UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, March 26, 2024

Attending: Achilleas Anastasopoulos, Jeremy Basis, Robert Bordley, Marina Epelman, Chris Fidkowski, Fei Gao, Saadet Albayrak Guralp, Amir Kamil, Leena Lalwani, Xiaogan Liang, Frank Marsik, Radoslaw Michalowski, Eric Rutherford, Rachael Schmedlen, Ben Spector, Elyse Vigiletti, Roxanne Walker, Steve Yalisove

Support Staff: Mercedes Carmona, Betsy Dodge, Matthew Faunce

Call to Order: 1:35 PM

Adjourned: 2:53 PM

Agenda:

1. Approval of 3.12.2024 Meeting Minutes – Page 3 - **APPROVED**
2. CCC Email Vote for SI CARFs – Informational Item - Page 7
    a. Urgent email vote sent to CoE Curriculum Committee members for SI department CARFS cross listed with CSE that had the effective term listed as Fall 2024, which was confirmed with the University Registrar Office that these were okay to process after the Fall 2024 deadline dates.
    b. Issues raised by many members regarding the Course Description 80-word count limit being passed the requirement for both CARFs.
        i. Due to SI being the home department, this department does not need to abide by CoE CARF requirements. What is in M-Pathways for the Course Description, should reflect on the CARF and is also reflected on the Bulletin.
            1. Suggestion that future CARFs with non-CoE home departments cross listed with CoE departments are to abide by 80-word count limit or provide a shortened Course Description.
    c. Both CARFs were approved by members and sent to the URO for processing.
3. CLaSP in Applied Climate MEng Program Modification Proposal – Action Item – Page 14 - **APPROVED**
    a. Three changes are proposed to the program and the rationale is described below:
        i. Changing the name of the program to better reflect program content, MEng in Climate Impacts and Solutions.
            1. This name change is intended to attract more students and better reflect program content in engineering and distinguish U of M from all other programs.
            2. Question as to how this name change came to be and what other institutions have similar programs and what they're named.
                a. There were several institutions that were viewed with similar programs, such as Stanford, Columbia, Scripps Institution of Oceanography, and University of California Berkeley that focused on the social, policy, and management aspects but missed the engineering aspect. The most relevant program was Northeastern University which is situated in Civil and Environmental Engineering focused on aspects of adaption and mitigation.
        ii. Reducing the number of credits, 30 to 26, to allow the program to be completed in 2 semesters instead of 3 and be consistent with the other MEng programs offered.
            1. This change will make the program financially accessible to students. Incoming students are better prepared and do not need the 3-semester program anymore.
        iii. Revision of required courses and electives to provide a skill-based course schedule with greater flexibility.
            1. Proposed revision includes required core courses (10 credits), skill based elective courses (9 credits) and electives (7 credits).

b. The intended effective term for these changes is Fall 2025 with the new credit requirement being implemented in Winter 2026. Fall 2025 admitted students will be allowed to graduate under the new requirements.
c. CoE Curriculum Committee members voted unanimously to approve the program proposal. The proposal will appear at the next CoE Faculty meeting.

4. HLC Annual Audit Questions 3 & 4 for the CoE Curriculum Committee – Action Item – Page 18 - **APPROVED**
    a. Final review and vote of the Draft HLC Discussion Document to finalize revisions to the current CoE Credit Hour Policy.
        i. MATSCIE suggests adjusting "at least two to three hours" as this needs to be directly specified as this causes confusion for the faculty, staff, and students. Recommendations to change this to "two hours" or remove "at least" from the sentence.
            1. Most members are in favor of removing "at least" in the sentence to provide more clarity on the work outside of class.
        ii. IOE brings up the issue with seminar being included in the "Independent Study, Experiential and Seminar courses…" sentence as the information that follows is not always followed for seminar courses.
            1. EECS-CSE points out that seminar is included in the federal definition of the credit hour and is to be the 3 hours minimum. This is relied on by financial aid and accreditation. If a seminar course has less work to meet the credit hour policy, then the course should be adding more work so that the course is in compliance.
            2. MATSCIE follows up with how research should be included in this sentence as research is its own category and not always done independently as courses have group research.
                a. EECS-CSE states that on the CARF that Research is not a course component, but Independent Study is listed on the CARF and research, of any kind, should fall into this course component. If research is to be listed on the policy, Directed Research is what should be listed.
        iii. Suggestion of modifying "same total engagement requirements…" to specify course engagements.
            1. After some deliberation, this was revised to "same total academic work requirements…".
    b. After all final revisions and discussions were had, the committee voted unanimously to approve this final revised CoE Credit Hour Policy. This policy will be pushed to the next CoE Faculty Meeting, if needed for approval.
5. CoE/LSA Joint Meeting Agenda Items – Informational Item
    a. Are there any other topics worth discussing for this meeting?
        i. IOE brings up how CoE is to work with LSA on SUGS Programs, such as who does the review process, advising expectations. Overall, some type of agreement between CoE and LSA as to how to navigate these programs and to provide accurate information and/or assistance to students.

CARF SUMMARIES – TABLED from last meeting on 3.12.2024

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	Is Course on LSA Course Guide?	APPROVED	NOTES & REVISIONS	TABLED
21	CLIMATE	746	NEW		WT 2025	NO	NO	APPROVED	Cross listed with SPACE 746.	
35	CSE	598	MOD	Change in Course Components.	WT 2025	NO	YES	APPROVED		
38	ECE	510	NEW		WT 2025	NO	NO	APPROVED	Cross listed with NERS 675	
48	ECE	598	MOD	Change in Course Components.	WT 2025	NO	YES	APPROVED		
51	EECS	498	MOD	Change in Course Components.	WT 2025	NO	YES	APPROVED		
54	ENGR	101	MOD	Change in Credit Exclusions.	WT 2025	NO	YES	APPROVED		
57	ENGR	151	MOD	Change in Credit Exclusions.	FT 2025	NO	YES	APPROVED		
60	MATSCIE	506	NEW		WT 2025	NO	NO	CONDITONAL APPROVAL	Cross listed with CHE 506 and MACROMOL 506. Course Description needs adjustment.	
70	MATSCIE	509	NEW		WT 2025	NO	NO	CONDITONAL APPROVAL	Cross listed with BIOMEDE 509, CHE 509, and MACROMOL 509. Course Description needs adjustment.	

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	Is Course on LSA Course Guide?	APPROVED	NOTES & REVISIONS	TABLED
84	CEE	527	DEL		WT 2025	NO	YES	APPROVED		
87	CEE	527	NEW		WT 2025	NO	NO	APPROVED		

UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, March 12, 2024

Attending: Achilleas Anastasopoulos, Robert Bordley, Yavuz Bozer, Robert Dick, Chris Fidkowski, Fei Gao, Saadet Guralp, Amir Kamil, Leena Lalwani, Xiaogan Liang, Emmanuelle Marquis, Frank Marsik, Radoslaw Michalowski, Yulin Pan, Mika Panagou, Eric Rutherford, Rachael Schmedlen, Jeffrey Scruggs, Ben Spector, Elyse Vigiletti, Roxanne Walker

Support Staff: Mercedes Carmona, Betsy Dodge, Matthew Faunce

Call to Order: 1:35 PM

Adjourned: 2:53 PM

Agenda:

1. Approval of 2.13.2024 Meeting Minutes – Page 4 – **APPROVED**
2. 3 CEE MSE Modification Program Proposals – Action Item – Page 7 - **APPROVED**
    a. All 3 Master of Science Degrees in Civil Engineering, Environmental Engineering, and Construction Engineering & Management from the Department of Civil & Environmental Engineering propose to reduce the credits from 30 to 26. The Rackham Graduate School currently imposes a 30-credit minimum requirement for all Engineering degrees, a restriction only put on the College of Engineering as other colleges/schools are allowed to be at a minimum of 24 credits. This requirement is handed down from the Michigan Association of State Universities (MASU) to be implemented by the Rackham Graduate School so CEE will need Rackham to grant this approval of reducing credits before presenting to MASU, as well as needing departmental, CoE Curriculum Committee, and CoE Faculty approvals in the process. The alterations of the MSE curricula for various specializations are minimal as Rackham use to require 3 credits of cognate courses to be taken outside of the department, which was eliminated in 2018, so students will still get the same level of technical preparation in CEE courses.
    b. This change helps in degree time reducing from 3 semesters to 2 therefore reducing total cost of tuition, improving the department's ability to leverage fellowship resources, and better marketing for Masters programs and in turn growing the Masters programs.
    c. Many departments commented on the Rackham Graduate School minimum credit requirement of 30 credits and the CEE department wanting to reduce to 26, as if approved, many other CoE programs will follow in reducing the credit minimum.
        i. The CLaSP department has a similar proposal to reduce minimum credits of 30 to 26, so is in full support and can assist CEE if support is needed.
        ii. ISD states that the Rackham Graduate School credit requirement is different between MS and MEng, which MEng is already at 26 credits.
        iii. EECS – ECE says that MEng was first introduced to overcome all the difficulties listed in the proposal and now to make MS closer to MEng, we need to convert to achieve the same requirements. How does this make sense?
            1. CEE Department says current requirements make it incredibly difficult to market CEE MS Programs. Why get an MS when you can get a MEng? More applicants choose MEng over MS due to the points listed, shorter time for a degree, less money, flexibility with classes, etc. Students who graduate with MEng were not to continue with the university as student may not realize they attend the same classes taught by the same professors. The CEE Department does not want to have to market 6 MS degrees.
                a. IOE agrees as there is a long and complicated history with MEng and MS degrees. MEng in Manufacturing was first introduced to the college, 25 years ago, and overtime all departments adapted this degree or an interpretation of it.
    d. Poll taken for CCC members to vote on the proposal and received a near unanimous vote for approval. This proposal will proceed to the next CoE Faculty Meeting and Jeff Scruggs to continue to present for the CEE Department.

3. CE BSE Modification Program Proposal – Action Item – Page 42 - **APPROVED**
    a. Currently, the CoE mathematics course requirements must be satisfied with Multivariable & Vector Calculus, MATH 215. The department proposal intends on permitting Linear Algebra, MATH 214, as an option to satisfy the math requirements of the Computer Engineering BSE program. Other course options listed in lieu of MATH 215 other than MATH 214 are MATH 217, MATH 417, or MATH 419. The CE Program is less flexible than other sister programs of Electrical Engineering and Computer Science, so this is preferred rather than adding another requirement.
        i. EECS – CSE comments that Computer Science has already done the same requirements for some time for the very same reasons stated.
    b. Poll taken for CCC members to vote on the proposal and received a near unanimous vote for approval. This proposal will proceed to the next CoE Faculty Meeting.
4. Questions for the CCC for Fall 2022 – Informational Item – Page 45
    a. The HLC Annual Audit cited EECS 587 as a 4 credit course that is not in alignment with the CoE Policy for the Assignment of Credit Hours, as the course is taught with 3 hours of Lecture and 1 hour of Lab. The department says there are 300 minutes of office hours in addition to the class and discussion section hours as well as significant use of Piazza so the students are interacting with GSIs and the professor more than 540 minutes per week. More time is spent on the computer and in class than other students in lab courses spend in the lab.
    b. Should the use of Piazza and office hours factor into contact hours? If so, how should these elements reflect in the CoE Policy for the Assignment of Credit Hours?
        i. Question raised by ChE as to how the office hours are scheduled, such as open for anyone to attend, like most office hours are set, or is this scheduled for each student to attend at a certain time to fulfill the 300 minutes.
            1. MECHENG/Chair states that if students are developing software and have real time interaction with the instructor, like a virtual lab, that this should count towards contact hours. But, if the student is just attending office hours to sit and complete homework, then this should not count towards contact hours. More details are needed to determine if this should or should not count towards contact hours.
        ii. BIOMEDE/ENGR/UG Edu. questions how the ratio of 2 hours of lab to 1 contact hour came about and sees that the spirit of contact hours is being met, but still sees the issue this raises.
        iii. ChE, EECS – CSE in agreement that this type of interaction should not count towards office hours. Additional course component, such as Recitation or Discussion, should be added to the course to comply with the credit hour policy.
5. CCC Review and Approval of Declaration/Common Requirements Changes – Informational Item – Page 46
    a. Kevin Pipe raised this issue to the CoE Registrar Office about what committee or group within the college can approve changes to Declaration and/or Common Requirements. The CoE RO found documents in previous CCC Meeting Minutes regarding this inquiry and are stated in the document.
    b. Vote was taken for both changes and both approved that the CCC should be the approving body for both Declaration and Common Requirements, which then proceeds to the Faculty Committee vote.
    c. Betsy will follow up with Kevin about the results and have this be a standing policy that all requirements will go through the CCC.
        i. The CCC Processes for Non-Course Related Requests document will be updated as a result.
6. HLC Annual Audit Questions 3 & 4 for the CoE Curriculum Committee – Informational Item – Page 47 – **PENDING**
    a. Review Draft HLC Discussion Document to finalize revisions to the current CoE Policy for the Assignment of Credit Hours.
        i. Xiaogan took edits from members into consideration and updated the draft policy to reflect feedback.
        ii. Change made to 'non-critical hardware' in the document as members gave feedback that this needed to be defined more.
    b. Members are to continue to make edits to the Draft HLC Discussion Document as needed. At the next CCC meeting, there will be a final review of the document and member vote for the revision of the current CoE Policy for the Assignment of Credit Hours.
7. CoE/LSA Joint Meeting Agenda Items – Informational Item - **PENDING**
    a. We are reaching out to ADUE and LSA to determine if a joint meeting is of interest between both colleges and determining what topics are to be discussed.
        i. Discuss CoE Incomplete Grade Policies and Course Withdrawals and the LSA I-Grade Policy.
        ii. The topics discussed thus far are not enough for a joint meeting to take place per chair.
    b. Any other topics that are urgent that would need for a joint meeting to take place?
        i. If there are any ideas or topics, please email Mercedes, carmonam@umich.edu, or Xiaogan, xiaoganl@umich.edu.
8. Tabled CARFs on today's agenda will be on the next CoE Curriculum Committee meeting agenda for 3.26.2024.

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	Is Course on LSA Course Guide?	APPROVED	NOTES & REVISIONS	TABLED
50	CEE	212	MOD	Change in Advisory and Enforced Prerequisite.	WT 2025	C-	YES	APPROVED		
53	CEE	365	MOD	Change in Course Description, Enforced Prerequisite, and Course Components.	WT 2025	C-	YES	CONDITIONAL APPROVAL	Remove Advisory Prerequisites listed as these are requirements for the Enforced Prerequisite, CEE 265.	
56	CEE	450	MOD	Change in Course Description, Enforced Prerequisite, Course Components, and Contact Hours.	WT 2025	C	YES	CONDITIONAL APPROVAL	Define Enforced Prerequisites for "statistics classes". Need to list specific courses if you wish to be enforced.	
60	CEE	521	MOD	Change in Course Title, Advisory Prerequisite, and Course Components.	WT 2025	NO	YES	APPROVED		
63	CEE	537	MOD	Change in Course Credit Type, Advisory Prerequisite, and Terms Typically Offered.	WT 2025	NO	YES	APPROVED		
66	CEE	575	MOD	Change in Course and Abbreviated Titles and Course Description.	WT 2025	NO	YES	CONDITIONALL APPROVAL	Add spaces in the Abbreviated Title.	
69	CLIMATE	746	NEW		WT 2025	NO	NO	TABLED	Cross listed with SPACE 746.	
80	CSE	598	MOD	Change in Course Components.	WT 2025	NO	YES	TABLED		
83	ECE	510	NEW		WT 2025	NO	NO	TABLED	Cross listed with NERS 675	
93	ECE	598	MOD	Change in Course Components.	WT 2025	NO	YES	TABLED		
96	EECS	498	MOD	Change in Course Components.	WT 2025	NO	YES	TABLED		
99	ENGR	101	MOD	Change in Credit Exclusions.	WT 2025	NO	YES	TABLED		
102	ENGR	151	MOD	Change in Credit Exclusions.	FT 2025	NO	YES	TABLED		

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	Is Course on LSA Course Guide?	APPROVED	NOTES & REVISIONS	TABLED
105	MATSCIE	506	NEW		WT 2025	NO	NO	TABLED	Cross listed with CHE 506 and MACROMOL 506.	
115	MATSCIE	509	NEW		WT 2025	NO	NO	TABLED	Cross listed with BIOMEDE 509, CHE 509, and MACROMOL 509.	

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-03-05
Effective Term: Fall 2024

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): School of Information Subject: SI Catalog: 649	Dept (Home): School of Information Subject: SI Catalog: 649
☐	☑ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number Comp Sci Eng - CSE -548	☑ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number Comp Sci Eng - CSE -548
☐	Course Title (full title) Information Visualization	Course Title (full title) Information Visualization
☐	Abbreviated Title (20 char) Info Visualization	Abbreviated Title (20 char) Info Visualization
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Introduction to information visualization. Topics include data and image models, multidimensional and multivariate data, design principles for visualization, hierarchical, network, textual and collaborative visualization, the visualization pipeline, data processing for visualization, visual representations, visualization system interaction design, and impact of perception. Emphasizes construction of systems using graphics application programming interfaces (APIs) and analysis tools.	
☐	Full Term Credit Hours Undergraduate Min: Graduate Min: 3 Undergraduate Max: Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: School of Information Catalog: 649

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

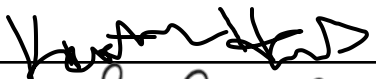
	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) SI 582, 618 and 622 are strongly encouraged. EECS 493 or graduate standing and (C or better) or equivalent.	Advisory Prerequisite (254 char) SI 582, 618 and 622 are strongly encouraged. EECS 493 or graduate standing and (C or better) or equivalent.
☑	Enforced Prerequisite (254 char) {[Prerequisite: SI 506; (C- or better) or SI 506 Waiver] and [Co-requisite: SI 507; (C- or better) or SI Waiver]} or SI 508; (C- or better); or Graduate Standing Minimum grade requirement: C-	Enforced Prerequisite (254 char) (SI 506 or waiver) and (SI 507 or waiver) and (SI 544 or waiver); or Graduate Standing Excluding UMSI Programs Minimum grade requirement: C-
☐	Credit Exclusions	Credit Exclusions

☐	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Eytan Adar Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Punam Vyas Email:vyas@umich.edu Phone: 647-1754

CoE Curriculum Committee Representative:		Print: Amir Kamil	Date: 3/5/24
CoE Curriculum Committee Chair: Xiaogan Liang (MKC)		Print: Xiaogan Liang	Date: 3/20/2024
Home Department Chair:		Print: Kristen Havens	Date: 3/11/24
Cross-Listed Department Chair:		Print: Emily Mower Provost	Date:3/5/24
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description Introduction to information visualization. Topics include data and image models, multidimensional and multivariate data, design principles for visualization, hierarchical, network, textual and collaborative visualization, the visualization pipeline, data processing for visualization, visual representations, visualization system interaction design, and impact of perception. Emphasizes construction of systems using graphics application programming interfaces (APIs) and analysis tools.	Course Description Introduction to information visualization. Topics include data and image models, multidimensional and multivariate data, design principles for visualization, hierarchical, network, textual and collaborative visualization, the visualization pipeline, data processing for visualization, visual representations, visualization system interaction design, and impact of perception. Emphasizes construction of systems using graphics application programming interfaces (APIs) and analysis tools.
Class Length Full term	Class Length Full term
Contact hours (lecture): 3	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Cross-listed dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
The committee reviewed learning objectives across our curriculum and made shifts to the requirements of our degree paths, then updated the prerequisite structure of several courses to better align those two things.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-03-05
Effective Term: Fall 2024

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): School of Information Subject: SI Catalog: 650	Dept (Home): School of Information Subject: SI Catalog: 650
☐	☑ Course is Cross-Listed with Other Departments	☑ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
	Comp Sci Eng - CSE - 549	Comp Sci Eng - CSE - 549
☐	Course Title (full title) Information Retrieval	Course Title (full title) Information Retrieval
☐	Abbreviated Title (20 char) Informatn Retrieval	Abbreviated Title (20 char) Informatn Retrieval
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Information is everywhere. We encounter it in our everyday lives in the form of E-mail, newspapers, television, the Web, and even in conversations with each other. Information is hidden in a variety of media: text, images, sounds, videos. While casual information consumers can simply enjoy its abundance and appreciate the existence of search engines that can help them find what they want, information professionals are responsible for building the underlying technology that search engines use. Building a search engine involves a lot more than indexing some documents -- information retrieval is the study of the interaction between users and large information environments. It covers concepts such as information need, documents and queries, indexing and searching, retrieval evaluation, multimedia and hypertext search, Web search, as well as bibliographical databases. In this course, students go over some classic concepts of information retrieval and then quickly jump to the current state of the art in the field, where crawlers, spiders, and hard-of-hearing personal butlers roam.	
☐	Full Term Credit Hours Undergraduate Min: Graduate Min: 3 Undergraduate Max: Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: School of Information Catalog: 650

☐

Grading Basis
- ☑ Graded (A – E)
- ☐ Credit/No Credit
- ☐ Satisfactory/Unsatisfactory
- ☐ Pass/Fail
- ☐ Business Administration

Grading
- ☐ Not for Credit
- ☐ Not for Degree Credit
- ☐ Degree Credit Only

Add Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

Drop Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☐	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
☑	Enforced Prerequisite (254 char) SI 507 or Waiver or Graduate Standing Minimum grade requirement: C-	Enforced Prerequisite (254 char) (SI 507 or waiver) and (SI 618 or waiver); or Graduate Standing Excluding UMSI Minimum grade requirement: C-
☐	Credit Exclusions	Credit Exclusions

☐

Course Components
- ☑ Lecture
- ☐ Seminar
- ☐ Recitation
- ☐ Lab
- ☐ Discussion
- ☐ Independent Study

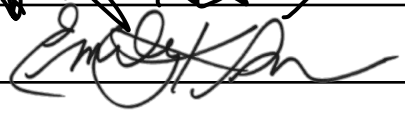
Graded Component
- ☑
- ☐
- ☐
- ☐
- ☐
- ☐

Terms Typically Offered
- ☑ Fall
- ☐ Winter
- ☐ Spring
- ☐ Summer
- ☐ Spring/Summer

Cognizant Faculty Member Name: David Jurgens Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person:Punam Vyas Email: vyas@umich.edu Phone: vyas@umich.edu

CoE Curriculum Committee Representative:		Print: Amir Kamil	Date: 3/8/24
CoE Curriculum Committee Chair:		Print: Xiaogan Liang	Date: 3/20/2024
Home Department Chair:		Print: Kristen Havens	Date: 3.12.24
Cross-Listed Department Chair:		Print: Emily Mower Provost	Date: 3/8/24
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description Information is everywhere. We encounter it in our everyday lives in the form of E-mail, newspapers, television, the Web, and even in conversations with each other. Information is hidden in a variety of media: text, images, sounds, videos. While casual information consumers can simply enjoy its abundance and appreciate the existence of search engines that can help them find what they want, information professionals are responsible for building the underlying technology that search engines use. Building a search engine involves a lot more than indexing some documents -- information retrieval is the study of the interaction between users and large information environments. It covers concepts such as information need, documents and queries, indexing and searching, retrieval evaluation, multimedia and hypertext search, Web search, as well as bibliographical databases. In this course, students go over some classic concepts of information retrieval and then quickly jump to the current state of the art in the field, where crawlers, spiders, and hard-of-hearing personal butlers roam.	Course Description Information is everywhere. We encounter it in our everyday lives in the form of E-mail, newspapers, television, the Web, and even in conversations with each other. Information is hidden in a variety of media: text, images, sounds, videos. While casual information consumers can simply enjoy its abundance and appreciate the existence of search engines that can help them find what they want, information professionals are responsible for building the underlying technology that search engines use. Building a search engine involves a lot more than indexing some documents -- information retrieval is the study of the interaction between users and large information environments. It covers concepts such as information need, documents and queries, indexing and searching, retrieval evaluation, multimedia and hypertext search, Web search, as well as bibliographical databases. In this course, students go over some classic concepts of information retrieval and then quickly jump to the current state of the art in the field, where crawlers, spiders, and hard-of-hearing personal butlers roam.
Class Length Full term	Class Length Full term
Contact hours (lecture): 3	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Cross-listed dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:

The committee reviewed learning objectives across our curriculum and made shifts to the requirements of our degree paths, then updated the prerequisite structure of several courses to better align those two things.

Jeremy N. Bassis
Professor of Climate and Space Sciences and Engineering

Proposal for Curriculum Changes to Masters of Engineering (MEng) Program in Applied Climate in the Department of Climate and Space Sciences and Engineering (CLaSP).

Jeremy N. Bassis

Feb 29th, 2024

This is a proposal for changes to the published curriculum for the Masters of Engineering (MEng) program in Applied Climate in the Department of Climate and Space Sciences and Engineering (CLaSP).

The changes address three issues:

1) Changing the name of the program from ***Applied Climate*** to ***Climate Impacts and Solutions*** to better reflect program content.
2) Reducing the number of required credits to 26 to allow students to complete the program in two semesters instead of 3 semesters and to be consistent with other Masters of Engineering programs offered.
3) Revision of required courses and electives to provide a skill-based menu with greater flexibility.

The proposed change and rationale for the proposed changes are discussed below.

1. Program Name Change

The MEng program in ***Applied Climate*** was established in 2011 as a three-semester standalone program that features a sponsor-defined "hands-on" project focused on the quantitative analysis and application of climate information to analyze past, present, and future impacts of climate on vulnerability, adaptation, and mitigation efforts. Since the program was founded, the need for climate information in decision-making and design has increased significantly. However, the MEng in Applied Climate program remains a small, niche program that primarily serves as a graduate program for our undergraduates who do not wish to pursue a PhD. We propose to change the name of the program to ***Climate Impacts and Solutions*** as part of a larger rebranding to attract more students and to better reflect the focus of the program on applying climate information to analyze the impacts of climate change and to better emphasize the use of climate information in engineering solutions.

This decision is broadly supported by our alumni, who have reported that they had to frequently explain what the program teaches to prospective employers. (A Google search of Applied Climate reveals several HVAC companies that also use the term Applied Climate.) A comparison with existing programs at peer institutions shows several new programs have been developed since our program was first proposed. This includes new schools of climate and

Climate and Space Research Building, 2455 Hayward Street T: 734 615-3606 Ann Arbor, Michigan 48109-2143
jbassis@umich.edu | clasp.engin.umich.edu

sustainability at Columbia and Stanford. Many of these programs focus on sustainability, policy and management and there remains a dearth of programs that are physical science- and engineering-based. For example, the Scripps Institution of Oceanography has created a Master's program in Climate Science and Policy. Similarly, the University of California Berkeley has proposed establishing a new project based Masters of Climate Solutions program. The focus of these programs, however, is rooted in policy and management instead of science and engineering. The most relevant existing program that focuses on engineering is the program in Climate Science and Engineering at Northeastern University, which is situated in Civil and Environmental Engineering focused on engineering aspects of adaptation and mitigation.

Our proposed name change better reflects our roots in engineering and distinguishes us from the many programs focused on policy and sustainability that are not based in engineering practices and physical climate science.

2. Proposal to reduce required credits from 30 credits to 26 credits

Our MEng program in Applied Climate was initially modeled on our successful ***Master of Engineering in Space Engineering*** program, which has a three-semester curriculum. As of now, there are more than 40 Masters of Engineering programs with the College of Engineering which typically require 30 credits or 26 credits. We proposed changing our program to a 26- credit requirement, which would allow students to complete the program in 2 semesters. This would significantly reduce the cost of the degree, make our program more financially competitive and, provide future growth opportunities to offer a dual degree (e.g., Construction Engineering and Management offers dual MBA degrees and Architecture degrees). Currently, most of our students are SUGS students from our own program who complete the program in two semesters. It is primarily students from outside the University that need to take the full 3 semesters to acquire the 30 credits. In the past, the skillsets of these students that entered our program included minimal climate knowledge, requiring these students to take several 400-level courses to build a broad-based knowledge platform before they engaged in key graduate courses. This is no longer the case and most students have already been exposed to aspects of the physical climate system. Changing the program credit requirements to 26 credits will significantly broaden the accessibility of the program to a prospective students of more diverse academic backgrounds.

We aim to have the change approved for Fall 2025. The new credit requirements will be implemented in Winter 2026. All students admitted in Fall 2025 will be allowed to graduate under the new credit requirements. Because most of our students are internal and finish in two semesters, we anticipate few students will be impacted by this change, but those that are impacted will be admitted in Fall 2025 knowing the new credit requirements will be in effect and will have the opportunity to benefit from them.

3. Proposed revision to curriculum

In addition to revising the curriculum to require 26 credits, we also propose a curriculum refresh because several of the core courses are no longer consistently offered. Moreover, the growing catalog of climate and sustainability courses at the University of Michigan provides a rich and evolving buffet of options for students. Our proposed curriculum revamp is designed to build in

flexibility that reduces the core course requirements and allows students from different backgrounds to acquire and expand upon skills across three foundational areas: (1) Climate process fundamentals; (2) Statistics and; (3) Geographic Information Systems (GIS).

Proposed core courses. Table I summarizes the existing required courses and proposed revision. CLIMATE 591 and CLIMATE 592 are the practicum classes that students enroll in for their hand-on projects and are the core of our program. CLIMATE 530 and 480 provides an introduction to climate solutions and design. CLIMATE 530 is the preferred option for students with some climate science background. CLIMATE 480 provides a gentler introduction to climate science and solutions for students that come from disciplines that have less exposure to climate. The remaining core classes are either not offered consistently every year (CLIMATE 586 and CLIMATE 588) or are best offered as part of a menu of skill based classes.

Existing and Proposed Curriculum in the Tables below:

Table I: Departmental Core Courses

Existing	Proposed
CLIMATE 586 Climate Data Analysis	CLIMATE 530 Climate Change in Planning and Design (preferred) or CLIMATE 480 Climate Change: A Multidisciplinary Approach to Problem Solving
CLIMATE 588 Regional Scale Climate	CLIMATE 591 Climate Practicum I
CLIMATE 591 Climate Practicum I	CLIMATE 592 Climate Practicum II
CLIMATE 592 Climate Practicum II	
NRE 531 Principles of GIS (preferred), or UP 506 Introduction to GIS, or NRE 541 Remote Sensing for Environmental GIS	

Notable Changes: Reduction of core classes to allow greater flexibility and to better streamline the skillset concentrations.

Total credits required: 26

Required Courses:
Climate 591-Climate Practicum 1 (4 credits)
Climate 592-Climate Practicum 2 (4 credits)
Climate 530-Climate Design and Solutions (2 credits)
Total: 10 credits of required courses

Skill based electives
1. Geospatial elective: EAS 541, EAS 531, EARTH 408, UP 506, or advisor approved substitute ***(Minimum of 3 credits)***

2. **Statistics elective:** Climate 586 or advisor approved 400 level or higher substitute
(Minimum of 3 credits)

3. **Climate electives*:*** Any 400 level or higher CLIMATE course
(Minimum of 3 credits)

Total: 9 credits of skill based courses

Electives (7 credits)
Any 400 level or higher course TBD with Program Director.

4. Sample program sequence
Fall: CLIMATE 591, CLIMATE 586*,* UP 506, CLIMATE 440 *(*Total credits: 13) *Winter*: CLIMATE 592, CLIMATE 530, CEE 565, EAS 510, EAS 501 (Total credits: 13) Total credits: 26

Statistics elective: CLIMATE 586 (3 credits)
GIS elective: UP 506 (3 credits)
Climate elective: CLIMATE 440 (3 credits)
Program electives: CEE 565, EAS 510, EAS 501 (7 credits)

Sincerely,

Jeremy Bassis
Professor and Applied Climate Program Director,
Department of Climate and Space Sciences and Engineering

Proposed CoE credit hour policy (the highlighted words are newly added parts):

Course credit is based on contact hours (time spent by students engaged with the course instructor) for all Engineering courses. This means one contact hour per credit hour in a week for Lectures, Discussions, and Recitations.

For each credit earned per full academic term, students are expected to receive at least one contact hour of instruction and perform two to three hours of work outside of class each week.

Independent Study, directed research, experiential and seminar courses have the same total academic work requirements (contact hours plus hours of additional work) as listed above with the understanding that engagement may not be scheduled on a weekly basis as determined at the department level.

Laboratory sections are expected to meet for at least two hours for each credit earned. A laboratory section should be set up as a meeting in an actual laboratory classroom if the laboratory work involves in-person operation of equipment under oversight of instructors. A laboratory section can be set up as a meeting in a virtual or remote laboratory classroom if the laboratory work only involves software development or operation of easily accessible, portable hardware and/or remote sensors, and an equivalent amount of instruction as required by in-person laboratory sections is provided.

Hybrid and Online courses require an equivalent amount of instruction and student work as required by in-person courses. The online, self-paced, or asynchronous learning modules in such courses can be counted as contact hours if these modules are prepared by the instructors.

Courses that do not fall within any of the aforementioned categories will be treated individually. The course description must justify the conditions for credit. The CoE Curriculum Committee must approve the credit hour to contact hour ratio for such courses.

The current federal definition of a credit hour (34 CFR 600.2) states: for each credit earned, students must engage in a minimum of one hour of faculty-led instruction or academic engagement and at least an additional two hours of work outside of class each week for approximately 15 weeks. It also states that an equivalent amount of academic engagement is required on the part of the student who participates in other academic activities for which the institution awards credit hours. These activities could include independent studies, internships, experiential learning, or similar activities that are integrated into the formal curricula of a school or college. Hybrid and online courses require an equivalent amount of instruction and student work as required by in-person courses.

Office of the provost guidance:

Faculty and instructors — with oversight and input from faculty-led curriculum committees — should determine the activities that would appropriately be viewed as faculty-led engagement within the context of a course and academic program.

Current LSA credit hour policy:

Course credit is based on contact hours (time spent in class with the instructor) for all LSA courses. This means one contact hour per credit for Lectures, Discussions, Recitations, and Seminars. Students do not get credit for homework, field trips, film screenings, or reading and writing assignments. For each credit earned, students are expected to spend in three hours of work each week outside of class. The same rule also applies to Experiential and Independent Study courses.

Labs that meet in an actual laboratory classroom such as used in Biology and Chemistry must meet for at least two hours for each credit earned. When departments schedule a “lab” for the purpose of film screenings, for example, this is just a scheduling tool to ensure students set aside that time for required class activity. In this case the instructor need not be present and therefore this time is not considered a part of contact hours for the course.

In the case of Discussions, students are spending time with the instructor (or GSI) to deal with more complex or detailed course content. This is considered a part of contact hours, so students earn one credit for each hour of discussion.

Ross School of Business:

……

Independent Study: Definition Students receive substantial individual consultation and guidance from the instructor. Total student effort should be comparable to that involved in lecture or seminar courses to justify the credit allocated to the Independent Study. Number of contact hours per week Substantial contact between instructor and student is required, but not necessarily on a weekly basis.

Architecture and Urban Planning

Independent Study Definition: Students receive individual consultation and guidance from the instructor. Total student effort should be comparable to that involved in lecture or seminar courses. Number of contact hours per week Contact between instructor and student is required, but not necessarily on a weekly basis

Education School:

…….

Hybrid and fully remote courses require an equivalent amount of

instructor contact hours.

School of Kinesiology:

……..

Exceptions shall be granted on a course-by-course basis and under truly special circumstances, at the program level. A program may appeal for an exception to the policy by contacting the Associate Dean for Undergraduate Affairs who will direct the appeal to the CIC and EC.

Rackham:

Current CoE credit hour policy:

Course credit is based on contact hours (time spent by students engaged with the course instructor) for all Engineering courses. This means one contact hour per credit hour in a week for Lectures, Discussions, and Recitations.

For each credit earned per full academic term, students are expected to receive at least one contact hour of instruction and perform at least two to three hours of work outside of class each week.

Independent Study, Experiential and Seminar courses have the same total engagement requirements (contact hours plus hours of additional work) as listed above with the understanding that engagement may not be scheduled on a weekly basis as determined at the department level.

Laboratory sections are expected to meet for at least two hours for each credit earned. A laboratory section should be set up as a meeting in an actual laboratory classroom if the laboratory work involves in-person operation of equipment under oversight of instructors. A laboratory section can be set up as the meet in a virtual or remote laboratory classroom if the laboratory work only involves software development or operation of non-critical (not essential; provide a list of examples that can be done remotely) hardware, and an equivalent amount of instruction as required by in-person laboratory sections is provided.

Hybrid and Online courses require an equivalent amount of instruction and student work as required by in-person courses. The online, self-paced, or asynchronous learning modules in such courses can be counted as contact hours if these modules are prepared by the instructors.

Courses that do not fall within any of the aforementioned categories will be treated individually. The course description must justify the conditions for credit. The CoE Curriculum Committee must approve the credit hour to contact hour ratio for such courses.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-12
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☑	Dept (Home): Subject: Catalog:	Dept (Home): Climate & Meteorology Subject: CLIMATE Catalog: 746
☑	☐ Course is Cross-Listed with Other Departments	☑ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
		CLaSP - SPACE - 746
☑	Course Title (full title)	Course Title (full title) CLaSP PhD Professional Seminar
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) PhD Professional Sem
☑	Course Description (Please limit to 80 words and attach separate sheet if necessary) Introduction to professional skills which support PhD student success within the CLASP Department. Topics include advisor relationships, student rights, personal finances, scientific communication, project definition and planning, attending conferences, reading journal articles, mentoring others, and code and data management.	
☑	Full Term Credit Hours Undergraduate Min: Graduate Min: 1 Undergraduate Max: Graduate Max: 1	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Rackham Graduate Student, Non-Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Catalog:

☑	Grading Basis ☐ Graded (A – E) ☐ Credit/No Credit ☑ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☐	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☐ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Michael Liemohn Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Claire Miller Email: ccdewitt@umich.edu Phone:

CoE Curriculum Committee Representative:	Frank J. Marsik	Print:	Frank J. Marsik	Date:	2/14/24
CoE Curriculum Committee Chair:		Print:		Date:	
Home Department Chair:	Gretchen Keppel-Aleks	Print:	Gretchen Keppel-Aleks	Date:	14 Feb 2024
Cross-Listed Department Chair:	Gretchen Keppel-Aleks	Print:	Gretchen Keppel-Aleks	Date:	14 Feb 2024
Cross-Listed Department Chair:		Print:		Date:	
Cross-Listed Department Chair:		Print:		Date:	

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description	Course Description Introduction to professional skills which support PhD student success within the CLASP Department. Topics include advisor relationships, student rights, personal finances, scientific communication, project definition and planning, attending conferences, reading journal articles, mentoring others, and code and data management.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 1
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:
Optional but highly recommended for all first-year PhD CLaSP students.

Special resources of facilities required for this course:

Supporting statement:
Through a Rackham Student Ally grant, 4 PhD students were hired to develop the course, during which they brainstormed topics, evaluated the list and chose 14 for a semester-long series, researched content and developed presentation material and resource sheets. The course is typically taught with not only one of the co-instructors but also a senior PhD student present for Q&A.

Syllabus
CLIMATE/SPACE 501-004:
CLaSP PhD Professional Seminar
Fall 2023 (1 Credit)

A course in successfully navigating the first year of CLaSP PhD student life

Course Description:

Successfully navigating a PhD program requires more than academic and research abilities. Mastery of professional and administrative skills are critical to getting the most of your time as a student to prepare for future careers. In this course, we cover a range of 'soft skills' topics that do not fall into an academic discipline but are nevertheless important to ensure successful education. Each class session will feature a lecture or activity on a particular topic, often accompanied by resource sheets. By the end of the course, the student shall gain an understanding of scientific communication venues such as conferences and publications, learn strategies for project identification, management, and reproducibility, and explore strategies for communicating with advisors, mentees, the research community, and the general public.

Course Prerequisites:

Graduate standing.

Instructors:

Dr. Mike Liemohn, Professor, Department of Climate and Space Sciences and Engineering
Room 1420, Climate and Space Research Building (on North Campus, 2455 Hayward St.)
Email: liemohn@umich.edu

Dr. Allison Steiner, Professor, Department of Climate and Space Sciences and Engineering
Room 2517E, Climate and Space Research Building
Email: alsteine@umich.edu

Dr. Jeremy Bassis, Professor, Department of Climate and Space Sciences and Engineering
Room 2529, Climate and Space Research Building
Email: jbassis@umich.edu

Class Sessions:

Wednesdays from 2:30 pm – 3:20 pm, in GG Brown room 2147 (in the Civil and Environmental Engineering wing).

We are also using Lecture Capture and will post the videos after each class session.

Learning Objectives:

It is expected that, by the end of the course, students will be able to:

- Understand what it means to be a PhD student at the University of Michigan
- Know how to read a scientific journal article and, generally, about the publication process
- Be familiar with techniques for optimizing your experiences at science conferences
- Understand the mentor-mentee relationship, from both sides

- Set up a github site and a structure for data set management

Grading Apportionment:

This is a 1-credit class. Not much beyond attending class sessions is expected of you. Your overall course grade is made of several elements:

In-class participation	70%	Weekly
Professional Development Activity	10%	One extra seminar/workshop
After-class assignments	20%	There will be two, so 10% each

I hope that you all get 100% in this class.

In-Class Participation:

If you attend and participate, then you get credit for that day. We have 14 class sessions; for full credit on this grading element, you must attend (in person) 12 of them. An excused absence for illness, religious observance, or school-related activities counts as attendance. Less than 12 will result in a proportional drop in your grade for this element (70% / 12 = 5.83% towards the course grade for each unexcused absence beyond two).

Details of Homework and the Professional Development Activity:

There will be two graded-for-completion homework assignments: (1) a draft mentoring plan between you and your advisor and (2) a draft data management plan for how you might handle the data sets for your research. These will be brief (~1 page) written documents, uploaded to Canvas (full grade for completion).

For the professional development activity, please attend one extra seminar or workshop beyond what is required of you (i.e., beyond our class sessions, beyond the RCRS training, and beyond the requirements for other classes, like CLaSP 747/749). This can be a seminar in another department, a CRLT training, or meeting with a visitor to your department. If you need clarification on what is acceptable, then please check with Dr. Liemohn. You will be asked to write a brief statement (< 1/2 page) about the event and upload it to Canvas (full grade for completion).

Additional optional out-of-class activities will be suggested. These are not required and will not be graded but are encouraged for additional skill-building enrichment.

Student Collaboration:

I encourage collaboration and peer tutoring. Please help each other learn and get through the course requirements. Even more so, help each other get through life as U-M PhD students. When it comes to actually writing/typing up a submission, though, I expect each of you to do your own work. You learn very little by copying another's answers.

Course Grade Policy:

Your overall grade in the course will be a satisfactory or unsatisfactory. You need to reach an 80% on the overall course score to receive a satisfactory grade. Yes, if you attend all of the class sessions, then you only need to do one of the three "assignments" to pass. I hope that you do them all, though.

Extra Credit:

There will be one opportunity for extra credit near the end of the course: turning in the receipt acknowledging that you filled out the course evaluation. If you upload a screen shot/pic/PDF of the page showing that you submitted it, then this will count for extra percentage points towards your overall course grade. Specifically, it will replace one unexcused absence (5.83%). This will not be reflected in Canvas but will be added afterwards.

I highly value your feedback about the course and look forward to reading your comments on what went well and what could be done differently. I strive to improve my teaching skills every term. I hope that you submit a course evaluation even if you don't need the extra credit.

Late Policy:

The three assignments turned in via Canvas are all due by 11:59 pm on the last day of class: December 6. I need to be done with this class before the Fall AGU Meeting the next week, so assignments submitted late are reduced by 10% **per day** off the possible score (i.e. 1% towards the total grade). Excused late submissions **must** be requested ***before*** the due date and time. I will be fairly lenient in granting extensions, but please request extensions ahead of time. A sudden injury or illness with doctor's note is about the only excuse I will accept after the due date.

Religious or School-Function-Related Absence

If students expect to miss classes as a consequence of their religious observance or are traveling with a U-M sports team or organization, then alternate arrangements will be made to accommodate missed academic work. It is the obligation of students to provide the instructor with reasonable notice of the dates on which they will be absent (*before* they occur). We will determine a mutually agreeable alternative timeline within the boundaries of the class (usually a shifted deadline).

Disability Access

If you think you may need an accommodation for a disability, then please inform the instructor early in the term. You should contact the Services for Students with Disabilities (SSD) office to be issued a Verified Individual Services Accommodation (VISA) form, to be given to the instructor. I will fully accommodate all such requests.

Student Mental Health and Wellbeing

If you or someone you know if feeling overwhelmed, depressed, and/or in need of support, then services are available. Grad school can be hard, but please know that you are not alone in having such thoughts and feelings, nor do you have to go through it alone. The first option is talking to a trusted friend or relative. This includes me; I am our department's Rackham Diversity Ally and I am ready and willing to listen to your story. For professional help, please contact Counseling and Psychological Services (CAPS) at 734-764-8312 or online at https://caps.umich.edu. You may also consult University Health Service (UHS) at 734-764-8320 and at https://www.uhs.umich.edu/mentalhealthsvcs, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources. For a listing of other mental health resources available on and off campus, visit http://umich.edu/~mhealth/. We are still in a pandemic; please take care of yourself.

Student Sexual Misconduct Policy

Title IX prohibits discrimination on the basis of sex, which includes sexual misconduct – including harassment, domestic and dating violence, sexual assault, and stalking. Sexual violence can undermine students' academic success and I encourage anyone dealing with sexual misconduct to talk to someone about their experience, so that they can get the support they need. Confidential support and academic advocacy can be found with the Sexual Assault Prevention and Awareness Center (SAPAC) on their 24-hour crisis line 734-936-3333 and at https://sapac.umich.edu. Alleged violations can be reported to the Office for Equity, Civil Rights, and Title IX (ECRT) at https://ecrt.umich.edu/ .

CLIMATE/SPACE 501-004 Course Outline (Fall 2023)

Date	Topic	Instructor
W Aug 30	Introduction to the class, initial conversation	Liemohn/all
W Sep 6	PhD job description, student rights and responsibilities	Bassis
W Sep 13	Personal finance as a grad student	Liemohn
W Sep 20	Advisor relations	Steiner
W Sep 27	Reading scientific literature	Liemohn
W Oct 4	Developing a 5-year plan	Liemohn
W Oct 11	Project management	Liemohn
W Oct 18	Practices of Good Mentoring (you as mentor)	Bassis
W Oct 25	Data management and reproducibility in scientific research	Liemohn
W Nov 1	Sparking scientific creativity	Liemohn
W Nov 8	Scientific publication process	Steiner
W Nov 15	Github tutorial	Welling
W Nov 22	**No class,** Thanksgiving Break	--
W Nov 29	Academic networking, making the most of conferences	Bassis
W Dec 6	Community engagement, final conversation	Liemohn

Assignments

Assigned	Due	Description
W Aug 30	W Dec 6	Professional development activity, seminar, workshop
W Sep 20	W Dec 6	Draft mentoring plan
W Oct 25	W Dec 6	Draft data management plan

CLIMATE/SPACE 501-004: CLaSP PhD Professional Seminar
Course Conduct Statement

Profs. Mike Liemohn, Allison Steiner, and Jeremy Bassis

The College of Engineering has an honor code. This is taken seriously.
See the website: http://www.engin.umich.edu/students/honorcode/code/

Policy on Homework and Projects

You are encouraged to form study groups to work on homework problems and to study in other ways. You are allowed to consult with other students during the conceptualization of a problem. However, all written work, whether in scrap or final form, is to be generated by you alone. You are not allowed to possess, look at, use, or in any way derive advantage from the existence of solutions prepared in prior years, whether these solutions were former students' work product or copies of solutions that had been made available by others.

Unless arrangements are made with me beforehand, late assignments are marked down by 10% per day and will not be accepted after one week or when it is graded and returned, whichever is first.

Violations

Violation of this policy is grounds for the initiation of a report filed with the Dean's office and the case would come before the Honor Council of the College of Engineering. If you have any questions about this policy, then please do not hesitate to contact me.

University of Michigan
Winter 2023 Instructor Report
CLIMATE 501 003 - SPACE 501 003
Jeremy Bassis he-him-his

2 out of 11 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	0	2	0	0	0	0	4.0	4.4	4.5
My interest in the subject has increased because of this course. (Q1632)	0	1	1	0	0	0	3.5	4.1	4.2
I knew what was expected of me in this course.(Q1633)	0	2	0	0	0	0	4.0	4.3	4.6
I had a strong desire to take this course.(Q4)	0	1	1	0	0	0	3.5	4.0	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	0	1	1	0	0	0	3.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Jeremy Bassis he-him-his seemed well prepared for class meetings.(Q230)	1	1	0	0	0	0	4.5	4.7	4.8
Jeremy Bassis he-him-his explained material clearly.(Q199)	1	1	0	0	0	0	4.5	4.6	4.7
Jeremy Bassis he-him-his treated students with respect. (Q217)	1	1	0	0	0	0	4.5	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	0	2	0	0	0	0	4.0

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Jeremy Bassis he-him-his was an excellent teacher. (Q2)	1	1	0	0	0	0	4.5
Jeremy Bassis he-him-his acknowledged all questions insofar as possible. (Q216)	1	1	0	0	0	0	4.5
Jeremy Bassis he-him-his encouraged constructive criticism. (Q218)	1	1	0	0	0	0	4.5

The medians are calculated from Winter 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Winter 2023 Instructor Report
CLIMATE 501 003 - SPACE 501 003
Mike Liemohn

2 out of 11 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	0	2	0	0	0	0	4.0	4.4	4.5
My interest in the subject has increased because of this course. (Q1632)	0	1	1	0	0	0	3.5	4.1	4.2
I knew what was expected of me in this course.(Q1633)	0	2	0	0	0	0	4.0	4.3	4.6
I had a strong desire to take this course.(Q4)	0	1	1	0	0	0	3.5	4.0	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	0	1	1	0	0	0	3.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Mike Liemohn seemed well prepared for class meetings.(Q230)	1	1	0	0	0	0	4.5	4.7	4.8
Mike Liemohn explained material clearly.(Q199)	1	1	0	0	0	0	4.5	4.6	4.7
Mike Liemohn treated students with respect.(Q217)	1	1	0	0	0	0	4.5	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	0	2	0	0	0	0	4.0

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Mike Liemohn was an excellent teacher. (Q2)	1	1	0	0	0	0	4.5
Mike Liemohn acknowledged all questions insofar as possible. (Q216)	1	1	0	0	0	0	4.5
Mike Liemohn encouraged constructive criticism. (Q218)	1	1	0	0	0	0	4.5

The medians are calculated from Winter 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Winter 2023 Instructor Report
CLIMATE 501 003 - SPACE 501 003
Allison Steiner

2 out of 11 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	0	2	0	0	0	0	4.0	4.4	4.5
My interest in the subject has increased because of this course. (Q1632)	0	1	1	0	0	0	3.5	4.1	4.2
I knew what was expected of me in this course.(Q1633)	0	2	0	0	0	0	4.0	4.3	4.6
I had a strong desire to take this course.(Q4)	0	1	1	0	0	0	3.5	4.0	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	0	1	1	0	0	0	3.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Allison Steiner seemed well prepared for class meetings.(Q230)	1	1	0	0	0	0	4.5	4.7	4.8
Allison Steiner explained material clearly.(Q199)	1	1	0	0	0	0	4.5	4.6	4.7
Allison Steiner treated students with respect.(Q217)	1	1	0	0	0	0	4.5	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	0	2	0	0	0	0	4.0

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Allison Steiner was an excellent teacher. (Q2)	1	1	0	0	0	0	4.5
Allison Steiner acknowledged all questions insofar as possible. (Q216)	1	1	0	0	0	0	4.5
Allison Steiner encouraged constructive criticism. (Q218)	1	1	0	0	0	0	4.5

The medians are calculated from Winter 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Fall 2023 Instructor Report
CLIMATE 501 004 - SPACE 501 004
Jeremy Bassis

12 out of 12 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	6	4	2	0	0	0	4.5	4.5	4.5
My interest in the subject has increased because of this course. (Q1632)	5	3	2	0	0	2	4.5	4.2	4.2
I knew what was expected of me in this course.(Q1633)	9	1	1	0	0	1	4.9	4.4	4.5
I had a strong desire to take this course.(Q4)	6	3	2	1	0	0	4.5	4.1	4.0
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	6	3	3	0	0	0	4.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Jeremy Bassis seemed well prepared for class meetings.(Q230)	9	2	0	0	0	0	4.9	4.7	4.8
Jeremy Bassis explained material clearly.(Q199)	10	2	0	0	0	0	4.9	4.6	4.7
Jeremy Bassis treated students with respect.(Q217)	11	1	0	0	0	0	5.0	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	9	1	2	0	0	0	4.8

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Jeremy Bassis was an excellent teacher. (Q2)	9	3	0	0	0	0	4.8
Jeremy Bassis acknowledged all questions insofar as possible. (Q216)	9	3	0	0	0	0	4.8
Jeremy Bassis encouraged constructive criticism. (Q218)	9	3	0	0	0	0	4.8

The medians are calculated from Fall 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Fall 2023 Instructor Report
CLIMATE 501 004 - SPACE 501 004
Mike Liemohn

12 out of 12 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	6	4	2	0	0	0	4.5	4.5	4.5
My interest in the subject has increased because of this course. (Q1632)	5	3	2	0	0	2	4.5	4.2	4.2
I knew what was expected of me in this course.(Q1633)	9	1	1	0	0	1	4.9	4.4	4.5
I had a strong desire to take this course.(Q4)	6	3	2	1	0	0	4.5	4.1	4.0
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	6	3	3	0	0	0	4.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Mike Liemohn seemed well prepared for class meetings.(Q230)	9	2	0	0	0	0	4.9	4.7	4.8
Mike Liemohn explained material clearly.(Q199)	10	2	0	0	0	0	4.9	4.6	4.7
Mike Liemohn treated students with respect.(Q217)	11	1	0	0	0	0	5.0	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	9	1	2	0	0	0	4.8

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Mike Liemohn was an excellent teacher. (Q2)	9	3	0	0	0	0	4.8
Mike Liemohn acknowledged all questions insofar as possible. (Q216)	9	3	0	0	0	0	4.8
Mike Liemohn encouraged constructive criticism. (Q218)	9	3	0	0	0	0	4.8

The medians are calculated from Fall 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Fall 2023 Instructor Report
CLIMATE 501 004 - SPACE 501 004
Allison Steiner

12 out of 12 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	6	4	2	0	0	0	4.5	4.5	4.5
My interest in the subject has increased because of this course. (Q1632)	5	3	2	0	0	2	4.5	4.2	4.2
I knew what was expected of me in this course.(Q1633)	9	1	1	0	0	1	4.9	4.4	4.5
I had a strong desire to take this course.(Q4)	6	3	2	1	0	0	4.5	4.1	4.0
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	6	3	3	0	0	0	4.5	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Allison Steiner seemed well prepared for class meetings.(Q230)	10	2	0	0	0	0	4.9	4.7	4.8
Allison Steiner explained material clearly.(Q199)	10	2	0	0	0	0	4.9	4.6	4.7
Allison Steiner treated students with respect.(Q217)	12	0	0	0	0	0	5.0	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	9	1	2	0	0	0	4.8

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Allison Steiner was an excellent teacher. (Q2)	9	3	0	0	0	0	4.8
Allison Steiner acknowledged all questions insofar as possible. (Q216)	9	3	0	0	0	0	4.8
Allison Steiner encouraged constructive criticism. (Q218)	9	3	0	0	0	0	4.8

The medians are calculated from Fall 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-08
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Computer Science and Engineering Subject: CSE Catalog: 598	Dept (Home): Computer Science and Engineering Subject: CSE Catalog: 598
☐	☐ Course is Cross-Listed with Other Departments	☐ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
☐	Course Title (full title) Special Topics	Course Title (full title) Special Topics
☐	Abbreviated Title (20 char) Special Topics	Abbreviated Title (20 char) Special Topics
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Topics of current interest in computer science and engineering. Lectures, seminar or laboratory. Can be taken more than once for credit.	
☐	Full Term Credit Hours Undergraduate Min: 1 Graduate Min: 1 Undergraduate Max: 4 Graduate Max: 4	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student, Rackham Graduate Student	
☐	Repeatability ☑ Course is Repeatable for Credit Maximum number of repeatable credits: 999	☐ Course is Y graded ☑ Can be taken more than once in the same term

Subject: Computer Science and Engineering Catalog: 598

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

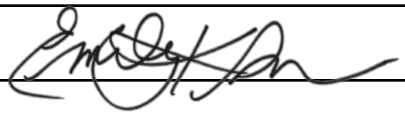
	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) Permission of instructor or counselor	Advisory Prerequisite (254 char) Permission of instructor or counselor
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☑ Seminar ☐ Recitation ☑ Lab ☑ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Emily Mower Provost Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Punam Vyas Email:vyas@umich.edu Phone:734-647-1754

CoE Curriculum Committee Representative:		Print: Amir Kamil	Date: 2/13/24
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Emily Mower Provost	Date:2/8/24
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description Topics of current interest in computer science and engineering. Lectures, seminar, or laboratory. Can be taken more than once for credit.	Course Description Topics of current interest in computer science and engineering. Lectures, seminar or laboratory. Can be taken more than once for credit.
Class Length Full term	Class Length Full term
Contact hours (lecture):	Contact hours (lecture):
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
CSE 598 is a special-topics course. Course components vary by offering, so we are selecting lab and discussion components to allow offerings to include those components. The CoE Policy for the Assignment of Credit Hours will be followed when scheduling course components.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-05
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	REQUESTED LISTING
☑	Dept (Home): Subject: Catalog:	Dept (Home): Electrical & Computer Engineering Subject: ECE Catalog: 510
☑	☐ Course is Cross-Listed with Other Departments	☑ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
		Nuclear Engineering & Radiological Sciences - NERS - 675
☑	Course Title (full title)	Course Title (full title) Plasma Chemistry and Plasma Surface Interactions
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) Plasma Chem
☑	Course Description (Please limit to 80 words and attach separate sheet if necessary) Focuses on the plasma chemistry and plasma-surface interactions occurring in low temperature plasmas as used in, for example, materials processing, chemical conversion, biotechnology, environmental remediation, and photon sources. Emphasis is on the atomic and molecular processes that produce chemically reactive species by electron and ion-molecule collisions, neutral-neutral reactions; and reactions with inorganic, organic and liquid surfaces. Plasma-surface interactions will be addressed that result in deposition, etching and sputtering. Radiation transport producing photoionization and photodissociation, and trapping will be discussed.	
☑	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: 3 Undergraduate Max: 3 Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Undergraduate Student, Rackham Graduate Student, Non-Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject:	Catalog:

☑	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☑	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char) ECE 517, permission of instructor, or graduate standing
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☐ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Mark J Kushner	Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Nancy Slowey Email: nslowey@umich.edu Phone: 734-763-2305

CoE Curriculum Committee Representative: Achilleas Anastasopoulos Print: Achilleas Anastasopoulos Date: 2/28/24

CoE Curriculum Committee Chair: Print: Date:

Home Department Chair: Heath Hofmann Print: Heath Hofmann Date: 2/26/24

Cross-Listed Department Chair: Todd Allen Print: Todd Allen Date: 29 Feb 2024

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description	Course Description Focuses on the plasma chemistry and plasma-surface interactions occurring in low temperature plasmas as used in, for example, materials processing, chemical conversion, biotechnology, environmental remediation, and photon sources. Emphasis is on the atomic and molecular processes that produce chemically reactive species by electron and ion-molecule collisions, neutral-neutral reactions; and reactions with inorganic, organic and liquid surfaces. Plasma-surface interactions will be addressed that result in deposition, etching and sputtering. Radiation transport producing photoionization and photodissociation, and trapping will be discussed.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:
None

Supporting statement:
This class has been offered several times as the special topics course EECS 598/NER590 Plasma Chemistry and Plasma Surface Interactions. Enrollment varies from a low of 6-10 to a high of 15-20. Students from several departments (ChemE, ECE, NERS, ME, AeroE, CLaSP) take this course, as the topics are of interest to a wide range of materials and chemical processing applications. There is no other offering at UM that provides this course content.

Version 02

EECS 598-001 / NERS 590-001
Plasma Chemistry and Plasma Surface Interactions
Winter 2020, MW 9:00–10:30 AM, 1008 EECS

Instructor: **Mark J. Kushner**
2236 EECS Building (734-647-1695)
Office Hours: Tuesday, Thursday, 3-5 pm; or by appointment
e-mail: mjkush@umich.edu

Goals and overview of course: This course addresses the fundamental science and technology of plasma activated chemistry occurring in low temperature plasmas, and plasma-surface interactions of materials in contact with these plasmas. The plasma chemical systems of interest are those used in, for example, materials processing (e.g., etching, deposition, sputtering) at low pressure and atmospheric pressure air plasmas as used in toxic gas remediation, functionalization of polymers, treatment of liquids or plasma medicine. The intent of the course is to provide a sufficient knowledge base in the fundamental processes occurring in these systems. Using that knowledge base, models of plasma chemical systems (volume and surface processes) of arbitrary composition can be developed. To accomplish these goals, we will discuss fundamental processes that describe the interaction of electrons with atoms and molecules, ion-molecule reactions, neutral-neutral reactions; and reactions of those species with surfaces. We will start with less complex systems, such as rare gas plasmas, and increase complexity to multi-component plasmas as used in plasma etching and humid air plasmas. During this course, students will develop a global plasma chemistry model of increasing complexity capable of simulating these systems.

Text: As this is a special topics course, there is no single text that covers all of the materials. The closest reference text, and the required textbook is

A. Fridman, Plasma Chemistry (Cambridge University Press, New York, 2008)

There is an electronic version of this text available to you – and I recommend using the electronic version until such time that buying the hard copy is a good investment for you.

Electronic Version:

https://www.cambridge.org/core/books/plasma-chemistry/842EA140F5D8C59F15AB82544A3E44CC

This website parses out the chapters one at a time. I have compiled a single PDF file of the text, which can be downloaded from the Canvas course website. (Files > Textbook)

Course Website: A Canvas website is available for distribution of class materials. The site is accessible from https://canvas.it.umich.edu/ listed under "EECS 598 001 WN 2024". You should have access to this site by being enrolled in either EECS 598 001 or NERS 590 001. If you do not have access, please contact Prof. Kushner (mjkush@umich.edu).

Prior Preparation: We will briefly review the basic concepts of low temperature plasmas, however we assume that students taking this course have a working familiarity with low

temperature plasmas. This background knowledge includes the concepts of ambipolar diffusion, electron energy distributions, cross section, rate coefficients, self-sustaining electric fields, sheaths, dc glows and rf discharges. This preparation would be the equivalent of EECS 517 / NERS 578 *Introduction to Low Temperature Plasmas*.

Handouts and Class notes: Handouts are available on the Canvas website under Files > Handouts_Notes. The posted version of the handouts will be periodically updated.

A copy of my hand-written class notes are available on the Canvas website under Files > Handouts_Notes. These notes are provided as a backup to your own notes taken in class and will be periodically updated.

There is no guarantee everything covered in class are in these notes!!!
There is no guarantee that everything in the notes will be covered in class!!!
Come to class, take your own notes, use these as backup!!!

Grading Policy: Plasma chemistry is intrinsically an interdisciplinary field with many fundamental concepts that feed into higher level processes. These linkages are difficult to appreciate in the absence of *practicing the craft*. So there is considerable emphasis on homework ("mini-projects") as part of the learning process. A final project will provide the student with an opportunity to apply what has been learned. The grading policy will be:

Homework	35%
Mid-Term Exam	30%
Final Project	35%
Instructor's discretion	5%

Lecture-Recordings: Lectures will be recorded through the CAEN lecture capture system, and made available through the Canvas website. With the course being recorded, as part of your participation in this course your voice or image may be also recorded. The in-class camera will not be directed towards the student seating, however, your image may be recorded if you look back at the camera or step to the front of the classroom. Your voice will likely be recorded if you ask a question in-person during class. Students are prohibited from recording/distributing any class activity without written permission from the instructor, except as necessary as part of approved accommodations for students with disabilities. Any approved recordings may only be used for the student's own private use. Please let me know if you have any questions.

A Welcoming and Respectful Class: As instructor in this class, I aim to provide a welcoming, respectful, mentoring and collegial learning environment for all students of all backgrounds, beliefs and identities. I hope and expect that all students in the class share that same goal. If at any time you feel that the class is not meeting this goal, or you have any suggestions on how to provide a better learning environment, please contact me.

Students with Disabilities: If you have a disability that requires special accommodation (e.g., extra exam time), please contact the Services for Students with Disabilities (SSD) office (G-664 Haven Hall, 734-763-3000, http://ssd.umich.edu).

Version 02

Class Schedule and Makeup Classes: The tentative class schedule is shown below. Prof. Kushner will have periodic travel and we will have make-up classes at Fridays at 8:00 am for those missed classes. The early hour is because there are no classrooms available at reasonable hours. (Sorry about the early hour.)

Week	M	T	W	Th	F
Jan. 8			No Class		Makeup Class
Jan. 15	MLK Day No Class		Class MIPSE Seminar		
Jan. 22	Class		Class		Makeup Class
Jan. 29	No Class		No Class		
Feb. 5	Class		Class MIPSE Seminar		Makeup Class
Feb. 12	Class		Class		
Feb. 19	Class		Class		
Feb. 26	Spring Break No Class		Spring Break No Class		
Mar. 4	Class		Class MIPSE Seminar		
Mar. 11	Class		Class		
Mar. 18	Class (Exam)		Class MIPSE Seminar		
Mar. 25	Class		Class – Midterm Exam		
Apr. 1	Class		Class		
Apr. 8	Class		Class		
Apr. 15	Class		Class MIPSE Seminar		
Apr. 22	Class				Projects Due

Projects

Instead of a final exam, there will be a final project for this class. The project should consist of developing a model for or performing an in depth analysis of a low temperature plasma chemical system that interacts with the surfaces in contact with the plasma. During the course a global plasma chemistry model will be developed, and that model can be (should be) used in the final project.

The project should include a literature search to provide you with background on the basics of the plasma chemical system you have chosen to study and to see how other researchers have analyzed the system. Some of the models which appear in the literature are quite involved and complex. The intent of the project is not for you to duplicate the complexity of those models. Rather, the intent is to give you some sense of how the device and the "final product" (e.g., deposition rate, etching rate, rate of removal of toxic gas) scale. Your model should have at least the degree of sophistication of the global model developed in class, but should include real device parameters. For example, use the actual gas pressures, gas mixtures, dimensions, cross sections, currents, and voltages.

Your final project deliverables will consist of the written report. The limit on length is 25 pages, though 25 pages are not required. (Fewer pages of higher quality are preferred.) Please include a description of the discharge system, how you have analyzed it, the scaling laws you developed and a discussion of what you have learned. Generously use plots to display parametric results.

Due date: Friday, 26 April 2024, 5:00 PM
Paper copy to: Prof. Kushner office (2236 EECS)
PDF copy to: mjkush@umich.edu

Version 02

EECS 598-001 / NERS 590-001
Plasma Chemistry and Plasma Surface Interactions
Winter 2024 Syllabus and Reading Assignments (v01)

Unit	Topic	Reading Assignment (Fridman)
1.0	Introduction	Ch. 1
Gas Phase Plasma Chemistry		
2.1	Quick Review of Glow Discharges	4.2
2.2	Basic Global Plasma Chemistry Model	Handout
2.3	Kinetics	3.1
2.4	Rate Coefficients and Electron Impact Processes	3.1
2.5	Thermodynamics	3.1
2.6	Atomic and Molecular Spectra	
2.7	Charge Exchange, cluster ions, 3-body reactions	2.2
2.8	Transport Coefficients: Neutrals	3.3
2.9	Transport Coefficients: Ions	3.3
2.10	Transport Coefficients: Electrons and Electron Impact Cross Sections and Processes	2.5
2.11	Vibrational Collisions: VT, VV	2.6
2.12	Gas heating in low pressure plasmas	
2.13	Charged Particle Neutralization: Ion-Ion	2.3
2.14	Charged Particle Neutralization: Electron Ion Recombination	2.2
2.15	Radiation Transport	3.3
3.1	Rare Gas Plasma Chemistry: (low pressure and high pressure)	4.1, 4.2, 4.5
3.2	Stability of Atmospheric Pressure Plasmas and Dielectric Barrier Discharges	4.3, 4.5
3.3	Air Plasma Chemistry (Dry and Humid)	Handouts
3.4	Plasma Etching Chemistries	8.2, 8.3, Handouts
3.5	Plasma Deposition Chemistries	8.5, Handouts
3.6	Plasma Remediation of Gases	11.7
Plasma Surface Interactions		
4.1	Deposition	Handouts
4.2	Functionalization of Polymers	9.7, 9.8
4.3	Sputtering and Ion Implantation	8.5, 8.6
4.4	Chemically Enhanced Sputtering	8.2
4.5	Biological Surfaces	12

Plasma Initiated Liquid Chemistry		
5.1	Electron and ion reactions at liquid surfaces	
5.2	Liquid phase chemistry	

Textbook:
A. Fridman, Plasma Chemistry (Cambridge University Press, New York, 2008)

University of Michigan
Fall 2020 Instructor Report With Comments
EECS 598 004 - EECS 598 904 - NERS 590 004 - NERS 590 804
Mark Kushner

7 out of 13 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
This course advanced my understanding of the subject matter. (Q1631)	5	2	0	0	0	0	4.8	4.6	4.5
My interest in the subject has increased because of this course. (Q1632)	4	3	0	0	0	0	4.6	4.2	4.2
I knew what was expected of me in this course.(Q1633)	3	4	0	0	0	0	4.4	4.5	4.4
Overall, this was an excellent course.(Q1)	5	2	0	0	0	0	4.8	4.4	4.3
I had a strong desire to take this course.(Q4)	2	5	0	0	0	0	4.2	4.1	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	1	0	5	1	0	0	3.0	2.9	2.8
How did you participate in this course? (Q1854)	3	3	0	1	0	0	4.3	4.7	4.5

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
Overall, Mark Kushner was an excellent teacher.(Q2)	6	1	0	0	0	0	4.9	4.7	4.8
Mark Kushner seemed well prepared for class meetings.(Q230)	6	1	0	0	0	0	4.9	4.8	4.9
Mark Kushner explained material clearly.(Q199)	6	1	0	0	0	0	4.9	4.7	4.8
Mark Kushner treated students with respect.(Q217)	6	1	0	0	0	0	4.9	4.9	4.9

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median
Prerequisites provided adequate preparation for this course. (Q61)	4	2	1	0	0	0	4.6	4.5
The textbook made a valuable contribution to the course. (Q64)	2	3	1	0	0	1	4.2	3.9
I developed confidence in my abilities as an engineer. (Q1769)	4	3	0	0	0	0	4.6	4.2
I developed the ability to solve real world engineering problems. (Q1770)	4	3	0	0	0	0	4.6	4.2

The medians are calculated from Fall 2020 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-08
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Electrical & Computer Engineering Subject: ECE Catalog: 598	Dept (Home): Electrical & Computer Engineering Subject: ECE Catalog: 598
☐	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☐	Course Title (full title) Special Topics	Course Title (full title) Special Topics
☐	Abbreviated Title (20 char) Special Topics	Abbreviated Title (20 char) Special Topics
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Topics of current interest in electrical computer and engineering. Lectures, seminar or laboratory. Can be taken more than once for credit.	
☐	Full Term Credit Hours Undergraduate Min: 1 Graduate Min: 1 Undergraduate Max: 4 Graduate Max: 4	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student, Rackham Graduate Student	
☐	Repeatability ☑ Course is Repeatable for Credit Maximum number of repeatable credits: 999	☐ Course is Y graded ☑ Can be taken more than once in the same term

Subject: Electrical & Computer Engineering Catalog: 598

☐

Grading Basis
- ☑ Graded (A – E)
- ☐ Credit/No Credit
- ☐ Satisfactory/Unsatisfactory
- ☐ Pass/Fail
- ☐ Business Administration

Grading
- ☐ Not for Credit
- ☐ Not for Degree Credit
- ☐ Degree Credit Only

Add Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

Drop Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) Permission of instructor or counselor	Advisory Prerequisite (254 char) Permission of instructor or counselor
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑

Course Components / Graded Component

	Graded Component
☑ Lecture	☑
☑ Seminar	☐
☐ Recitation	☐
☑ Lab	☐
☑ Discussion	☐
☐ Independent Study	☐

Terms Typically Offered
- ☑ Fall
- ☑ Winter
- ☐ Spring
- ☐ Summer
- ☐ Spring/Summer

Cognizant Faculty Member Name: Heath Hofmann Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Punam Vyas Email: vyas@umich.edu Phone:647-1754

CoE Curriculum Committee Representative:	Achilleas Anastasopoulos	Print: Anastasopoulos, Achilleas	Date:2/8/24
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:	Heath Hofmann	Print: Heath Hofmann	Date:2/8/24
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description Topics of current interest in electrical computer and engineering. Lectures, seminar or laboratory. Can be taken more than once for credit.	Course Description Topics of current interest in electrical computer and engineering. Lectures, seminar or laboratory. Can be taken more than once for credit.
Class Length Full term	Class Length Full term
Contact hours (lecture):	Contact hours (lecture):
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
ECE 598 is a special-topics course. Course components vary by offering, so we are selecting lab and discussion components to allow offerings to include those components. The CoE Policy for the Assignment of Credit Hours will be followed when scheduling course components.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-12
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Elec Engin & Computer Sci Subject: EECS Catalog: 498	Dept (Home): Elec Engin & Computer Sci Subject: EECS Catalog: 498
☐	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☐	Course Title (full title) Special Topics	Course Title (full title) Special Topics
☐	Abbreviated Title (20 char) Special Topics	Abbreviated Title (20 char) Special Topics
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Topics of current interest selected by the faculty. Lecture, seminar or laboratory.	
☐	Full Term Credit Hours Undergraduate Min: 1 Graduate Min: 1 Undergraduate Max: 4 Graduate Max: 4	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student, Rackham Graduate Student	
☐	Repeatability ☑ Course is Repeatable for Credit Maximum number of repeatable credits: 999	☐ Course is Y graded ☑ Can be taken more than once in the same term

Subject: Elec Engin & Computer Sci Catalog: 498

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

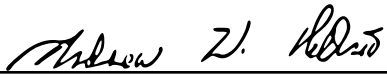
	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) Permission of instructor	Advisory Prerequisite (254 char) Permission of instructor
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☑ Seminar ☐ Recitation ☑ Lab ☑ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Amir Kamil Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Punam Vyas Email: vyas@umich.edu Phone: 647-1754

CoE Curriculum Committee Representative:		Print:Amir Kamil	Date: 2/13/24
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Andrew W DeOrio	Date:2/12/24
Cross-Listed Department Chair:		Print: Heath Hofmann	Date: 2/14/24
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description Topics of current interest selected by the faculty. Lecture, seminar or laboratory.	Course Description Topics of current interest selected by the faculty. Lecture, seminar or laboratory.
Class Length Full term	Class Length Full term
Contact hours (lecture):	Contact hours (lecture):
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
EECS 498 is a special-topics course. Course components vary by offering, so we are selecting lab and discussion components to allow offerings to include those components. The CoE Policy for the Assignment of Credit Hours will be followed when scheduling course components.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-26
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Engineering Subject: ENGR Catalog: 101	Dept (Home): Engineering Subject: ENGR Catalog: 101
☐	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☐	Course Title (full title) Introduction to Computers and Programming	Course Title (full title) Introduction to Computers and Programming
☐	Abbreviated Title (20 char) Intro Comp&Prog	Abbreviated Title (20 char) Intro Comp&Prog
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Algorithms and programming in C++ and Matlab, computing as a tool in engineering, introduction to the organization of digital computers.	
☐	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Engineering Catalog: 101

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) Prior or concurrent enrollment in MATH 115 or equivalent.	Advisory Prerequisite (254 char) Prior or concurrent enrollment in MATH 115 or equivalent.
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☑	Credit Exclusions Credit for only one: EECS 180, EECS 183, ENGR 101, or ENGR 151	Credit Exclusions Only 2 credits granted for ENGR 101 to those who have completed or are enrolled in ENGR 161; Credit for only one: EECS 180, EECS 183, ENGR 101, OR ENGR 151
☐	Course Components / Graded Component ☑ Lecture — ☑ ☐ Seminar — ☐ ☐ Recitation — ☐ ☑ Lab — ☐ ☐ Discussion — ☐ ☐ Independent Study — ☐ Terms Typically Offered ☑ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer	
	Cognizant Faculty Member Name: Laura Alford	Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Ryan Latimer Email: rlatimer@umich.edu Phone: 734-647-9039

CoE Curriculum

Committee Representative: Rachael Schmedlen Print: Rachael Schmedlen Date: 2/26/24

CoE Curriculum Committee Chair: Print: Date:

Home Department Chair: Kevin Pipe Print: Kevin Pipe Date: 02/26/24

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description Algorithms and programming in C++ and Matlab, computing as a tool in engineering, introduction to the organization of digital computers.	Course Description Algorithms and programming in C++ and Matlab, computing as a tool in engineering, introduction to the organization of digital computers.
Class Length Full term	Class Length Full term
Contact hours (lecture): 3	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab) 2	Contact hours (lab) 2

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
Updating credit exclusions with creation of MATLAB course ENGR 161

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-02-21
Effective Term: Fall 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Engineering Subject: ENGR Catalog: 151	Dept (Home): Engineering Subject: ENGR Catalog: 151
☐	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☐	Course Title (full title) Accelerated Introduction to Computers and Programming	Course Title (full title) Accelerated Introduction to Computers and Programming
☐	Abbreviated Title (20 char) Accel Intro Prog	Abbreviated Title (20 char) Accel Intro Prog
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) Algorithms and programming in C++ and matlab. Procedural and object-oriented algorithm design, implementation, and testing. Emphasis on engineering analysis and embedded computing application.	
☐	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: Undergraduate Max: 4 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Engineering Catalog: 151

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) Previous experience with computer programming	Advisory Prerequisite (254 char) Previous experience with computer programming
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☑	Credit Exclusions Credit for only one: EECS 180, EECS 183, ENGR 101, OR ENGR 151	Credit Exclusions Only 2 credits granted for ENGR 151 to those who have completed or are enrolled in ENGR 161. Credit for only one: EECS 180, EECS 183, ENGR 101, OR ENGR 151

☐	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☑ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☐ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Yang Zhang Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Ryan Latimer Email: rlatimer@umich.edu Phone: 734-647-9039

CoE Curriculum Committee Representative: Rachael Schmedlen Print: Rachael Schmedlen Date: 2/26/24

CoE Curriculum Committee Chair: Print: Date:

Home Department Chair: Kevin Pipe Print: Kevin Pipe Date: 2/26/24

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description Algorithms and programming in C++ and matlab. Procedural and object-oriented algorithm design, implementation, and testing. Emphasis on engineering analysis and embedded computing application.	Course Description Algorithms and programming in C++ and matlab. Procedural and object-oriented algorithm design, implementation, and testing. Emphasis on engineering analysis and embedded computing application.
Class Length Full term	Class Length Full term
Contact hours (lecture): 3	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab) 2	Contact hours (lab) 2

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
Updating credit exclusions with creation of MATLAB course ENGR 161

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-03-01
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING			**REQUESTED LISTING**		
☑	Dept (Home): Subject: Catalog:			Dept (Home): Material Science Engineering Subject: MATSCIE Catalog: 506		
	☐ Course is Cross-Listed with Other Departments			☑ Course is Cross-Listed with Other Departments		
☑	Department	Subject	Catalog Number	Department	Subject	Catalog Number
				Macromolecular science and Engineering - MACROMOL - 506 Chemical Engineering - CHE -506		
☑	Course Title (full title)			Course Title (full title) Soft Robotic Matter		
☑	Abbreviated Title (20 char)			Abbreviated Title (20 char) Soft Robotic Matter		
☑	Course Description (Please limit to 80 words and attach separate sheet if necessary) Soft robotic matter consists in active materials that can sense, move within, and alter their working environment. This course will explore fundamentals and emerging approaches in soft active matter design, actuation, power, and fabrication across length scales, with focus on engineering their properties and structures for programmable robotic functions.					
☑	Full Term Credit Hours Undergraduate Min: 3 Undergraduate Max: 3	Graduate Min: 3 Graduate Max: 3		Half Term Credit Hours Undergraduate Min: Undergraduate Max:	Graduate Min: Graduate Max:	
☑	Course Credit Type Undergraduate Student, Rackham Graduate Student					
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:			☐ Course is Y graded ☐ Can be taken more than once in the same term		

Subject: Catalog:

☑	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☐	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
☑	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Senior Standing or Graduate Standing Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☐ Fall ☑ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Abdon Pena-Francesch Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Email: Phone:

CoE Curriculum Committee Representative:	EM	Print: Emmanuelle Marquis	Date: 3/1/24
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Elizabeth Holm	Date: 1/29/2024
Cross-Listed Department Chair:		Print: Jinsang Kim	Date: 2/1/2024
Cross-Listed Department Chair:		Print: Sharon Glotzer	Date: 2/13/24
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description	Course Description Soft robotic matter consists in active materials that can sense, move within, and alter their working environment. This course will explore fundamentals and emerging approaches in soft active matter design, actuation, power, and fabrication across length scales, with focus on engineering their properties and structures for programmable robotic functions.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
Course has been taught 2 time, and has had good enrollment

MSE 593: Special Topics
Soft Robotic Matter

Semester: Winter, 2024
Days/Times: Tuesday/Thursday 4:30 – 6:00 PM

Location: 1003 EECS

Professor: Abdon Pena-Francesch, Ph.D. (he/him)
Assistant Professor of Materials Science and Engineering, Macromolecular Science and Engineering, Chemical Engineering, Robotics Institute

Office: NCRC 28-3007E
Office Hours: by appointment
E-mail: abdon@umich.edu

I. Course Description

This course is aimed at *senior undergraduate* and *graduate students* with interests in materials science, robotics, functional soft materials, and bioengineering. While traditional robots are typically composed of rigid and hard materials, the growing field of soft robotics explores flexible and deformable materials to achieve compliance, dexterity, and functions akin to those of biological systems. Soft robotic materials design presents new opportunities to bypass inherent limitations in the design of devices, especially at small scales and when operating in unstructured environments. This course will explore fundamentals and emerging approaches in design, actuation, power, and control across length scales, with focus on leveraging the properties and structures of soft materials for programmable robotic functions.

II. Course Objectives

1. Development of an interdisciplinary perspective of materials, multiscale design, and robotics.
2. Development of foundation of soft matter physics, polymer chemistry, and manufacturing applied to robotics.
3. Explore approaches to engineering design and the role of materials in robotic functions and performance.
4. Understanding of structure-property-function relationships in a robotics context.
5. Learning the working principles of tethered and untethered actuation through materials design.
6. Understanding performance metrics and scaling laws in actuators across length scales.
7. Understanding materials interaction with their environment in a robotics context.
8. Introduce the state-of-the-art in the field through research articles, reviews, and conference technical programs.
9. Critical thinking and analysis of state-of-the-art technical literature.
10. Apply materials and structure design in soft microrobotics in a lab activity.
11. Development of communication skills through written reports and oral presentations.
12. Include discussions of ethical, societal, and environmental aspects in a robotics context.

III. Course Outcomes

After this course, a student:

1. Understands chemical and physical aspects to the design of functional polymer networks.
2. Understands fundamental structure-property-function relationships in active soft materials.
3. Understands physical scaling laws at macro-, micro-, and nanoscale length scales.
4. Can identify trade-offs among materials properties and actuator performance, and identify drivers in soft robot engineering design across length scales.
5. Can apply soft matter engineering to the design of small-scale soft robots using a variety of tethered and untethered actuation methods.
6. Can demonstrate the ability to justify materials engineering in soft robotic designs.
7. Can search and analyze technical information (including patents, reports, and technical research articles).
8. Can discuss study cases and critically analyze their design and performance.
9. Can write a high-quality technical report.
10. Can deliver excellent oral and poster presentations.

IV. Topics

1. Introduction to soft robotics
2. Introduction to soft materials
    - Intro to polymers, elastomers, and their material properties
    - Intro to smart materials
3. Tethered soft actuation: working principles, design, materials, and fabrication
    - Tendon-driven actuation
    - Pneumatic actuation
    - Electrical soft actuation (DEAs)
    - Artificial muscles: design, performance metrics, and applications
    - Soft grippers: design, performance metrics, and applications
4. Introduction to microrobotics.
    - Forces at the micro/nanoscale
    - Scaling laws for microrobots
    - Design principles at the micro/nanoscale
5. Untethered actuation: working principles, design, materials, fabrication, and power
    - Magnetic actuation
    - Electrical actuation
    - Acoustic actuation
    - Thermal actuation
    - Light-driven actuation
    - Chemical actuation
    - Eco-microrobots: environmental applications
    - Bio-microrobots: biomedical applications

V. Reference text

Mobile Microrobotics, Metin Sitti, The MIT Press, 2017 (*book not required*)

The course text will be supplemented with numerous research publications, review articles, and online resources.

VI. Tentative Schedule

Class	Date		Topic	Deliverables
1	Jan 11	Th	Introductions / Class logistics	
2	Jan 16	Tu	Soft Robotics - "hard" vs "soft" paradigm / Soft Matter I - Intro to polymer physics. Ideal chains.	
3	Jan 18	Th	Soft Matter II - Ideal chains and entropic elasticity. Polymer Networks	
4	Jan 23	Tu	Soft Matter III - Polymer Networks. Finite chains and linear viscoelasticity	
5	Jan 25	Th	Sort Matter IV - Applications of soft matter in robotics	
6	Jan 30	Tu	No class	
7	Feb 1	Th	Soft actuators: design, performance metrics, and applications	
8	Feb 6	Tu	Biological structural materials	HW I
9	Feb 8	Th	Continuum soft robots: tendon-driven robots and actuators	
10	Feb 13	Tu	Fluidic actuation: hydrostats & pneumatic actuators	
11	Feb 15	Th	**Guest lecture: Dr. Abby Juhl** (AFRL) (F 16th MSE seminar) Metamaterials for aerodynamic control	Select paper APS
12	Feb 20	Tu	DEAs & electroactive materials	
13	Feb 22	Th	Thermal actuation & shape memory alloys	Paper report I
-	Feb 27/29		Spring Break	
14	Mar 5	Tu	**Guest lecture: Prof. Hamed Shahsavan** (U Waterloo) Liquid crystal elastomers & light-driven robots	Select paper MRS
15	Mar 7	Th	Hydrogels / Self-healing robots & actuators	
16	Mar 12	Tu	Forces at the micro/nanoscale. Scaling laws	
17	Mar 14	Th	Chemical actuation - self-propelled robots	Paper report II
18	Mar 19	Tu	**Guest lecture: Prof. Amirreza Aghakhani** (U Stuttgart) Acoustic microrobots	
19	Mar 21	Th	Magnetic actuation - magnetic field fundamentals	Swimmer design
20	Mar 26	Tu	Magnetic actuation - soft/hard magnetic materials	
21	Mar 28	Th	Biohybrid microrobots	
22	Apr 2	Tu	**Lab visit** (microswinner race)	Swimmer race
23	Apr 4	Th	Presentations	Presentation
24	Apr 9	Tu	Presentations	Presentation
25	Apr 11	Th	Presentations	Presentation
26	Apr 16	Tu	Presentations	Presentation
27	Apr 18	Th	No class (buffer slot)	
28	Apr 23	Tu	No class	

VII. Assessment tools

Evaluation of written reports for written communication
Evaluation of oral presentations for oral communication
Evaluation of the design of a small-scale chemical swimmer robot
Participation in class discussions

VIII. Academic Integrity
Short version: Do your own work, don't lie, don't cheat. Give credit where credit is due.
Longer version: here.

IX. Grading

Homework set I: 10%
Lab activity I: 20%
Paper report I: 20%
Paper report II: 20%
Final presentation: 30%

X. Use of Generative Artificial Intelligence (GAI)

Generative AI (Artificial Intelligence that can produce contents) is now widely available to produce text, images, and other media. You can freely use such AI resources to inform yourself about the field, to understand the contributions that AI can make, and to help your learning.
In principle you may submit material that contains AI-generated text, or is based on or derived from it, as long as this use is *properly documented and justified*. This includes for example drafting an outline, finding information, revising for grammar and style, combining elements and removing redundant parts, or compiling and annotating references.
The use of generative AI tools is not permitted in this course for impersonating you in classroom contexts, completing group work that your group has assigned to you (unless it is mutually agreed upon that you may utilize the tool), writing a draft of a writing assignment, writing entire sentences, paragraphs or papers to complete class assignments.
However, please keep the following three principles in mind:

(1) An AI cannot pass this course. This is necessary to ensure you are competent to surpass generative AI in the future – whether in academia, research, industry, or any other domains of society. If this cannot be achieved, if you are not able to maintain control of the rules, you are entering an unwinnable competition. Because of this, the minimum passing requirements are likely higher than what we would have accepted previously. Your project contributions will be assessed based on your critical thought processes, discussions, and communication efforts rather than on a single end result, and you will be expected to demonstrate a level of competence that can and must surpass AI.

(2) AI contributions must be attributed and true. You are taking full responsibility for AI-generated materials as if you had produced them yourself: ideas must be attributed and facts must be true.

(3) The use of AI resources must be open and documented. Your documentation must make the process transparent – the submission itself must meet our standards of attribution and validation.

Misusing GAI resources and/or failure to disclose it will be considered a violation of the academic integrity code, and will be treated and reported as academic misconduct with according consequences.

XI. Attendance Policy

Attendance and punctuality are basic requirements for an effective discussion in this class. Beyond that, each person's frequency and quality of contribution to the class discussion will be assessed and reflected in the class participation score. If you cannot attend a class it is a courtesy to inform your group or team members and your professor in advance if possible. Excessive unexcused absence will result in your final grade lowered and/or recommending that you withdraw from the course.

XII. Syllabus Inclusion Statement

It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.

XIII. Syllabus is in flux…

This syllabus is subject to revision. Developments in the class are in flux and the guidelines and policies expressed in this syllabus may need to change on short notice. This may affect the contents of assignments, their evaluation, dates, or any other part of the syllabus. All changes affecting the syllabus contents and overall class logistics will be discussed with the class and announced as soon as possible.

University of Michigan
Winter 2022 Instructor Report With Comments
MATSCIE 593-077: MSE Special Topics
Abdon Pena-Francesch

21 out of 24 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
This course advanced my understanding of the subject matter. (Q1631)	17	3	1	0	0	0	4.9	4.6	4.7
My interest in the subject has increased because of this course. (Q1632)	15	5	1	0	0	0	4.8	4.2	4.6
I knew what was expected of me in this course.(Q1633)	17	3	1	0	0	0	4.9	4.6	4.5
I had a strong desire to take this course.(Q4)	13	5	2	0	0	0	4.7	4.1	4.5
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	4	11	6	0	0	0	3.9	3.0	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
Abdon Pena-Francesch seemed well prepared for class meetings.(Q230)	18	2	1	0	0	0	4.9	4.8	4.8
Abdon Pena-Francesch explained material clearly.(Q199)	16	4	1	0	0	0	4.8	4.7	4.7
Abdon Pena-Francesch treated students with respect. (Q217)	19	1	1	0	0	0	4.9	4.8	4.9

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	17	3	1	0	0	0	4.9

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Abdon Pena-Francesch was an excellent teacher. (Q2)	19	1	1	0	0	0	4.9

The medians are calculated from Winter 2022 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 16 to 74 in College of Engineering.

University of Michigan
Winter 2023 Instructor Report
MATSCIE 593-077: MSE Special Topics
Abdon Pena-Francesch

15 out of 21 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	11	4	0	0	0	0	4.8	4.4	4.5
My interest in the subject has increased because of this course. (Q1632)	12	3	0	0	0	0	4.9	4.1	4.2
I knew what was expected of me in this course.(Q1633)	6	9	0	0	0	0	4.3	4.3	4.6
I had a strong desire to take this course.(Q4)	12	2	1	0	0	0	4.9	4.0	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	3	11	1	0	0	0	4.1	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Abdon Pena-Francesch seemed well prepared for class meetings.(Q230)	13	2	0	0	0	0	4.9	4.7	4.8
Abdon Pena-Francesch explained material clearly.(Q199)	12	3	0	0	0	0	4.9	4.6	4.7
Abdon Pena-Francesch treated students with respect. (Q217)	13	2	0	0	0	0	4.9	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	12	2	1	0	0	0	4.9

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Abdon Pena-Francesch was an excellent teacher. (Q2)	12	2	1	0	0	0	4.9

The medians are calculated from Winter 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 16 to 74 in College of Engineering.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2024-01-26
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☑	Dept (Home): Subject: Catalog:	Dept (Home): Material Science Engineering Subject: MATSCIE Catalog: 509
☑	☐ Course is Cross-Listed with Other Departments	☑ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
☑		Biomedical Engineering - BIOMEDE - 509 Chemical Engineering - CHE - 509 Macromolecular Science and Engineering - MACROMOL - 509
☑	Course Title (full title)	Course Title (full title) Advanced Biomaterials
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) Adv Biomaterials
☑	Course Description (Please limit to 80 words and attach separate sheet if necessary) Biomaterials have important roles and growing impact on broad applications, including medical devices, implants, regenerative medicine, tissue engineering, sensors, diagnostics, and drug delivery. This graduate level course is designed primarily for graduate and senior undergraduate students in engineering or biological sciences, as a complement to BME 410. It will cover both basic concepts and contemporary concepts and applications in advanced biomaterials.	
☑	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: 3 Undergraduate Max: 3 Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Undergraduate Student, Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Catalog:

☑

Grading Basis
- ☑ Graded (A – E)
- ☐ Credit/No Credit
- ☐ Satisfactory/Unsatisfactory
- ☐ Pass/Fail
- ☐ Business Administration

Grading
- ☐ Not for Credit
- ☐ Not for Degree Credit
- ☐ Degree Credit Only

Add Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

Drop Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☑	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char) MATSCIE 220 or MATSCIE 250
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑

Course Components
- ☑ Lecture
- ☐ Seminar
- ☐ Recitation
- ☐ Lab
- ☐ Discussion
- ☐ Independent Study

Graded Component
- ☑
- ☐
- ☐
- ☐
- ☐
- ☐

Terms Typically Offered
- ☐ Fall
- ☑ Winter
- ☐ Spring
- ☐ Summer
- ☐ Spring/Summer

Cognizant Faculty Member Name: Geeta Mehta

Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Email: Phone:

CoE Curriculum Committee Chair:		Print:	Date:
CoE Curriculum Committee Representative:	E Marquis	Print: Emmanuelle Marquis	Date: 2/20/2024
Home Department Chair:		Print: Elizabeth Holm	Date: 1/29/2024
Cross-Listed Department Chair:		Print: Jinsang Kim	Date: 2/1/2024
Cross-Listed Department Chair:		Print: Sharon C. Glotzer	Date: 2/14/24
Cross-Listed Department Chair:		Print: Tim Bruns	Date: 02/14/2024

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description	Course Description Biomaterials have important roles and growing impact on broad applications, including medical devices, implants, regenerative medicine, tissue engineering, sensors, diagnostics, and drug delivery. This graduate level course is designed primarily for graduate and senior undergraduate students in engineering or biological sciences, as a complement to BME 410. It will cover both basic concepts and contemporary concepts and applications in advanced biomaterials.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
Course has been taught for more t2 terms and has good enrollment

Course Syllabus for Winter 2024

MATSCIE 593 - 053 **Advanced Biomaterials** (3 Credits)

Semester: Winter, 2024

Days/Times: Monday/Wednesday 12:00 PM - 1:30 PM

***Classroom*:** 1008 EECS

Instructional Staff:

Professor: Geeta Mehta, Ph.D., Associate Professor, Depts. of Materials Science and Engineering, Biomedical Engineering, and Macromolecular Science and Engineering

E-mail: mehtagee@umich.edu

Please see Communications section for notes about contacting the instructor

Office Hours: By appointment either on Zoom or in NCRC

Prerequisites:

This course is intended for graduate students in MSE, BME, CHE, Macro, Chemistry, ME, and PIBS. There are no formal prerequisites, but students are advised to have completed an introductory course in materials or biomaterials, and basic knowledge of chemistry, materials science and engineering, & biochemistry/cell biology concepts.

Communications Policy:

All instructor communication must be conducted through Canvas conversations (https://umich.instructure.com/conversations#filter=type=inbox).

Select “Inbox” from the left menu bar, choose “MATSCIE 593-053 W 2024” from the course list, and in the “To:” field type Geeta Mehta, and my name will be easily available to message. Using Canvas Inbox is important for tagging each of your messages, and identifying them as course communication, to ensure that your messages aren't lost in our mailboxes.

Accommodations for Students with Disabilities:

If you think you need an accommodation for a disability, please let us know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way I teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, I can work with the Office of Services for Students with DisabilitiesLinks to an external site. (SSD) to help me determine appropriate accommodations. SSD (734-763-3000 or ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information you provide as private and confidential.

Your success in this class is important to me. If you are not formally registered with Office of Services for Students with DisabilitiesLinks to an external site. (SSD) and have anxiety, depression, learning disabilities or any other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with me so that I can best help you do well. Please set up a meeting with me via Canvas Inbox e-mail.

Inclusion and Diversity:

I aim to create an inclusive classroom where I value all students regardless of their background, country of origin, race, religion, ethnicity, disability status, gender, sexual orientation, etc. I am committed to providing a climate of excellence and inclusiveness within all aspects of the course. If there are aspects of your culture or identity that you would like to share with me, as they relate to your success in this class, I am happy to meet to discuss. Likewise, if you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss this matter with me (set up a meeting via e-mail) with an assurance of full confidentiality (only exception being mandatory reporting of academic integrity/honor code violations and sexual harassment).

Student Mental Health and Well-being:

University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact **Counseling and Psychological Services (CAPS)** at (734) 764-8312 and https://caps.umich.edu/Links to an external site. during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult **University Health Service (UHS)** at (734) 764-8320 and https://www.uhs.umich.edu/mentalhealthsvcsLinks to an external site., or for alcohol or drug concerns, see www.uhs.umich.edu/aodresourcesLinks to an external

site.. For a listing of other mental health resources available on and off campus, visit: http://umich.edu/~mhealth/Links to an external site..

Normal levels of stress and anxiety are exacerbated by the continued uncertainties associated with the COVID-19 global pandemic. The College of Engineering has resources specifically designed to support students through this especially difficult time (https://care.engin.umich.edu/). Prof. Mehta is willing to contact the C.A.R.E center on behalf of any students (with their consent). Please don't hesitate to reach out!

Religious Observances

The University of Michigan, as an institution, does not observe religious holidays. However, I will make every reasonable effort to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. If you find that an assignment due date conflicts with a religious observance, it is your obligation to let Prof. Mehta know at least 2 weeks in advance of the conflict. You will be given every opportunity to make up the work without penalty, unless it interferes unreasonably with course delivery. Please read the University of Michigan's full policy here: http://www.provost.umich.edu/calendar/religious_holidays18-19.html#conflictsLinks to an external site.

It is recommended that you review all other general University of Michigan College of Engineering policies, academic rules, information and more in the online bulletin, which can be found at https://bulletin.engin.umich.edu/Links to an external site.

Course structure and Expectations:

This is a graduate level course in Advanced Biomaterials that provides foundation on contemporary biomaterials principles. The overall objectives of this course include:

1. Provide graduate-level knowledge on biomaterials principles and applications
2. Introduction of biomimetic & rational design approaches to biomaterial engineering.
3. Understand fundamental principles of biomaterials surfaces and interfaces
4. Discuss the cellular and molecular aspects cell and tissue interactions with biomaterials.
5. Develop critical analysis and evaluation skills through literature review and proposal writing

The following assignments comprise the final scores and assess your understanding of the materials discussed in this course.

Mini-reviews:

Each student will be required to write 4 mini-reviews (one page). The goal of this assignment is to develop paper reading skills and provide experience with writing manuscript reviews.

It is expected that each student (as part of a group) will assist in leading one discussion during a specific class. Each group will sign up for a paper for the presentation of a specific assigned paper.

Final project (Market Research Plan):

Each student will participate in a group **Market Research Plan**. You will work as a team (3-4 students per group) to prepare the final project. Group assignments will be based on students' background and education level.

Each group will formulate and present an idea for a new start-up company that will develop a materials-based technology or therapy.

A 1/2 paragraph summary providing a general overview of the project is due on 8th March (tentatively), more than 6 weeks prior the final proposal. Each group will present their project proposal as a group to judges consisting of instructors, other faculty members and a student group. Critiques and a final score will be provided by the judges.

Final Market Research Plan reports should be no more than four pages long (not including references), Arial 11 font, single spaced and 0.5" margins. The reports must address the sections detailed below. Please include schematics and pictures to illustrate and outline your project.

Significance: Outline the healthcare problem that your project aims to address. Explain the clinical importance of the problem or existing barriers that your technology/therapy will solve.

Product overview: Provide an overview of the technology/therapy that you will develop. Explain how your product/therapy will change current clinical standards. Describe any new concepts, approaches or methodologies that you will develop or apply.

Innovation/Market analysis: Describe current technologies/therapies that compete with your idea. Explain the advantages of your idea over existing technologies/therapies (this may be from other companies or still in developmental stage).

Approach/aims: Detail the overall approach, methodology required to implement your technology/therapy. Include any research experiments, pre-clinical and clinical studies that will be needed.

Contingency plan: Describe the anticipated challenges and strategies how you will address these to bring your technology/therapy to the market.

References: Include references to relevant literature for all aspects of your proposal. Place your idea in the context of existing research and technologies/therapies.

The overall grading breakdown consists of the following:

Grading Criteria:

Participation (attendance; in-class discussions) 20%

Mini-reviews (4 written critiques of discussion papers) 25%

Paper Presentation (of 1 paper) 25% (group)

Market Research Plan (paragraph abstract, written draft Market Research Plan, Presentation, Final Market Research Plan) 30% (group)

Grading Breakdown for **Market Research Plan (group)** is shown below:

5% Paragraph Summary

45% Presentation in Class

45% Final Proposal

5% Peer Evaluations

References and Additional Reading:

- *Biomaterials Science: An Introduction to Materials in Medicine.* Wagner, W., Sakiyama-Elbert, S., Zhang, G., Yaszemski, M., (Editors) 4th Edition, Academic Press, 2020.
- *Advanced Materials and Manufacturing Techniques for Biomedical Applications*. Prasad, A., Kumar, A., Gupta, M., John Wiley and Sons. 2022.
- *Regenerative Medicine: Emerging Techniques to Translation Approaches*. Chakravorty, N., Shukla, P. C. (Editors), Springer Nature Singapore, 2023.
- *Advances in 3D bioprinting*. Narayan, R. (Editor), CRC Press, Taylor & Francis, 2024.

- *Hydrogels for tissue engineering and regenerative medicine: from fundamentals to applications.* Oliveira, J. M., Silva-Correia, J., Reis, R. L., (Editors), Academic Press, 2024.
- *Biomimetic biomaterials for tissue regeneration and drug delivery*, Dash, M., Springer, 2022.
- *Biomaterials: The Intersection of Biology and Materials Science,* Temenoff, J. S.; Mikos A. G.*,* Prentice Hall, New Jersey, 2008.
- *Principles of Tissue Engineering,* Lanza, R. P.; Langer, R.; Vacanti, J., (Editors) 2nd Ed., Academic Press, San Diego, 2000.
- *Biomaterials: An Introduction*, Park, J. B.; Lakes R. S.*,* 3rd Ed, Plenum Press, New York, 2007.
- *Synthetic Biodegradable Polymer Scaffolds*, Atala, A; Mooney, D. J. (Editors), Springer Verlag, New York, 1997.

Tentative Schedule for Winter 2024:

No	Date	Modules	Topic
1	01/10	1: Fundamentals	Overview and Introduction Final project instructions and examples
2	01/17		Final project instructions and examples Native tissue and cell sources
3	01/22		Concepts of biocompatibility and signaling
4	01/24	2: Biomimetic & Engineered Materials	Hydrogels I
5	01/29		Hydrogels II
6	01/31		Biomimetic materials I
7	02/05		Biomimetic materials II
8	02/07		Biofabrication

9	02/12		Surface characterization I **Mini-review 1 due on Feb 11th** **Paper discussion on 2024 Nature Comm, Bioinspired Structural Hydrogels**
10	02/14	3: Surfaces and interfaces	Surface characterization II
11	02/19		Protein adsorption
12	02/21		Biodegradation
13	03/04		Cell-Biomaterial interactions I **Mini-review 2 due on March 3rd** **Paper presentation on 2023 Nature, Cartilage Protein Entanglements**
14	03/06		Cell-Biomaterial interactions II **Mini-review 3 due on March 5th** **Paper discussion for 2023 Nature BME, Inflammation-induced Neovascularization**
15	03/11	4: Host reaction/Immune-response	Wound healing I
16	03/13		Wound healing II **Paragraph summary due on Market Research Project Plan** **Paper presentation on 2022 Nature Comm, Dynamic actuation**
17	03/18		Inflammation I
18	03/20		Inflammation II Immune responses guest lecture (Dr. Priyan Weerappuli)
19	03/25		Immune responses guest lecture (Dr. Priyan Weerappuli)
20	03/27		Immune response guest lecture (Dr. Priyan Weerappuli) **Mini-review 4 due on March 26th** **Paper discussion on 2023 Nature Comm, Tracing immune cells around biomaterials**

21	04/01		Immune modulation of biomaterials
22	04/03	5: Applications of Biomaterials	Drug delivery systems/Tissue engineered products/grafts
23	04/08		Clinical products in market **Market Research Project Report Draft proposal due**
24	04/10		Practical aspects and commercialization of biomaterials I
25	04/15	6: Final Presentations	Final Presentations
26	04/17		Final Presentations
27	04/22		Final Presentations
	04/28		**Final Market Research Project Plan and Final Presentation due**

Request for establishing permanent course number for 'Advanced Biomaterials'

The course has been offered during the following 3 semesters:

WN 2022 MATSCIE 593 – 076, Number of Students Enrolled – 34.

WN 2023 MATSCIE 593 – 076, Number of Students Enrolled – 12 and 5 Participants (not enrolled, from Dr. Marco Bottino's lab in Dental School).

WN 2024 MATSCIE 593 – 053, Number of Students Enrolled – 10. (includes 1 participant from Dr. Marco Bottino's lab in Dental School).

To be cross-list with: MATSCIE, BIOMEDE, MACRO, CHE

Course description:

Graduate-level course on contemporary concepts and applications in advanced biomaterials

'**Advanced Biomaterials'** is a graduate level course, created for learners who already have completed foundational studies on biomaterials. Biomaterials have important roles and growing impact on broad applications, including medical devices, implants, regenerative medicine, tissue engineering, sensors, diagnostics, and drug delivery. This graduate level course is designed primarily for graduate and senior undergraduate students in engineering or biological sciences, as a complement to the undergraduate course 'Design and Applications of Biomaterials' (BIOMEDE 410 or MATSCIE 410 or MACRO 410). This graduate course will cover contemporary concepts and applications in advanced biomaterials.

This course was taught as MATSCIE 593-076 in Winter 2022 and Winter 2023. The course was received well by the students during its past offerings. Therefore, I am requesting to make the '**Advanced Biomaterials'** course permanent in MATSCIE, BIOMEDE, CHE, and MACRO.

Course Evaluations in WN 2022 and WN 2023:

Course Evaluation for WN 2022:

University of Michigan
Winter 2022 Instructor Report With Comments
MATSCIE 593-076: MSE Special Topics
Geeta Mehta

30 out of 34 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
This course advanced my understanding of the subject matter. (Q1631)	15	13	0	1	0	0	4.5	4.6	4.7
My interest in the subject has increased because of this course. (Q1632)	13	13	2	1	0	0	4.4	4.2	4.6
I knew what was expected of me in this course.(Q1633)	12	11	6	1	0	0	4.2	4.6	4.5
I had a strong desire to take this course.(Q4)	13	10	6	0	1	0	4.3	4.1	4.5
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	1	6	21	1	0	1	3.1	3.0	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
Geeta Mehta seemed well prepared for class meetings.(Q230)	15	11	4	0	0	0	4.5	4.8	4.8
Geeta Mehta explained material clearly.(Q199)	11	11	5	2	1	0	4.1	4.7	4.7
Geeta Mehta treated students with respect.(Q217)	29	1	0	0	0	0	5.0	4.8	4.9

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	12	14	4	0	0	0	4.3

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Geeta Mehta was an excellent teacher. (Q2)	14	13	1	2	0	0	4.4

The medians are calculated from Winter 2022 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 16 to 74 in College of Engineering.

Course Evaluation for WN 2023:

University of Michigan
Winter 2023 Instructor Report
MATSCIE 593-076: MSE Special Topics
Geeta Mehta

12 out of 12 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	9	3	0	0	0	0	4.8	4.4	4.5
My interest in the subject has increased because of this course. (Q1632)	7	4	1	0	0	0	4.6	4.1	4.2
I knew what was expected of me in this course.(Q1633)	5	5	2	0	0	0	4.3	4.3	4.6
I had a strong desire to take this course.(Q4)	6	4	2	0	0	0	4.5	4.0	4.1
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	1	6	5	0	0	0	3.7	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Geeta Mehta seemed well prepared for class meetings.(Q230)	6	4	1	1	0	0	4.5	4.7	4.8
Geeta Mehta explained material clearly.(Q199)	6	4	1	0	1	0	4.5	4.6	4.7
Geeta Mehta treated students with respect.(Q217)	10	2	0	0	0	0	4.9	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	8	4	0	0	0	0	4.8

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Geeta Mehta was an excellent teacher. (Q2)	7	3	1	0	1	0	4.6

The medians are calculated from Winter 2023 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are graduate level with enrollment of 1 to 15 in College of Engineering.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☐ New Course
- ☐ Modification of Existing Course
- ☑ Deletion of Existing Course

Date of Submission: 2024-03-01
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☐	Dept (Home): Civil & Environmental Engin Subject: CEE Catalog: 527	Dept (Home): Subject: Catalog:
☐	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐ Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☐	Course Title (full title) Coastal Hydraulics	Course Title (full title)
☐	Abbreviated Title (20 char) Coastal Hydraulics	Abbreviated Title (20 char)
☐	Course Description (Please limit to 80 words and attach separate sheet if necessary) General description of wave systems including spectral representation; solutions to oscillatory wave equation; wave breaking;harbor resonance; wave shoaling, refraction, and diffraction; wave forecasting; selection of design wave conditions; forces on coastal structures; shoreline erosion processes.	
☐	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: 3 Undergraduate Max: 3 Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☐	Course Credit Type Undergraduate Student and Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Civil & Environmental Engin Catalog: 527

☐	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char) CEE 325 or MECHENG 320	Advisory Prerequisite (254 char)
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☐	Course Components ☐ Lecture ☐ Seminar ☑ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☐ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Radoslaw Michalowski Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Lynn Shock Email: lshock@umich.edu Phone: 734-7644106

CoE Curriculum Committee Representative:	Radoslaw L. Michalowski	Radoslaw L. Michalowski	03/18/2024
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Yafeng Yin	Date: 3/18/2024
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description General description of wave systems including spectral representation; solutions to oscillatory wave equation; wave breaking;harbor resonance; wave shoaling, refraction, and diffraction; wave forecasting; selection of design wave conditions; forces on coastal structures; shoreline erosion processes.	Course Description
Class Length Full term	Class Length
Contact hours (lecture):	Contact hours (lecture):
Contact hours (recitation) 3	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:

Special resources of facilities required for this course:

Supporting statement:
Steven Wright has retired and this course is no longer being taught.

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

Course Approval Request Form

Office of the Registrar, University of Michigan

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission:
Effective Term: Winter 2025

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	**REQUESTED LISTING**
☑	Dept (Home): Subject: Catalog:	Dept (Home): Civil & Environmental Engin Subject: CEE Catalog: 527
☐	☐ Course is Cross-Listed with Other Departments	☐ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
☐		
☑	Course Title (full title)	Course Title (full title) Flood, Tsunami, and Hurricane Hydraulics, Damage, and Countermeasures
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) Flood Tsunami Hurric
☑	Course Description (Please limit to 50 words and attach separate sheet if necessary) Practical concepts for inland and coastal flood risk reduction. Physics of natural hazards, damage prediction, effects of climate change, structural and land use planning methods. Numerical modeling, hydraulic design tools for rainfall, hurricane storm surge and waves, and tsunami hazards. Geotechnical and structural fundamentals of floodwall, breakwater, building damage.	
☑	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: 3 Undergraduate Max: 3 Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Undergraduate Student, Rackham Graduate Student, Non-Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject:	Catalog:

☑	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	**REQUESTED LISTING**
☐	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char)
☑	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) CEE 325 or ME 320 or NAVARCH 320 or CHE 341 or NERS 344 or AEROSP 225 Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☐ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Jeremy Bricker	Cognizant Faculty Member Title: Associate Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Lynn Shock Email: lshock@umich.edu Phone: 734-764-4106

CoE Curriculum Committee Representative:		Radoslaw L. Michalowski	03/20/2024
CoE Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Yafeng Yin	Date: 3/20/2024
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	**Requested:**
Course Description	Course Description Practical concepts for inland and coastal flood risk reduction. Physics of natural hazards, damage prediction, effects of climate change, structural and land use planning methods. Numerical modeling, hydraulic design tools for rainfall, hurricane storm surge and waves, and tsunami hazards. Geotechnical and structural fundamentals of floodwall, breakwater, building damage.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:
This is a design course that applies concepts learned in CEE 211, CEE 212, and CEE 325. This course also introduces students to the field of coastal engineering.

Special resources of facilities required for this course:

Supporting statement
Due to climate change and ensuing sea level rise, coastal cities and their infrastructure, buildings, and residents are subject to an ever increasing risk. This course introduces students to the hazards that coastal and other flood-prone areas can experience, and gives them engineering tools to evaluate these hazards and to design civil infrastructure that is resilient in the face of coastal and inland flood hazards. It is expected that these skills will be in ever-increasing demand as climate change continues.

A unique aspect of this course is that it integrates principles of hydraulic, structural, and geotechnical engineering, all of which are needed for the design of coastal and hydraulic structures such as seawalls. Civil engineering students in the

course have commented that this integration of fundamentals applied to practical design of coastal structures, is a comprehensive way for them to integrate what they learned throughout their undergraduate and graduate courses.

This course has been taught 2 times as CEE 501.062. In Fall 2022, this course had an enrollment of 17 students, and received evaluations of 4.8 for Q1 and 4.63 for Q2. In Fall 2023, the course had an enrollment of 13 students, with an evaluation of 5.0 for Q1 and 4.8 for Q2.

CEE 501.062
FLOOD, TSUNAMI, AND HURRICANE HYDRAULICS, DAMAGE, AND COUNTERMEASURES
Fall 2023

Class Hour: M,W 9am-10:20am **Classroom:** EECS 1012 or via Zoom livestream, passcode FLOOD
Class Website: CEE 501 062 on Canvas

Instructor: Jeremy D. Bricker, PhD, PE
Office Hours: Th 8:30am, via Canvas/Zoom, Passcode FLOOD

Scope and Objectives of Course: The overall objective of this course is to introduce students to practical concepts and tools used for inland and coastal flood risk reduction. This course will be useful for anyone interested in the physical causes of natural hazards, damage prediction and reduction, the effects of climate change on flood risk, and structural and land use planning methods to reduce flood risk. We cover physical principles, modeling methods, and hydraulic design tools for rainfall, hurricane storm surge and waves, and tsunami hazards. The course covers methods to simulate seismic tsunami source, propagation, and runup, as well as hurricane pressure and wind fields, storm surge and wave generation, and resulting inundation. Homework sets and small design projects focus on using analytical, empirical, and numerical methods to predict flood risk and to design hydraulic structures and spatial planning methods to reduce flood risk. We also discuss how climate change is being incorporated into flood risk analyses in practice.

Throughout the course, we will make use of publicly-available hydraulic simulation software using CAEN computers. We will apply HEC-SSP (a tool of the US Army Corps of Engineers) to conduct extreme value analysis, HEC-RAS to simulate a stream flood and design a culvert, Deltares' Delft3D model to simulate tsunami and hurricane storm surge inundation, and SWAN to simulate ocean waves and their impact on a harbor. We will also write a python code from scratch to describe simple tsunami propagation. The course will include tutorial sessions for each of these tools. These modeling tools will help students develop conceptual designs for levees, breakwaters, and seawalls, which must be designed to be structurally stable against the hydraulic forces and scour that they are subject to. Examples will be drawn from hydraulic structures in the US, Japan, and the Netherlands.

Specific objectives are that students are able to:

- Apply simple hydrological methods and extreme value analysis to calculate flood flow in a stream.
- Understand the fundamental theory behind hydrological and hydraulic modeling tools used in the stormwater industry.
- Design a stormwater retention basin to prevent flooding of a city.
- Design a robust culvert to prevent flooding of a road, using the HEC-RAS numerical model.
- Understand the fundamental theory behind shallow-water flood inundation and wave modeling tools used in the river riverine and coastal engineering industry.
- Calculate tsunami, storm surge, and wave heights impacting a coast
- Apply the Delft-3D numerical model to design breakwaters and levees to protect a coastal community from hurricanes and tsunamis.
- Calculate revetment armor unit size needed to stabilize a coast.
- Design breakwaters, seawalls, and levees to withstand extreme events.

- Estimate damages to buildings expected from a hurricane or tsunami.
- Understand how climate change affects flood risk.

Prerequisites: CEE211 (statics and dynamics), CEE325 (fluid mechanics), and differential equations, or equivalent courses, are required. The course will re-teach fundamental materials from CEE212 (solid and structural mechanics) and CEE421 (hydrology and hydraulics), so these are not mandatory prerequisites.

Useful Materials:
Texts (scans of directly relevant pages are in the lecture notes on Canvas):

- CEM (Coastal Engineering Manual), US Army Corps of Engineers. https://www.publications.usace.army.mil/USACE-Publications/Engineer-Manuals/u43544q/636F617374616C20656E67696E656572696E67206D616E75616C/
- HEC-22, Urban Drainage Design Manual, Federal Highway Administration. http://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=22&id=140
- HEC-11, Design of Riprap Revetment, Metric Version, Federal Highway Administration http://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=11&id=26
- HEC-18, Evaluating Scour at Bridges, Federal Highway Administration http://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=17&id=37

Software (these are installed on CAEN computers; you may also be able to install yourself on a PC):

- HEC-SSP, US Army Corps of Engineers https://www.hec.usace.army.mil/software/hec-ssp/download.aspx
- HEC-RAS, US Army Corps of Engineers https://www.hec.usace.army.mil/software/hec-ras/download.aspx
- DELFT 3-D, Deltares https://oss.deltares.nl/web/delft3d
- SWAN, Delft Institute of Technology http://swanmodel.sourceforge.net/

Grading:

Assignment	Points
HW1	5
HW2	11
HW3	8
HW4	11
HW5	11
HW6	10
DP1	11
DP2	11
DP3	11
DP4	11

Problem Sets: Indicate units in all results. Use units specified in the problem. Please present a detailed methodology of how the answer was achieved, including annotated codes or spreadsheets for any computations that require more than several steps. Each problem set must be submitted individually via Gradescope, but groupwork in doing the problem sets is encouraged. In addition to the problem set itself, each student must submit the detail check form that he/she received from his/her randomly assigned detail checker for that assignment.

Detail checking: For each homework problem set, I will randomly assign detail check groups. This is where each student checks another's homework, fills out a detail check form (under the "Files/HWsets" tab on Canvas), and gives it to the detail check partner. Each student should then correct their own homework based on the detail check before submitting the homework to Gradescope together with the detail check form they received from their partner. This Detail Check procedure is used in the industry, and is a formalized way to encourage you and your classmates help each other.

Design Projects: Each design project will be conducted in groups of 2 students, with one report submitted by each group via Gradescope. You may choose your design project partner freely, and this can be the same or different for each design project, as you decide. Please try to find project partners during class, or via Piazza.

Honor Code Policy: You are welcome to discuss the assignments and project ***with other members of the current class***, but you may not discuss them with members of previous classes or make use of solutions prepared in previous semesters. This will be considered a violation of the Honor Code. Assignments will be accepted until 5 p.m. on the day they are due before they are considered late. Assignments should be submitted via Canvas (tab Assignments). If ***emergencies*** arise, please talk to me.

Hybrid Course: Lectures will be held in person, but you may alternately attend via livestream Zoom if you like. **The Zoom password is FLOOD**. Pre-recorded lectures are also available in the Canvas "Media Gallery".

Office Hours: Office hours will be held via zoom. This allows multiple students to attend together, and to learn from each other's' questions and answers. **The Zoom password is FLOOD.** Each time you plan to attend office hours, **please arrive sharp at the start of the session**, as I will close the session when all questions are answered.

Communication: For individual administrative questions, you can email me at jeremydb@umich.edu. For questions related to course content, or for questions that also affect other students, please post your question on Piazza. That way everyone can learn from the response, and you can help each other instead of having to wait for my response (I will post responses on Piazza as well).

University of Michigan
Fall 2023 Instructor Report
CEE 501-062: Special Topics CEE
Jeremy Bricker

12 out of 13 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
This course advanced my understanding of the subject matter. (Q1631)	10	2	0	0	0	0	4.9	4.5	4.5
My interest in the subject has increased because of this course. (Q1632)	9	2	0	1	0	0	4.8	4.2	4.2
I knew what was expected of me in this course.(Q1633)	9	3	0	0	0	0	4.8	4.4	4.5
I had a strong desire to take this course.(Q4)	10	1	0	1	0	0	4.9	4.1	4.0
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	0	2	9	1	0	0	3.1	2.8	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	School/College Median	Univ-Wide Median
Jeremy Bricker seemed well prepared for class meetings.(Q230)	12	0	0	0	0	0	5.0	4.7	4.8
Jeremy Bricker explained material clearly.(Q199)	8	4	0	0	0	0	4.8	4.6	4.7
Jeremy Bricker treated students with respect.(Q217)	12	0	0	0	0	0	5.0	4.8	4.8

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	11	1	0	0	0	0	5.0
I increased my ability to formulate, and solve engineering problems. (Q23)	9	3	0	0	0	0	4.8
I gained a good understanding of concepts/principles in this field. (Q121)	8	4	0	0	0	0	4.8
Work requirements and grading system were clear from the beginning. (Q232)	8	4	0	0	0	0	4.8
Examinations covered the important aspects of the course. (Q356)	4	0	1	0	0	7	4.9
Exams were reasonable in length and difficulty. (Q360)	0	1	1	0	0	10	3.5

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Jeremy Bricker was an excellent teacher. (Q2)	8	3	0	0	0	0	4.8
Jeremy Bricker stressed important points in lectures/discussions. (Q203)	9	3	0	0	0	0	4.8
Jeremy Bricker appeared to have a thorough knowledge of the subject. (Q207)	12	0	0	0	0	0	5.0
Jeremy Bricker acknowledged all questions insofar as possible. (Q216)	12	0	0	0	0	0	5.0
Jeremy Bricker used class time well. (Q229)	10	2	0	0	0	0	4.9

University of Michigan
Fall 2022 Instructor Report
CEE 501-062: Special Topics CEE
Jeremy Bricker

14 out of 17 students responded to this evaluation.

Responses to University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
This course advanced my understanding of the subject matter. (Q1631)	9	5	0	0	0	0	4.7	4.5	4.7
My interest in the subject has increased because of this course. (Q1632)	7	7	0	0	0	0	4.5	4.2	4.5
I knew what was expected of me in this course.(Q1633)	9	5	0	0	0	0	4.7	4.6	4.6
I had a strong desire to take this course.(Q4)	9	5	0	0	0	0	4.7	4.0	4.5
As compared with other courses of equal credit, the workload for this course was (SA=Much Lighter, A=Lighter, N=Typical, D=Heavier, SD=Much Heavier). (Q891)	1	2	10	1	0	0	3.1	3.0	3.0

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	Univ-wide Median	School/College Median
Jeremy Bricker seemed well prepared for class meetings.(Q230)	10	4	0	0	0	0	4.8	4.8	4.8
Jeremy Bricker explained material clearly.(Q199)	6	6	2	0	0	0	4.3	4.7	4.7
Jeremy Bricker treated students with respect.(Q217)	12	2	0	0	0	0	4.9	4.8	4.9

Responses to questions about the course:

	SA	A	N	D	SD	N/A	Your Median
Overall, this was an excellent course. (Q1)	10	4	0	0	0	0	4.8
I increased my ability to formulate, and solve engineering problems. (Q23)	9	5	0	0	0	0	4.7
I gained a good understanding of concepts/principles in this field. (Q121)	9	3	2	0	0	0	4.7
Work requirements and grading system were clear from the beginning. (Q232)	11	2	1	0	0	0	4.9
Examinations covered the important aspects of the course. (Q356)	4	2	0	0	0	8	4.8
Exams were reasonable in length and difficulty. (Q360)	4	0	0	0	0	10	5.0

Responses to questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median
Overall, Jeremy Bricker was an excellent teacher. (Q2)	8	6	0	0	0	0	4.6
Jeremy Bricker stressed important points in lectures/discussions. (Q203)	10	2	1	1	0	0	4.8
Jeremy Bricker appeared to have a thorough knowledge of the subject. (Q207)	12	2	0	0	0	0	4.9
Jeremy Bricker acknowledged all questions insofar as possible. (Q216)	11	3	0	0	0	0	4.9
Jeremy Bricker used class time well. (Q229)	11	3	0	0	0	0	4.9