The University of Michigan
College of Engineering
Curriculum Committee

Agenda
October 12, 2010
1:30-3:00 p.m.
GM Room Fourth Floor
Lurie Engineering Center

1. Approval of Minutes From 09-28-2010
2. Course Approvals
3. Chemical Engineering Mission, Goals and Educational Objectives

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday September 28, 2010
1:30-3:00 p.m.
Room 2210 LEC

Minutes

Marina Epelman called the meeting to order at 1:40 p.m.

Members Present: M. Epelman, J. Barker, L. Bernal, M. Collette, E. Durfee, J. Holloway, A. Hunt, R. Hryciw, E. Larsen, J. Li, J. Pan, R. Robertson, F. Terry, S. Vozar, F. Ward

Members Absent: E. Gulari, D. Kieras, L. Meadows, S. Montgomery

Guests: Aileen Huang-Saad, Thomas Zurbuchen

The minutes of the last meeting(s) (April 13, April 20 and September 14, 2010) were approved ***The minutes of the September 14, 2010 meeting were approved with the addition to the "proposal for revision of the CoE Core Curriculum for Intellectual Breadth" that the proposal to revise general electives credit to a required minimum of 12 was tabled.***

Course Approval Forms

These Courses Were Approved

CHE 343 Modification—Changed Prerequisite from: ChE 230 (enforced) ***to:*** ChE 230, ChE 330, Preceded or accompanied by ChE 342 (enforced)

CHE 596(X-listed with PHARMSCI 596 and BME 596) Modification—Changed Prereq from: Grad Standing (enforced) ***to: Grad Standing (advised)***

IOE 439 Deletion

IOE 636 Deletion

MSE 517 Requested X-Listing with MACROMOL 530

ME 501 Modification—Changed Title from: Analytical Methods in Mechanics ***to: Mathematical Methods in Mechanical Engineering***; Changed Description; Changed Prereq from: ME 211, ME 240, and MATH 216 ***to: Math 216; Math217 or equivalent recommended***

ME 552(X-listed with MFG 552) Changed Level of Credit from: Min 3 Max 3 ***to: Min 4 Max 4***; Contact Hrs Wk from: 3 ***to: 6***

This Course Was Tabled

BME 350 Modification—Changing Title from: Introduction to Biomedical Instrumentation Design to: Introduction to Biomedical Engineering Design; Changing Description; Changing Prereq from: None to: Biomede 211, 221,

231; co-requisite BME 241 This course was tabled for clarification as to why it was changed to be a Core Course.

Proposal to Create a Joint Masters Degree in Entrepreneurship

This was a continuation of the discussion from the last (September 14) meeting.

Information regarding this was handed out at this meeting.

Aileen Huang-Saad and Thomas Zurbuchen from the Center for Entrepreneurship presented this proposal for a second time.

Program Overview

The Center for Entrepreneurship (CFE) and the Samuel L. Zell and Robert H. Lurie Institute for Entrepreneurial Studies (ZLI), as representatives from the College of Engineering (CoE) and the Ross School of Business, respectively, propose the establishment of a joint professional master's degree to arm students with the critical multidisciplinary knowledge necessary to create new high tech ventures as standalone entities and/or within established innovative organizations. Students will learn to create and capture value from novel technologies within the context of entrepreneurship. The joint Masters Degree in Entrepreneurship described in this proposal brings together curricula and faculty from the CoE and Ross, organizing them within a structure that leverages the strengths of both institutions.

The program objectives are as follows:

1. Provide graduate scientists and engineers with a comprehensive understanding of technology opportunity identification and implementation.
2. Educate students in the scientific design approach to product development, emphasizing the important of customer input throughout design.
3. Provide students with fundamental entrepreneurial business skills for venture creation.
4. Provide students with the opportunity to integrate the key principles of entrepreneurship and technology development and experience the added-value of this cross-disciplinary approach.

After some discussion and some requested revisions it was moved and seconded to vote to approve this Program. This was approved and the revised Program will be submitted to the Faculty on October 6, 2010.

Adjournment: Motion to adjourn was made and seconded
Motion carried (approved)

Next Meeting: October 12, 2010 1:30 PM, GM Room 4th Floor Lurie Engineering Center

COURSE APPROVAL FORMS

For October 12, 2010 CoE CC Meeting

BME 350	Modification—Changing Title from: Introduction to Biomedical Instrumentation Design ***to: Introduction to Biomedical Engineering Design***; Changing Description; Changing Prerequisite from: None ***to: Biomede 211, 221, 231; co-requisite BME 241***
CHE 230	Modification—Changing Title from: Material and Energy Balances ***to: Introduction to Material and Energy Balances***; Changing Prerequisite from: "Engr. 103, Chem 126, Math 116 ***to: "Engr. 100, Eng 101, Chem 130, Math 116***
CHE 341	Modification—Changing Prerequisite from: "Physics 140, P/A ChE 230 and Math 216"***to: "Preceded by Physics 140 and Math 215, Preceded or accompanied by ChE 230 and Math 216***
CHE 343	Modification—Changing Prerequisite from: ChE 230 ***to: ChE 230, ChE 330 and preceded or accompanied by ChE 342***
CHE 466	Modification—Changing Course Description
CEE 325	Modification—Changing Prerequisite from: CEE 211 and ME 235 or ChemE 230 ***to: CEE 211 and prior or concurrent enrollment in CEE 230 or MechEng 235***
CEE 520	Modification—Changing Title from: Deterministic and Stochastic Models in Hydrology ***to: Physical Processes of Land-Surface Hydrology***; Changing Description; Changing Prerequisite from: CEE 420, CEE 421 ***to: CEE 421***
CEE 573	New Course
EECS 418	New Course
EECS 419	New Course
EECS 463	New Course

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

Form Number 2141
Date 3/23/2010
Effective Term Winter 2011

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

Course Offer Freq ☒ Indefinitely ☐ One term only

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department: BIOMEDE Biomedical Engineering	Home Department: BIOMEDE Biomedical Engineering
Course Number: 350	Course Number: 350
☐ Cross Listed Course Information:	Cross Listed Course Information:
☒ Course Title: Introduction to Biomedical Instrumentation Design	Course Title: Introduction to Biomedical Engineering Design
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	Time Sched Max = 19 Spaces: Intro Bio Engr Des
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	Transcript Max = 20 Spaces: Intro Bio Engr Des
☒ Course Description: Fast paced introductory course open to all students interested in circuit design. Two terms introductory physics recommended, programming skills helpful. Topics: basic analog and digital circuit applications, sensors, micro power design, data acquisition, computer I/O, electro-mechanical and electro-optical devices, applications to biological and medical research.	Course Description for Official Publication (Max = 50 words): This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.
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 ◉ Tech Elective ○ Core Course ○ Other ○ Free Elective	Degree Requirements: ○ Degree Requirement ○ Tech Elective ◉ Core Course ○ Other ○ Free Elective
Prereq: None.	Prereq: BiomedE 211, 221, 231; co-requisite BME 241
☒ ○ Enforced ◉ Advised	○ 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	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: 4 Max: 4
Contact Hrs/Wk:	Contact Hrs/Wk: 10
Number of Wks:	Number of Wks: 14

C.
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

☐ **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: Andrew Putnam
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. Biomedical Engineering	DC Taff
Cross-listed Dept(s).	

Form Number

2141

SUPPORTING STATEMENT

The BiomedE Department is requesting a modification to BiomedE 350: Introduction to Biomedical Instrumentation Design. The rationale for this is twofold. First, BiomedE students need additional exposure to, and explicit experience with, computational design tools in order to propose and validate feasible solutions to real world biomedical engineering problems with industrial and/or clinical relevance. This exposure and experience will provide a strong fundamental background and foundation for the design experience in the senior year (BiomedE 450). It is believed that incorporating additional design tools into this course, and the BiomedE curriculum in general, will also better prepare our graduates for success in the biomedical device and biotechnology industries.

Second, the previous BiomedE 350 course was tailored primarily to the "bioelectrics" concentration. The proposed changes will broaden 350 to more closely match the needs of students in all three of our undergraduate concentrations.

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

Detail the Special requirements

The course will need to be taught in a dedicated CAEN teaching classroom (e.g., LBME 1310 or equivalent) equipped with the appropriate software (Matlab, SolidWorks, COMSOL, and Simpleware for the first iteration of this revised course in Winter 2011) so that the instructor can give students thorough software tutorials and demonstrations.

BIOMEDE 350: INTRODUCTION TO BIOMEDICAL ENGINEERING DESIGN
WINTER 2011

Bulletin Description: This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.

Instructor: Andrew Putnam, Ph.D.
Associate Professor
2154 Lurie Biomedical Engineering Building
Phone: (734) 615-1398
E-mail: putnam@umich.edu

GSI: TBD

Course Description:
This course, intended for 3rd-year undergraduates majoring in biomedical engineering, will expose students to key aspects of the process of designing a biomedical device or biotechnology product, and provide them with the technical fundamentals to perform design. What the students learn in this course is foundational to the design experience in the 4th-year of the curriculum (BME 450).

The primary focus of this class will be a series of problem-based learning (PBL) modules used to provide student teams with practical experience through "virtual" design of biomedical devices and technologies. Students working in small groups will pose feasible solutions to real-world biomedical problems and perform engineering analyses to substantiate their proposed solutions. These PBL vignettes will be open-ended problems with no single correct answer, but somewhat more constrained than in senior design to reflect the more introductory nature of this course.

Lectures will impart general knowledge of problem solving skills and algorithm design, present the engineering and physiology background relevant for specific PBL topics, and provide tutorials for relevant software packages commonly used in biomedical engineering. Through the PBL-based design vignettes, students will gain familiarity with CAD (e.g., SolidWorks), computational (e.g., COMSOL, Matlab), and image processing (e.g., Simpleware) software packages.

Midterm and final examinations will test individual students and their knowledge of the various modules and their solution strategies.

Required Textbooks: TBD
Additional References: TBD

Prerequisites: BIOMEDE 211, 221, and 231
Corequisites: BIOMEDE 241

Tentative Lecture Topics:

1. Introduction to engineering problem solving and algorithms.
2. Design cycle: Problem identification, conceptual model, mathematical model, coding, application.
3. Problem formulation and algorithmic design.
4. PBL Module #1
    a. Matlab tutorial
    b. Background biology and physiology related to module #1
5. PBL Module #2
    a. CAD tutorial (SolidWorks)
    b. Background physiology and fluid dynamics related to module #2
6. PBL Module #3
    a. Image analysis tutorial (Simpleware)
    b. Background biology and physiology related to module #3
7. PBL Module #4
    a. Computational tool tutorial (COMSOL)
    b. Background physiology and mechanics related to module #4

Course Outcomes:

Upon completion of this course, students should be able to:

1. Define and solve design-oriented problems to gain familiarity with state-of-the-art software packages that are commonly used in engineering design.
2. Formulate feasible design strategies based on model algorithms.
3. Document the problem identification and algorithmic design.
4. Translate algorithms into computational tools.
5. Use computational tools for virtual design, including development, validation, and optimization of prototypes.

Grading Criteria:

PBL Assignments (4)	60% (15% each)
Midterm exam	20%
Final exam	20%

Course Profile: Biomedical Engineering Program

COURSE #: BIOMEDE 350	**COURSE TITLE:** INTRODUCTION TO BIOMEDICAL ENGINEERING DESIGN
TERMS OFFERED: Fall and Winter	**PREREQUISITES:** Junior standing **COGNIZANT FACULTY:** A. Putnam
TEXTBOOK/REQUIRED MATERIAL: Course pack.	**DATE OF PREPARATION:** 3/15/2010
	SCIENCE/DESIGN: 1/2
CATALOG DESCRIPTION: This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in small groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.	**COURSE TOPICS:** 1. Introduction to engineering problem solving and algorithms. 2. Design cycle: Problem identification, conceptual model, mathematical model, coding, application. 3. Problem formulation and algorithmic design. 4. PBL Module #1 a. Matlab tutorial b. Background biology and physiology related to module #1 5. PBL Module #2 a. CAD tutorial (SolidWorks) b. Background physiology and fluid dynamics related to module #2 6. PBL Module #3 a. Image analysis tutorial (Simpleware) b. Background biology and physiology related to module #3 7. PBL Module #4 a. Computational tool tutorial (COMSOL) b. Background physiology and mechanics related to module #4

COURSE OBJECTIVES*	1. To expose students to key aspects of the process of designing a biomedical device or biotechnology product. 2. To provide students with the technical fundamentals to perform design. 3. To impart general knowledge of problem solving skills and algorithm design. 4. To expose students to relevant software packages commonly used in biomedical engineering design and analyses. 5. To provide students with practical experience in the use of software tools through "virtual" team-based design of biomedical devices and technologies.

COURSE OUTCOMES*	Upon completion of this course, students should be able to: 1. Define and solve design-oriented problems to gain familiarity with state-of-the-art software packages that are commonly used in engineering design. 2. Formulate feasible design strategies based on model algorithms. 3. Document the problem identification and algorithmic design. 4. Translate algorithms into computational tools. 5. Use computational tools for virtual design, including development, validation, and optimization of prototypes.
ASSESSMENT TOOLS	1. Midterm and final exams for individual students related to the course theory and background. 2. Problem-based learning modules (4 total) for student groups evaluated based on written design documentation (solutions to each of the 4 PBL modules) and group oral presentations.

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

Form Number: 2170
Date: 10/4/2010
Effective Term: Winter 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: CHE Chemical Engineering	Home Department: CHE Chemical Engineering
Course Number: 230	Course Number: 230
☐ Cross Listed Course Information:	Cross Listed Course Information:
☒ Course Title: Material and Energy Balances	Course Title: Introduction to Material and Energy Balances
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Mat & Enrgy Balnces	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Mat & Enrgy Balnces
TITLE ABBREVIATION — Transcript Max = 20 Spaces: MAT & ENRGY BALANCES	TITLE ABBREVIATION — Transcript Max = 20 Spaces: MAT & ENRGY BALANCES
☐ Course Description: An introduction to material and energy balances in chemical engineering applications, including environmental and biological systems. Engineering problem-solving, the equilibrium concept, first law of thermodynamics. Introduction to chemical engineering as a profession.	Course Description for Official Publication (Max = 50 words): An introduction to material and energy balances in chemical engineering applications, including environmental and biological systems. Engineering problem-solving, the equilibrium concept, first law of thermodynamics. Introduction to chemical engineering as a profession.
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: "Engr. 103, Chem 126, Math 116
☒ ◉ Enforced ○ Advised	◉ 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 4 Max 4; Contact Hrs/Wk 5; Number of Wks 14	Credit Hours Min 4 Max 4; Contact Hrs/Wk 5; 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.

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
Lola Eniola-Adefeso | Assistant Professor
Jennifer Linderman | Professor
Susan Montgomery | Lecturer

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, Chem Engr
Cross-listed Dept(s).

Form Number

2170

SUPPORTING STATEMENT

Changing prerequisites and course title.

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 2171
Date 10/4/2010
Effective Term Winter 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: CHE Chemical Engineering	Home Department: CHE Chemical Engineering
Course Number: 341	Course Number: 341
Cross Listed Course Information:	Cross Listed Course Information:
Course Title: Fluid Mechanics	Course Title: Fluid Mechanics
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Fluid Mechanics	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Fluid Mechanics
TITLE ABBREVIATION — Transcript Max = 20 Spaces: FLUID MECH	TITLE ABBREVIATION — Transcript Max = 20 Spaces: FLUID MECH
Course Description: Fluid mechanics for chemical engineers. Mass, momentum, and energy balances on finite and differential systems. Laminar and turbulent flow in pipes, equipment, and porous media. Polymer processing and boundary layers. Potential, two-phase, and non-Newtonian flow.	Course Description for Official Publication (Max = 50 words): Fluid mechanics for chemical engineers. Mass, momentum, and energy balances on finite and differential systems. Laminar and turbulent flow in pipes, equipment, and porous media. Polymer processing and boundary layers. Potential, two-phase, and non-Newtonian 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: "Physics 140, P/A ChE 230 and Math 216" ◉ Enforced ○ Advised	Prereq: "Preceded by Physics 140 and Math 215, Preceded or accompanied by ChE 230 and Math 216 ◉ 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 4 Max 4; Contact Hrs/Wk 5; Number of Wks 14	Credit Hours Min 4 Max 4; Contact Hrs/Wk 5; Number of Wks 14

C.

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

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
Charles Monroe — Assistant Professor
Mark Burns — Professor, Chair
Sharon Glotzer — 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. Mark Burns, Chair
Cross-listed Dept(s).

Form Number

2171

SUPPORTING STATEMENT

Changing prerequisites

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: 2172
Date: 10/4/2010
Effective Term: Winter 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: CHE Chemical Engineering	Home Department: CHE Chemical Engineering
Course Number: 343	Course Number: 343
☐ Cross Listed Course Information:	Cross Listed Course Information:
Course Title: Separation Processes	Course Title: Separation Processes
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Separ Process	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Separ Process
TITLE ABBREVIATION — Transcript Max = 20 Spaces: SEPAR PROCESS	TITLE ABBREVIATION — Transcript Max = 20 Spaces: SEPAR PROCESS
Course Description: Introduction and survey of separations based on physical properties, phase equilibria, and rate processes. Emphasis on analysis and modeling of separation processes. Staged and countercurrent operations. Includes applications to chemical, biological, and environmental systems.	Course Description for Official Publication (Max = 50 words): Introduction and survey of separations based on physical properties, phase equilibria, and rate processes. Emphasis on analysis and modeling of separation processes. Staged and countercurrent operations. Includes applications to chemical, biological, and environmental systems.
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: ChE 230 — ◉ Enforced ○ Advised	Prereq: ChE 230, ChE 330 and preceded or accompanied by ChE 342. — ◉ 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 4 Max 4; Contact Hrs/Wk 4; Number of Wks 14	Credit Hours Min 4 Max 4; Contact Hrs/Wk 4; Number of Wks 14

C.

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

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
Mark Burns, ChE — Professor/Chair
Joerg Lahann, ChE — Associate Professor
Mike Solomon — 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. Mark A. Burns, Chair
Cross-listed Dept(s). ____

Form Number

2172

SUPPORTING STATEMENT

Changing Prerequisites

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 2173
Date 10/4/2010
Effective Term Winter 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: CHE Chemical Engineering	Home Department: CHE Chemical Engineering
Course Number: 466	Course Number: 466
☐ Cross Listed Course Information:	Cross Listed Course Information:
☐ Course Title: Process Dynamics and Control	Course Title: Process Dynamics and Control
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Proc Dyn & Cntrl	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Proc Dyn & Cntrl
TITLE ABBREVIATION — Transcript Max = 20 Spaces: PROC CNTRL	TITLE ABBREVIATION — Transcript Max = 20 Spaces: PROC CNTRL
☒ Course Description: Introduction to process control in chemical engineering. Application of Laplace transforms and frequency domain theory to the analysis of open-loop and closed-loop process dynamics. Stability analysis and gain/phase margins. Controller modes and settings. Applications to the control of level, flow, heat exchangers, reactors, and elementary multivariable systems.	Course Description for Official Publication (Max = 50 words): Introduction to process control in chemical engineering. Control architecture design, notation, and implementation. Mathematical modeling and analysis of open-loop and closed-loop process dynamics. Applications to the control of level, flow, heat exchangers, reactors, and elementary multivariable systems. Statistical process control concepts.
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: ChE 343 and 344 ◉ Enforced ○ Advised	Prereq: ChE 343 and 344 ◉ 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 3 Max 3; Contact Hrs/Wk 3; Number of Wks 14	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? ____ Max Times? ____ 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

Course Is Y Graded ☐

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

Cognizant Faculty Member: Title
Barry Barkel — Lecturer
Susan Montgomery — Lecturuer
Robert Ziff — 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. Mark Burns, Chair
Cross-listed Dept(s).

Form Number

2173

SUPPORTING STATEMENT

Course Description changed.

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: 2163
Date: 9/7/2010
Effective Term: Winter 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: CEE Civil & Environmental Engin	Home Department: CEE Civil & Environmental Engin
Course Number: 325	Course Number: 325
☐ Cross Listed Course Information:	Cross Listed Course Information:
☐ Course Title: Fluid Mechanics	Course Title: Fluid Mechanics
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Fluid Mechanics	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Fluid Mechanics
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	TITLE ABBREVIATION — Transcript Max = 20 Spaces:
☐ Course Description: Principles of mechanics applied to real and ideal fluids. Fluid properties and statics; continuity, energy, and momentum equations by control volume analysis; differential equations of motion for laminar and turbulet flow; dimensional analysis and similitude; boundary layers, drag, and lift; incompressible flow in pipes; fluid measurement and turbomachinery. Lectures and laboratory.	Course Description for Official Publication (Max = 50 words): Principles of mechanics applied to real and ideal fluids. Fluid properties and statics; continuity, energy, and momentum equations by control volume analysis; differential equations of motion for laminar and turbulet flow; dimensional analysis and similitude; boundary layers, drag, and lift; incompressible flow in pipes; fluid measurement and turbomachinery. Lectures and laboratory.
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 ◉ Core Course ○ Free Elective ○ Tech Elective ○ Other	Degree Requirements: ○ Degree Requirement ◉ Core Course ○ Free Elective ○ Tech Elective ○ Other
Prereq: CEE 211 and ME 235 or ChemE 230	Prereq: CEE 211 and prior or concurrent enrollment in CEE 230 or MechEng 235
X ◉ Enforced ○ Advised	○ 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	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 4 Max 4; Contact Hrs/Wk 6; Number of Wks 14	Credit Hours Min 4 Max 4; Contact Hrs/Wk 6; Number of Wks 14

C.

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

☐ 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: Aline Cotel
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.	Nancy G. Love, Professor	Nancy Love
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2163

SUPPORTING STATEMENT

The prerequisites for this course are being changed from enforced to advisory, to more accurately reflect the current practice.

Enforced prerequisites are also causing backups at registration, as nearly every student requires permission to register.

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: 2159
Date: 5/24/2010
Effective Term: Winter 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: CEE Civil & Environmental Engin	Home Department: CEE Civil & Environmental Engin
Course Number: 520	Course Number: 520
☐ Cross Listed Course Information:	Cross Listed Course Information:
☒ Course Title: Deterministic and Stochastic Models in Hydrology	Course Title: Physical Processes of Land-Surface Hydrology
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Determ Stoch Models	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Phys Proc Hydr
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Determ Stoch Models	TITLE ABBREVIATION — Transcript Max = 20 Spaces: Phys Proc Hydr
☒ Course Description: Mathematical description of the hydrologic cycle. Computation of overland flow. Flood routing through reservoirs and rivers. Unit hydrograph theory. Linear and nonlinear models for small watershed analysis. Application of time series and spectral analysis to hydrologic data. Streamflow simulation by autoregressive and moving average models.	Course Description for Official Publication (Max = 50 words): Key elements of land-surface hydrology. Water in the atmosphere; dry adiabatic and pseudoadiabatic processes. Vapor turbulent transfer. Heat fluxes and surface energy budgets. Mass transfer and energy budget methods for estimating evapotranspiration. Soil physical properties; water flow in unsaturated soils; infiltration. Snow hydrology. Runoff generation. Probabilistic approaches to describing spatial variability.
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 ○ Core Course ○ Free Elective ○ Tech Elective ○ Other	Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ◉ Other
☒ Prereq: CEE 420, CEE 421 — ◉ Enforced ○ Advised	Prereq: CEE 421 — ○ 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	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	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? — Max Times? — Can it be repeated in the same term? ○ Yes ◉ No

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other
Graded Section: ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other
Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U
Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension
Course Is Y Graded ☐

Cognizant Faculty Member: Valeriy Ivanov
Title: 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.	Nancy G. Love, Professor	
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number
2159

SUPPORTING STATEMENT

The course number, CEE 520, existed previously, however the class materials, problem sets, and tests were developed entirely by Valeriy Ivanov. The intention to change the title and description is necessary to better reflect the course content. The course develops mathematical description of key elements of the hydrological cycle, such as physical processes of water dynamics in the atmosphere, turbulent transfer of admixtures in the boundary layer, surface energy budget and heat fluxes, water flow in soils, and runoff generation. The course objective is to provide a concise description of essential physical processes in the land-phase of the hydrological cycle and develop skills necessary for problem numerical treatment (model development). This is substantially different from what the old description assumed.

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: 2162
Date: 9/7/2010
Effective Term: Winter 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:	Home Department: CEE Civil & Environmental Engin
Course Number:	Course Number: 573
☐ Cross Listed Course Information:	Cross Listed Course Information:
Course Title:	Course Title: Methods of Data Analysis
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	Meth Data Analysis
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	Meth Data Analysis
Course Description:	Course Description for Official Publication (Max = 50 words): Course topics are drawn from statistical inference and time series analysis to address problems encountered in engineering and environmental sciences. Goodness of fit and hypothesis testing; sampling and experimental design; linear and non-linear regression analysis; error estimation; stationary and non-stationary processes; autocovariance and cross covariance functions; linear autoregressive processes; spectral analysis of variance.
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: CEE 270 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	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 3
Contact Hrs/Wk:	Contact Hrs/Wk 3
Number of Wks:	Number of Wks 14

C.

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

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: Valeriy Ivanov
Title: 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.	Nancy G. Love, Professor	
Cross-listed Dept(s).	Civil & Environmental Engin	

Form Number

2162

SUPPORTING STATEMENT

The course objective is to learn conecpts and techniques that are frequently required in most environmental sciences (e.g.: ecology, hydrology, geomorphology, etc.) that deal with collection of data samples in field/lab experiments as well as analysis of long-term time series. The course represents a combination of topics from statistical inference and time series analysis. The only other data-oriented course offered in the department is CEE 570 "Introduction to Geostatistics" that deals with issues of genspatial data. Currently, CEE students interested in data analysis have to take courses offered through other departments, such as Industrial Engineering and Electrical Engineering and Computer Sciences. These courses are oriented towards applications of respective disciplines and therefore do not reflect the needs of CEE students.

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

Detail the Special requirements

University of Michigan, Department of Civil and Environmental Engineering

Winter 2011

CEE 573 "Methods of Data Analysis"

Instructor-in-charge:
Valeriy Ivanov
1351 Beal Avenue, 105 EWRE
Ann Arbor, MI 48109-2125
Phone: 734-763-5068
E-mail: ivanov@umich.edu

Prerequisites: CEE 270, equivalent course, or permission of the instructor.
Basic knowledge of Matlab or R, any other programming language.

Description: Course topics are drawn from statistical inference and time series analysis to address problems encountered in environmental sciences and engineering. Goodness of fit and hypothesis testing; sampling and experimental design; linear and non-linear regression analysis; error estimation; stationary and non-stationary processes; autocovariance and cross covariance functions; linear autoregressive processes; spectral analysis of variance.

Classes:
Tue., Thr.: X.00-X.30pm; EWRE XX

Office hours: Tue, Thr: X-Xpm.

References: There is no required textbook for the course. The topics explored are derived from various materials. However, the course will closely follow:

Rice, J. (1995) Mathematical statistics and data analysis. Duxbury Press. Available in Shapiro Science: QA 276.12 .R531 1995

Jenkins, G.M., and D.G. Watts (1968, 1998). *Spectral Analysis and its Applications*, Holden-Day (1968)/Emerson-Adams Press (1998). Available in Art Architecture & Engineering; Shapiro Science; CSCAR - Rackham Building (building use only): QA280.J52

* XX books will be on reserve at: Art, Architecture & Engineering Library Course Reserves
(734) 647-5747 aael.course.reserves@umich.edu

* A list of additional textbooks that might be useful is attached.

Grades:

Class participation	5%
Problem sets (5)	45%
Mid-term exam	20%
Final exam	30%

Grading policy: The letter grade for the class is based on a 100 point system for the assignments, test, and a project. The average grade for the class is a metric of assignment difficulty.

- (-5) – Erroneous numerics
- (-10) – Erroneous derivation/methodology

- (-1,-2) – Erroneous minor qualitative questions

Late returns: 25% of the grade per day of late return.

Problem sets: Use a symbolic form in all your derivations before providing a numerical answer. Present a detailed methodology of how the answer is achieved. Provide numerical values as wherever possible. Indicate units in all figures/estimation results. Attach the source code for computations that require more than several steps. Use *metric* units only.

Schedule:

Mid-term	February
Take home final quiz	April XX
Quiz turn-in	April XX

Additional references:

Bras, R.L., and I. Rodriguez-Iturbe, Random Functions and Hydrology, Dover Books on Advanced Mathematics, 559 pp., 1994.

Priestly, M.B. (1981, 1991). Spectral Analysis and Time Series. Academic Press (1981)/ Elsevier (1991). (Available in Shapiro Science: QA280.P741)

Ramsey, F. L., and D. Schafer (The Statistical Sleuth: A Course in Methods of Data Analysis, 816, 2002.

Week/ Class	Date	Topic
1/1	01/5-7	*Introduction and Review*: random variables & probability distributions
2/2	01/10-01/14	*Statistical Inference* (SI) from data: sampling distributions, test of significance
2/3	01/10-01/14	SI: confidence intervals; goodness of fit and hypothesis testing
3/4	01/17-01/21	SI: parameter estimation: moments and likelihood inference
3/5	01/17-01/21	SI: graphical presentation of data
4/6	01/24-02/28	SI: single factor analysis of variance
4/7	01/24-02/28	SI: design and power analysis in sampling and experimental design
5/8	01/31-02/4	SI: Monte-Carlo techniques in statistical inference
5/9	01/31-02/4	SI: linear and non-linear regression analysis
6/10	02/7-2/11	SI: linear and non-linear regression analysis
6/11	02/7-2/11	SI: error estimation: bootstrapping, correlated errors, bias, conditional sampling
7/12	02/14-2/18	*Time Series Analysis* (TSA): trends in data; stationary and non-stationary processes
7/13	02/14-2/18	TSA: tests of stationarity in the mean and the variance
8/14	02/21-02/25	**Review of class material**
8/15	02/21-02/25	**Mid-term test.**
	02/26-03/6	**SPRING BREAK**
9/16	03/7-03/11	TSA: autocovariance/correlation and cross covariance/correlation functions
9/17	03/7-03/11	TSA: estimation of auto/cross covariance functions; tests of their significance
10/18	03/14-03/18	TSA: linear autoregressive processes, AR(1), and moving average processes
10/19	03/14-03/18	TSA: AR(1) and MA: model identification, calibration, and use in simulation and forecasting
11/20	03/21-03/25	Fourier analysis: series, integrals, transforms, application to time series analysis
11/21	03/21-03/25	*Spectral Analysis* (SA): spectral density functions; power spectrum
12/22	03/28-04/1	SA: spectra of white noise, linear, AR(1), and MA processes
12/23	03/28-04/1	SA: sampling properties of power spectrum
13/24	04/4-04/8	SA: smoothing of spectral estimators
13/25	04/4-04/8	SA: spectral windows and their properties
14/26	04/11-04/15	SA: examples of spectral estimation
14/27	04/11-04/15	SA: spectrum sampling
15/28	04/18-04/19	**Review of class material. Take home final quiz.**
		Quiz turn-in

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

Form Number 2154
Date 4/15/2010
Effective Term Winter 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: EECS Elec Engin & Computer Sci / Course Number: 418
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Power Electronics
TITLE ABBREVIATION — Time Sched Max = 19 Spaces	Power Electronics
TITLE ABBREVIATION — Transcript Max = 20 Spaces	Power Electronics
Course Description	Course Description for Official Publication (Max = 50 words): AC-DC, DC-DC switch-mode power converter topologies. Power converter topologies. Power Semiconductor devices, inductors, capacitors. Loss mechanisms, thermal analysis. Drive, snubber circuits. Laboratory experience with power electronic circuits.
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 (EECS 215 and EECS 216 and preceded or accompanied by EECS 320) or 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 Max; Contact Hrs/Wk; Number of Wks	Credit Hours Min 4 Max 4; Contact Hrs/Wk 4; Number of Wks 14

C.

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

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: Heath Hofmann — Title: Asso. Prof.

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. EECS Khalil Najafi

Cross-listed Dept(s).

Form Number

2154

SUPPORTING STATEMENT

This course covers electronic circuits related to power conversion (e.g., AC-DC conversion, DC-DC conversion). It was offered in FA09 as a special topics class (EECS 498-08) and was highly reviewed (11/13 students responding Q1 4.89). It is being offered again now (FA10) and has 24 students at this time. Student interest and feedback about the course is very good and it serves a previously missing critical need in the EE course offerings.

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

Detail the Special requirements

The power and energy lab (3437 EECS) contains 8 lab stations. Pertinent lab equipment includes DC and 3-phase AC power supplies, a programmable DC electronic load, and components for AC-DC and DC-DC converter circuits.

EECS 498 Power Electronics
Fall 2010

1. Prerequisites: EECS 215 and 216, or graduate standing

2. Lecture, Lab Times:

Lecture: MW 3-4:30 in 3427 EECS

Lab: Lab times will be assigned after receipt of student's schedules.

3. Purpose: Meeting the future's energy and environmental challenges will require the efficient conversion of electrical energy from one form to another. This course will discuss the circuits used to efficiently convert AC power to DC power, DC power from one voltage level to another, and DC power to AC power. The components used in these circuits (e.g., diodes, transistors, capacitors, inductors) will also be covered in detail. A key aspect of power electronic circuits is the control algorithms used to achieve the desired behavior (e.g., output voltage regulation), and so control theory as it applies to these circuits will be discussed. A lab will be held with the class where the students will obtain hands-on experience with power electronic circuits.

4. Objectives: Upon successful completion of this course, the student should:

1. Understand how fundamental power electronic circuit topologies operate.
2. Quantitatively determine the power quality impact of AC-connected power electronic circuits.
3. Be able to design control algorithms for DC-DC converter circuits.
4. Be familiar with the properties of power semiconductor devices (i.e., diodes, transistors, ...) as they are used in power electronic circuits.
5. Understand how to calculate the efficiency of power electronic circuits.
6. Be able to analyze and design magnetic inductors and transformers for power electronic circuits.
7. Possess a basic understanding of the cooling of power electronic circuits
8. Have hands-on experience with many power electronic circuit topologies in the laboratory.
9. Have designed a power electronic circuit as part of a course project.

5. Topics

AC-DC Conversion
DC-DC Conversion
- Fundamental converter topologies
- Isolated converter topologies

Control of DC-DC Converters
Power Semiconductor Devices
- Diodes
- Thyristors
- BJTs
- MOSFETs
- IGBTs

Power Electronic Components
- Capacitors
- Inductors, Transformers

Auxiliary Circuitry

Gate and Base Drive Circuits
"Snubber" Circuits
Thermal Analysis

6. Texts:

Required:
Mohan, Undeland, and Robbins. *Power Electronics*, 3rd edition. John Wiley & Sons, Inc. New York, 2003.
Suggested:
Kassakian, Schlecht, and Verghese. *Principles of Power Electronics.* Addison-Wesley. Reading, Mass., 1991.
Krein. *Elements of Power Electronics.* Oxford University Press. New York, 1998
Erickson and Maksimovic. *Fundamentals of Power Electronics,* 2nd edition. Springer. New York, 1999.

7. Instructors:

Prof. Heath Hofmann
4116 EECS
(734) 647-1107
hofmann@eecs.umich.edu

Office hours:
Tuesdays and Wednesdays 10:30-12
Other times by appointment

Prof. G.R. Lahiji
3115 EECS
(734)763-1156
roientan@umich.edu

Office hours:
Monday and Thursday 1:30-3:00
Other times by appointment

8. Exams: The class will have one in-class midterm (whose time has yet to be determined) and a fina.l If you have a valid reason for missing the midterm, you must notify the instructor at least two weeks in advance so that a conflict exam can be prepared. Students from all sections will take identical exams. Exams are closed-book, but each student is allowed a single 8.5" by 11" note sheet. Exams are returned during lecture sessions. ~~Any student caught cheating on an exam will receive a grade of 0 for the exam. Additional sanctions may also be pursued, following university guidelines.~~

9. Homeworks: Homeworks will be assigned on Mondays, and, unless otherwise noted, will be collected during lecture on the Wednesday of the following week. Students are encouraged to discuss homework problems in groups. **However, each student must submit their own work.** Students submitting identical work will receive a grade of zero for the homework set. Problem set solutions will be posted on the CTOOLs web site. Graded homework sets will be returned in class. **Late homework will not be accepted.** However, the lowest homework score will be dropped in calculating your overall homework grade. In order to perform well on the exams, it is important that you work each problem assigned. Although your final homework grade may be unaffected if you do not turn in one of the problem sets, your exam grades, which play a much larger role in determining your final grade, will be adversely affected.

10. Labs: In addition to the lectures, a lab will be held every week where the students will obtain hands-on experience with electric machines and drives. Students will work with a partner in the labs, and submit a joint lab report. In addition to including the data obtained during the lab, lab reports must be well-written and clearly explain the concepts presented during the lab. It is **not**

acceptable to use data collected by other lab teams in your lab report; you must use your own. If there are problems with your lab data, contact the lab assistant. Measured results will be compared to expected values, with any discrepancies clearly discussed. Further information on the preparation of lab reports will be handed out during the first lab section.

Lab times will be established during the first week of classes, after student's schedules have been submitted, to determine times that will work best.

11. Project: At the end of the semester, students will complete a project involving the design, construction, testing, and demonstration of a power electronic circuit. Students will work on the project during lab times with their lab partner.

12. Grading: The following weighting factors determine your total course score:

Project	**10%**
Homework	**20%**
Lab Reports	**20%**
Midterm	**25%**
Final	**25%**

The class average does not determine the cutoff points for letter grades. Instead, the cutoff points reflect the technical competencies required of an electrical engineer. The following scale determines your final course grade:

A+	95%-100%
A	90%-95%
A-	85%-90%
B+	80%-85%
B	75%-80%
B-	70%-75%
C+	65%-70%
C	60%-65%
C-	55%-60%
D+	50%-55%
D	45%-50%
D-	40%-45%
E	<40%

At the discretion of the instructor, the minimum score needed to earn a certain letter grade may be lowered, but it will not be raised.

13. Web Page: Problems sets and other important files and announcements will be posted on the EECS 498 CTOOLS site.

14. Attendance: Although attendance will not be taken, you are expected to attend lecture. It is a student's responsibility to acquire handouts and information disseminated in class.

15. Honor Code: Students in the College of Engineering at the University of Michigan are expected to be intimately familiar with its Honor Code. Details of the Honor Code are available online at:

http://www.engin.umich.edu/students/honorcode/

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

Form Number 2155
Date 4/15/2010
Effective Term Winter 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:	Home Department: EECS Elec Engin & Computer Sci
Course Number:	Course Number: 419
☐ Cross Listed Course Information:	Cross Listed Course Information:
Course Title:	Course Title: Electric Machinery and Drives
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	Elec Mach and Drives
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	Elec Mach and Drives
Course Description:	Course Description for Official Publication (Max = 50 words): Generation of forces and torques in electromechanical devices. Power electronic drives, motion control. DC machines. AC machines, surface mount permanent magnet machines, induction machines. Applications examined include electric propulsion drives for electric/hybrid vehicles, generators for wind turbines, and high-speed motor/alternators for flywheel energy storage systems. Laboratory experience with electric drives.
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: ((Phys 240 or 260) and EECS 215 and EECS 216) or 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 Max:	Credit Hours Min 4 Max 4
Contact Hrs/Wk:	Contact Hrs/Wk 4
Number of Wks:	Number of Wks 14

C.

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

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: Heath Hofmann — Title: Asso. Prof.

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. EECS Khalil Najafi

Cross-listed Dept(s).

Form Number

2155

SUPPORTING STATEMENT

This course covers fundamental materials (i.e., electro mechanical devices, control theory, power electronics) related to electric drives. It was offered in WN10 as a special topics class (EECS 498-07) and was highly reviewed (14/22 students responding Q1 4.42). The class served both graduate and undergraduate students from programs including EE, ME, Concurrent Marine Design, Energy Systems Engineering, Naval Architecture and Design, and Space Engineering. It addresses needs both in the EE program and has broad interest across the College.

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

Detail the Special requirements

The power and energy lab (3437 EECS) contains 8 lab stations. Pertinent lab equipment includes a DC power supply, electric drive circuitry, microcontroller, and a motor dyne which includes DC, AC permanent magnet, and AC induction machines.

EECS 498 Electric Machinery and Drives

1. **Prerequisites**: EECS 215 and 216, or graduate standing

2. **Lecture, Lab Times:**
   Lecture: MW 3-4:30 in 3427 EECS
   Lab: Lab times will be assigned after receipt of student's schedules.

3. **Purpose:** In the struggle to address today's energy and environmental challenges, many potential solutions require electro-mechanical energy conversion. Examples include electric propulsion drives for electric and hybrid electric vehicles, generators for wind turbines, and high-speed motor/alternators for flywheel energy storage systems. Each of these systems contains: an electric machine operating either as a motor, a generator, or both; a power electronic circuit which interfaces the machine to a power supply or an electrical system; and a controller which measures electrical and mechanical quantities and uses this information to control the power electronic circuitry. In this course we will cover fundamental electromechanical, power electronic, and control theory in the context of electric drive systems. The capabilities and limitations of different types of electric machines (e.g., permanent magnet, induction) in various drive applications will be covered. MATLAB® Simulink® models will be used throughout the course to give students exposure to the dynamic behavior of these systems. A lab will be held with the class where the students will obtain hands-on experience with electric machines and drives.

4. **Objectives:** Upon successful completion of this course, the student should be able to:
   1. Derive expressions for forces and torques in electromechanical devices.
   2. Understand how power electronic converters and inverters operate.
   3. Possess an understanding of feedback control theory.
   4. Analyze and compare the performance of DC and AC machines.
   5. Understand the maximum power limitations as a function of rotor speed of the above machines when they are connected to electric drives.
   6. Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines.
   7. Develop Simulink® models which dynamically simulate electric machine and drive systems and their controllers.

5. **Topics**
   - Overview of electric machines and drives
   - Review of basic circuits and systems theory
   - Fundamentals of electromechanical devices
     - Flux linkage/current relationships
     - Energy, co-energy
     - Calculation of forces and torques
   - Fundamentals of power electronics
     - Switching elements
     - Pulse-Width-Modulation
   - Fundamentals of control theory
     - Feedback
     - Feedforward
   - DC machines

AC machines

Equivalent 2-phase models of three-phase machines
Surface-mount permanent magnet machines
Synchronous reluctance machines
Interior permanent magnet machines
Induction machines

6. Required Text: none (course handouts)
Suggested Texts:

T. Lipo and D. Novotny. *Vector Control and Dynamics of AC Drives.* Oxford, 1996.
R. Krishnan. Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, 2001.
N. Mohan. *Electric Drives: An Integrative Approach.* MNPERE, 2001.

7. Instructor:

Prof. Heath Hofmann
4116 EECS
(734) 647-1107
hofmann@eecs.umich.edu

Office hours:
TBD

Other times by appointment

8. Exams: The class will have one in-class midterm (whose time has yet to be determined) and a final If you have a valid reason for missing the midterm, you must notify your instructor at least two weeks in advance so that a conflict exam can be prepared. Students from all sections will take identical exams. Exams are closed-book, but each student is allowed a single 8.5" by 11" note sheet. Exams are returned during recitation/laboratory sessions. ~~Any student caught cheating on an exam will receive a grade of 0 for the exam. Additional sanctions may also be pursued, following university guidelines.~~

9. Homeworks: Homeworks will be assigned on a weekly basis. Each homework will have approximately six problems. In addition to the standard analytical problems, most homework assignments will also require the student to develop and model a system using Simulink®. Students are encouraged to discuss homework problems in groups. **However, each student must submit their own work.** Students submitting identical work will receive a grade of zero for the homework set. Unless otherwise noted, homework sets are posted on the CTOOLs web site and are due one week later in class. Problem set solutions will be posted on the CTOOLs web site. Graded homework sets will be returned in class. **Late homework will not be accepted.** However, the lowest homework score will be dropped in calculating your overall homework grade. In order to perform well on the exams, it is important that you work each problem assigned. Although your final homework grade may be unaffected if you do not turn in one of the problem sets, your exam grades, which play a much larger role in determining your final grade, will be adversely affected.

10. Labs: In addition to the lectures, a lab will be held every other week where the students will obtain hands-on experience with electric machines and drives. Students will submit a lab report for each lab. In addition to including the data obtained during the lab, lab reports must be well-written and clearly explain the concepts presented during the lab. Measured results will be compared to expected values, with any discrepancies clearly discussed.

Lab times will be established during the first week of classes, after student's schedules have been submitted, to determine times that will work best.

11. Grading: The following weighting factors determine your total course score:

Homework	**25%**
Lab Reports	**25%**
Midterm	**25%**
Final	**25%**

The class average does not determine the cutoff points for letter grades. Instead, the cutoff points reflect the technical competencies required of an electrical engineer. The following scale determines your final course grade:

A+	95%-100%
A	90%-95%
A-	85%-90%
B+	80%-85%
B	75%-80%
B-	70%-75%
C+	65%-70%
C	60%-65%
C-	55%-60%
D+	50%-55%
D	45%-50%
D-	40%-45%
E	<40%

At the discretion of the instructor, the minimum score needed to earn a certain letter grade may be lowered, but it will not be raised.

12. Web Page: Problems sets and other important files and announcements will be posted on the EECS 498 CTOOLS site.

13. Attendance: Although attendance will not be taken, you are expected to attend lecture. It is a student's responsibility to acquire handouts and information disseminated in class.

14. Honor Code: Students in the College of Engineering at the University of Michigan are expected to be intimately familiar with its Honor Code. Details of the Honor Code are available online at:

http://www.engin.umich.edu/students/honorcode/

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

Form Number 2157
Date 4/29/2010
Effective Term Winter 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: EECS Elec Engin & Computer Sci / Course Number: 463
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Power Systems Design and Operation
TITLE ABBREVIATION — Time Sched Max = 19 Spaces / Transcript Max = 20 Spaces	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Power Sys Deg and Ope / Transcript Max = 20 Spaces: Power Sys Deg and Ope
Course Description	Course Description for Official Publication (Max = 50 words): Power systems overview; Fundamentals: phasors, complex power, three phases; Transformer modeling; Transmission line modeling; Power flow analysis; Power system control; Protection; Economic operation and electricity markets; Impact of renewable generation on grid operation and control.
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: ((Phys 240 or 260) and EECS 215 and EECS 216) or 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 Max; Contact Hrs/Wk; Number of Wks	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? 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: Ian Hiskens — Title: Prof.
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. EECS Khalil Najafi
Cross-listed Dept(s).

Form Number

2157

SUPPORTING STATEMENT

This course provides an in-depth presentation of power systems. The depth, breadth, and intensity of the class is appropriate for senior undergraduate and beginning graduate students. It has been taught previously as a special topics class. In FA09 (498-04) there were 31 students (both undergraduate and graduates) for EE, Aero, Nuclear Eng. & Radiolog Sciences, Energy Systems Engineering, Natural Res & Environment, and IOE. The Q1 rating was 4.08. It addresses needs both in the EE program and has broad interest across the College.

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

Detail the Special requirements

University of Michigan
Department of Electrical Engineering and Computer Science

EECS498-4 - Power System Analysis and Design
Fall 2009

Course Administration and Outline

Instructor:	Professor Ian Hiskens 4437 EECS Building Phone: (734) 615-7076; Email: hiskens@umich.edu Office hours: Thursday 10:00am-noon
References:	J.D. Glover, M.S. Sarma and T.J. Overbye, *Power System Analysis and Design, 4th Edition*, Thomson, 2008. A.R. Bergen and V. Vittal, *Power Systems Analysis*, 2nd Edition, Prentice Hall, 2000.
Web Site:	All course material will be published on CTools.
Software:	Powerworld Simulator software will be used for illustrations and homework assignments. MATLAB will also be useful.
Homework:	Around 10 problem sets will be assigned. The worst homework grade will be dropped in computing the overall course grade. A small design project will be assigned around mid-semester, due end of semester.
Exams:	A mid-term exam will be held during class on Wednesday, November 4. *Please report conflicts early.* The final exam will be held during the official end-of-semester examination week.
Grading Policy:	Homework 20%; Mid-term exam 25%; Project 15%; Final exam 40%.
Syllabus:	See over...

Topics

1. Electric Power System Background
    - Overview of system structure: generation, transmission, and distribution
    - Utility scale systems versus industrial plant scale systems
    - Utility restructuring and "deregulation"
2. Fundamental Analysis Techniques
    - Review of phasors in sinusoidal steady state circuit analysis
    - RMS quantities
    - Concepts of active and reactive power
    - Three phase operation
3. Transformer Modelling
    - Three phase connections and per phase analysis
    - Per unit normalization
    - Use of tap changing and phase shifting transformers for control
4. Power Flow Analysis
    - Power flow formulation and solution techniques
    - Variable decoupling
    - Applications
5. Transmission Line Parameters and Modelling
    - Line geometry and physical parameters
    - Lumped circuit equivalent models
6. Power System Operation and Control
    - Voltage and frequency regulation
    - Generation and system control
    - Infrastructure requirements for controlling loads: thermostatically-controlled loads, plug-in electric vehicles
7. Grid Connection of Renewable Generation
    - Wind farm topology
    - Connection to weak grids
    - Variability inherent in renewable generation
8. Economic Operation and Competitive Markets
    - Traditional economic dispatch; relation to Power Pool concepts
    - Inclusion of system losses and equipment constraints
9. Faults and System Protection
    - Use of symmetrical components in fault calculations
    - Protection devices

Mission, goals, and educational objectives

Mission	To provide a solid and current technical foundation that prepares students for a career in chemical engineering or related fields.
Goals	To educate and support diverse students and prepare them to be leaders in chemical engineering or related fields.#
Educational Objectives	To provide students with a solid foundation in chemical engineering, while preparing them for a broad range of career opportunities. The program's primary emphasis is on chemical engineering fundamentals, while allowing students to personalize their curriculum to prepare them for ~~traditional~~ chemical engineering ~~careers and diver~~and multidisciplinary~~se~~ careers in areas such as medicine, law, energy and the environment, and biotechnology. To provide opportunities for teamwork, open ended problem solving and critical thinking.

Chemical Engineering program outcomes:

1. an ability to apply knowledge of mathematics, science, and engineering to chemical engineering problems [ABET: 3a]
2. an ability to design and conduct experiments, as well as to analyze and interpret data [ABET: 3b]
3. an ability to design a system, component, or process to meet desired needs [ABET: 3c; Program~~: 2~~]
4. an ability to function on multi-disciplinary teams [ABET: 3d]
5. an ability to identify, formulate, and solve engineering problems [ABET: 3e]
6. an understanding of professional and ethical responsibility [ABET: 3f]
7. an ability to communicate effectively orally and in writing [ABET: 3g]
8. the broad education necessary to understand the impact of engineering solutions in a global and societal context [ABET: 3h]
9. a recognition of the need for, and an ability to engage in life-long learning [ABET: 3i]
10. a knowledge of contemporary issues [ABET: 3j]
11. an ability to use the techniques, skills, and modern engineering and computing tools necessary for engineering practice [ABET: 3k; Program~~:~~ ~~2~~]
12. a thorough grounding in chemistry, physics, biology and materials science, with courses ~~and a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials, biochemistry, or environmental science,~~ selected based on the student's interest. [Program~~: 1~~]
13. a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control, chemical process economics, and design [Program~~: 2~~]

~~Program:1 and program:2 refer to old ChE criteria.~~

Approved by the Chemical Engineering faculty September 27, 2010 #