| J. Eric Bickel | CSE/Mechanical Eng. | Associate Prof. | Ph.D., Stanford |
| Ananth Dodabalapur | CSE/Electrical & Computer Eng. | Professor | Ph.D., UT Austin |
| John Markert | CNS/ Physics | Professor | Ph.D., Cornell |
| Cynthia Wilson (<i>ex officio</i>) | CSE/Dean's Office | Director of Academic Projects | Ph.D., UT Austin |

13. Academic Course Requirements:⁶ Use this table to identify the courses that qualify for this certificate program.

Academic course requirement for the minor in MS&E are specific to each major. See below for each major.

Chemistry Majors

| | Topic | Counts for |
|---|--|--------------------------|
| 1. ES 360M Experiments in MS&E | Relationships between atomic structure, microstructure and properties; characterization techniques | CSE Elective #1 |
| 2. Ch 353 Thermodynamics | Classical Thermodynamics | Already required for Ch |
| PHY 355 Modern Physics for Engineers | Introd. to modern physics | General Elective |
| 4. CHE 355: Introduction to Polymers | Polymers | CSE Elective #2 |
| 5. ME 349 Corrosion | Corrosion | CSE Elective #3 |
| 6. Optional Electives: <ul style="list-style-type: none"> ChE 323, Chemical Engineering for Micro- and Nanofabrication ChE 355, Introduction to Polymers Ch 367L, Materials Chemistry Ch 367L, Macromolecular Chemistry EE 334K Quantum Theory of Engineering Materials ME 336 Materials Processing ME 359 Materials Selection | Open | Tech. Option Elective #4 |

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|--|--|--|
| <ul style="list-style-type: none"> • PHY 375S Intro. To Solid State Physics • PHY 369 Thermodynamics and Statistical Mechanics • PHY 345 Biophysics | | |
|--|--|--|

Physics Majors

| | Topic | Counts for |
|---|--|--------------------------|
| 1. ES 360M Experiments in MS&E | Relationships between atomic structure, microstructure and properties; characterization techniques | General Elective |
| 2. PHY 369 Thermodynamics and Statistical Mechanics | Thermodynamics | Already required for PHY |
| 3. EE 325 Electromagnetic Engineering | E&M | General Elective |
| 4. CH 354S. Elements of Spectroscopy. | Spectroscopy | General Elective |
| 5. EE 334K Quantum Theory of Engineering Materials | Applied Quantum Theory | General Elective |
| 6. Optional Electives: <ul style="list-style-type: none"> • ChE 323, Chemical Engineering for Micro- and Nanofabrication • ChE 355, Introduction to Polymers • Ch 354, Quantum Chemistry and Spectroscopy • Ch 354L, Physical Chemistry II • Ch 367L-C, Materials Chemistry • Ch 367L, Macromolecular Chemistry • EE 325 Electromagnetic Engineering • EE 334K Quantum Theory of Engineering Materials • EE 339S Solar Engineering Conversion Devices • ME 336 Materials Processing • ME 359 Materials Selection • PHY 375S Intro. To Solid State Physics • PHY 345 Biophysics | Open | General Elective |

Electrical Engineering Majors

| | Topic | Counts for |
|--------------------------------|--|------------------------|
| 1. ES 360M Experiments in MS&E | Relationships between atomic structure, microstructure and properties; characterization techniques | Academic Enrichment #1 |

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| | | |
|---|----------------------------------|--|
| 2. PHY 369 Thermodynamics and Statistical Mechanics | Thermodynamics | Academic Enrichment #2 |
| 3. EE 325 Electromagnetic Engineering | E&M | EE Core |
| 4. CH 354S. Elements of Spectroscopy or CH 367C Materials Chemistry* | Spectroscopy/Materials Synthesis | Academic Enrichment #3 |
| 5. EE 334K Quantum Theory of Engineering Materials | Applied Quantum Theory | EE Technical Core |
| 6. Optional Electives: <ul style="list-style-type: none"> • ChE 323, Chemical Engineering for Micro- and Nanofabrication • ChE 355, Introduction to Polymers • Ch 354, Quantum Chemistry and Spectroscopy • Ch 354L, Physical Chemistry II • Ch 367LC, Materials Chemistry • Ch 367L, Macromolecular Chemistry • EE 339S Solar Eng. Conv. • EE 347 Modern Optics • EE 348 Laser and Opt. Eng. • ME 336 Materials Processing • ME 359 Materials Selection • PHY 375S Intro. To Solid State Physics • PHY 345 Biophysics | Open | Academic Enrichment #4(requires 1 extra credit hour to graduate for EE students) |

* currently limited to Chemistry students

Mechanical Engineering Majors

| | Topic | Counts for |
|---|--|----------------------------|
| 1. ES 360M Experiments in MS&E | Relationships between atomic structure, microstructure and properties; characterization techniques | Career Gateway Elective #1 |
| 2. ME 316T Thermodynamics | Classical Thermodynamics | Already required for ME |
| 3. PH 355 Modern Physics for Engineers or PH375S Intro. To Solid State Physics or PH 369 Thermodynamics and Statistical Mechanics | Intro to Solid State and Statistical Mech. | Natural Sci. Elective |
| 4. ME 378K Mechanical Behavior of Materials | Deformation and Fracture | Career Gateway Elective #2 |
| 5. ME 349 Corrosion | Corrosion | Career Gateway Elective #3 |
| 6. Optional Electives: <ul style="list-style-type: none"> • ChE 323, Chemical Engineering for Micro- and Nanofabrication • ChE 355, Introduction to Polymers • CH 353 Physical Chemistry I: Thermodynamics • Ch 354, Quantum Chemistry and Spectroscopy | Open | Career Gateway Elective #4 |

| | | |
|---|--|--|
| <ul style="list-style-type: none"> • Ch 354L, Physical Chemistry II • Ch 367L, Materials Chemistry • Ch 367L, Macromolecular Chemistry • EE 334K Quantum Theory of Engineering Materials • ME 336 Materials Processing • ME 359 Materials Selection • ME 379M Failure Analysis • PHY 355 Modern Physics for Engineers • PHY 375S Intro. To Solid State Physics • PHY 369 Thermodynamics and Statistical Mechanics • PHY 345 Biophysics | | |
|---|--|--|

14. OTHER MINOR REQUIREMENTS:

15. COLLEGE/SCHOOL APPROVAL PROCESS:

| | | |
|---------------------------|--------------------|-----------------------------------|
| Department approval date: | July 31, 2017 | Minor Faculty Committee |
| | August 28, 2017 | ME Faculty |
| | Pending | ECE Faculty |
| College approval date: | August 31, 2017 | Degrees & Courses Committee |
| Dean approval date: | September 18, 2017 | CSE Faculty; Sharon L. Wood, Dean |

PROPOSED NEW CATALOG TEXT

In Cockrell School of Engineering under Minor and Certificate Programs

MINOR PROGRAM MATERIALS SCIENCE AND ENGINEERING

The transcript-recognized undergraduate academic minor in Materials Science and Engineering must be completed in conjunction with an undergraduate degree at the University of Texas at Austin in one of the following majors: Chemistry, Physics, Electrical and Computer Engineering, or Mechanical Engineering; students pursuing an integrated undergraduate/graduate program must complete the requirements for the minor within one year after completing the undergraduate requirements of their program. For more information regarding the requirements for achieving a minor, including a comprehensive list of minors, please visit the Minor and Certificate Programs section of the *Undergraduate Catalog*. Details about the minor in Materials Science and Engineering are available at tmi.utexas.edu/minor.

Admissions

To be considered for admission into the Minor Program for Materials Science and Engineering, students must meet the following requirements:

- The minor must be completed in conjunction with an undergraduate degree in one of the four supported majors of Chemistry, Physics, Electrical and Computer Engineering, or Mechanical Engineering
- Students must have completed M 408C, M 408D, M427J, CH 301, PHY 303K and PHY 303L, or equivalent and all with a grade of C- or higher
- Students who have completed thirty hours or more and have not taken more than sixty hours will be encouraged to apply online at the earliest possible date; deadlines will be March 1 for fall or summer and October 1 for spring.
- Applications will be reviewed and rendered in time for fall and spring admissions.

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Requirements

The requirements for the minor in Materials Science and Engineering will consist of fifteen credit hours towards the minor. All students will be required to take a three-credit hour, laboratory-based bridge course (ES 360). The remainder of the required courses required for the minor will consist of a sequence of courses that are specific to the major degree and which are detailed below.

If students are interested in additional coursework, they can see tmi.utexas.edu/minor for a complete list of courses that would serve as optional electives. Courses beyond fifteen hours are not required for the completion of the **major** **minor**.

| <u>Chemistry Majors</u> | | <u>Hours</u> |
|---------------------------|--|--------------|
| <u>ES 360M</u> | <u>Experiments in MS&E</u> | <u>3</u> |
| <u>CH 353</u> | <u>Physical Chemistry I</u> | <u>3</u> |
| <u>PHY 355</u> | <u>Modern Physics for Engineers</u> | <u>3</u> |
| <u>CHE 355:</u> | <u>Introduction to Polymers</u> | <u>3</u> |
| <u>ME 349</u> | <u>Corrosion</u> | <u>3</u> |
| <u>Optional Electives</u> | <u>See tmi.utexas.edu/minor for a complete list of courses</u> | <u>3</u> |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

*An additional 3 hours of optional electives may be taken. For a complete list of courses available, please see tmi.utexas.edu/minor.

| <u>Physics Majors</u> | | <u>Hours</u> |
|---|--|--------------|
| <u>ES 360M</u> | <u>Experiments in MS&E</u> | <u>3</u> |
| <u>PHY 369</u> | <u>Thermodynamics and Statistical Mechanics</u> | <u>3</u> |
| <u>CH 367C or CH 367L or ME 336</u> | <u>Materials Chemistry or Macromolecular Chemistry or Materials Processing</u> | <u>3</u> |
| <u>CH 354S</u> | <u>Elements of Spectroscopy</u> | <u>3</u> |
| <u>EE 334K</u> | <u>Quantum Theory of Engineering Materials</u> | <u>3</u> |
| <u>Optional Electives</u> | <u>See tmi.utexas.edu/minor for a complete list of courses</u> | <u>3</u> |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

*An additional 3 hours of optional electives may be taken. For a complete list of courses available, please see tmi.utexas.edu/minor.

Electrical Engineering Majors

| | | |
|----------------|---|----------|
| <u>ES 360M</u> | <u>Experiments in MS&E</u> | <u>3</u> |
| <u>PHY 369</u> | <u>Thermodynamics and Statistical Mechanics</u> | <u>3</u> |

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| | | |
|---------------------------|--|----------|
| <u>EE 325</u> | <u>Electromagnetic Engineering</u> | <u>3</u> |
| <u>CH 354S or CH 367C</u> | <u>Elements of Spectroscopy or Materials Chemistry</u> | <u>3</u> |
| <u>EE 334K</u> | <u>Quantum Theory of Engineering Materials</u> | <u>3</u> |
| <u>Optional Electives</u> | <u>See tmi.utexas.edu/minor for a complete list of courses</u> | |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

*An additional 3 hours of optional electives may be taken. For a complete list of courses available, please see tmi.utexas.edu/minor.

Mechanical Engineering Majors

| | | |
|-----------------------------------|--|----------|
| <u>ES 360M</u> | <u>Experiments in MS&E</u> | <u>3</u> |
| <u>ME 316T</u> | <u>Thermodynamics</u> | <u>3</u> |
| <u>PH 355 or PH375S or PH 369</u> | <u>Modern Physics for Engineers or Intro. To Solid State Physics or Thermodynamics and Statistical Mechanics</u> | <u>3</u> |
| <u>ME 378K</u> | <u>Mechanical Behavior of Materials</u> | <u>3</u> |
| <u>ME 349</u> | <u>Corrosion</u> | <u>3</u> |
| <u>Optional Electives</u> | <u>See tmi.utexas.edu/minor for a complete list of courses</u> | |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

*An additional 3 hours of optional electives may be taken. For a complete list of courses available, please see tmi.utexas.edu/minor.

Please include a draft of the catalog copy immediately following the above form. If this is an update of an existing copy, the draft should be based on the text of the current catalog available at:

<http://catalog.utexas.edu/undergraduate/>.

Strike through and replace (with underlines) only the specific language to be changed. Do NOT use track changes. Submit form electronically to the Office of the General Faculty and Faculty Council at fc@austin.utexas.edu. For questions on completing this section, please contact Victoria Cervantes, fc@austin.utexas.edu, 471-5934 or Brenda Schumann, brenda.schumann@austin.utexas.edu, 475-7654

¹ Proposed Policy on the Recognition of Undergraduate Academic Minors on Official University Transcripts as Approved by the Educational Policy Committee ([D 10359-10361](#)):

- A. Minimum Criteria for a Transcript-Recognized Undergraduate Academic Minor
 - a. The transcript-recognized undergraduate academic minor must be completed in conjunction with an undergraduate degree at the University of Texas at Austin; students pursuing an integrated undergraduate/graduate program must complete the requirements for the minor within one year after completing the undergraduate requirements of their program.
 - b. Transcript-recognized undergraduate academic minors must require a minimum of fifteen hours of course work but not more than eighteen hours. None of the specified coursework for the minor can include

unnumbered topics courses. Minors will include a minimum of six hours of upper division coursework except in cases where students are pursuing a minor in a foreign language. In those instances, the minor must include at least nine semester hours of coursework beyond first year competence in a foreign language, including at least three hours of upper-division coursework.

- c. At least half of the required course work in the minor must be completed in residence at The University of Texas at Austin.
 - d. A student may not earn a minor in the same field of study as his or her major, and at least nine of the hours required for the minor must include coursework not used to satisfy the requirements of the student's major. However, courses in the minor may fulfill other degree requirements such as general education requirements or required elective hours.
 - e. Students apply for transcript-recognized undergraduate academic minors at the time they complete their undergraduate degree. Transcript recognition is awarded at that time.
- B. Approval Process For Transcript-Recognized Undergraduate Academic Minors
- The requirements of transcript-recognized undergraduate academic minors shall be listed in the undergraduate catalog, with proposals reviewed and approved by the Committee on Undergraduate Degree Program Review (CUDPR) and subsequently sent to the Faculty Council as minor legislation for approval. Proposals for these minors are required to obtain prior approval from the sponsoring college(s) or school(s).

Program proposals submitted by the offering unit (e.g., the department or academic program) must include a statement of objective and need (expected demand), anticipated enrollment capacity, academic course and other requirements, the field of study (and CIP code), and the composition of the minor faculty committee, including the committee chair. Proposals for a transcriptable minor should describe the admissions process (if any) for acceptance into the minor. In cases where minors are offered in the same field of study as a major, the faculty of the unit offering the major will de facto constitute the faculty committee for the minor, and the department chair (or designate) will be designated as the committee chair for the minor. The committee must have a minimum of five members, and at least two-thirds of the committee must be tenured or tenure-track faculty.

Once approved, programs are required to submit a report to CUDPR every four years. The report must list the current chair and all committee members and include the number of students completing the minor in each of the prior four years. If the committee plans any changes in the requirements of the minor, these changes should be explained; changes require the same approvals as an original application, that is, approval by the college(s) or school(s), CUDPR, and the Faculty Council.

- C. The Certification Process for Students Completing the Requirements for a Minor
- Certification of completion of the requirements is done by the program's faculty committee chair (or the department's undergraduate advisor). An application for the certification of completion is initiated by the student and submitted to the chair of the faculty oversight committee at the time they complete their undergraduate degree or the certificate program, whichever comes later. Transcript recognition is awarded at that time.

Application for certification must be made directly to the academic unit offering the minor and is not a substitute for the application for graduation required by a student's degree-granting school or college. After approval of the student's application, the Office of the Registrar will be notified so that the minor can be shown on the official transcript.

² Transcript-recognized minors will not appear on the University transcripts until next catalog.

³ Use the federal CIP code selector site to pick a code, <http://nces.ed.gov/ipeds/cipcode>. After all other areas of this form are completed, forward a copy to the Office of Institutional Reporting, Research, and Information Systems (IRRIS) IRRIS_data_request@utlists.utexas.edu with a request to verify the CIP code ("CIP CODE" in the subject line). Include your contact information, so an IRRIS member may contact you with any questions.

⁴ See footnote ¹A.b. above: 15-20hours are required.

⁵ See footnote ¹B. above

⁶ Note with an asterisk (*) courses that would be added if the transcript-recognized minor is approved. Specify changes to the qualifying courses by noting those no longer qualifying and those now qualifying. (*Add and delete rows as needed.*) If the course numbers and titles change on a regular basis, please indicate the types of courses and number of hours for required for each.

Note with a hashtag (#) courses that require a prerequisite and provide the prerequisite course numbers.

In Cockrell School of Engineering under Minor and Certificate Programs

Proposal to Create a Transcript-Recognized Minor in Materials Science and Engineering

Rationale for Minor in MS&E

Currently there are a broad range of MS&E-related courses offered in many departments and colleges at UT Austin. Despite this breadth of courses, there are significant challenges for students wishing to assemble a directed series of MS&E courses that can prepare them for advancement in the field. These include:

- 1) There is no easily obtainable source of information about what or when MS&E courses are taught
- 2) There is no information available to students about what courses are appropriate for students from a particular major
- 3) Critical courses are not taught, leaving gaps in knowledge
- 4) Since there is currently not a defined MS&E curriculum, MS&E courses generally have no pre-requisites. This results in a situation where introductory material must be repeated in every MS&E course, leaving less time to teach advanced topics.

Counting of Major and Minor Courses

An engineering minor offers unique challenges due to the extensive degree plans required of engineering majors. These degree plans are a result of the requirements imposed by ABET (the Cockrell School's Accrediting Agency) which stipulates an unusually high number of required courses for engineering majors compared to most other majors at UT Austin. For example, Mechanical Engineering has only 4 upper-division electives (which have a number of restrictions); Electrical Engineering have even fewer electives and they have additional restrictions on what can be counted towards the major. Majors in Natural sciences have a much greater degree of flexibility that can accommodate a minor. For example, the option 1 program in Physics has 67 hours of prescribed courses for the major, which leaves 59 hours for electives.

The proposed course requirements for the minor in MS&E are intended to meet the spirit of the existing rules for minors at UT Austin without adding time to degree for any of the participating majors. The rules for minors require that “at least nine of the hours required for the minor must include coursework not used to satisfy the requirements of the student’s major. However, courses in the minor may fulfill other degree requirements such as general education requirements or required elective hours.” For engineering majors, courses for the minor have been specified such that students will generally be required to take 9 hours from outside of their major department.

Thus, although these courses will be counted as major elective courses, they are courses that students from the major would not usually take as part of their major degree.

Bridge Course + Strands of Courses

The traditional approach for minors offers many advantages including that they are often open to a broad range of students from many backgrounds and they often give students flexibility to choose from a list of classes to fulfill minor requirements. The unique challenges outlined above, however, suggest that the proposed MS&E minor should take a different approach by

- Limiting enrollment to students that
 - have the pre-requisites (Mathematics, Chemistry, and Physics) knowledge base so that there can be a common entrance to the minor
- Introducing a new hands-on bridge course that is designed to
 - Act as an entry point for students from different majors so that they can learn the fundamentals of MS&E in single course. This will eliminate the need to repetitively teach introductory material in more advanced classes.
 - Teach abstract concepts by first motivating them with practical, hands-on applications for MS&E in the real world
- Requiring a specific strand of courses that are different for each major. This ensures that students are well-trained to succeed in areas where MS&E overlaps with their major.

Requirements

The requirements for the minor in MS&E will consist of 15 credit hours towards the minor. All students will be required to take a three-credit hour, laboratory-based bridge course (ES 360M). The remainder of the required courses will consist of courses that are currently offered at UT Austin, or courses that will be modified or developed. A goal is that students in the MS&E minor will be taking courses that:

- 1) Are not required for their major degree
- 2) Meet the requirements for their major degree so that they do not extend their time to graduation
- 3) Are relevant for developing expertise at the interface between their specific major degrees and MS&E. Details for each major provided below.

Required Courses

The list of required courses was developed after consideration of the core topics in Materials and a consideration of MS&E applications in the specific majors. The minor was also benchmarked relative to existing MS&E Minors (or Dual Degrees) at peer institutions including Cornell Univ., the University of California at Berkeley, and Texas A&M Univ. The following were adopted by all degree programs in selecting required courses:

1. Must add up to 5 courses for the minor with up to one optional course
 - a. The courses can come from a mixture of electives, existing required courses, or courses that do not currently exist, but should exist
 - b. Consistent with similar minor programs, the courses should include
 - i. The introductory ES 360M Experiments in Materials Science and Engineering Course

- ii. One thermodynamics course: CH 353, PH 369, or equivalent
 - iii. The other MS&E courses should be tailored to the major and may include course topics such as solid state properties, electronic materials, corrosion, mechanical properties, polymers, etc.
2. Where possible, courses should be taught be taken from outside of the student's home department
3. To the extent possible, the required minor courses should not add time to degree.

1. New Bridge Course: ES 360M: Experiments in Materials Science and Engineering

The bridge course will be the required entry point for students from all majors. We have received funding from Project 2021 and are currently working on the curriculum for this course. Key elements that have been identified include the following.

- Teaching the fundamentals of MS&E including bonding, crystallography, phase equilibria and the role of composition and microstructure in material properties
- Noting that many of the fundamental topics are conceptually abstract, we will strive to link these concepts to practical, hands-on experiments
- Course will consist of a mixture of group-based, hands-on and open-ended experiments, supplemented with lectures.
- We will utilize the National Instruments Projects Center/Longhorn Maker Studio to conduct experiments and teach this course
- At the end of the course, students will have the necessary background to pursue courses across a broad range of fields

Advising, and Administration

The Texas Materials Institute has agreed to provide administrative staff support for the minor. Support will include the following

- Maintaining a website that describes the minor, opportunities and requirements
- An on-line application for the minor
- Advising applicants and students in the program about course options, degree requirements, etc.
- Tracking the progress of students in the minor and certifying their completion

In addition, a MS&E Minor Faculty Advisor from one of the participating departments will be appointed who will be available to answer technical questions about the program and courses and make decisions regarding course equivalencies, etc.

Some of the courses that students in the minor will take currently have restricted enrollment. The participating departments have agreed to allow access to these courses for students in the minor. The MS&E Minor Faculty Advisor will work with the faculty committee members and undergraduate advisors to ensure that students in the minor can enroll in these courses.

Required Resources

Beyond the support that will be provided by TMI there are some additional one-time and recurring costs associated with the minor that consist of:

One-time Costs

ES 360M course: Since this course is a new course, there are development costs.

Summer 2017: Project 2012 had allocated \$5,000 for costs during the summer of 2017 for a 10 hour TA and 1 week of faculty support towards developing the course content for this course.

Fall 2017: 10 hour TA + supply and minor equipment purchases (estimated \$5,000). This will allow the course to be piloted.

Spring 2018: 10 hour TA to again pilot the course + part time lecturer estimated at 10 hours/week to learn and assist in piloting

Running Costs for Fall 2018 and beyond

Part-time lecturer 10 hours per week to be responsible for ES 360M course + supplies (estimated at \$1,500 year)

Timetable for Approval and Implementation

1. Summer 2016: Complete and finalize requirements for the minor
 - a) Seek approval from MS&E Minor Advisory committee on courses that will be required for each major
 - i. Seek approval from participating departments/colleges
 - ii. Finalize course schedules to ensure courses will be taught
 - b) Complete outline for common required course: ES 360M: Experiential Materials Science
 - c) Prepare Minor Impact Statement
 - d) Prepare formal proposal to CSE and Provost's office
2. Fall 2017: Pilot ES 360M course with TA and approximately 10 volunteer (?) students/ determine which experiments work and revise appropriately
3. Spring 2018: Pilot ES 360M course with TA, staff member who will be teaching in fall and approximately 12 students/ determine which experiments work and revise appropriately
4. Fall 2018: Launch minor.

MINOR PROGRAM MATERIALS SCIENCE AND ENGINEERING

The transcript-recognized undergraduate academic minor in Materials Science and Engineering must be completed in conjunction with an undergraduate degree at the University of Texas at Austin in one of the following majors: Chemistry, Physics, Electrical and Computer Engineering, or Mechanical Engineering; students pursuing an integrated undergraduate/graduate program must complete the requirements for the minor within one year after completing the undergraduate requirements of their program. For more information regarding the requirements for achieving a minor, including a comprehensive list of minors, please visit the [Minor and Certificate Programs](#) section of the *Undergraduate Catalog*. Details about the minor degree in Materials Science and Engineering are available at tmi.utexas.edu/minor.

Admissions

To be considered for admission into the Minor Program for Materials Science and Engineering, students must meet the following requirements:

- The minor must be completed in conjunction with an undergraduate degree in one of the four supported majors of Chemistry, Physics, Electrical and Computer Engineering, or Mechanical Engineering
- Students must have completed M 408C, M 408D, M427J, CH 301, PHY 303K and PHY 303L, or equivalent and all with a grade of C- or higher
- Students who have completed 30 hours or more and have not taken more than 60 hours will be encouraged to apply online at the earliest possible date; deadlines will be March 1 for fall or summer and October 1 for spring.
- Applications will be reviewed and rendered in time for fall and spring admissions.

Requirements

The requirements for the minor in MS&E will consist of 15 credit hours towards the minor. An additional sixth course is optional. All students will be required to take a three-credit hour, laboratory-based bridge course (ES 360M). The remainder of the required courses required for the minor will consist of a sequence of courses that are specific to the major degree and which are detailed below.

| Chemistry Majors | | Hours |
|-------------------------|---|--------------|
| ES 360M | Experiments in MS&E | 3 |
| CH 353 | Physical Chemistry I | 3 |
| PHY 355 | Modern Physics for Engineers | 3 |
| CHE 355: | Introduction to Polymers | 3 |
| ME 349 | Corrosion | 3 |
| Optional Electives | See tmi.utexas.edu/minor for a complete list of courses | 3 |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

| Physics Majors | | Hours |
|------------------------------|---|--------------|
| ES 360M | Experiments in MS&E | 3 |
| PHY 369 | Thermodynamics and Statistical Mechanics | 3 |
| CH 367C or CH 367L or ME 336 | Materials Chemistry or Macromolecular Chemistry or Materials Processing | 3 |
| CH 354S | Elements of Spectroscopy | 3 |
| EE 334K | Quantum Theory of Engineering Materials | 3 |

| | | |
|--------------------|---|---|
| Optional Electives | See tmi.utexas.edu/minor for a complete list of courses | 3 |
|--------------------|---|---|

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

Electrical Engineering Majors

| | | |
|--------------------|---|---|
| ES 360M | Experiments in MS&E | 3 |
| PHY 369 | Thermodynamics and Statistical Mechanics | 3 |
| EE 325 | Electromagnetic Engineering | 3 |
| CH 354S or CH 367C | Elements of Spectroscopy or Materials Chemistry | 3 |
| EE 334K | Quantum Theory of Engineering Materials | 3 |
| Optional Electives | See tmi.utexas.edu/minor for a complete list of courses | |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.

Mechanical Engineering Majors

| | | |
|----------------------------|---|---|
| ES 360M | Experiments in MS&E | 3 |
| ME 316T | Thermodynamics | 3 |
| PH 355 or PH375S or PH 369 | Modern Physics for Engineers or Intro. To Solid State Physics or Thermodynamics and Statistical Mechanics | 3 |
| ME 378K | Mechanical Behavior of Materials | 3 |
| ME 349 | Corrosion | 3 |
| Optional Electives | See tmi.utexas.edu/minor for a complete list of courses | |

All classes must be taken on the letter-grade basis. The student must earn a combined grade point average of at least 2.00 in these courses.