The University of Michigan
College of Engineering
Curriculum Committee

Agenda
October 25, 2011
1:30-3:00 p.m.

Room 265 Chrysler Center

1. Approval of Minutes From 10-11-2011
2. Course Approval Forms
3. Proposed BSE Degree in Environmental Engineering

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday October 11, 2011
1:30-3:00 p.m.
Room 2210 Lurie Engineering Center
Minutes

Fred Terry called the meeting to order at 1:40 p.m.

Members Present: F. Terry, Y. Bozer, J. Holloway, A. Hunt D. Kieras, E. Larsen, S. Montgomery, T. Olson, J. Pan, T. Perakis, R. Robertson, S. Vozar, F. Ward

Members Absent: L. Bernal, E. Durfee, A. Gallimore

Guests: Kim Hayes, Steve Skerlos, Kathleen Vargo

The minutes of the last meeting (September 27, 2011) were approved

Course Approval Forms

This Course Was Approved:

CHEM 567 (X-Listed with AOSS 567) Modification—Changing Title from: Chemical Kinetics ***to: Chemical Dynamics***

This Course was Tabled:
AEROSP 481 Modification—Changing Prerequisites from: (advised) AE 315, AE 325, required, AE 335 and 348 can be concurrent ***to: (enforced) Preceded by AE 325. Preceded or accompanied by AE 315, AE 335 and AE 348***, Changing contact hours from: 4 ***to: 6***, Changing Level of Credit from: undergrad only ***to: All Credit Types***, Changing Cognizant Faculty Member from: Peretz P. Friedmann ***to: Joaquim Martins***
Joaquim Martins from the Aerospace department asked that this course be tabled so some corrections could be made and then re-submitted to the Committee.

There was also some discussion regarding BME 403 which was cross listed with MEDADM 403. It was decided to remove the BME 403 cross listing with MEDADM 403.

B.S.E. Degree in Environmental Engineering—Informational Item

Information regarding this was included in the meeting packet. Teri Olson introduced this item.
The Proposal for this degree will go before the CEE Faculty Committee for approval on Friday (October 14) and will likely be brought back to this Committee for the next (October 25) meeting with about 8 course approval forms. The majority of the course approvals will be modifications.
There were some questions and some discussion regarding this.
James Holloway asked if they were going for accreditation for this course. This was confirmed that it should be in about two years.

Proposal for Program in Sustainable Engineering—Kim Hayes and Steve Skerlos

Information regarding this proposal was included in the meeting packet.
The Program in Sustainable Engineering is an academic program that allows undergraduate engineering students to take 9- credit hours of courses focused on sustainability to earn the following notation on their transcript:"Program in Sustainable Engineering".
There was some discussion regarding this Proposal. In response to a question from Susan Montgomery it was noted that this will be a new program and not a certificate.
There were some changes suggested to this Proposal.
It was moved and seconded to approve this Proposal with the suggested changes. This was voted on and approved.
This will go to the Faculty and then be added to the Bulletin.

Renaming CUGP to JI-SGUS

Information regarding this was included in the meeting packet.
James Holloway stated that he had talked to Alec Gallimore at Rackham regarding formally renaming the Combined Undergraduate-Graduate Program (CUGP) to Sequential Graduate Undergraduate Study Program (JI-SGUS). If that is approved by this Committee, it will be forwarded to the Rackham Executive board for their approval and then to the University Registrar for execution. All existing programs will also be asked to consistently re-title their materials regarding this program.
Moved and Seconded. This was voted on and approved.

Adjournment: Motion to adjourn was made and seconded

Motion carried (approved)

Next Meeting: October 25, 2011 ROOM 265 Chrysler Center

COURSE APPROVAL FORMS

For October 25, 2011 CoE CC Meeting

ChE 601 Modification—Changing Course to be Repeatable
ME 590 Modification—Changing Course to be Repeatable
NAME 585 New Course

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number: 2247
Date: 9/28/2011
Effective Term: Winter 2012
Course Offer Freq: ☒ Indefinitely ☐ One term only

Action Requested
- ○ New Course
- ◉ Modification of Existing Course
- ○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department: CHE Chemical Engineering	Home Department: CHE Chemical Engineering
Course Number: 601	Course Number: 601
Cross Listed Course Information:	Cross Listed Course Information:
Course Title: Chemical Engineering Seminar	Course Title: Chemical Engineering Seminar
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Chem Eng Seminar	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Chem Eng Seminar
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Chem Eng Seminar	TITLE ABBREVIATION — Transcript Max = 20 Spaces: Chem Eng Seminar
Course Description: This seminar will feature various chemical engineering-related speakers	Course Description for Official Publication (Max = 50 words): This seminar will feature various chemical engineering-related speakers
PROGRAM OUTCOMES: ☐a ☐c ☐e ☐g ☐i ☐k ☐b ☐d ☐f ☐h ☐j	PROGRAM OUTCOMES: ☐a ☐c ☐e ☐g ☐i ☐k ☐b ☐d ☐f ☐h ☐j
Degree Requirements: ○ Degree Requirement ○ Free Elective ◉ Other ○ Core Course ○ Tech Elective	Degree Requirements: ○ Degree Requirement ○ Free Elective ◉ Other ○ Core Course ○ Tech Elective
Prereq: Graduate Standing — ◉ Enforced ○ Advised	Prereq: Graduate Standing — ◉ Enforced ○ Advised
Credit Restrictions:	Credit Restrictions:
Level of Credit: ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R ☒ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types	Level of Credit: ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I ☒ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types
Credit Hours Min 1 Max 1; Contact Hrs/Wk 1; Number of Wks 14	Credit Hours Min 1 Max 1; Contact Hrs/Wk 1; Number of Wks 14

C.

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ◉ Yes ○ No Max Hours? 999 Max Times? 999 Can it be repeated in the same term? ◉ Yes ○ No

Class Type(s): ☐ Lec ☒ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Graded Section: ☐ Lec ☒ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Grading: ☐ A-E ☐ CR/NC ☒ P/F ☒ S/U

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member: Phillip Savaage — Title: Professor/Grad Chair

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Mark Burns, ChE	
Cross-listed Dept(s).		

Form Number

2247

SUPPORTING STATEMENT

Reason for update is the course is being changed to allow students to take it repeatedly. Credits earned do not count toward their degree.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2249
Date 10/13/2011
Effective Term Fall 2011
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
- ○ New Course
- ◉ Modification of Existing Course
- ○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: MECHENG Mechanical Engineering / Course Number: 590
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Study or Research in Selected Mechanical Engineering Topics
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Res Sel ME Topics
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	TITLE ABBREVIATION — Transcript Max = 20 Spaces: Res Sel ME Topics
Course Description	Course Description for Official Publication (Max = 50 words): Individual or group study, design, or laboratory research in a field of interest to the student. Topics may be chosen from any of the areas of mechanical engineering. The student will submit a report on the project at the close of the term. Course grade is reported as "Satisfactory" or "Unsatisfactory"
PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k	PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective
Prereq: ○ Enforced ○ Advised	Prereq: ○ Enforced ◉ Advised — Graduate Standing: Permission before registration of Instructor who will guide the work.
Credit Restrictions	Credit Restrictions
Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work	Level of Credit: ☐ Undergrad only ☒ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work
Credit Hours Min Max:	Credit Hours Min 3 Max 6
Contact Hrs/Wk:	Contact Hrs/Wk: 3-6
Number of Wks:	Number of Wks: 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ◉ Yes ○ No Max Hours? 6 Max Times? 2 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s): ☐ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☐ Lab ☒ Ind

Graded Section: ☐ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☐ Lab ☐ Ind

Grading: ☐ A-E ☐ CR/NC ☐ P/F ☒ S/U

Course Is Y Graded ☐

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Cognizant Faculty Member: Staff — Title

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Mechanical Engineering	
Cross-listed Dept(s).		

Form Number

2249

SUPPORTING STATEMENT

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2248
Date 10/6/2011
Effective Term Winter 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: NAVARCH Naval Arch & Marine Engin / Course Number: 585
☐ Cross Listed Course Information	Cross Listed Course Information
X Course Title	Course Title: Maritime Economics and Management
TITLE ABBREVIATION: Time Sched Max = 19 Spaces / Transcript Max = 20 Spaces	TITLE ABBREVIATION: Time Sched Max = 19 Spaces: Maritime Econ & Mgt; Transcript Max = 20 Spaces: Maritime Econ & Mgt
X Course Description	Course Description for Official Publication (Max = 50 words): Engineering economics review. Evaluating risks, utility theory. Sea transport, global economy. Shipping market organization, supply, demand, freight rates. The four shipping markets. Shipping company economics, costs, financing and risks. International trade and shipping. Barriers to trade. Cartels, OPEC, tankers. Dry bulk, general cargo and containerized shipping. Maritime forecasting.
PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k	PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	Degree Requirements: ○ Degree Requirement ◉ Free Elective ○ Other ○ Core Course ○ Tech Elective
X Prereq ○ Enforced ○ Advised	Prereq None ○ Enforced ○ Advised
X Credit Restrictions	Credit Restrictions: NONE
X Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min ___ Max ___; Contact Hrs/Wk ___; Number of Wks ___	Level of Credit: ☐ Undergrad only ☒ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min 3 Max 3; Contact Hrs/Wk 3; Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? ___ Max Times? ___ Can it be repeated in the same term? ○ Yes ○ No

C.

X **Class Type(s)**: ☒ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Graded Section: ☒ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member: A.N. Perakis — Title: Assoc Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Naval Arch & Marine Engin	
Cross-listed Dept(s).		

Form Number

2248

SUPPORTING STATEMENT

The course aims to acquaint the student with the fundamentals of shipping market economics, shipping costs and finance, the principles of maritime trade, (liquid bulk, dry bulk, general and containerized cargoes, and specialized cargoes), the ship designs needed for each trade, the economics of ship building and scrapping, the regulation of the maritime industry, and the challenges of maritime forecasting.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

NA 585(3), Winter 2012
Maritime Economics and Management

Objectives: The course aims to acquaint the student with the fundamentals of shipping market economics, shipping costs and finance, the principles of maritime trade, (liquid bulk, dry bulk, general and containerized cargoes, and specialized cargoes), the ship designs needed for each trade, the economics of ship building and scrapping, the regulation of the Maritime industry, and the challenges of maritime forecasting.

Brief Description: Structural analysis of industries case study, and application in the operations of marine and intermodal systems. Review of engineering economics. Management attitudes toward risk, utility theory. Sea transport and the global economy. Organization of shipping markets. Shipping market economics, supply, demand and freight rates. The four shipping markets. Shipping company economics, costs, financing and risks. Elements of international trade and shipping. Tariffs, quotas and other barriers to trade. Cartels, OPEC and tanker shipping. Dry bulk shipping. General cargo and Containerized shipping, Liner shipping and Conferences. Rate formation in Conference shipping. Specialized cargoes. Regulation of the maritime industry, US and world maritime policy. Maritime Forecasting, applications to shipping and shipbuilding decisions, and its shortcomings. Case Studies as appropriate.

Course Syllabus , No. of 1 hour Lectures

1.	Introduction, Mechanics, the marine industry (overview), eng. economics	2
2.	Structural analysis of industries, (case study), application in marine field	2
3.	Management attitudes toward risk, utility theory	5
3.	Sea transport and the global economy	2
4.	Shipping market economics, supply, demand and freight rates.	3
5.	The four shipping markets	2
6.	Shipping company economics, costs, financing and risks.	4
7.	Elements of international trade and shipping	2
8.	International Trade theory, supply-demand, tariffs, quotas, other barriers	3
9.	Cartels; OPEC and tanker Shipping; Cynia Oil co. Case Study	4
10.	Liner shipping; Conferences, Rate formation in Conference Shipping	4
11.	Freight rates; Worldscale; Marine Insurance; UNCTAD/IMO	3
12.	A rational, 8-step Marine forecasting procedure; problems, case studies	4
	Midterm Exam	2
	Final Exam	2
	Total	44

Required Textbooks:"Maritime Economics", by Martin Stopford, Third Edition, Routeledge, excellent for reference purposes also.

Recommended textbook: "The Handbook of Maritime Economics and Business", edited by C.Th. Grammenos, Lloyd's list, 2nd Edition. Of particular interest is Chapter 21, "Fleet Operations Optimization and Fleet Deployment" by A.N. Perakis

Additional Material will be posted at the NA585 ctools site and/or will be distributed in class.

Office Hours: TBA

Homeworks: Six problem-solving homeworks planned. Several Reading assignments as well. Additional case studies with applications will be discussed.

Exams: (tentative) Two exams planned, one two-hour midterm and one final.

Grades:		
	Homeworks	20%
	Exam 1	30%
	Exam 2 (Final)	40%
	Class Discussion Participation, Case Studies	10%

For more information: Contact Professor A.N. Perakis, Rm. 213, NA&ME; Phone: 764-3723; Or e-mail: tassos@engin.umich.edu .

UNIVERSITY OF MICHIGAN
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
UNIVERSITY OF MICHIGAN
2350 Hayward ♦ 2340 G.G. Brown Building ♦ Ann Arbor, Michigan 48109-2125
734-764-8495 ♦ FAX: 734-764-4292

October 18, 2011

To: CoE Curriculum Committee
From: Terese Olson, CEE Curriculum Committee Chair
Re: Proposed BSE Degree in Environmental Engineering

The Civil and Environmental Engineering Department proposes to establish an ABET accredited BSE degree in Environmental Engineering. The attached proposal details the motivation, resources available, implementation plan, CoE Bulletin text, and ABET program outcomes. It is the goal of the Department to seek accreditation of the degree after producing the first graduating class in the major.

In order to constitute the new curriculum, changes to the following courses are required:
CEE 270, CEE 365, CEE 366, CEE 465, CEE 481, CEE 482, CEE 528, CEE 428, and CEE 560.
and the necessary course approval forms are included in the package.

The CEE faculty voted to approve the structure of the new degree and the related course approval forms at its October 14, 2011 faculty meeting.

Proposed B.S.E. Degree in Environmental Engineering

Motivation. The Department of Civil and Environmental Engineering (CEE) proposes to offer an ABET-accredited BSE degree in Environmental Engineering. The Department has a long-standing top ranking in the discipline and has for many years offered environmental engineering as a focus area within its Civil Engineering major. In the past, students interested in environmental engineering were well advised to earn a degree in civil engineering, given the structure of the job market for environmental engineers. However, the field has matured considerably and the employment options and employer criteria are more diverse today. Students interested in environmental engineering are less willing to select an educational path through Civil Engineering, because of the emphasis of that degree on construction, structures, and materials. The proposed degree will provide students interested in environmental engineering the opportunity to focus their coursework more deeply in the necessary science, such as chemistry and biology.

Faculty. The Civil and Environmental Engineering Department has 12 core faculty in its Environmental and Water Resources Engineering (EWRE) group, as well as six affiliated faculty with joint appointments in other academic departments to support the degree program.

Facilities. The facilities available for student research and instruction include the state-of-the-art CEE laboratories in the G.G. Brown (hydrology, hydraulics, and geo-environmental labs), EWRE (environmental chemistry, microbiology, computational fluid mechanics labs), and EPB (air, water, and soil quality, chemistry and microbiology labs) buildings.

Implementation. To implement the proposed curriculum, changes to several CEE courses are planned: CEE 270, CEE 365, CEE 366, CEE 465, CEE 481, CEE 482, CEE 528, CEE 428, and CEE 560. Course approval forms for these courses are attached. .

It is proposed that students be allowed to declare the major starting in Fall 2012. The minimum GPA to declare would correspond to the College-wide standard, 2.0. Recommended minimum GPA requirements for external and cross-campus transfer students will match those of the Civil Engineering major (3.2 and 2.5, respectively). Accreditation for the degree would be sought upon producing its first graduating class. It is anticipated that this would be no later than Fall 2014.

CoE Bulletin text:

Environmental Engineering

Environmental engineering is the branch of engineering that addresses the impact of human activities on the environment and the maintenance of the environment so as to promote human and ecological health. Environmental engineering grew out of sanitary engineering whose focus was the provision of clean drinking water and the proper disposal of wastewater. Environmental engineers are still involved in the design of treatment schemes to take raw water and turn it into a healthful drink, and the design of treatment schemes to take wastewater from homes and industries and clean it to the point that it may be disposed of in rivers and lakes. But-today, an environmental engineer is involved in much more. Environmental engineers see the environment as a resource to be protected and sustainably managed for the health of humans as well as for the health of the planet itself. For example, environmental engineers may be involved in the monitoring and mitigation of contaminants that result in global warming; the reduction of emissions from manufacturing and power plants; the recovery of resources and energy from waste streams; the design of alternative energy sources; the clean-up of hazardous waste sites; the restoration of streams and lakes damaged by human activities; the manipulation of microbial characteristics for the degradation of pollutants; and the allocation of water to provide both a water supply and a minimum stream flow to support recreational activities. In this major, students acquire a strong science foundation in math, chemistry, physics, and biology, and then apply this foundation to engineer solutions to the environmental problems confronting society.

Mission

To provide an outstanding education in environmental engineering that prepares students for leadership positions in the improvement of human and ecological health at the intersection of built and natural systems.

Goals

To provide an enriching educational environment that prepares students with the environmental science and engineering design principles to develop sustainable solutions to environmental problems and the professional skills to become leaders in the discipline.

Objectives

The following objectives describe what our graduates are expected to achieve within several years of graduation.

- The graduates of the Environmental Engineering Program at Michigan will have the necessary intellectual tools and technical skills to take on careers of leadership in the development of new technologies for environmental protection and the design of sustainable modern environmental infrastructure, analysis of natural and engineered environmental systems, and to contribute to society through participation in policy making and governance. Graduates will have a solid foundation in environmental engineering and achieve success in graduate education and a broad range of career opportunities.
- Our graduates will become team leaders and have the critical thinking skills to successfully address open-ended problems.

- U-M Environmental Engineering graduates will become effective communicators of technical and professional information in written, oral, visual, and graphical form.
- Professional careers of U-M graduates will be distinguished with a high degree of awareness of moral, ethical, legal and professional obligations to protect human health, human welfare, and the environment.

Outcomes

The outcomes we desire are that graduates of the program demonstrate:

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, and to critically analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function on multidisciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global/societal context;
- A recognition of the need for and an ability to engage in life-long learning
- A knowledge of contemporary issues;
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- A proficiency in more than one environmental focus area;
- An understanding of professional practice issues related to environmental engineering.

Sample Schedule

B.S.E. (Environmental Engineering)

SAMPLE SCHEDULE

B.S.E. Degree in Environmental Engineering									
		SEMESTER							
		F1	**W1**	**F2**	**W2**	**F3**	**W3**	**F4**	**W4**
	Credits								
SUBJECTS REQUIRED BY ALL PROGRAMS (55 Hrs)									
MATH 115, 116, 215, 216	16	4	4	4	4				
ENGR 100	4	4							
ENGR 101	4		4						
CHEM 130 and CHEM 125/126	5	5							
PHYS 140/141 and PHYS 240/242	10		5		5				
Intellectual Breadth (to include 3-4 cr hrs in micro or macroeconomics)	16	4	4				4	4	
ADVANCED MATHEMATICS (7 Hrs)									
CEE 270 Statistical Methods for Data Analysis and Uncertainty Modeling	3					3			
CEE 303 Computational Methods	4						4		
TECHNICAL CORE SUBJECTS (32 Hrs)									
CEE 200 Professional Practice in Civil and Environmental Engineering	1				1				
CHEM 210 Organic Chemistry	4			4					
CEE 230 Energy and Environment (Thermodynamics)	3			3					
CEE 211 Statics and Dynamics	4			4					
CEE 265 Sustainable Engineering Principles	3				3				
CEE 325 Fluid Mechanics	4				4				
CEE 365 Environmental Engineering Principles	4					4			
CEE 366 Environmental Engineering Laboratory	2					2			
CEE 421 Hydrology and Floodplain Hydraulics	4							4	
CEE 465 Environmental Engineering Processes	3						3		
ENVIRONMENTAL SCIENCES (9 Hrs)									
Earth Science Elective: AOSS 320 or AOSS 410 or AOSS 475 or GEOSCI 427 or GEOSCI 442	3					3			
CEE 482 Environmental Microbiology	3							3	
CEE 481 Aquatic Chemistry	3						3		
ENVIRONMENTAL ENGINEERING DESIGN (4 Hrs)									
CEE 402 Professional Issues and Design	4								4
TECHNICAL ELECTIVES (9 Hrs) Take three courses from following list, two must be CEE courses.									
Water Quality and Health: CEE 528, CEE 560, CHE 342, EHS 500								3	
Earth Systems: CEE 549, AOSS 467, GEOSCI 513									
Environmental Fluid Dynamics: CEE 521, CEE 526, CEE 528									3
Energy and Sustainable Infrastructure: CEE 567, UP 423, GEOSCI 344									3
Environmental Policy and Entrepreneurship: ENGR 520, NRE 475, AOSS 480									
GENERAL ELECTIVES (12 Hrs)									
GENERAL ELECTIVES	12					4		2	6
B.S.E. TOTAL	**128**	17	17	15	17	16	14	16	16

ATTACHMENT 1.

Earth Science Electives:

AOSS 320. (GEOSCI 320) Earth System Evolution

Prerequisite: MATH 116. I (4 credits)

Introduction to the physics and chemistry of Earth. Gravitational energy, radiative energy, Earth's energy budget, and Earth tectonics are discussed along with chemical evolution and biogeochemical cycles. The connections among the carbon cycle, silicate weathering, and the natural greenhouse effect are discussed. Required for AOSS/GS-321, which introduces Earth system dynamics.

AOSS 410. Earth System Modeling

Prerequisite: none, I (4 credits)

Introduction to Earth System Modeling; discussion of energy balance models, carbon cycle models, and atmospheric chemistry models with multiple time scales; methods for numerical solution and practice building and analyzing results from models.

AOSS 475. (ENSCEN 475) (GEO SCI 475) Earth System Interactions

Prerequisite: Senior standing in science or engineering. II (4 credits)

Students will work on open-ended research problems with mathematical models from Earth System Science. The models may include, for example, surface characteristics, hydrology, solar-land-ocean-atmosphere exchanges, and space-based observations. Numerical experiments will promote further understanding and interpretation of earth system interactions, team building, and scientific communication.

GEOSCI 427. Environmental and Technological Applications of Mineralogy

Advisory prerequisite: GEOSCI 231/232, comparable course in solid state or permission of instructor (3 credits)

This course will introduce basic principles in mineralogy and materials science with their application to environmental and technological problems. Topics will include phase transitions, corrosion and alteration, trace element behavior, colloids and surfaces. Materials discussed will include clays, soils, cement, zeolites, and actinide/toxic metal phases.

GEOSCI 442. (ENVIRON 442) Earth Surface and Soils

Advisory prerequisite: MATH 115, CHEM 130. I (4 credits)

Study of processes resulting in landforms on the Earth's surface and the formation of soils on these landforms. Emphasis includes present day processes as well as the evolution of landforms over geologic time. Several required field trips will examine landforms and processes in southern Michigan.

ATTACHMENT 2.

Technical Electives

Water Quality and Health:

CEE 528 Groundwater Hydrology (3 cr, I)
Prereq: CEE 325 and CEE 365

CEE 560 Design of Environmental Engineering Systems (3 cr, I)
Prereq: CEE 465

CHE 342 Mass and Heat Transfer (4 cr, I)
Prereq: CHE 230, CHE 341, and Math 216

EHS 500 Principles of Environmental Health Sciences (3 cr, I)
Prereq: none

Earth Systems:

CEE 549 Geoenvironmental Engineering (3 cr, I odd years)
Prereq: CEE 345 or equivalent

AOSS 467 Biogeochemical Cycles (3 cr, II)
Prereq: Math 116, Chem 210, Physics 240

GEOSCI 513 Geomicrobiology (3 cr, I odd yrs)
Prereq: none

Environmental Fluid Dynamics:

CEE 521 Flow in Open Channels (3 cr, I even yrs)
Prereq: CEE 421

CEE 526 Design of Hydraulic Systems (3 cr, II)
Prereq: CEE 325 or equivalent

CEE 528 Groundwater Hydrology (3 cr, I)
Prereq: CEE 325 and CEE 365

Energy and Sustainable Infrastructure

CEE 567 Energy Infrastructure Systems (3 cr, II)
Prereq: Senior standing

UP 423 Introduction to Urban and Environmental Planning (3 cr, I)
Prereq: none

GEOSCI 344 Sustainable and Fossil Energy: Options and Consequences (3 cr, IIIb)
Prereq: Acceptance by the Graham Environmental Sustainability Institute

Environmental Policy and Entrepreneurship:

ENGR 520	Entrepreneurial Business Fundamentals for Engineers and Scientists (3 cr, II) *Prereq: Senior or graduate standing*
NRE 475	Environmental Law (3 cr, II) *Prereq: none*
AOSS 480	Climate Change: Move to Action (3 cr, II) *Prereq: Senior or graduate standing, Math 216*

Attachment 3. Mapping of Program Outcomes into the Environmental Engineering Curriculum

	Core Courses													
Program Outcomes	**Enr 100**	**Engr 101**	**Math 115**	**Math 116**	**Math 215**	**Math 216**	**Phys 140**	**Phys 141**	**Phys 240**	**Phys 241**	**Chem 125/6**	**Chem 130**	**Chem 210**	**Chem 211**
a. an ability to apply knowledge of mathematics, science and engineering	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*
b. an ability to design and conduct experiments, as well as analyze and interpret data	*X*		*X*	*X*	*X*	*X*		*XX*		*XX*	*XX*			*XX*
c. an ability to design a system, component, or process to meet desired needs	*X*	*XX*												
d. an ability to function on multidisciplinary teams	*XX*		*XX*	*XX*	*XX*	*XX*		*XX*		*XX*	*XX*			*XX*
e. an ability to identify, formulate and solve engineering problems	*XX*	*X*												
f. an understanding of professional and ethical responsibility	*XX*													
g. an ability to communicate effectively	*XX*							*X*		*X*	*X*		*X*	
h. the broad education necessary to understand the impact of engineering solutions in a global/societal context	*X*													
i. a recognition of the need for and an ability to engage in life-long learning	*X*													
j. a knowledge of contemporary issues	*X*													
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	*X*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*X*	*XX*	*XX*	*X*
l. a proficiency in more than one environmental engineering focus area														
m. an understanding of professional practice issues in environmental engineering														

XX: strong relationship (significant focus in this area)

X: weak relationship (minimal focus in this area)

Program Outcome Mapping (cont)

	CEE Courses													
Program Outcomes	**200**	**211**	**230**	**265**	**270**	**303**	**325**	**365**	**366**	**402**	**421**	**465**	**481**	**482**
a. an ability to apply knowledge of mathematics, science and engineering		*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*
b. an ability to design and conduct experiments, as well as analyze and interpret data					*XX*	*X*	*XX*		*XX*		*X*	*X*		*X*
c. an ability to design a system, component, or process to meet desired needs			*X*	*X*	*X*	*XX*		*X*		*XX*	*X*	*X*	*XX*	*X*
d. an ability to function on multidisciplinary teams							*X*		*X*	*XX*	*X*	*X*		
e. an ability to identify, formulate and solve engineering problems		*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*	*X*
f. an understanding of professional and ethical responsibility	*X*							*X*		*XX*				*X*
g. an ability to communicate effectively	*X*	*X*				*X*	*XX*		*XX*	*XX*		*X*	*X*	*X*
h. the broad education necessary to understand the impact of engineering solutions in a global/societal context				*XX*				*XX*		*XX*	*X*		*X*	*X*
i. a recognition of the need for and an ability to engage in life-long learning	*X*					*X*				*X*	*X*	*X*	*X*	*X*
j. a knowledge of contemporary issues	*X*			*X*		*X*		*X*			*X*	*X*	*X*	*X*
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice		*X*	*X*	*X*	*X*	*XX*	*XX*	*X*	*X*	*X*	*X*	*XX*	*XX*	*X*
l. a proficiency in more than one environmental engineering focus area								*X*	*X*	*XX*	*XX*	*XX*	*X*	*X*
m. an understanding of professional practice issues in environmental engineering	*XX*							*X*		*XX*				

XX: strong relationship (significant focus in this area)
X: weak relationship (minimal focus in this area)

Program Outcome Mapping (cont)

	CEE Courses					
Program Outcomes	**521**	**526**	**528**	**549**	**560**	**567**
a. an ability to apply knowledge of mathematics, science and engineering	*X*	*X*	*XX*	*XX*	*XX*	*XX*
b. an ability to design and conduct experiments, as well as analyze and interpret data			*X*			
c. an ability to design a system, component, or process to meet desired needs	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*
d. an ability to function on multidisciplinary teams		*X*	*XX*	*X*		
e. an ability to identify, formulate and solve engineering problems	*XX*	*XX*	*XX*	*XX*	*XX*	*XX*
f. an understanding of professional and ethical responsibility					*X*	
g. an ability to communicate effectively		*X*	*X*	*X*	*X*	
h. the broad education necessary to understand the impact of engineering solutions in a global/societal context			*X*	*X*	*X*	*X*
i. a recognition of the need for and an ability to engage in life-long learning			*X*	*X*	*X*	*X*
j. a knowledge of contemporary issues	*X*	*X*	*X*	*X*	*X*	*X*
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	*X*	*XX*	*XX*	*X*	*XX*	*X*
l. a proficiency in more than one environmental engineering focus area	*XX*	*X*	*X*		*XX*	
m. an understanding of professional practice issues in environmental engineering		*X*	*X*		*X*	

XX: strong relationship (significant focus in this area)

X: weak relationship (minimal focus in this area)

October 7, 2011

Summary of Proposed Course Changes:

CEE 270:	Reduce from 4 to 3 cr. hr. Drop the laboratory section, reducing contact hours to 3 hr/wk. Slight modification to description.
CEE 365:	Replace laboratory with discussion section; reduce contact hours from 6 to 4/wk. Slight modification to description.
CEE 366:	New 2 cr-laboratory course with technical communications content.
CEE 465:	Technically a new 3 cr course, but is actually primarily the material in CEE 360.
CEE 481:	Renumbered from 500 to 400 course number; cross-listing renumbered; correction in prerequisite listing; revised contact hour range depending on undergraduate or graduate level standing
CEE 482:	Renumbered from 500 to 400 course number; slight modification to course description; revised contact hour range depending on undergraduate or graduate level standing.
CEE 528:	Technically is a modification of existing course, but is actually the material in CEE 428. (in effect to renumber to 500 level)
CEE 428:	Deletion of course (see CEE 528 changes).
CEE 560:	Renumbered from 400 to 500 course number. Prerequisite change to reflect new numbering.

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2234
Date 9/19/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	
	Transcript Max = 20 Spaces	

Course Description
Introductory probability and statistics with emphasis on data analysis and uncertainty modeling for engineering and environmental systems. Descriptive statistics, graphical representation of data, linear regression, correlation, discrete and continuous probability distributions, conditional probability, estimation, statistical inference, hypothesis testing, sampling design, load factors, extreme events, reliability analysis. Lecture, recitation and computation.

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 4 Max 4
Contact Hrs/Wk 6
Number of Wks 14

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin | Course Number: 270

Cross Listed Course Information

Course Title: Statistical Methods for Data Analysis and Uncertainty Modeling

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	Statistical Methods
	Transcript Max = 20 Spaces	Statistical Methods

Course Description for Official Publication (Max = 50 words)
Introductory probability and statistics with emphasis on data analysis and uncertainty modeling for engineering and environmental systems. Descriptive statistics, graphical representation of data, linear regression, correlation, discrete and continuous probability distributions, conditional probability, estimation, statistical inference, extreme events, reliability analysis, and techniques for design under uncertainty.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☐ g ☐ i ☒ k ☒ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq Math 116 and Engr 101
○ Enforced
◉ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 3
Number of Wks 14

C.

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☐ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member: Jeffrey Scruggs | Title: Assistant Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2234

SUPPORTING STATEMENT

CEE 270 is a degree requirement in both the Civil Engineering and proposed Environmental Engineering BS degrees. The computational laboratory sessions in the course will, however, no longer be included in the course and the number of contact hours per week will therefore be reduced from 4 to 3. The reduction in credit hours will allow the degrees to achieve or nearly achieve the College's goal of 12 credit hours in the general elective category.

Course will also be re-tooled to focus more heavily on design under uncertainty and less heavily on data analysis.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2238
Date 9/19/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department: | Course Number:

Cross Listed Course Information:

X Course Title: Environmental Engineering Principles

TITLE ABBREVIATION		
	Time Sched Max = 19 Spaces	Env Engr Prin
	Transcript Max = 20 Spaces	Env Engr Prin

X Course Description:
An introduction to mass balance modeling of contaminant fate and transport in the environment; commonly used reactor configurations for water and air quality control; pollutant types, sources; government legislation and regulation, exposure pathways, and health risks of priority pollutants; local, regional and global contemporary issues. Lecture and laboratory.

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

X **Level of Credit**
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 4 Max 4
Contact Hrs/Wk 6
Number of Wks 14

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin | Course Number: 365

Cross Listed Course Information:

Course Title: Environmental Engineering Principles

TITLE ABBREVIATION		
	Time Sched Max = 19 Spaces	Env Engr Principles
	Transcript Max = 20 Spaces	Env Engr Principles

Course Description for Official Publication (Max = 50 words)
An introduction to mass balance modeling of contaminant fate, transport and removal in the environment; commonly used reactor configurations for water and air quality control; partitioning of contaminants among environmental media; contaminant types and sources; regional and global contemporary environmental issues.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☐ g ☐ i ☒ k ☐ b ☐ d ☒ f ☒ h ☒ j

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq Chem 130 and Math 116
○ Enforced
◉ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 4 Max 4
Contact Hrs/Wk 4
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 4 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☒ Lec ☐ Sem ☒ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Graded Section
☐ Lec ☐ Sem ☒ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Avery H. Demond | Title: Associate Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2238

SUPPORTING STATEMENT

The lab for this class is being removed, and a discussion section is being added. As part of the reorganization of the CEE curriculum to allow for the introduction of a BS in Environmental Engineering degree, a new separate lab class (CEE 366) will be introduced. Also there is some modification of the content in that the mass balance, mass partitioning, and mass transport portions are being amplified.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 365 ENVIRONMENTAL ENGINEERING PRINCIPLES (4 credits)

Prerequisites: Chem 130, Math 116

Scope and Objectives of Course: The deteriorating quality of our environment is a concern more and more engineers are being called on to confront. Consequently, environmental basics are important for the training of all engineers. The course covers the basic principles underlying the physical and chemical processes which control the concentration of contaminants in water, air and soil. The overall objective of this course is to teach the student about health impacts and regulations governing typical contaminants, and to make basic calculations as to the fate and transport of contaminants in the environment and their removal from water, air and soil. After this course, the student should be able to:

1) work with the basic units of concentration, mass loading and flux,
2) given the exposure pathway, compute the acceptable level of exposure for a particular chemical,
3) given the rate of reaction and the flowrate, compute the size of reactor needed to accomplish a particular removal efficiency or compute contaminant concentrations in lakes and rivers,
4) given the characteristics of a chemical, compute the concentrations in various media based on the chemical's partitioning behavior,
5) understand how the characteristics of a chemical are utilized to design remediation technologies,
6) understand how issues other than technological soundness influence approaches to environmental quality.

Text: Masters, G.M., and W. Ela, 2008, *Introduction to Environmental Engineering and Science*, Prentice-Hall.

Grading: Homework: 11, total worth: 20%
Midterms: 3, total worth: 60%
Final: 20%

CEE 365 ENVIRONMENTAL ENGINEERING PRINCIPLES

	CLASS TOPIC
Week 1	
1)	Introduction
2)	Causes of environmental problems
3)	Environmental regulation
4)	Standard formation
Week 2	
5)	Units: Concentration
6)	Units: Flow rate, flux
7)	Open and closed systems Conservation of mass: Conservative pollutants Steady state
8)	Conservation of mass: Residence time
Week 3	
9)	Conservation of mass: Nonsteady state
10)	Basic rules for mass balances
11)	Conservation of mass: Nonconservative pollutants Types of reactions
12)	Conservation of mass: Nonsteady state Nonconservative pollutants
Week 4	
13)	Batch and PFR reactors
14)	Comparison of reactor types
15)	Conservation of mass: Summary and review
16)	Hazardous wastes
Week 5	
17)	Volatile organic contaminants MSDS Equilibrium partitioning between liquid and air: Vapor pressure

18)	Review for MT #1
19)	MT #1
20)	Partitioning between organic liquid and water: Solubility
Week 6	
21)	Partitioning of organic solute between water and air: Henry's Law
22)	Partitioning including solids: Isotherms
23)	Protection from hazardous organic liquids
24)	Remediation of organic liquid contamination by partitioning: Air and steam stripping; carbon adsorption
Week 7	
25)	Nonhazardous organics ThOD, BOD
26)	DO and Streeter-Phelps Equation
27)	Applications of Streeter-Phelps
28)	DO in aerated lagoons
Week 8	
29)	Metals: Precipitation-dissolution
30)	Remediation of metal contamination
31)	Heavy metal contamination
32)	Nonhazardous solids
Week 9	
33)	Removal of solids: Sedimentation Stokes' Law Sizing a reactor for sedimentation
34)	Review for MT #2
35)	MT #2
36)	Removal of solids: Filtration Coagulation/flocculation
Week 10	

37)	Pathogens Indicator organisms Destruction of pathogens
38)	Water treatment
39)	Wastewater treatment
40)	Transport phenomena Diffusion
Week 11	
41)	Advection Darcy's Law
42)	Dispersion Contaminant transport in groundwater
43)	Impact of partitioning and biodegradation
44)	Remediation of contaminated groundwater
Week 12	
45)	Groundwater contamination in the Woburn watershed
46)	A Civil Action
47)	Air pollution: NAAQS Criteria pollutants
48)	Gaussian Plume Model
Week 13	
49)	Maximum concentrations
50)	Use of Gaussian Plume Model to determine emissions
51)	Removal of particles from air flows
52)	Engineered control of gaseous emissions
Week 14	
53)	Global warming
54)	Review for MT #3
55)	MT #3

FINAL: Covers entire semester.

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2235
Date 9/19/2011
Effective Term Winter 2013
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: CEE Civil & Environmental Engin / Course Number: 366
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Environmental Engineering Laboratory
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: / Transcript Max = 20 Spaces:	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Env Engr Lab / Transcript Max = 20 Spaces: Env Engr Lab
Course Description	Course Description for Official Publication (Max = 50 words): Weekly lecture and experimental projects designed to illustrate key analytical measurements of water and air quality parameters, soil properties, and environmental process engineering. Emphasis on data analysis, report writing, oral presentations, experimental design, and teamwork.
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	PROGRAM OUTCOMES: ☒ a ☐ c ☒ e ☒ g ☐ i ☒ k ☒ b ☒ d ☐ f ☐ h ☐ j
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	Degree Requirements: ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective
Prereq: ○ Enforced ○ Advised	Prereq: Prior or concurrent enrollment in CEE 270 and CEE 365 ○ Enforced ◉ Advised
Credit Restrictions	Credit Restrictions
Level of Credit: ☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad ☐ Rackham Grad ☐ All Credit types ☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work ☐ Ugrad or Rckhm Grad; Credit Hours Min ___ Max ___; Contact Hrs/Wk ___; Number of Wks ___	Level of Credit: ☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad ☐ Rackham Grad ☐ All Credit types ☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work ☐ Ugrad or Rckhm Grad; Credit Hours Min 2 Max 2; Contact Hrs/Wk 4; Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 2 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s): ☒ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☒ Lab ☐ Ind

Graded Section: ☐ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☒ Lab ☐ Ind

Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member: Terese M. Olson — Title: Associate Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2235

SUPPORTING STATEMENT

This laboratory will be required of students earning a BS in Environmental Engineering. It will support the topical material covered in CEE 365, which is also required of BS EnE students. Experimental laboratory exercises in the areas of water and air quality, soil properties, and environmental engineering process principles will be conducted either in groups or as experimental demonstrations. An emphasis on effective written and oral technical communications will be included. ABET criteria for the BS EnE degree requires 'an ability to conduct laboratory experiments and to critically analyze and interpret data in more than one major environmental engineering focus area, e.g., air, water, land, environmental health'. This course will satisfy the ABET criteria in part through its focus on air, water, and soil properties, as well as microbial health parameters and disinfection technologies.

Students will conduct weekly laboratory experiments and meet weekly for one-hour lectures or discussions. Twelve 3-hour laboratory exercises will be distributed in four areas as follows: air quality testing experiments (e.g. scrubber/Henry's law, particulate matter analysis), water quality tests (e.g., alkalinity, biochemical oxygen demand, chromatography measurements), soil property tests (e.g., grain size distribution, sedimentation rate, permeability measurements), environmental engineering process/field tests (e.g., reactor hydraulics, field air monitoring, disinfection processes, adsorption) . Coverage will include important analytical techniques such as electrode methods, titrations, gravimetric methods, spectrophotometry, chromatography, and microbial assays. Lab groups will be structured to ensure that different team member roles (team leader, quality assurance, etc.) rotate among the group members. Lecture and discussion periods will focus on technical written and oral communication skills, lab safety, statistical data analysis principles, and lab content.

Are any special resources or facilities required for this course? ☒ Yes ☐ No

Detail the Special requirements

The laboratory will be held primarily in space used previously in CEE 360 (EPB Rms 113 and 115). CEE 360 will no longer be offered after Winter 2012. This lab facility can accommodate up to 20 students with approximately 5 stations and is currently outfitted for wet laboratory experiments. Some additional equipment for the process, air quality, and field laboratories will be required. Acquisition of the equipment will be included on the Department's shortlist of priorities.

Course Topical Outline and Schedule:

Week	Laboratory	Lecture
1	Overview and lab safety	Written technical communications
2	Soil Property Lab 1 Grain size distribution analysis	Data analysis principles
3	Soil Property Lab 2 Sedimentation rates and gravimetric analyses	Written technical communications
4	Soil Property Lab 3 Soil permeability and soil types	Written technical communications feedback session
5	Water Quality Lab 4 pH, titrations and alkalinity measurements	Alkalinity problem solving
6,7	Water Quality Lab 5 Biochemical oxygen demand (BOD) determinations (2-wk)	BOD calculations (Week 6) BOD application problems (Week 7)
8	Water Quality Lab 6 Chromatography demonstration	Method detection limits
9	Air Quality Lab 7 Henrys law and air scrubbing	Oral technical communications
10	Air Quality Lab 8 Particulate measurements	Oral technical communications
11	Environmental Process Lab 9. Reactor hydraulic testing /spectrophotometry	Data analysis principles
12	Environmental Process Lab 10 UV Disinfection processes	Most Probable No (MPN) calculations Chicks Law problem solving
13	Environmental Process Lab 11 Sorption processes	Oral presentations and feedback session
14	Field Measurement Lab 12 Air (roof-top) monitoring	Oral presentations and feedback session

Reference Material:

Handouts for each lab exercise.

Grading:

Grades for the course will be based on the following weight distribution:

Laboratory Reports &
Written Technical Communication: 65%
Oral Communication: 15%

Data Analysis Problems: 10%

Quizzes: 10%

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2236
Date 9/19/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

TITLE ABBREVIATION	Time Sched Max = 19 Spaces	
	Transcript Max = 20 Spaces	

Course Description

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min ___ Max ___
Contact Hrs/Wk ___
Number of Wks ___

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 465

Cross Listed Course Information

Course Title: Environmental Process Engineering

TITLE ABBREVIATION	Time Sched Max = 19 Spaces	Env Process Engr
	Transcript Max = 20 Spaces	Env Process Engr

Course Description for Official Publication (Max = 50 words)

An introduction to the analysis, characterization and principles of physical, chemical and biological processes, operations and reactor configurations commonly used for water quality control; preliminary design of specific water and wastewater treatment processes and operations; discussion of economic and legislative constraints and requirements.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☒ g ☐ i ☒ k ☒ b ☐ d ☐ f ☐ h ☒ j

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq CEE 325 and CEE 365
○ Enforced
◉ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 3
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Nancy G. Love
Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2236

SUPPORTING STATEMENT

In concert with the renumbering process associated with the undergraduate environmental engineering courses within CEE, the lecture content of CEE 360 is being moved to CEE 465. The move will allow us to retain the elements of our curriculum that deal with the design of water quality control processes. Civil engineering undergraduates will be able to take CEE 465 as a technical elective. Students pursuing the proposed environmental engineering undergraduate degree will be required to take this course.

The course introduces students to the principles of water quality process control from the standpoint of physical and chemical operations, and biological processes. The students will then be guided on how to apply these principles, given regulatory (environmental) and economic constraints, to preliminary design outcomes where reactor sizing and chemical dosing levels are determined. The detailed topics to be covered in the course are provided on the attached syllabus.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

Course Outline
CEE 465
Environmental Process Engineering

Course Outcomes

Students who complete this course will meet the following course outcomes:

1. Apply mathematical, scientific and engineering principles to water quality process control systems
2. Analyze and interpret information and data associated with water quality process control systems
3. Design drinking water and wastewater process control systems
4. Formulate open ended information into a solvable problem applied to water quality process control systems.
5. Establish effective practices in communicating design decisions through written and computer-based engineering calculations
6. Discuss and evaluate current case histories in water quality process control systems

Required Textbook: Mackenzie L. Davis. 2011. *Water and Wastewater Engineering. Design Principles and Practice*, McGraw-Hill, New York, NY.

Course Content and Distribution

Topic	**# Lectures (40 total)**
Regulatory Frameworks	2
Economic frameworks	1
Case studies	2
Drinking Water Treatment Principles and Design:	
Water Demand and Availability	2
Chemical principles applied to treatment	1
Rapid mixing, coagulation, flocculation	3
Hardness removal – softening	2
Sedimentation	2
Filtration (granular and membrane)	3
Disinfection	2
Residuals management	1
Wastewater Treatment Principles and Design:	
Wastewater collection	1
Preliminary treatment	1
Primary treatment	2
Microbiological principles applied to treatment	1
Secondary treatment – suspended growth	3
Secondary treatment – attached growth or hybrid systems	2
Solids separation (gravity and membrane)	2
Disinfection	2
Residuals management	3
Exams	2

Grading: Grades will be based on homeworks (approximately 10 total for 35% of grade), exams (2 total for 60% of grade) and class participation (5% of grade).

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2240
Date 9/22/2011
Effective Term Winter 2013
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department: CEE Civil & Environmental Engin — Course Number: 581	Home Department: CEE Civil & Environmental Engin — Course Number: 481
[X] Cross Listed Course Information: GEOSCI Geological Sciences — 581	Cross Listed Course Information: EARTH Earth & Environmental Sciences — 481
[ ] Course Title:	Course Title: Aquatic Chemistry
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: ; Transcript Max = 20 Spaces:	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Aquatic Chemistry ; Transcript Max = 20 Spaces: Aquatic Chemistry
[ ] Course Description:	Course Description for Official Publication (Max = 50 words): Chemical principles applicable to the analysis of the chemical composition of natural waters and engineered water treatment systems; covers acid-base, precipitation-dissolution, complexation, and oxidation-reduction reactions; emphasis on graphical, analytical, and computer-speciation methods; presented in the context of contemporary environmental issues including water quality, climate change, and pollution prevention and abatement.
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☒ g ☒ i ☒ k ☒ b ☒ d ☐ f ☒ h ☒ j
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective	Degree Requirements: ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective
Prereq: Chem 125 or equivalent. [X] ○ Enforced ◉ Advised	Prereq: Chem 130 or equivalent. ○ Enforced ◉ Advised
[ ] Credit Restrictions:	Credit Restrictions:
[X] Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☐ Rckhm Grad w/add'l Work — Credit Hours Min 3 Max 3 — Contact Hrs/Wk 4 — Number of Wks 14	Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☒ Rckhm Grad w/add'l Work — Credit Hours Min 3 Max 3 — Contact Hrs/Wk 3-4 — Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s): ☒ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☒ Lab ☐ Ind

Graded Section: ☒ Lec ☐ Sem ☐ Dis ☐ Other ☐ Rec ☐ Lab ☐ Ind

Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member:	Title
Kim F. Hayes, CEE	Interim Chair & Prof.
Joel Blum, EARTH	Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	
	Earth & Environmental Sci	Peter Eveleth

PETER E. VAN KEKEN, 10/19/2011
ASSOCIATE CHAIR FOR CURRICULUM

Form Number

2240

SUPPORTING STATEMENT

The course will become a required environmental science course in the new BS Environmental Engineering major. It is requested that the course be renumbered to a 400 level to reflect its status as a required undergraduate course. Civil Engineering majors may still elect the course as a technical elective. For undergraduates, the meeting pattern will include 3 hours of lecture per week. Graduate students who take the course will register for a section that meets for an additional 1 hour of lab per week. Hence the contact hours will now be 3-4 hours per week.

The course was cross-listed as 500-level course in Geoscience (GeoSci 581) and for consistency, the crosslisting is also requested to reflect a 400 level as Earth 481.

An error in the prerequisite coursework listing should be corrected to say Chem 130 or equivalent. (The current requirement is incorrectly listed as a laboratory course, Chem 125.)

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 481
AQUATIC CHEMISTRY
Winter Term

Instructor: Professor Kim F. Hayes, EWRE 181 (ford@umich.edu)
Office Hours: MW 10:30 - 11:30 PM (or by appointment)

Lectures: MWF 9:30 -10:30 AM (EWRE 185)

Computer Laboratory: F: 2:00 - 4:00 PM (Media Union) - Required for graduate student credit

Required Text: Principles and Applications of Aquatic Chemistry, Francois M.M. Morel and Janet G. Hering, John Wiley and Sons, NY, 1993.

***Supplemental Reading**: Water Chemistry, M. M. Benjamin, McGraw-Hill Companies, Inc., NY, 2002.

Aquatic Chemistry Concepts, James F. Pankow Lewis Publishers, Inc., Michigan, 1991.

Aquatic Chemistry, W. Stumm and J. Morgan 3rd Ed., John Wiley and Sons, NY, 1996.

Course Notes Pack (CNP)-Handouts.

*** On reserve in Engineering Library in Media Union**

Grading: The course grade will be based on homework and three exams, and for graduate students - a computer project. A five percent per day penalty will be assessed for late homework or computer assignments. Homework not turned in by 5 PM on the day it is due will be considered late.

Undergraduate (no lab):

Homework	20%
Exam I	20%
Exam II	20%
Final Exam	40%

Graduate (w/computer lab):

Computer Term Project	15%
Homework	20%
Exam I	20%
Exam II	20%
Final Exam	25%

Homework and Computer Assignments: You may work with other class members for the purpose of solving the homework and computer problems. Each person, however, is responsible for generating their own solutions for grading.

Honor Code: Only materials explicitly provided for this class by the instructor or the teaching assistant may be used for solving the computer or homework problems or studying for exams. Any access to unauthorized material will be considered a violation of the honor code. You are not allowed to possess, look at, use, or in anyway derive advantage from the existence of solutions prepared in prior years, whether these solutions were former students' work or copies of solutions that had been made available by me. Violation of this policy is grounds for me to initiate an action that would be filed with the Dean's office and would come before the College of Engineering's Honor Council. If you have any questions about this policy, please do not hesitate to contact me.

Course Description:

This course provides an introduction to the principles of aquatic chemistry and reactions applicable to the analysis of the chemical composition of natural and engineered water treatment systems. Four principal chemical reaction classes are covered: (1) acid-base, (2) precipitation-dissolution, (3) complexation, and (4) oxidation-reduction reactions. Emphasis is placed on developing problem solving skills and includes the use of graphical, analytical (e.g., the Tableaux method), and computer solution (MINEQL+) techniques. Problems are selected from a host of environmentally relevant systems including water treatment, groundwater remediation, and fate of pollutants in natural aquatic systems.

CEE 481 AQUATIC CHEMISTRY

Week	Date	Topic	Reading MH	Reading B	Reading CNP
1	Jan. 5	Organizational Meeting Course Overview	1-8	1-19	**7-20**
	Jan. 7	Chemical Equilibrium	40-56	35-40	**21-31**
2	Jan. 10	Chemical Equilibrium Standard Free Energies	45-56	104-110	**31-39**
	Jan. 12	Reference/Standard States Effects of Temperature/Pressure	82-87	19-34 119-122	**39-44**
HW#1	Jan. 14	Reference/Standard States Activity Corrections	70-82	28-34	**46-56**
3	Jan. 17	Martin Luther King, Jr. Day No Class			
	Jan. 19	Water-Aqueous Species Electrolytes, Acids, Bases		131-144 144-146	**58-90**
HW#2	Jan. 21	Chemical Equilibrium Calcs. Components and Tableaux	**9-31** **56-63**	169-182 203-236 294-308	**112-113**
4	Jan. 24	Chemical Equilibrium Calcs. Strong Acid/Base Systems	56-63	170-172	**114-115**
	Jan. 26	Chemical Equilibrium Calcs. Weak Acid/Base Systems	**56-63**	172-177	**116-117**
HW#3	Jan. 28	Chemical Equilibrium Calcs. Diprotic Acid/Base Systems	**56-63**	181-185	**118-123**
5	Jan. 31	Chemical Equilibrium Calcs. Diprotic Acid/Base Systems	**56-63**	181-185	**118-123**
	Feb. 2	Chemical Equilibrium Calcs. Acid Mixtures/Principal Components	**56-63**	218-229	**124-127**
HW#4	Feb. 4	Chemical Equilibrium Calcs. Graphical Methods	**63-70**	188-202 154-161	**102-106** **128-129**

Week	Date	Topic	Reading MH	Reading B	Reading CNP
6	Feb. 7	Chemical Equilibrium Calcs. Graphical Methods-Ion. Frac.	**178-181**	150-154	**107-111** **130-134**
	Feb. 9	Chemical Equilibrium Calcs. Graphical Methods-Open Systems	**182-185**	322-358	**135-137**
	Feb. 11	Chemical Equilibrium Calcs. Equivalence Points/Titrations	**157-174**	237-287	**138-140** **149-152**
7	Feb. 14	Diprotic Acids/Titrations and Recipes	**157-174**	249-261	**141-145**
	Feb. 16	Review	EXAM I (7-9PM)		
	Feb. 18	Titrations and Alkalinity Definitions	**157-191**	260-276	**146-148**
8	Feb. 21	Alkalinity Calculations Mixture of Two Waters	**191-195**	264-273	
	Feb. 23	Alkalinity Calculations C_T, Alk, pH or P_{CO2}, alk, pH	**191-195**	264-273	
HW#5	Feb. 25	Alkalinity Calculations Alk/charged PCs at CO_2 eq. pt.	**164-166**	264-273	**149**
9	Mar. 7	Buffer Capacity	**210-218**	276-286	**150-155**
	Mar 9	Buffer Calculations Minor Species Theroem	**212-218**	276-286	**156-158**
	Mar. 9	Complexation Metal Ion Hydrolysis	**319-358**	362-370	**150**
HW#6	Mar. 11	Complexation Inorganic Ligands	**319-358**	370-381	**163-170**
10	Mar. 14	Complexation Inorganic Ligands	**319-358**	370-381	**140-144**
	Mar. 16	Complexation Inorganic Ligands	**319-358**	370-381	**140-144**
HW#7	Mar. 18	Complexation Organic Ligands (Inorganic ligand in excess)	**358-375**		**145-148**

Week	Date	Topic	Reading MH	B	CNP
11	Mar. 21	Heterogeneous Equilibria Introduction	**236-254**	394-399 430-431	
	Mar. 23	Heterogeneous Equilibria pC-pH Solubility Diagrams	**249-252**	399-403 411-413	**171-172**
HW#8	Mar. 25	Heterogeneous Equilibria Open System, Critical pH	**254-261**	230-264	**177-184**
12	Mar. 28	Heterogeneous Equilibria Closed System, Critical pH Carbonate Solids and Alk	**254-261**	409-411 417-420	**185-194**
	Mar. 30	Heterogeneous Equilibria Solids Coexistence, ARD	**261-276**	404-409 421-430	**195-207**
	Apr. 1	Oxidation/Reduction Concept of pe	**421-434**	316-338	**208-209**
13	Apr. 4	Natural pe controls	**434-451** **CN**	501-511	**210**
	Apr. 6	Review	EXAM II (7-9PM)		
HW#9	Apr. 8	pe Controls ARD	**434-451**		**211-213**
14	Apr. 11	Case Study (Cr wastewater-wetlands)	Handouts		**214**
	Apr. 13	Case Study (Cr wastewater-wetlands)	Handouts		**214**
	Apr. 15	(Term Project Due) (Course Wrap Up)			
15	Apr. 18	TBA			
16	Apr. 27	Final Exam (10:30 PM - 12:30 PM)			

Reading Key:
MH: Morel and Hering (required reading)
B: Benjamin (supplemental reading)
CNP: Course Notes Pack

Bold print indicates primary reading source for lecture material

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2241
Date 9/22/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 582

X Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION — Time Sched Max = 19 Spaces:
Transcript Max = 20 Spaces:

X Course Description:
Discussion of basic microbial metabolic processes, thermodynamics of growth and energy generation, and genetic and metabolic diversity. Emphasis is placed on the application of these concepts of biogeochemical cycling, subsurface microbiology, wastewater microbiology, pollutant degradation, and microbial ecology.

PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

X **Level of Credit**
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☒ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 5
Number of Wks 14

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 482

Cross Listed Course Information:

Course Title: Environmental Microbiology

TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Env Microbiology
Transcript Max = 20 Spaces: Env Microbiology

Course Description for Official Publication (Max = 50 words)
Introductions to microbial metabolic processes and nutrition, thermodynamics of growth and energy generation, genetic and metabolic diversity, evolution and systematics, and microbial ecology. Emphasis is placed on the application of these concepts to environmental biotechnology, including microbial treatment of water and wastewater, bioenergy production, and pollutant degradation.

PROGRAM OUTCOMES: ☒ a ☒ b ☒ c ☒ d ☒ e ☒ f ☐ g ☒ h ☒ i ☒ j ☐ k

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq Chem 130.
○ Enforced
◉ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☒ All Credit types
☐ Non-Rckhm Grad ☒ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 3-5
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other
☐ Rec ☒ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Lutgarde Raskin
Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2241

SUPPORTING STATEMENT

The course will become a required environmental science course in the new BS Environmental Engineering major. It is requested that the course be renumbered to a 400 level to reflect its status as a required undergraduate course. Civil Engineering majors may still elect the course as a technical elective. For undergraduates, the meeting pattern will include 3 hours of lecture per week. Graduate students who take the course will register for a lab section that meets 7 times during the semester.

The course description, which has not been updated for 10 years, was modified to more accurately describe the topics that are currently emphasized in the course.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 482 – ENVIRONMENTAL MICROBIOLOGY
FALL 2012

2315 GG Brown – Tue. Thu. 1 – 2:30 PM

SYLLABUS

Instructor. Lutgarde Raskin
107 EWRE Bldg.
phone: 734-647-6920; e-mail: raskin@umich.edu

GSI.
9 EWRE
e-mail: @umich.edu

Office hours.
You should feel free to discuss course related, other academic, or personal questions with your instructor in person or by e-mail. Feel free to stop by without an appointment, or e-mail me to set up a time to meet.

Course prerequisites. Chem 130 or consent of instructor. For CEE undergraduate students, CEE 265 and CEE 365 are prerequisites.

Course purpose.
To gain a thorough understanding of the fundamentals of microbiology, and to be able to integrate these principles in the context of important natural and engineered environmental systems.

Required Text. M. T. Madigan and J. M. Martinko, P. V. Dunlap, D. P. Clark (2009), Brock Biology of Microorganisms, 12th Edition, Pearson Education Inc., San Francisco, CA.

In addition to the textbook, handouts and papers will be used as reading assignments or study materials. They will be provided during the semester and posted on the CEE 582 CTools site.

Companion Website: www.microbiologyplace.com

QUIZZES

I will give a short (5 min) quiz at the beginning of most **Tuesday** lectures to encourage you to keep up with reading assignments and to study on a regular basis. These quizzes will be 'closed-book' and will be graded (10% of course grade). The quiz with your lowest grade (or for which you were absent) will be dropped (only one grade will be dropped). Permission for a make-up quiz needs to be obtained *before* the quiz (send e-mail message with reason of absence). *Without this permission, it will not be possible to take the quiz after class* .

The submission of another person's intellectual effort on a quiz represents a violation of the Honor Code and will be taken up with the College of Engineering's Honor Council. The participation in such an activity, even if you are submitting your own work, is also a violation of the Honor Code.

HOMEWORK

Homework sets will be assigned to allow you to study material in more depth than possible in the quizzes. This may include material that has not been covered in depth in class, but requires reading of journal papers or our textbook. You are encouraged to use references other than the assigned reading material. When using information from these references in your homework please make sure to reference the original source (you can consult Wikipedia, but please find the original reference as well). Also, don't forget to reference the assigned readings appropriately, including our textbook.

It is your choice to work and submit your homework as an individual or as part of a team. If you choose to work in teams, select one or more people from your lab team to work on the homework assignment and hand in one team solution (homework solution needs to clearly list names of all participants as well as a signature to certify participation by each member on all problems).

Homework format.

1. Each submitted homework solution must include a cover page (ctools site) listing the name(s) and signature(s) of the participants who worked together on the solution. Your signature on the cover page certifies that you actively participated in the solution of *all* the problems in the homework set.
2. Use 8.5"x11" paper with straight edges, *not* paper torn from a spiral notebook.
3. Number all pages (e.g. 1/5, 2/5, etc.).
4. Use only one side of each page.
5. Begin each problem on a new page.
6. Box the final answers.
7. Staple all pages together.
8. Write and draw neatly and legibly!
9. For writing assignments, your answers should be typed (use 1.5 line spacing and 1" margins). Writing assignments are primarily evaluated for content, but writing effectiveness is also important (e.g., organization, style, grammar, punctuation, spelling, and neatness).
10. You are encouraged to use references other than the assigned reading material. When using information from these references in your homework, make sure to reference the original source using an appropriate reference format (e.g., check instructions for authors of research journals in our field, such as *Water Research* http://www.iwaponline.com/wr/i2a.htm or *Applied and Environmental Microbiology*, http://aem.asm.org/misc/ifora.shtml).

Late homework. Homework will be due one-two weeks after it is assigned and will be posted on CTools. Completed assignments should be turned in *at the beginning of class on the due date*. If it is your job to turn in the homework and if you are late, so is the homework. If the homework cannot be turned in at the beginning of class on the due date, permission from the instructor to change the due date is necessary. *Without this permission, the homework will not be graded.*

LABORATORY

The laboratory is required for graduate students taking the course.

Purpose. The purpose of the laboratory sessions is to communicate microbiological techniques and skills through hands-on experience and demonstrations. The laboratory exercises are designed to complement the material covered in class and require review of reading assignments or occasionally require additional reading.

Teams. Your instructor will designate the teams, but you can provide input on your preferences.

Time. Mo. 1:30-3:30 PM or Mo. 4-6 PM, Room 114 EPB (Engineering Programs Building).

Requirements.

1. Attendance and participation is mandatory for all labs.
2. Prepare for lab by reading assigned sections in textbook and completing the pre-lab assignment.
3. Laboratory report needs to be prepared after each lab (detailed instruction will be provided in the Lab syllabus).
4. Wear closed-toe shoes to the lab.
5. Wear laboratory coats, goggles, and gloves when asked by GSI.

EXAMS

All exams will be 'closed-book' exams. Permission for a make-up exam needs to be obtained *before* the exam.

The submission of another person's intellectual effort on an exam represents a violation of the Honor Code and will be taken up with the College of Engineering's Honor Council. The participation in such an activity, even if you are submitting your own work, is also a violation of the Honor Code.

GRADING

Calculation of course grade. A weighted average grade will be calculated as follows:

Graduate students		Undergraduate students	
Quizzes:	10 %	Quizzes:	10 %
Homework:	15 %	Homework:	20 %
Laboratory:	20 %		
Exam 1:	15 %	Exam 1:	20 %
Exam 2:	15 %	Exam 2:	20 %
Final Exam:	25 %	Final Exam:	30 %

Re-grade. If you believe an error has been made in quiz, homework, lab report, or exam grading, bring it to the instructor's attention in writing first, then discuss it during office hours or after making an appointment.

Note: I do not curve grades in this course. It is possible for everyone in the class to get an A. Your performance depends only on how well you do, not on how everyone else in the class does. It is therefore in your best interests to help each other, learn from each other, and work together as long as you are in accordance with the College of Engineering Honor Code.

PROFESSIONAL ORGANIZATIONS AND JOURNALS

American Society for Microbiology (ASM) (www.asm.org)
Publishes a monthly news magazine *Microbe*. Also publishes a series of high-quality journals, including *Applied and Environmental Microbiology*.

International Society for Microbial Ecology (ISME) (www.microbes.org)
ISME and the Nature Publishing Group (NPG) publish a high impact journal, *The ISME Journal*.

Society for Applied Microbiology (SfAM) (www.sfam.org.uk)
Publishes a high quality journal, *Environmental Microbiology*.

Federation of European Microbiological Societies (FEMS) (www.fems-microbiology.org)
Publishes a series of journals, including *FEMS Microbiology Ecology*.

The journal *Microbial Ecology* is published by Springer (http://www.environmental-expert.com/magazine/springer/)

TENTATIVE COURSE OUTLINE

Date	Topic	Reading Assignment	Quiz/HW		Tentative Date Lab	Topic	Reading Assignment
T. Sept. 7	Introduction	Sections 1.1-1.5 and 1.10 Sections 2.5-2.11					
Th. Sept. 9 T. Sept. 14	Macromolecules	Sections 3.1-3.4 Sections 3.5-3.8	 Quiz 1		Lab 1: M. Sept. 13	Microscopy	Sections 2.1-2.4, 6.9
Th. Sept. 16 T. Sept. 21 Th. Sept. 23	Cell Biology **NO CLASS**	Sections 4.1-4.6, Sections 4.7, 4.9, 4.10, 4.12, 4.13, 4.15	HW1 Quiz 2		Lab 2: M. Sept. 20 - LR 1 due	Gram staining	Sections 2.2, 4.6-4.7
T. Sept. 28 Th. Sept. 30 T. Oct. 5	Nutrition and Metabolism	Sections 5.1-5.6 Sections 5.7-5.10 Sections 5.11-5.14	Quiz 3 HW1 due, HW 2 Quiz 4		Lab 3: M. Oct. 4- LR 2 due	Culturing bacteria	Sections 5.1-5.3, 6.10, 22.2
Th. Oct. 7 T. Oct. 12 Th. Oct. 14 T. Oct. 19 Th. Oct. 21 T. Oct. 26	Microbial Growth – Cellular and Molecular **EXAM 1** **Fall Study Break**	Sections 6.1, 6.5-6.18 Sections 7.1-7.8 Sections 7.9-7.12 Sections 7.13-7.15	HW2 due No quiz Quiz 5		Lab 4: M. Oct. 11 - LR 3 due LR 4 due	Microbial Growth	Sections 6.5-6.7, 6.11
Th. Oct. 28 T. Nov. 2	Molecular methods and genetic engineering	Sections 12.1-12.8, 12-10, and 22.1-22.5	HW3 Quiz 6		Lab 5: M. Nov. 1 Lab 6: M. Nov. 8 - LR 5 due	Restriction digestion and electrophoresis PCR	Section 12.1 Section 12.8
Th. Nov. 4 T. Nov. 9 Th. Nov. 11	Microbial Evolution and Systematics **NO CLASS**	Sections 14.5-14.14	 HW3 due		 Lab 7: M. Nov. 15 - LR 6 due	 Phylogenetic analyses	 Sections 14.6-14.8, 14.12-14.13
T. Nov. 16	Microbial genomics	Sections 13.1-13.3, 13.6-13.8, 13.13-13.14; 22.6					
Th. Nov. 18	Symposium "Medical Ecology: A new paradigm" Palmer Commons						
T. Nov. 23 Th. Nov. 25 T. Nov. 30 Th. Dec. 2 T. Dec. 7 Th. Dec. 9	**EXAM 2** **Thanksgiving–No class** Bacterial and Archaeal Diversity	 Chapters 15, 16, 17, 20, 21, 23, 24	HW4 Quiz 7 HW4 due		LR 7 due		
T. Dec. 14	**Study Day – No class**						
W., Dec. 15, 4:00-6:00	**Final Exam**						

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2239
Date 9/22/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: CEE Civil & Environmental Engin / Course Number: 528
☐ Cross Listed Course Information	Cross Listed Course Information: ENSCEN Environmental Sciences & Engin 528
☒ Course Title: Flow and Transport in Porous Media	Course Title: Groundwater Hydrology
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Por. Med Fl & Trans; Transcript Max = 20 Spaces: Por Med Flow	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Groundwater Hydrol; Transcript Max = 20 Spaces: Groundwater Hydrol
☒ Course Description: Basic principles governing flow and transport in porous media; development of mathematical models at pore and continuum levels; single and multiphase flow; solute transport and dispersion theory; parameter estimation; application to saturated and unsaturated groundwater flow, flow in fractured media, petroleum reservoirs, saltwater intrusion and miscible and immiscible subsurface contamination.	Course Description for Official Publication (Max = 50 words): Basic principles which govern the flow of water in the subsurface. Development and solution of groundwater flow and contaminant transport equations, in presence and absence of pumping wells, for both confined and phreatic aquifers. Measurement and estimation of parameters governing flow and transport. Use of computer software for the simulation of flow.
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	**PROGRAM OUTCOMES:** ☒ a ☒ c ☒ e ☐ g ☐ i ☒ k ☒ b ☐ d ☐ f ☒ h ☒ j
Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	**Degree Requirements** ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective
Prereq CEE 428 or equivalent. ☒ ◉ Enforced ○ Advised	Prereq CEE 365 and CEE 325 or equivalent. ○ Enforced ◉ Advised
☐ Credit Restrictions	Credit Restrictions
☐ **Level of Credit**: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min ___ Max ___; Contact Hrs/Wk ___; Number of Wks ___	**Level of Credit**: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min 3 Max 3; Contact Hrs/Wk 5; Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

☒ **Class Type(s)**: ☒ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☒ Lab ☐ Ind

Graded Section: ☐ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☒ Lab ☐ Ind

Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Course Is Y Graded ☐

Cognizant Faculty Member: Avery H. Demond — Title: Associate Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2239

SUPPORTING STATEMENT

The changes are requested to reflect the reorganization of the Civil Engineering undergraduate curriculum for the introduction of a BSE in Environmental Engineering.

The proposed course is currently being taught as CEE 428. Its enrollment consists of seniors (tech elective) and lower-level graduate students specializing in hydraulics, environmental engineering, and geotechnical engineering. It will continue to serve the same audience.

This material is being moved to CEE 528, and CEE 428 will be deleted.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 528 GROUNDWATER HYDROLOGY
Fall 2011

Class Hour: TTh 9:30-11:00 **Classroom:** 136 EWRE
Lab: M or T 4:00-6:00, Windows Training Room 2, Duderstadt Center
Instructor: Dr. Avery H. Demond
120 EWRE Bldg.
Email: averyd@umich.edu
Office Hours: TWTh 11:00-12:00 p.m.
Class Website: ctools.umich.edu

Prerequisites: CEE 325 and CEE 365 or equivalent.

Scope and Objectives of Course: The overall objective of this course is to learn the basic principles of saturated groundwater flow. The course will emphasize flow in confined and unconfined aquifers, pump test design and analysis, and the transport of contaminants in saturated groundwater flow. Material covered in class will emphasize analytic solutions, whereas the material covered in lab will emphasize the use of commercial software and numerical simulation.

Text:
Fetter, C.W., *Applied Hydrogeology*, 4th ed., Prentice Hall, Upper Saddle River, NJ. Available in the bookstore, from the publisher or from Amazon.com.

Grading:

Homework (both problem sets and labs)	25%
Exams 2 @ 25% each (there is no final)	50%
Project	25%

There are both individual and group assignments in this class. You are welcome to discuss the assignments and project *with other members of the current class*, but you may not discuss the assignments or the project 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 4:00 p.m. on the day they are due before they are considered late. If emergencies arise, please come and talk to me about extensions. Assignments should be deposited in the homework basket marked CEE 428 in Room 179. Written work will be returned in class about one week after the due date. Solutions to problems sets will be put on the class ctools site.

Class Outline: See assignment sheet.

CEE 528 GROUNDWATER HYDROLOGY
Fall 2011

Assignments for September
T: text; PS: problem set; Lab: laboratory.

DATE	CLASS TOPIC	READING ASSIGNMENT	LABORATORY ASSIGNMENT OR PROBLEM SET FOR THE FOLLOWING WEEK
1) Tues., Sept. 6	Introduction	T: 1-18; 93-99	
2) Thurs., Sept. 8	Groundwater environment	T: 69-78; 93-98; 283-322 (skim); Glacial Lakes of MI Glacial Landforms	Lab #1: Mapping (Lab Sept. 12, 13; due Sept. 15, 16)
3) Tues., Sept. 13	Hydrologic cycle	T: 24-60; 442-449	
4) Thurs., Sept. 15	Darcy's Law	T: 66-69; 81-93; 113-125	Lab #2: Water budget (Lab Sept. 19, 20; due Sept. 22, 23)
5) Tues., Sept. 20	Generalization to multiple dimensions	T: 104-106; Heterogeneity and Anisotropy	
6) Thurs., Sept. 22	Aquifer properties	T: 78-81; 100-104	PS #1: Darcy's Law (due Sept. 29, 30) (No lab Sept. 26, 27)
7) Tues., Sept. 27	Confined aquifers	T: 125-128; 138-139	
8) Thurs., Sept. 29	Unconfined aquifers	T: 129; 140-146	Lab #3: Hydrologic mapping (Lab Oct. 3, 4; due Oct. 6, 7)

CEE 528 GROUNDWATER HYDROLOGY
Fall 2011

Assignments for October
T: text; PS: problem set; Lab: laboratory.

DATE	CLASS TOPIC	READING ASSIGNMENT	LABORATORY OR PROBLEM SET FOR THE FOLLOWING WEEK
9) Tues., Oct. 4	Flow nets	T: 129-138; Flownets	
10) Thurs., Oct. 6	Analytic solutions	Analytic Solutions of 1D Steady Flows	PS #2: Confined and unconfined aquifers (due Oct. 13, 14) (No lab Oct. 10, 11)
11) Tues. Oct. 11	Numerical modeling	T: 514-530	
12) Thurs., Oct. 13	Review		Lab #4: Intro to MODFLOW (Lab Oct. 24, 25; due Oct. 27, 28)
Mon-Tues., Oct. 17-18	Fall Break		No lab Oct. 17, 18, no class Oct. 18
13) Thurs., Oct. 20	Midterm Exam #1		Covers Lectures 1-10, PS #1-2; Labs #1-3
14) Tues., Oct. 25	Wells and steady radial flow	T: 166-169	
15) Thurs., Oct. 27	Non-steady radial flow	T: 150-166	Lab #5: Project conceptualization (Lab Oct. 31, Nov. 1; due Nov. 3, 4)

CEE 528 GROUNDWATER HYDROLOGY
Fall 2011

Assignments for November
T: text; PS: problem set; Lab: laboratory.

DATE	CLASS TOPIC	READING ASSIGNMENT	LABORATORY OR PROBLEM SET FOR THE FOLLOWING WEEK
16) Tues., Nov. 1	Superposition	T: 207-209; Handout	
17) Thurs., Nov. 3	Pump tests: confined aquifers	T: 166-177; 210-213	PS #3: Radial flow (due Nov. 10, 11) (No lab Nov. 7, 8)
18) Tues., Nov. 8	Pump tests: other situations	T: 177-188	
19) Thurs., Nov. 10	Slug tests	T: 190-205	Lab #6: Application of MODFLOW (Lab Nov. 14, 15; due Nov. 17, 18)
20) Tues., Nov. 15	Composition of groundwater	T: 373-381	
21) Thurs., Nov. 17	Contaminant properties	T: 415-426	PS #4: Pump tests (due Dec. 1, 2) (No lab Nov. 21, 22)
22) Tues., Nov. 22	Transport processes	T: 400-415	Lab #7: Project check (Lab Nov. 28, 29; nothing written due)
Thurs., Nov. 24	Thanksgiving	Be thankful!	
23) Tues., Nov. 29	Mass balance eqns. for contaminant transport		

CEE 528 GROUNDWATER HYDROLOGY
Fall 2011

Assignments for December
T: text; PS: problem set; Lab: laboratory.

DATE	CLASS TOPIC	READING ASSIGNMENT	LABORATORY OR PROBLEM SET FOR THE FOLLOWING WEEK
24) Thurs., Dec. 1	Analytic solutions	Analytical Solutions of the AD Eqn.	PS #5: Transport processes (due Dec. 8, 9) (No lab Dec. 5, 6)
25) Tues., Dec. 6	Capture zones and pump and treat	T: 426-439; Capture Zones	
26) Thurs., Dec. 8	Alternative methods for groundwater remediation		
Weds., Dec. 14, 5:00 p.m.	Projects due		No lab Dec. 12, 13
Thurs., Dec. 22	Midterm Exam #2 10:30-12:30, 136 EWRE		Covers Lectures 11-26, PS #3-5; Labs #4-6

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2246
Date 9/23/2011
Effective Term Fall 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
○ Modification of Existing Course
◉ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 428

Cross Listed Course Information: ENSCEN Environmental Sciences & Engin 428

Course Title: Introduction to Groundwater Hydrology

TITLE ABBREVIATION		
	Time Sched Max = 19 Spaces	Intro Ground Water
	Transcript Max = 20 Spaces	Intro Ground Water

Course Description:
Basic principles which govern the flow of water in the subsurface. Development and solution of groundwater flow and contaminant transport equations, in presence and absence of pumping wells, for both confined and phreatic aquifers. Measurement and estimation of parameters governing flow and transport, including methods such as pump tests and moment analysis. Remediation of contaminated groundwater.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☐ g ☐ i ☒ k ☒ b ☐ d ☐ f ☒ h ☒ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective

Prereq: CEE 325 and CEE 365 or equivalent.
○ Enforced
◉ Advised

Credit Restrictions:

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☒ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 5
Number of Wks 14

B. REQUESTED LISTING

Home Department:
Course Number:

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION		
	Time Sched Max = 19 Spaces	
	Transcript Max = 20 Spaces	

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq:
○ Enforced
○ Advised

Credit Restrictions:

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min ___ Max ___
Contact Hrs/Wk ___
Number of Wks ___

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ○ No Max Hours? ___ Max Times? ___ Can it be repeated in the same term? ○ Yes ○ No

C.

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☒ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Avery H. Demond
Title: Associate Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	
	Environmental Sciences & Engin	

Form Number

2246

SUPPORTING STATEMENT

The material covered in CEE 428 will be moved to CEE 528.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2237
Date 9/19/2011
Effective Term Winter 2013
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
○ New Course
◉ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 460

X Cross Listed Course Information:

X Course Title:

TITLE ABBRE-VIATION		
	Time Sched Max = 19 Spaces	Des Env Engr
	Transcript Max = 20 Spaces	Des Env Engr

Course Description:

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq CEE 360
X ○ Enforced ◉ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min ___ Max ___
Contact Hrs/Wk ___
Number of Wks ___

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 560

Cross Listed Course Information:

Course Title: Design of Environmental Engineering Systems

TITLE ABBRE-VIATION		
	Time Sched Max = 19 Spaces	Des Env Engr Sys
	Transcript Max = 20 Spaces	Des Env Engr Sys

Course Description for Official Publication (Max = 50 words)
Design and theoretical understanding of environmental processes; biological, physical, and chemical processes, and reactor configurations commonly used for water quality control; applications to the design of specific water and wastewater treatment operations; discussion of pollution prevention and green engineering options.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☒ g ☐ i ☒ k ☒ b ☒ d ☐ f ☒ h ☒ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective

Prereq CEE 465
○ Enforced ◉ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☒ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 3
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U
Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Terese M. Olson
Title: Associate Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2237

SUPPORTING STATEMENT

CEE 560 will contain material largely from CEE 460 and the latter will no longer be taught. It is necessary to renumber this material into a 500-level course in order to accommodate other courses that must be renumbered in the environmental engineering degree. CEE 460 is currently taken by MS students and by undergraduates in both the environmental and civil engineering degree programs. Because two other courses in the proposed environmental engineering degree are dropping from a 500 to a 400 level , it is necessary to increase the level of two technical electives, CEE 460 and CEE 428, so that MS students can still take them for credit as part of their degree program and not exceed the Rackham limit on 400-level coursework.

Previously CEE 360 was a prerequisite for CEE 460. Since the material in CEE 360 is now in CEE 465, the appropriate prerequisite for CEE 560 will be CEE 465.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 560: Design of Environmental Engineering Systems

Lecture Period: MW 12:00-1:30, 185 EWRE

Instructor: Terese Olson
Offc: 111 EWRE
tmolson@umich.edu
Phone: 647-1747

Office Hrs: Tues. 9:00-11:00 am or by appointment

Text: *Water Treatment: Principles and Design*, 2ed, Montgomery Watson Harza, Inc., revised by John Crittenden, John Wiley, 2005. ISBN: 978-0-471-11018-7. Library offers on-line edition. It will be referred to as *"MWH"* in the reading assignments.

Other Readings: All other reading assignments will be available via CTools.

Lecture notes: Available generally through CTools in the *Resources* folder.

Course Description:
Design and theoretical understanding of environmental processes; biological, physical, and chemical processes, and reactor configurations commonly used for water quality control; applications to the design of specific water and wastewater treatment operations; discussion of pollution prevention and green engineering options.

Course Outcomes:
Key principles of reactor and process design will be mastered and applied to several engineering examples of water quality control systems. Students will be asked to apply these tools to address several open-ended design problems. An awareness of the evolutionary forces that require the development of continuing technological advances and new strategies to achieve sustainable water quality will be developed through several contemporary case studies. Other specific outcomes for the course include:

1. To teach students how to apply material conservation relationships to environmental processes.
2. To teach students selection criteria for reactor types and process scale-up principles.
3. To review equilibrium relationships for component distributions in multiphase systems.
4. To provide students with an understanding of physical and chemical rate limiting factors in environmental processes, and how to estimate mass transfer rates in homogeneous and heterogeneous systems.
5. To apply the modeling principles of objectives 1-4 to the conceptual design of engineered treatment processes, incorporating economic analysis into the selection of design alternatives.
6. To hone the students' professional and technical writing skills in design assignments.
7. To introduce students to principles of pollution prevention.
8. To provide students with an historical context for current practice, and emphasize important future directions in environmental engineering and the need for lifelong learning.

Homework, Attendance Policy, and Honor Code:

The homework assignments will consist of closed solution problems, some open-ended design problems, and occasional essays. Assignments will be posted on CTools and are due in class according to the scheduled due dates. Late homework will not be accepted for full credit unless prior approval was obtained. A penalty of 20% of the credit will be exacted on late assignments for each day past the due date.

Your assignments must conform to the following basic standards:

1) All submitted work must reflect your **own effort**. You may discuss homework problems with other classmates, but the work you submit must be written in your own words. Use of old homework assignments, old homework solutions, or solution manuals is NOT permitted. Any violations of these standards will be considered an Honor Code violation. Similarly, the participation in such a violation, even if you are submitting your own work, is also a violation of the Honor Code. Please review the Engineering Honor Code on the course CTools site.

2) Assignments must be **neat and legible**. Begin each new problem on a separate page. Always include units. Label all graph axes. Show all your work. Graphs should be prepared with a plotting software package. If spreadsheet software is used to solve a problem, be sure the equations used to obtain each entry and the parameter units are evident.

3) Plagiarism in essays is always a serious Honor Code violation. Proper citation and credit of all ideas or quotations used that were developed by other authors must be given, including internet sources. The citations must be sufficient to enable the reader to locate these sources. If verbatim wording of another author's work is included, direct quotations must be indicated.

Attendence during lectures is HIGHLY encouraged. Missing a class is never an excuse for missing information delivered during the lecture. Out of courtesy to other classmates, promptness is also very much appreciated.

Exam Policies

Exam work must be entirely the student's own. No collaboration of any kind with other students is permitted. No consultation of references outside those specified on the exam is allowed. Any violation of this policy is considered a breach of the Engineering Honor Code and will be pursued as such.

No wireless communication devices of any type may be used during an exam. Cell phones or any other wireless device must be turned OFF, not just silenced, and out of sight.

Students must sign the Honor Pledge on their exam cover. Exams without a signature will not be graded.

Students are expected to take all exams according to the posted schedule. **ALL** absences from a scheduled exam must be excused **prior** to the exam. All planned absences, except those related to sickness or family emergencies, must be cleared with me **at least 3 weeks prior to the exam**. Requests to reschedule an exam may be denied, depending on the reason given.

Grading Scheme:

2 Midterm Exams:	25% each
Final Exam	30%
Homework	20%

Topical Outline

Dates	Topic	Readings*	Assignments
	I. Introduction	Ch. 1,2	
9/7,12	***A.*** Reactor Analysis, Reaction Rates	5.4-5.5, 6.1-6.6	Prob. Set 1
9/14,19	***B.*** Pollution Prevention & Water Conservation	Bishop Ch 10	
	II. Removal of Dissolved Species		
9/19,21, 26	***A***. Adsorption	7.1-7.5, 15.4, LaGrega 9.3	Prob. Set 2
9/28; 10/3,5	***B***. Gas Transfer	7.6, 14.1-14.5	Prob. Set 3
10/10, 12,19	***C.*** Membranes & Reverse Osmosis	12.1, 17.1-17.5	Prob. Set 4
10/17	STUDY BREAK – no class		
10/19	Case Study 1: Arsenic Removal	CTools refs	
10/24	**EXAM 1**		
	III. Disinfection	3.1-3.2	
10/26,31	***A.*** Chlorination/Chloramination	13.0-13.5	Prob. Set 5
11/2	***B.*** UV	13.8	
11/7,9	***C.*** Ozonation	13.7	Prob. Set 6
11/14	Case Study 2: Byproducts vs disinfection in AA and Lake Elsinore, CA	CTools refs	
11/21	**EXAM 2**		
	IV. Removal of Particulates		
11/16, 23,28, 30	***A.*** Coagulation/Flocculation/ Sedimentation	9.0-9.7 10.1-10.4	Prob. Set 7
12/5,7	***B.*** Filtration	11.1-11.6	
12/12	Case Study 3: Milwaukee Crypto outbreak forensics	CTools refs	
12/15	**FINAL EXAM**		

* Readings are from MWH (as approximate sections) unless otherwise specified. *Exact* page assignments of the text are given in the Lecture Notes for each topic. Readings other than text are provided through CTools in "Additional Readings" folder.

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2166
Date 9/22/2011
Effective Term Winter 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	
	Transcript Max = 20 Spaces	

Course Description

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min ___ Max ___
Contact Hrs/Wk ___
Number of Wks ___

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin | Course Number: 470

Cross Listed Course Information

Course Title: Introduction to Transportation Engineering

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	Intro Transp Engr
	Transcript Max = 20 Spaces	Intro Transp Engr

Course Description for Official Publication (Max = 50 words)

Fundamentals of planning, design, and operation of highway transportation facilities. Topics covered include driver and vehicle performance characteristics, highway geometric design principles, basics of traffic analysis, and transportation planning.

PROGRAM OUTCOMES: ☒ a ☒ c ☒ e ☒ g ☒ i ☒ k ☐ b ☐ d ☒ f ☒ h ☒ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective

Prereq Math 116.
○ Enforced
◉ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 3 Max 3
Contact Hrs/Wk 3
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Graded Section
☒ Lec ☐ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member: Lidia P. Kostyniuk
Title: Adj. Prof., Urb. Plan. Res. Sci., UMTRI

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2166

SUPPORTING STATEMENT

Transportation engineering is a major component of the civil engineering discipline, and civil engineers contribute to the planning, design, construction, maintenance, operation and management of transportation facilities. Civil engineers are also among the innovators of new transportation technology such as intelligent transportation systems, advanced traveler information systems, and vehicle infrastructure integration. However, no transportation courses are currently offered in CEE or in the U-M college of engineering. The purpose of this course is to introduce students to the principles of transportation engineering with a focus on highway engineering and traffic analysis. The course material will provide students with the basic skill set to solve commonly-encountered problems in design, operation, and planning of highway transportation. The course will be taught by Dr. Lidia Kostyniuk, P.E. whose professional career spans over 30 years and has included research, teaching and practice in the areas of transportation and traffic engineering, transportation safety, and travel behavior. Dr. Kostyniuk has taught introduction to transportation engineering courses at the University of Michigan (1977-1983). She also taught the course in the proposed format in a trial offering as CEE 490 in Winter 2011. The course was well-received by the students.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 470
Introduction to Transportation Engineering
Winter 2012, Time TBD

Course Description
This course introduces students to the fundamentals of planning, design, and operation of highway transportation facilities. Topics covered include driver and vehicle performance characteristics, highway geometric design principles, pavement design, basics of traffic analysis, signal timing, and transportation planning.

Prerequisite – Math 116 or permission of instructor

Credits – 3

Course Objectives:
The purpose of this course is to provide students with a solid introduction to the principles of transportation engineering with a focus on highway engineering and traffic analysis. The material learned will provide the basic skill set that will allow students to solve commonly-encountered problems in design, operation, and planning of highway transportation.

Instructor
Lidia P. Kostyniuk, Ph.D., P.E.
126 UMTRI
Phone: (734)764-0213
E-mail: lidakost@umich.edu

Office Hours:
3 hours per week – to be determined
Also available by E-mail & appointment

Textbook
Required: Mannering, F.L., Washburn, S.S., Kilarski, W.P. *Principles of Highway Engineering and Traffic Analysis*, Fourth Edition, John Wiley & Sons, 2009.

Additional class handouts and notes will be available at the course CTOOLS website.

Course Requirements
1. Eight problem-oriented homework assignments. The objective of these assignments is to assist in the learning of the course material, so discussion among students is encouraged. However, each student must hand in solutions that have been generated individually ***unless otherwise clearly stated***. Photo-, electronic- or hand-copying of any solution that is supposed to be handed in as independent work is not allowed.

2. Each student will be required to complete a design project with a report and presentation. The project can deal with any transportation-oriented problem and can be completed individually or in groups of two or three students. The project report should be on the order of 10 to 12 pages.

Key Dates:
Feb 24: Submit description of proposed design project. Approval of instructor is required.
Apr 16: Design project reports due.

3. A mid-term and a final exam will be given. The final exam will be comprehensive, but approximately 75% will focus on material from the second half of the class. Exams will be open book and notes. No wireless devices of any type can be used during the exam. Each student must complete the exam solely by her or his own efforts, and sign the Honor Pledge on the exam cover.

Grading Policy

Homework problem assignments	20%
Mid-term Exam	25%
Design Project Report/Presentation	20%
Final Exam	35%

Dates	Topic	Readings	Assignments
1/4	Introduction The fields of transportation engineering Economic, social, political role of transportation Role of civil engineering in transportation	Chapter 1	
1/6,9,11,13 1/18,20	Vehicle and driver Road vehicle performance Driver performance	Chapter 2	Chapter 2 problems
1/23 1/25 1/27,30 2/1,3	Geometric design of highways Sight distance requirements Superelevations Horizontal alignment Vertical Alignment	Chapter 3	Chapter 3 problems
2/6,8 2/10,13 2/15,17	Pavement Design Flexible pavements Rigid pavements Pavement Performance	Chapter 4	Chapter 4 problems
2/20,	Fundamentals of traffic flow and queuing theory Queuing theory	Chapter 5	Chapter 5 problems

2/22,24 3/5,7	Applied queuing models Traffic delay computations		
3/9	Midterm Exam (chapters 1-4)		
3/12 3/14 3/16	Highway Capacity and Level of Service Level of service concept Basic Freeway Segments Multilane and two lane highways	Chapter 6	Chapter 6 problems
3/19, 3/21,23 3/26	Traffic control and analysis at signalized intersections Probabilistic arrivals Traffic signal timing Intelligent transportation systems	Chapter 7	Chapter 7 problems
3/28,29 4/2,4	Travel demand and traffic forecasting Traveler decisions Travel demand model system	Chapter 8	Chapter 8 problems
4/6 4/9	Evaluation Environmental and sustainability Issues Safety	C-tools refs	
4/11,13,16	Design Project Presentations		
	Final Exam (Comprehensive with emphasis on Ch. 5-8)		

Guidelines for Design Project and Report

Each student is required to complete a design project. The project can deal with any transportation-oriented problem. The students will prepare a written report on the project and also present their findings to the class at the end of the term. Students can work individually or in groups up to three students.

Key Dates:

Feb 24:	Submit description of proposed design project. Approval of instructor is required.
April 11-16:	Design project presentations to class.
April 16:	Reports due.

1. Any transportation-related design problem is acceptable. Examples of topics include:
   - Study of signal dilemma zones
   - Analysis of a specific intersection's sight distance
   - Analysis of speed problem in specific neighborhood
   - Study of bicycle braking distances
   - Effects of advanced braking and stability systems in urban driving conditions
   - The effect of alternate fuels on vehicle performance, emissions and economics
   - Report on the impact of speed humps as a speed control mechanism
   - A study of school zone speed limit compliance
   - Geometric analysis of a specific highway segment
   - Redesign of a specific congested or dangerous intersection
   - Study of traffic calming devices
   - Assessment of high-speed rail transportation
   - Assessment of race-track design
   - America's dependency on oil and the need for alternative fuel
   - Effects of age, race, gender and speeding on crash risk

2. There are two general types of design projects:
   Site Specific Study - In this case you analyze an existing problem (poorly designed intersection, speeding problem through a neighborhood) and propose a solution. You can also evaluate a solution proposed by someone else. You can get information from state/city officials and/or gather reports from library/internet sources. You may also have to collect some data (counts of vehicles, vehicle speeds, etc.).
   General Design Analysis - Information is collected from library/internet sources on a design problem that is local, nationwide, or worldwide in scope. A number of journals available online are an excellent place to start.
3. Report - It is important for your report to be well structured. Although each report will be different, most should have:
   Problem Statement, including the significance of the problem and who is likely to be interested in the solution.
   Evaluation of the important factors involved in solving the problem.
   Presentation of one or more proposed solutions.
   Conclusions
   The report should be 10 to 12 pages typed (including figures and tables). Try to be succinct and to the point but be careful not to leave out important information.

4. Presentation – The students will also prepare a 15-20 minute presentation summarizing their project, and present it to the class.

Office of Evaluations & Examinations
University of Michigan
Report ID: MSR04734 2011-04-08 - 2011-04-20

Winter 2011 Final

Instructor with Comments Report

5 students responded out of the total enrolled 9

Instructor: Kostyniuk,Lidia P
CEE 490 048

		Responses from your Students**							Other Users of This Item* University Wide			School/College		
		5 SA	4 A	3 N	2 D	1 SD	NA	Your Median	75% Above	50% Above	25% Above	75% Above	50% Above	25% Above
1	Overall, this was an excellent course.	3	2	0	0	0	0	4.67	3.90	4.25	4.67	3.88	4.25	4.62
2	Overall, the instructor was an excellent teacher.	2	3	0	0	0	0	4.33	4.08	4.56	4.83	4.17	4.50	4.80
3	I learned a great deal from this course.	3	2	0	0	0	0	4.67	4.00	4.30	4.67	4.00	4.30	4.67
4	I had a strong desire to take this course.	5	0	0	0	0	0	5.00	3.67	4.10	4.59	3.50	4.00	4.58
15	I increased my ability to apply math and science knowledge to engineering problems.	2	2	1	0	0	0	4.25	3.94	4.17	4.38			
17	I increased my ability to analyze and interpret data.	2	3	0	0	0	0	4.33	4.00	4.20	4.43			
20	My confidence in my design abilities increased because of this course.	1	4	0	0	0	0	4.13	4.00	4.13	4.38			
21	I gained valuable experience working in teams in this course.	0	2	1	0	0	2	3.75	3.70	4.00	4.38			
23	I increased my ability to formulate, and solve engineering problems.	1	4	0	0	0	0	4.13	3.98	4.14	4.33			
25	I developed a greater understanding of my responsibilities as a professional.	1	4	0	0	0	0	4.13	3.93	4.17	4.63			
28	Course improved my ability to communicate technical information, designs, and analyses.	2	2	1	0	0	0	4.25	3.90	4.08	4.25			
30	I developed a greater understanding of the impact of engineering on the environment.	0	2	2	1	0	0	3.25	3.63	3.90	4.14			
32	This course increased my desire to learn more about this subject in the future.	3	2	0	0	0	0	4.67	3.79	4.08	4.34			
34	I have a greater understanding of how course concepts apply to contemporary problems.	3	2	0	0	0	0	4.67	4.06	4.20	4.50			
35	I increased my ability to apply engineering tools and methods.	1	4	0	0	0	0	4.13	4.00	4.17	4.40			
121	I gained a good understanding of concepts/principles in this field.	3	2	0	0	0	0	4.67	3.96	4.20	4.50			
125	I developed the ability to solve real problems in this field.	2	3	0	0	0	0	4.33	3.86	4.14	4.50			
201	The instructor gave clear explanations.	2	2	1	0	0	0	4.25	4.02	4.42	4.75			
203	The instructor stressed important points in lectures/discussions.	4	1	0	0	0	0	4.88	4.13	4.50	4.75			
207	The instructor appeared to have a thorough knowledge of the subject.	4	1	0	0	0	0	4.88	4.40	4.75	4.91			
216	The instructor acknowledged all questions insofar as possible.	3	2	0	0	0	0	4.67	4.21	4.56	4.80			
229	The instructor used class time well.	1	4	0	0	0	0	4.13	4.07	4.44	4.71			
230	The instructor seemed well prepared for each class.	3	2	0	0	0	0	4.67	4.25	4.64	4.84			
232	Work requirements and grading system were clear from the beginning.	2	3	0	0	0	0	4.33	4.00	4.25	4.57			
239	The amount of work required was appropriate for the credit received.	2	3	0	0	0	0	4.33	3.90	4.17	4.44			
356	Examinations covered the important aspects of the course.	3	2	0	0	0	0	4.67	4.00	4.25	4.56			
360	Exams were reasonable in length and difficulty.	2	2	0	1	0	0	4.25	3.83	4.10	4.44			
366	The grading system was clearly explained.	2	3	0	0	0	0	4.33	4.00	4.25	4.58			

Written Comments

900 Comment on the quality of instruction in this course.

Student 1
NA

Student 2
NA

Instructor with Comments Report

Winter 2011 Final

5 students responded out of the total enrolled 9

Instructor: Kostyniuk,Lidia P

CEE 490 048

Student 3
The professor was able to offer a lot of helpful real world examples and applications given her experience in the field.

Student 4
So interesting!! I wish we had more courses available in this area. Powerpoint was well used and helpful. Examples were key to understanding most of the material I think, they helped me the most.

Student 5
NA

* The quartiles are calculated from Winter 2011 data. The university-wide quartiles are based on all UM classes in which an item was used. The school/college quartiles in this report are based on upper division classes with an enrollment of 1 to 15 students in College of Engineering.
** SA - Strongly Agree, A - Agree, N - Neutral, D - Disagree, SD - Strongly Disagree, NA - Not Applicable.

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2243
Date 9/22/2011
Effective Term Winter 2012
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	
	Transcript Max = 20 Spaces	

Course Description

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☐ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min ___ Max ___
Contact Hrs/Wk ___
Number of Wks ___

B. REQUESTED LISTING

Home Department: CEE Civil & Environmental Engin
Course Number: 812

Cross Listed Course Information

Course Title: Structural Engineering Graduate Seminar

TITLE ABBRE-VIATION	Time Sched Max = 19 Spaces	Struct Engr Grad Sem
	Transcript Max = 20 Spaces	Struct Engr Grad Sem

Course Description for Official Publication (Max = 50 words)
Presentation and discussion of selected topics relating to structural engineering practice and research by invited lecturers.

PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j

Degree Requirements ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective

Prereq: Graduate standing.
◉ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Non-Rckhm Grad
☐ Rackham Grad ☒ All Credit types
☐ Non-Rckhm Grad ☐ Rckhm Grad w/add'l Work
☐ Ugrad or Rckhm Grad

Credit Hours Min 1 Max 1
Contact Hrs/Wk 1
Number of Wks 14

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ◉ Yes ○ No Max Hours? 2 Max Times? ___ Can it be repeated in the same term? ○ Yes ◉ No

C.

Class Type(s)
☐ Lec ☒ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Graded Section
☐ Lec ☒ Sem ☐ Dis ☐ Other ___
☐ Rec ☐ Lab ☐ Ind

Grading
☐ A-E
☐ CR/NC
☐ P/F
☒ S/U

Course Is Y Graded ☐

Location
☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Cognizant Faculty Member:	Title
Ann Jeffers	Assistant Professor
Jason McCormick	Assistant Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.

	Department Chair Name	Chair Signature
Home Dept.	Kim F. Hayes, Interim Chair	Kim F. Hayes
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2243

SUPPORTING STATEMENT

This seminar is an integral part of structural engineering graduate education, exposing students to recent research advances and case-histories of actual projects. Presentations will be made by our own researchers as well as invited guests from academia and practicing engineers. A discussion and question/answer session will follow each presentation.

The intention is to offer the seminar in Fall and Winter terms.

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

CEE 812: Structural Engineering Graduate Seminar **Winter 2012**

Instructor:

Ann Jeffers
Assistant Professor, CEE
2376 G.G. Brown
jffrs@umich.edu

Jason McCormick
Assistant Professor, CEE
2372 G.G. Brown
jpmccorm@umich.edu

Class Meeting Times: Thursdays from 4:30-5:30pm

Course Description

CEE 812 is a 1 credit hour graduate seminar that covers selected topics related to structural engineering practice and research. Course meetings will comprise a mixture of invited speakers from industry and academia along with presentations from graduate students. The objectives of the course are:

- To strengthen understanding of fundamental principles by introducing applications of theory in industry and research
- To highlight contemporary issues in the structural engineering profession
- To expose students to a range of potential career options available upon graduation
- To provide a networking opportunity for students to meet professionals from industry and academia
- To cultivate professional skills and enhance understanding of ethics
- To allow current graduate students an opportunity to refine their presentation skills and receive feedback on areas of improvement
- To create a sense of community within the structural engineering graduate program

Grading

This course can only be taken with the Satisfactory (S)/Unsatisfactory (U) grading option. Satisfactory completion of the seminar course will be based on attendance and active participation during the seminars.