

**The University of Michigan
College of Engineering
Curriculum Committee**

**Agenda
October 21, 2003
1:30-3:00 p.m.
GM ROOM
Fourth Floor Lurie Engineering Center**

1. Approval of Minutes from September 30, 2003 Meeting
 2. ENGR 450 Presentation – Bob Dennis
 3. Course Approval Forms
 4. ENGR 400 Presentation – Bill Schultz
-

**University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday September 30, 2003
1:30-3:30 p.m.
Lurie Engineering Center GM Room
Minutes**

Greg Hulbert called the meeting to order at 1:40 p.m.

Members Present: G.Hulbert, C. Cesnik E. Chan, V. Chung J.Fessler, W. Hansen, J. Holloway, S. Montgomery, M. Parsons, J. Patel, H. Peng, R. Robertson, P. Samson

Members Absent: S. Pang, S. Takayama L. Thompson

Guest: Susan Bitzer sitting in for S.Takayama

Greg Hulbert suggested that meeting times be changed from 1:30 to 3:30 p.m. to: 1:30 to 3:00 p.m. since the meeting seems to thin out around 3:00. This change was approved.

Motion to approve the minutes of the last meeting

Under **Enforced/Advised Pre-requisites**: Addition: *The Curriculum Committee does NOT need to approve course changes from advised to enforced, or vice-versa.* The word *abstentions* under course approvals (ME 587) was corrected

The minutes of the last meeting were approved

NAME Program Changes

Included in the Meeting Packet were a letter from Michael Parsons regarding a NAME program change and the NAME sample schedule change

Mike talked about these. This was a continuation of the courses that were changed in the last CC meeting, an effort to respond to the change in Thermodynamics and Mechanical as well as strengthen the Electrical component of the NAME program. This was done by changing two 4 credit courses down to 3 credit hours (NAME 330 4 credits **changed** to *NAME 331 3 credits*; NAME 430 4 credits **changed** to *NAME 431 3 credits*).

Susan Montgomery noted that now this is down to nine unrestricted electives and that is the limit. Greg Hulbert called for motion to approve the NAME Program Change and the sample schedule pending approval of NAME 491. This was moved and seconded

Motion Carried (approved)

Greg noted that this will be going to the College Faculty meeting on October 21.

Course Approvals

Tabled Course: EECS 420 Modification – Changing Course Title, Changing Description.
Tabled Pending Syllabus.

Greg Hulbert called for a motion to approve the following courses. This was moved and seconded.

Motion Carried (approved)

CEE 432 Deletion

CEE 500 (X-Listed with CHE 500 and ENSCEN 500) New Course Approved pending change in course description regarding water.

NAME 491 New Course

This was moved and seconded.

Greg Hulbert noted that he had sent out an e-mail regarding using the e-mail sub-committee for course approval forms and this will be in place for the next meeting. The course approvals will be sent to the Committee by Judy the Tuesday before the next CoE CC Meeting.

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

Next Meeting

Tuesday, October 21, 2003

1:30-3:00 p.m.

GM Room-LEC

COURSE APPROVAL FORMS

For October 21, 2003 CoE CC Meeting

CEE 230 New Course

CEE 490 Modification – Changing Max Credit Hours from 3 to 4.

ENGR 450 New Course

IOE 333 Modification – Changing Pre-requisites from IOE 265 to: *Preceded or accompanied by IOE 265*

IOE 836 Modification – Changing Level of Credit from Rackham Grad to: *Rackham Grad and Non-Rackham Grad*; Changing Max Credit Hours from 2 to: *1*

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

Date 3/7/2003

Effective Fall 2003

A. CURRENT LISTING

Home Department _____ Div # _____ Course Number _____

Cross Listed Course Information _____

Course Title _____

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

Course Description _____

B. REQUESTED LISTING

Home Department _____ Div # _____ Course Number _____
Civil & Environmental Engineering 248 230

Cross Listed Course Information _____

Course Title
Thermodynamics

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

Course Description for Official Publication (Max = 50 words)

Engineering thermodynamics. First and second law applications for closed and open systems. Heat and refrigeration cycles. Physical properties of fluids and equations of state. Phase equilibria for pure fluids and fluid mixtures. Chemical reaction equilibria and aqueous-phase chemistry. Combustion processes. Vapor-liquid and solid-liquid equilibria.

PROGRAM OUTCOMES:

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

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

Prerequisites _____

☐ 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

PROGRAM OUTCOMES:

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

Degree Requirements ☐ Degree Requirement ☐ Free Elective ☐ Other
☒ Core Course ☐ Tech Elective

Prerequisites _____

☒ 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

C. Repeatability (Indi Research, Dir. Study, Dissertation:

Is this course repeatable? ☐ Yes ☒ No

Maximum Hours? _____

Maximum 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
☐ S/U
☐ P/F
☐ Y

Location

☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Printing Information
(Optional)

☒ Print the course in the Bulletin
☐ Print the course in the Time Schedule

Terms & Freq. of Offering ☒ I ☐ II ☐ IIIa ☐ IIIb ☐ III

☒ Yearly ☐ Alter Years ☐ Even Years ☐ Odd Years

Half term ☐ 1st
☐ 2nd

Cognizant Faculty
Member:

C. Lastoskie

Title Assoc. Professor

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

Approval

☐ Curriculum Comm.

☐ Faculty

☐ Rackham

☐ Cross listed Unit 1

☐ Cross listed Unit 2

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

Name, Signature & Department

Home Dept. Nikolaos Katopodes, CEE

Cross-listed Dept(s): _____

SUPPORTING STATEMENT

CEE 230 is the new undergraduate thermodynamics course in the CEE program. Additional supporting documentation for the introduction of this course is being provided to the College Curriculum Committee.

This course is being created to address problems that have been identified with CEE students taking the ME or CHE thermodynamics courses to satisfy their thermodynamics requirement. These courses are not well suited to provide the thermodynamics instruction that CEE students need due to an emphasis on mechanical systems (in the ME course) and an overlap in content with CEE 260 (in the case of the CHE course). The new CEE 230 course will provide thermodynamics instruction with an emphasis on phase equilibria and chemical equilibrium calculations, a key component of the environmental portion of the CEE curriculum. The CEE 230 thermodynamics course will also integrate more effectively with the introductory environmental engineering course, CEE 260.

Are any special resources or facilities required for this course?

☐ Yes ☒ No

Detail the Special requirements

Justification for new CEE Thermodynamics course:

Presently, CEE students have a choice between taking one of two courses, CHE 230 or ME 235, to satisfy their thermodynamics requirement. Neither course has proven to be satisfactory, for reasons detailed herein.

The ME thermodynamics course is principally focused on application of energy and entropy balances for analysis of heating and refrigeration cycles, work outputs and power generation, engines, and automotive or other propulsion systems. The textbook and course outline for ME 235 give relatively little attention to the topics of phase equilibria and chemical equilibria (one textbook chapter of coverage for each). While some coverage of heating and cooling cycles and work/power calculations is useful to CEE students as “general thermodynamic knowledge”, the environmental portion of the CEE curriculum is better served by giving more attention to the subjects of phase equilibrium and reaction equilibrium (particularly for aqueous systems), while de-emphasizing the engine-related topics in thermodynamics.

The textbook and syllabus proposed for CEE 230 follows this recommendation, devoting three chapters of coverage to phase equilibria and two chapters to chemical reaction equilibria. The increased attention to these topics will benefit CEE students “down the line” when they need to apply their knowledge of phase and chemical equilibria to determine the distribution of reactive pollutants in multiphase environmental systems (air/surface water, soil/groundwater, etc.) in CEE 260, and to the design of pollution treatment systems for water, wastewater, soil and air in CEE 360 and 460. This is not meant to imply that the “ME flavored” topics of heating and refrigeration, power cycles and engines are not useful or important to know about; rather, it is argued here that they are less essential to the education of a CEE student than other topics that need to be covered within the allotted 4 credit hours for the thermodynamics portion of the CEE B.S. degree program.

The CHE 230 course covers phase equilibrium in more detail than ME 235, and so thematically it is a better fit to the CEE curriculum than ME 235. The problem with CHE 230 is that its coverage of material balances extensively overlaps the content of CEE 260. This redundancy penalizes CEE students, who do not normally go on to take the second course in the CHE thermodynamics sequence, CHE 330, in which topics such as solution chemistry and reaction equilibria are presented. Eliminating the topic of material balances from CEE 260 is not an option, because this course is the introductory CEE course in environmental engineering and as such it is taken by many non-majors (e.g. IOE students) who need instruction on material balance concepts. A new CEE thermodynamics course, CEE 230 is therefore indicated as the best solution to eliminating content overlap with CHE 230. This will also impart the additional benefit of providing more detailed coverage of phase equilibrium and reaction equilibrium, important content areas in environmental engineering that are not adequately addressed for CEE students by the ME 235 thermodynamics course.

CEE 230: Thermodynamics
Course Information

Text: Chemical and Process Thermodynamics, 3rd edition,
by B.G. Kyle, Prentice Hall, NJ, 1999

Coverage: Chapters 1-6, 8-9, 11-15

Chapter 1:	Introduction, process variables
Chapter 2:	First law, energy balances
Chapter 3:	Physical properties of fluids
Chapter 4:	Second law, entropy concepts
Chapter 5:	Free energy functions
Chapter 6:	Heat effects
Chapter 8:	Phase diagrams
Chapter 9:	Phase equilibrium calculations
Chapter 11:	Ideal and nonideal solutions
Chapter 12:	Chemical equilibrium
Chapter 13:	Reactive systems
Chapter 14:	Mixing and separation processes
Chapter 15:	Heating and refrigeration cycles

Schedule: Offered yearly in Fall semester, starting Fall 2003

Lecture	WF	2:30 – 4:00
Recitation	M	2:30 – 3:30

Homework: 7-8 homework sets (~1 every 2 weeks)

Exams: Two one-hour midterm exams (weeks 6 & 12)
One two-hour final exam
All exams will be open book and open lecture notes

Grading:	Three exams (2 midterms + final) @ 25% each	=	75%
	<u>Homework average</u>	=	<u>25%</u>
	Total		100%

Website: A course website will be maintained on U-M Coursetools

CEE 230: Thermodynamics
Draft Syllabus

Week	Assigned Reading	Coverage
1	Chp 1,2	Introduction; the first law
2	Chp 2,3	Energy balances; phase diagrams
3	Chp 3	Equations of state; compressibility charts
4	Chp 4	Second law; reversibility
5	Chp 4,5	Entropy balances; free energy functions
6	Chp 6	Heat capacities; heats of formation
7	Chp 6,8	Applied thermochemistry; thermodynamic tables
8	Spring Break	
9	Chp 8,9	Pure component phase equilibria; phase rule
10	Chp 9	Ideal solutions; activity coefficients
11	Chp 11	Phase equilibria of mixtures; solubility
12	Chp 12	Chemical equilibria; standard states
13	Chp 12, 13	Reactions in aqueous solution; multiphase reactions
14	Chp 14	Mixing and separation; combustion reactions
15	Chp 15	Thermodynamic cycles; refrigeration

SAMPLE - REVISED STEP II

1-12-99

STEP II: Civil & Environmental Engineering Program

COURSE #: CEE 230	COURSE TITLE: Thermodynamics
TERMS OFFERED: Fall	PREREQUISITES: Chem 125&130 or Chem 210&211; Math 116
TEXTBOOKS/REQUIRED MATERIAL: Chemical and Process Thermodynamics, 3 rd edition, by B.G. Kyle, Prentice Hall, NJ 1999	COGNIZANT FACULTY: C. Lastoskie DATE OF PREPARATION: 2/20/2003
INSTRUCTOR(S): C. Lastoskie	SCIENCE/DESIGN: 3.5/0.5
CATALOG DESCRIPTION: Engineering thermodynamics. First and second law applications for closed and open systems. Heat and refrigeration cycles. Physical properties of fluids and equations of state. Phase equilibria for pure fluids and fluid mixtures. Chemical reaction equilibria and aqueous-phase chemistry. Combustion processes. Vapor-liquid and solid-liquid equilibria.	COURSE TOPICS: (number of hours in parentheses) 1. First law and energy balances (5) 2. Equations of state (4) 3. Second law and entropy balances (5) 4. Enthalpy and heat capacity (6) 5. Pure-component phase equilibria (5) 6. Multicomponent phase equilibria (5) 7. Chemical reaction equilibria (8) 8. Thermodynamic cycles (4)

COURSE OBJECTIVES (links refer to course outcomes)	1. To teach students how to formulate energy and entropy balances for flow and nonflow systems. [1,5,6] 2. To educate students on the physical properties and phase behavior of pure substances. [1,2,6] 3. To instruct students in the application of the first and second laws of thermodynamics for analysis of physical processes. [1,6] 4. To teach students how to carry out phase equilibrium calculations for gas and liquid mixtures. [2,3] 5. To educate students on principles of aquatic chemistry and solution-phase chemical reaction equilibria calculations. [3,4,5] 6. To instruct students on how to formulate elemental balances for analysis of combustion and other chemical reactions. [4,5]
COURSE OUTCOMES (links refer to COE outcomes)	1. Construct and solve energy and entropy balances for calculation of heat requirements and work inputs/outputs of physical processes. [a,c,e] 2. Use equations of state and/or thermodynamic charts and tables to determine the physical properties of substances. [a] 3. Determine the compositions of gas and liquid mixtures using activity relationships, Raoult's and Henry's laws. [a] 4. Calculate the compositions of reactive aqueous solutions from chemical equilibrium equations. [a] 5. Analyze combustion processes and chemical/biological reaction systems using elemental mass balances. [a,e] 6. Combine conservation equations and thermophysical property data to solve design problems in civil and environmental engineering. [a,c,e,k]
ASSESSMENT TOOLS	1. Weekly homework problem sets. 2. Two midterm examinations and one final examination. 3. Lecture and office-hour discussions and student course evaluations.

Due Date:

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

Date 5/5/2003

Effective Fall 2003

A. CURRENT LISTING

Home Department _____ Div # _____ Course Number _____

Cross Listed Course Information

Course Title

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

Course Description

B. REQUESTED LISTING

Home Department _____ Div # _____ Course Number _____
Civil and Environmental Engineering 248 490

Cross Listed Course Information

Course Title
Independent Study in Civil and Environmental Engineering

TITLE _____
ABBRE- _____
VIATION _____
Time Sched _____
Max = 19 Spaces
Transcript _____
Max = 20 Spaces
Indep Study CE
Ind Study CE

Course Description for Official Publication (Max = 50 words)

Individual or group experimental or theoretical research in any area of Civil and Environmental Engineering. The program of work is arranged at the beginning of each term by mutual agreement between the student and a faculty member. Written and oral reports may be required.

PROGRAM OUTCOMES:

a b c d e f g h i j k

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

Prerequisites ☐ 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
1 3

Contact

Hrs/Wk _____
Number of Wks _____

PROGRAM OUTCOMES:

a b c d e f g h i j k

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

Prerequisites ☐ Permission of Instructor
☒ 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
1 4

Contact

Hrs/Wk _____
Number of Wks _____

C. Repeatability (Indi Research, Dir. Study, Dissertation:

Is this course repeatable? ☐ Yes ☐ No

Maximum Hours? _____ Maximum 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
☐ S/U
☐ P/F
☐ Y

Location

☒ Ann Arbor
☐ Biological Station
☐ Camp Davis
☐ Extension

Printing Information (Optional)

☒ Print the course in the Bulletin
☒ Print the course in the Time Schedule

Terms & Freq. of Offering ☒ I ☒ II ☐ IIIa ☐ IIIb ☐ III
☒ Yearly ☐ Alter Years ☐ Even Years ☐ Odd Years

Half term ☐ 1st
☐ 2nd

Cognizant Faculty Member:

Title

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

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

Name, Signature & Department

Home Dept. Nikolaos Katopodes, CEE

Cross-listed Dept(s):

Approval

☐ Curriculum Comm.

☐ Faculty

☐ Rackham

☐ Cross listed Unit 1

☐ Cross listed Unit 2

[illegible]

Yes No

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	5
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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

Date 10/7/2003

Effective Winter 2004

A. CURRENT LISTING

B. REQUESTED LISTING

Home Department		Div #	Course Number
Engineering		258	450
Cross Listed Course Information			
Course Title			
TITLE ABBREVIATION		Time Sched Max = 19 Spaces	
		Transcript Max = 20 Spaces	
Course Description			
Course Description for Official Publication (Max = 50 words) A senior capstone interdisciplinary engineering design experience. The student is exposed to the design process from concept through analysis to system integration, prototyping, testing and report. Interdisciplinary projects are proposed from the different areas within engineering. Two hours of lecture and two laboratories.			
PROGRAM OUTCOMES: <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e <input type="checkbox"/> f <input type="checkbox"/> g <input type="checkbox"/> h <input type="checkbox"/> i <input type="checkbox"/> j <input type="checkbox"/> k			
Degree Requirements <input type="radio"/> Degree Requirement <input type="radio"/> Free Elective <input type="radio"/> Other <input type="radio"/> Core Course <input type="radio"/> Tech Elective			
Prerequisites <input type="radio"/> Enforced <input type="radio"/> Advised			
Credit Restrictions			
Level of Credit		Credit Hours Min Max	Contact Hrs/Wk
<input type="checkbox"/> Undergrad only <input type="checkbox"/> Rackham Grad <input type="checkbox"/> Non-Rackham Grad <input type="checkbox"/> Ugrad or Rackham Grad			
<input type="checkbox"/> Ugrad or Non-Rackham Grad <input type="checkbox"/> All Credit types <input type="checkbox"/> Rackham Grad w/add'l Work			
			Number of Wks
Repeatability (Indl Research, Dir. Study, Dissertation): Is this course repeatable? <input type="radio"/> Yes <input checked="" type="radio"/> No Maximum Hours? Maximum Times? Can it be repeated in the same term? <input type="radio"/> Yes <input type="radio"/> No			
Printing Information (Optional) <input checked="" type="checkbox"/> Print the course in the Bulletin <input checked="" type="checkbox"/> Print the course in the Time Schedule			
Terms & Freq. of Offering <input checked="" type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> IIIa <input type="checkbox"/> IIIb <input type="checkbox"/> III <input type="checkbox"/> Yearly <input type="checkbox"/> Alter Years <input type="checkbox"/> Even Years <input type="checkbox"/> Odd Years			
Half term <input type="checkbox"/> 1st <input type="checkbox"/> 2nd			
Cognizant Faculty Member: Robert Dennis Title Associate Professor			
Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty			

Approval

☐ Curriculum Comm.

☐ Faculty
☐ Rackham

☐ Cross listed Unit 1
☐ Cross listed Unit 2

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

Name, Signature & Department

Home Dept. Engineering Levi Thompson

Cross-listed Dept(s).

SUPPORTING STATEMENT

The design faculty at the University of Michigan have a collective vision and consensus that a multidisciplinary Major Design Experience (MDE) involving students from many different departments, both within and outside of the CoE, would provide an excellent opportunity... for professional development and technical training of our students. Toward realizing this vision, we propose a pilot course "ENG 450" to be offered by the CoE initially as a senior capstone design experience, with the understanding that the scope and inclusiveness of the course is to evolve as we gain experience with such a course. By developing this course, U of M will assume a position of international leadership in design curricula for complex systems.....

Are any special resources or facilities required for this course?

☐ Yes ☐ No

Detail the Special requirements

ENG450: Multidisciplinary Design

CATALOG DESCRIPTION: A senior capstone interdisciplinary engineering design experience. The student is exposed to the design process from concept through analysis to system integration, prototyping, testing and report. Interdisciplinary projects are proposed from the different areas within engineering. Two hours of lecture and two laboratories.

<u>Core Instructors (first 2 terms)</u>	<u>Departmental Affiliation</u>
Robert Dennis	Mechanical & Biomedical Engineering
Sridhar Kota	Mechanical Engineering
Nilton Renno	Atmospheric, Oceanic & Space Science
Thomas Zurbuchen	Space Physics Research Laboratory

<u>Pilot Project Leaders:</u>	<u>contact information</u>
Robert Dennis (Faculty)	bobden@umich.edu
Nilton Renno (Faculty)	nrenno@umich.edu
Thomas Zurbuchen (Faculty)	thomasz@umich.edu
Michael A Drake (Corporate Relations)	madrake@umich.edu
Anna Paulson (student, Mars Rover Team)	apaulson@umich.edu

Long range objective:

To develop a curriculum that provides all engineering students with an opportunity to engage in a truly multidisciplinary design experience that crosses the boundaries of individual departments and academic term limitations, and to promote excellence in system-level design, complex project management, technical communication, and student-to-student mentoring and leadership skills.

Vision:

To establish a multidisciplinary major design experience that provides systems engineering training for undergraduate students.

Credits: 4 Credit Hours. Credit toward program will be defined by each Department: "Free Elective", "Technical Elective", or "Senior Capstone Design Requirement".

Lectures: two one-hour lectures each week, plus two three-hour laboratory sessions each week

Web Page: All course materials will be available from a central web page.

Overall structure of the course (divided into the following four periods, approximately by month):

- I - January:** Design Specification + Concept Generation
 - II - February:** Concept Development & Selection, Detailed Design & Process Specification
 - III - March:** α -Prototype & Quantitative Evaluation of Subsystem Performance
 - IV - April:** Redesign, β -Prototype, System Integration & Evaluation, Final Presentation & Report
- Spring/Summer: interested students remain engaged as volunteers, or in independent study courses

Course Structure:

At the beginning of the term the students will be presented with the design opportunity from the standpoint of the overall *mission objective*, not from the standpoint of individual, pre-determined design projects. Each student will select one of the available Design Missions, and design teams will be formed to define and address a set of open-ended design problems for each mission. In subsequent terms, part of this effort will be directed toward developing an understanding of previous work on the Design Missions. For newly-introduced Design Missions, the students will have the somewhat different, but equally challenging requirement of determining what has been done elsewhere to address their specific Design Mission, and to identify related design efforts, relevant technologies, and other initial resources. Each Design Mission will have one or two faculty who serve as “mission advisors”, who have agreed to serve for the duration of the Design Mission, a time period that would be expected to span at least several years.

The lectures will be structured around the modern system for conceptual development and design, which is common to all engineering domains. By emphasizing philosophical and conceptual approaches that span engineering disciplines, students will come to realize that their highly-specialized engineering tools can be generalized and brought to bear on a very wide range of engineering and technical problems. The course will be structured around a series of lectures, with parallel laboratory and discussion exercises, following the sequence outlined below:

1. Problem definition: quantitative definition of the engineering problem or opportunity
2. Design specification: definition of quantitative figures of merit (FoM) for performance
3. Concept generation: collect and categorize a large number of design concepts
4. Concept evaluation: quantitatively evaluate each design concept
5. Convergence: reduce the number of concepts by merging the best attributes of each
6. Concept selection: identify the best concept(s) for detailed engineering design & analysis
7. Detailed design & analysis: utilize engineering design and analysis tools
8. Alpha prototype construction: sub-system prototyping, demonstrate “proof of concept”
9. Alpha prototype evaluation: evaluate on the basis of the FoM from the Specification
10. Re-design: evaluate failures and identify opportunities to improve performance
11. Beta prototype construction: focus on system integration
12. Beta prototype evaluation: evaluate system level performance
13. Project Wrap-up/Transition: document the design in detail for future students

Generally, it will be assumed that students enrolled in ENG450 will bring domain-specific knowledge from their individual departmental training, so lectures will focus on the general design process and system-level engineering, applicable to all engineering disciplines. Lectures for the course will include general lectures on the design process, with specific examples taken from a wide range of engineering disciplines. Guest lecturers will provide particular examples to demonstrate the generality of the design sequence that the students are carrying out for their team design projects. Domain-specific lectures will also be incorporated to familiarize students with new material that pertains to their design projects, such as planetary environments, mechatronic design, materials in design, occupational biomechanics, etc.

The design sequence above will be carried out over the period of one academic term (14 weeks). At key points during the term, the students will undergo formal Design Reviews. Four such Design Reviews will be instituted at the completion of each key design milestone: (1) Design Specification and Concept Generation, (2) Concept Selection and Detailed Design & Analysis, (3) α -Prototype evaluation, and (4) Redesign & β -Prototype evaluation. At each major milestone, students will be required to communicate effectively with other students on the project who are trained in different disciplines. Evidence of system-level integration must be documented at each Design Review. At each Design Review, the students will be required to provide both oral and written deliverables specific to each design milestone. Grading will be on the basis of team performance during each of the Design Reviews, confidential student self- and team-evaluations, and instructor evaluation of deliverables.

The deliverables for the course will emphasize the appropriate use of engineering tools from each discipline and the clear technical communication of key concepts and details of the design in the form of a comprehensive Engineering Notebook that is a cumulative record of all engineering activities, including the final Design Specification, a detailed Bill of Materials, component, material, and process specifications, test results, sketches and photographs, detailed designs and analyses, software source code, meeting notes, engineering change notices, etc.

Grading: No examinations. Grading is on the basis of graded deliverables, presentations, and Peer Evaluations

% of grade Graded Deliverable for each of the four periods:

25%	I - Design Review I: Detailed Design Specification & at least 5 Design Concepts
25%	II - Design Review II: Review of Concept Selection and Detailed Design & Engineering Analysis
25%	III - Evaluation of α-Prototype vs. Design Specification: Quantitative Metrics
25%	IV - Evaluation of Redesign, β-Prototype and Final Presentation & Report

Peer Evaluations at each Deliverable will count heavily toward individual grades.

Requirements for each Deliverable:

I - Design Review I: Detailed Design Specification & 5 Design Concepts

Peer Evaluation I from each team member (these will remain *confidential*)

Definition of the Design Problem or Opportunity (brief, 1 paragraph)

QFD Chart filled in for each Project, including:

An evaluation of competing systems, if any

An evaluation of 5 alternative Design Concepts

A Gantt Chart (a timetable of each step in the design process until completion of the α -Prototype)

Definition of Functional Metrics (how will you quantitatively evaluate your prototypes?)

II - Design Review II: Review of Detailed Design & Engineering Analysis

Peer Evaluation II from each team member (these will remain *confidential*)

The Detailed Design must include:

3-view drawings of all components to be manufactured in the Machine Shop

A description of manufacturing processes to be used for fabrication of the parts

A Bill of Materials (BoM), listing each item to be purchased, including the vendor & cost

III - Evaluation of α -Prototype vs. Design Specification: Quantitative Metrics

Peer Evaluation III from each team member (these will remain *confidential*)

Completed Gantt Chart, showing Projected Time Table vs. Actual Time Table

The α -Prototype hardware

Prototype Evaluation: Quantitative functional test results for the α -Prototype hardware (vs. Design Spec)

A detailed critique of your design, quantitatively comparing performance against your Design Specification

Final Bill of Materials (BoM) for the α -Prototype

IV - Evaluation of Redesign and β -Prototype (at the Design Expo)

Peer Evaluation IV from each team member (these will remain *confidential*)

Redesign Plan based on evaluation of the α -Prototype, to include:

Engineering Change Notices (ECNs), Modifications to the Design Specification, Detailed Design & BoM

β -Prototype Hardware and Poster for the EXPO

Final Bill of Materials (BoM) for the β -Prototype

Engineering Notebook (this includes records of all aspects of the design process, from Day 1)

Expectations of Student Performance:

Students will be expected to utilize broadly-distributed University resources, their Sponsors, and all other available resources to gather information and to enable them to solve the problems associated with their Design Mission.

Enrollment Eligibility:

Because this is a “capstone” design experience, students will be required to have senior standing to enroll in the course for credit. We anticipate that the interdisciplinary nature of the design projects will attract students from many levels, so we will allow interested students at any level to unofficially audit the course and take part, to a limited extent, in the Design Mission. Such students are accepted at the discretion of the course instructors. Please see text below for a detailed discussion.

Outline of Proposed Syllabus:

Lec.	Topic	[Lecturer]	<u>Deliverables Due</u>
#1	Introduction, Inspiration, Project Mission Descriptions Place each Design Mission into the context of current events and previous work	[[?]]	
#2	Definition of sub-system design opportunities, team formation, team roles Students make contact with their sponsors & Principle Faculty Mentors		
#3	The Modern Design Process (applicable to all engineering disciplines): Project Planning , Problem Definition, Notebook, QFD, Gantt, Pugh, Design Specification [Dennis] IDEO Video		
#4	Domain-Specific Design Considerations, Lecture 1: (Example: planetary environments)		
#5	Domain-Specific Design Considerations, Lecture 2: (Example: spacecraft engineering)		
#6	Domain-Specific Design Considerations, Lecture 3: (Example: Human Factors, Occupational Biomechanics, and Ergonomics)		
#7	Domain-Specific Design Considerations, Lecture 4: (Example: electro-mechanical systems & mechatronics)		
#8	Student Group Presentations: Design Review #1		<u>Design Specification Due</u>
#9	Domain-Specific Design Considerations, Lecture 5: (Example: Biomedical Design)		
#10	Domain-Specific Design Considerations, Lecture 5: (Example: Mechanisms)		
#11	System-level Design, Lecture 1: Overview		
#12	Systems Design Case Studies: Example: Systems Design in Aerospace Engineering (Invited Speaker)		
#13	Systems Design Case Studies: Example: Systems Design in Biomedical Engineering (Invited Speaker)		
#14	Design Tools: Example: Reverse Engineering: Dissection of a Mechatronic Device		
#15	Design Tools: Example: CAD-UG		
#16	Student Group Presentations: Design Review #2		<u>Detailed Design Due</u>
#17	Design Tools: Example: Rapid Prototyping		
#18	Design Tools: Example: Modern Manufacturing Processes		
#19	Design Tools: Example: Design for Ease of Assembly & Manufacturing		
#20	Robust Design: Design of Experiments		
#21	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#22	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#23	First Prototype review and Evaluation: α -Prototypes MUST be complete.		<u>α-Prototype Due</u>
#24	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#25	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#26	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#27	No Lecture (Lecture and Lab time periods are allocated for intensive prototype development)		
#28	Final Design Review: β -Prototypes are due		<u>β-Prototype Due</u>

Note: Deliverables and Peer Evaluations (ENG450 web page) are due immediately following the indicated lecture, or as arranged with your instructor.

Student eligibility:

Typically, a multidisciplinary design experience of this type would be defined as a “capstone” design experience. In practice, this means that students are near graduation, having taken all or most of their technical courses in preparation for this capstone experience. At the University of Michigan and elsewhere, this is usually enforced by requiring a series of upper-level courses as prerequisites before students are permitted to enroll in the capstone course. In adhering to our collective vision for this new curriculum, we feel that this requirement is too restrictive. In the interests of involving students at all levels, we propose to institute the following policy: in order to *enroll* in the course, students must meet the prerequisite course requirements and standing within their department, but to *participate*, students need only be able to commit adequate time as a volunteer assistant. This experimental approach to instruction brings with it several challenges, but it also opens many opportunities for the personal and professional development of our students. Students could potentially become involved in a design mission early in their freshman year, only to enroll in the course and actually receive course credit late in their senior year. The challenges inherent in this experimental approach include the difficulty of predicting of student numbers, safety training, adequacy of available facilities, the administrative logistics of managing larger numbers of students, and the inability to enforce the execution of responsibilities given to students who are not enrolled in the course. These challenges are by far overshadowed by the positive aspects of this experimental approach, which includes an excellent opportunity to nurture student leadership and self-organization among students, mentorship from senior to junior students, a sense of long-term involvement on a project that could very well be the basis for a future career, an atmosphere of diversity and inclusivity, the opportunity for students to watch and participate in a design concept as it evolves over a long period of time, the opportunity for students to directly benefit and learn from the successes and failures of their peers, the opportunity for underclassmen to see the ultimate application of the courses which they are only beginning to take, and the ability of students to establish and maintain contact with an external sponsor on a project of mutual interest for several years before graduation.

Some might suggest that students would never volunteer to do work for which they would receive no pay or credit. Our experience at the University of Michigan is strongly to the contrary. We have several very well established competitive teams made up entirely of student volunteers, and operating entirely outside of the system of grades and credits. These students self organize into highly professional and internationally competitive design teams that work evenings and weekends and holidays, driven entirely by their inherent interest in the process of learning to engineer complex, functional and competitive systems. Among these teams are notably the Solar Car Team, Mars Rover, the Formula SAE and Mini Baja race teams, the steel bridge design team, and the concrete canoe team. Recently, these teams have also included the Human-Powered Helicopter team, the Future car team, and many others. Post-graduate surveys carried out by the Department of Mechanical Engineering clearly indicate that the students who participate in these teams have correspondingly greater success in the early stages of their professional careers, particularly in their ability to successfully get job offers in areas of interest to them. The massive participation of students in these teams is a clear indication that the students are interested in, and in fact are looking for, challenging systems-level design opportunities. The main failing of this system is the lack of *faculty* participation. When working on these competitive teams, students typically have limited or no access to systematic faculty support. We feel that by allowing students at all levels to participate in this new design

curriculum, we will institute a system whereby the most dedicated and enthusiastic students will self select for inclusion and there will be a systematic incentive for faculty involvement, thereby achieving a level of excellence impossible by any other means.

Key components of the Proposed Course:

- The Design Missions will be “customer oriented”, with strong emphasis on technical communication in several dimensions:
 - students ↔ sponsor
 - faculty ↔ students
 - senior students ↔ junior students
 - discipline X ↔ discipline Y
 - current academic term ↔ past/future terms
- Each Design Mission will generate a series of prototypes which will embody the multidisciplinary design effort, enabling students to get real-world feedback on their design decisions.
- The Design Missions will span many disciplines and several semesters, permitting projects of much greater scope and complexity to be incorporated in this course than has been possible in previous senior design courses.
- Each Design Mission will have at least one “mission advisor” faculty member with a long-term commitment to the Design Mission, and the overall curriculum will have several faculty members from different engineering disciplines who have made a long-term commitment to the development and administration of this course.
- The course will be guided by feedback from individual engineering departments, to assure that the course meets the needs of their students. Departmental curriculum advisors and design instructors will be regularly encouraged to provide specific input on the content and scope of the course.
- Individual departments will retain the authority to determine the proper place for the course in the context of their departmental requirements and standards, and will permit students to take the course in one of the following capacities:
 - (1) in fulfillment of their senior capstone design requirement,
 - (2) as a technical elective, or
 - (3) as a “free” elective.

Departments will also evaluate each Design Mission for suitability in each of these three categories. For example, the Department of Civil Engineering may authorize students to participate in Design Mission X in fulfillment of their senior design requirement, whereas they may only allow free elective credit for students working on Design Mission Z.

Design Missions:

Design Missions for this course will be developed in consultation with individual sponsors. The initial target sponsor is NASA, but we anticipate considerable diversity in the future, to include biomedical device manufacturers, private foundations, and industrial sponsors.

Proposed Design Missions:

Mission I: Mars Autonomous Robot System. Students will be presented with the broad problem of the establishment of a permanent base on Mars, operated by a fleet of autonomous robots. Students will be challenged with defining the major and minor objectives of this broadly-defined mission, in consultation with their sponsors at NASA. They will be encouraged to consider the larger issues, such as societal impact, scientific value, and potential corporate interest in future missions to Mars. Students will then form design teams to address specific design challenges within the context of the overall Design Mission.

Mission II: Human performance assessment and augmentation systems. Students will be presented with the Design Mission of developing systems to monitor and augment human performance in harsh environments. The Mission will incorporate aspects from occupational biomechanics, exercise physiology, biomechanics, metabolic and mechanical monitoring, prosthetic and orthotics device design, and “exoskeleton” mechanisms to amplify human performance. Students will be encouraged to consider broader societal implications of their work, such as use in extra-terrestrial environments, defense applications, the use of the technology for athletic training, physical and occupational therapy, and to assist disabled persons by enhancing mobility and the ability to carry out the activities of daily living.

Future curricular and infrastructural support developments:

Future development of the proposed course and the related curriculum will be based on our experience with ENG450 as a pilot course in the winter of 2004 and 2005. We anticipate the following issues to be of importance for the further development of the multidisciplinary design curriculum:

- Expansion to accommodate larger numbers of students
- Establishment of dedicated space for design laboratory prototyping facilities
- Enhancement of content to address individual departmental requirements to fulfill senior capstone design credit
- Expansion to include additional long-term projects and new sponsors
 - (NASA and non-NASA partners: MedTronic, small/disadvantaged business, academic laboratories)
- ENG 450 to span several semesters (evolve into a 1-year course)
 - Offer ENG 450 both Fall and Winter terms
 - Offer ENG 450 Spring/Summer (year round)
- Explicit linkages with established design courses from individual departments
- Feeder courses or modules for underclassmen to receive credit
- Develop a graduate level course (Multidisciplinary Design & Project Management)
- Engagement on non-engineering students (e.g. physics, chemistry, biology, business, ...)
- Seek support from industry partners & foundations to maintain and expand curricular infrastructure

- Teaming with other Universities and outside institutions
- Maintain close collaborative ties with Sponsors to generate new projects
- Initiate student internship track for students at sponsoring institutions
- Trans-disciplinary teaching workshops taught by students, faculty or staff (examples):
 - Embedded systems design
 - Signals and sensors
 - Extra-terrestrial environments
 - Design for environment
 - CAD-CAM
 - Machine shop practices
 - Assembly and testing

STEP II: Multidisciplinary Engineering Design Course (Pilot Proposal)

COURSE #: ENG 450	COURSE TITLE: Multidisciplinary Design
TERMS OFFERED: Winter	PREREQUISITES: Must meet individual engineering departmental requirements for Senior Design. <i>Not open to graduate students.</i>
TEXTBOOKS/REQUIRED MATERIAL: None	COGNIZANT FACULTY: Robert Dennis DATE OF PREPARATION: 10/1/2003
COURSE LEADER(S): Robert Dennis & Nilton Renno	SCIENCE/DESIGN:
CATALOG DESCRIPTION: A senior capstone interdisciplinary engineering design experience. The student is exposed to the design process from concept through analysis to system integration, prototyping, testing and report. Interdisciplinary projects are proposed from the different areas within engineering. Two hours of lecture and two laboratories.	COURSE TOPICS: <ol style="list-style-type: none"> 1. Team design project-open-ended problem solving. Systematic design procedures include: <ul style="list-style-type: none"> • Understanding customer requirements. Task clarification. • Project management. • Patent search and competitive benchmarking. • Product design specifications, and quality function deployment. • Conceptual design & selection matrix. • Simple mathematical models of the final concept. • Presentation of project proposal. • Parameter design of various components of design. • Material and manufacturing tolerances. • Safety and liability. • Selection of off-the-shelf components. • Fabrication of custom components. • System integration 2. Construction of physical prototypes as proof-of-concept. 3. Demonstration and presentation of final project. 4. Technical communication with Sponsor, experts in disciplines other than that of the student, and design teams in future terms.

<p>COURSE OBJECTIVES*</p>	<p>(numbers shown in brackets are links to department educational outcomes)</p> <ol style="list-style-type: none"> 1. Apply engineering fundamentals to solve an open-ended design problem supplied by an industrial partner. The problem must provide opportunities for creative design. Each student team works on a different project. (1,5,9) 2. Work as a team on a "real-world" engineering design problem. (2,3,6,9) 3. Provide a practical solution to the problem keeping in mind performance, safety, cost, weight, and many other constraints specified by the customer (project sponsor). (1,2,4,5,6,8,9) 4. Generate and evaluate design concepts after gaining a good understanding of the problem background, and existing design concepts. (1,4,7) 5. Identify a set of design variables and the governing equations and optimize the design. (4,5) 6. Develop a physical prototype of the final design. (8) 7. All team members participate in proposal and final design presentations. (2,3,9)
<p>COURSE OUTCOMES*</p>	<p>(numbers shown in brackets are links to course objectives) {Letters = ABET outcomes}</p> <ol style="list-style-type: none"> 1. Given an open-ended "real-world" engineering design problem, suggest, evaluate, and develop potential solutions. (1,3,4) {c, e} 2. Learn to work with and manage multiple sub-tasks with limited physical, financial, and time resources. (2,3,7) {f} 3. Learn to work in interdisciplinary design teams. (2,7) {d} 4. Learn to make appropriate assumptions and exercise engineering judgment in solving an open-ended problem. (3,4,5) {a, h} 5. Learn to handle uncertain and incomplete information effectively in order to meet project goals. (1,3,5) {b} 6. Learn to communicate with the customer (project sponsor), peers, instructor, vendors, and other engineers in different disciplines. (2,3) {g} 7. Learn patent search procedures, specification and procurement of off-the-shelf components, independent learning, time and project management. (4) {i} 8. Learn to fabricate custom-components and construct and test a complete physical prototype. (3,6) {b, k} 9. Learn to present their project work to sponsors, instructors, other teams and even non-technical audience during the Design Expo. (1,2,3,7) {g}
<p>ASSESSMENT TOOLS</p>	<ol style="list-style-type: none"> 1. Monthly Design Reviews with assigned Deliverables 2. End of term projects: α- and β-prototype, Final Reports

*The ABET99 Group suggests up to 6 objectives and 1-3 outcomes per objective.

Program Outcomes and Assessment for ABET

Engineering programs must demonstrate that their graduates have:

- a) An ability to apply knowledge of mathematics, science and engineering
- b) An ability to design and conduct experiments, as well as to analyze and interpret data
- c) An ability to design a system, component, or process to meet desired needs
- d) An ability to function on multi-disciplinary teams
- e) An ability to identify, formulate, and solve engineering problems
- f) An understanding of professional and ethical responsibility
- g) An ability to communicate effectively
- h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
- i) A recognition of the need for, and an ability to engage in life-long learning
- j) A knowledge of contemporary issues
- k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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

Date 10/7/2003

Effective Winter 2004

A. CURRENT LISTING

B. REQUESTED LISTING

Home Department		Div #	Course Number
Cross Listed Course Information			
Course Title		Course Title	
TITLE ABBRE- VIATION	Time Sched Max = 19 Spaces Transcript Max = 20 Spaces	TITLE ABBRE- VIATION	
Course Description		Course Description for Official Publication (Max = 50 words)	
PROGRAM OUTCOMES: <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e <input type="checkbox"/> f <input type="checkbox"/> g <input type="checkbox"/> h <input type="checkbox"/> i <input type="checkbox"/> j <input type="checkbox"/> k		PROGRAM OUTCOMES: <input checked="" type="checkbox"/> a <input type="checkbox"/> b <input checked="" type="checkbox"/> c <input checked="" type="checkbox"/> d <input checked="" type="checkbox"/> e <input checked="" type="checkbox"/> f <input checked="" type="checkbox"/> g <input checked="" type="checkbox"/> h <input checked="" type="checkbox"/> i <input checked="" type="checkbox"/> j <input checked="" type="checkbox"/> k	
Degree Requirements <input type="radio"/> Degree Requirement <input type="radio"/> Core Course		Degree Requirements <input checked="" type="radio"/> Degree Requirement <input type="radio"/> Free Elective <input type="radio"/> Other <input type="radio"/> Tech Elective	
Prerequisites IOE 265 <input type="radio"/> Enforced <input type="radio"/> Advised		Prerequisites Preceded or accompanied by IOE 265 <input type="radio"/> Enforced <input checked="" type="radio"/> Advised	
Credit Restrictions		Credit Restrictions	
Level of Credit <input type="checkbox"/> Undergrad only <input type="checkbox"/> Rackham Grad <input type="checkbox"/> Non-Rackham Grad <input type="checkbox"/> Ugrad or Non-Rackham Grad <input type="checkbox"/> All Credit types <input type="checkbox"/> Rackham Grad w/add'l Work		Level of Credit <input checked="" type="checkbox"/> Undergrad only <input type="checkbox"/> Rackham Grad <input type="checkbox"/> Non-Rackham Grad <input type="checkbox"/> Ugrad or Rackham Grad <input type="checkbox"/> All Credit types <input type="checkbox"/> Rackham Grad w/add'l Work	
Credit Hours Min Max		Credit Hours Min Max	
Contact Hrs/Wk Number of Wks		Contact Hrs/Wk Number of Wks	
Repeatability (Indi Research, Dir. Study, Dissertation): Is this course repeatable? <input type="radio"/> Yes <input checked="" type="radio"/> No Maximum Hours? Maximum Times? Can it be repeated in the same term? <input type="radio"/> Yes <input type="radio"/> No		Printing Information (Optional) <input checked="" type="checkbox"/> Print the course in the Bulletin <input checked="" type="checkbox"/> Print the course in the Time Schedule	
Class Type(s) <input checked="" type="checkbox"/> Lec <input type="checkbox"/> Rec <input type="checkbox"/> Sem <input type="checkbox"/> Lab <input type="checkbox"/> Dis <input type="checkbox"/> Ind <input type="checkbox"/> Other		Terms & Freq. of Offering <input checked="" type="checkbox"/> I <input checked="" type="checkbox"/> II <input type="checkbox"/> IIIa <input type="checkbox"/> IIIb <input type="checkbox"/> III <input checked="" type="checkbox"/> Yearly <input type="checkbox"/> Alter Years <input type="checkbox"/> Even Years <input type="checkbox"/> Odd Years	
Graded Section <input checked="" type="radio"/> Lec <input type="radio"/> Rec <input type="radio"/> Sem <input type="radio"/> Lab <input type="radio"/> Dis <input type="radio"/> Ind <input type="radio"/> Other		Half term <input type="checkbox"/> 1st <input type="checkbox"/> 2nd	
Grading <input checked="" type="checkbox"/> A-E <input type="checkbox"/> CR/NC <input type="checkbox"/> S/U <input type="checkbox"/> P/F <input type="checkbox"/> Y		Cognizant Faculty Member: Yili Liu Title Professor	
Location <input checked="" type="checkbox"/> Ann Arbor <input type="checkbox"/> Biological Station <input type="checkbox"/> Camp Davis <input type="checkbox"/> Extension		Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty	

Approval

☐ Curriculum Comm.

- ☐ Faculty
☐ Rackham
☐ Cross listed Unit 1
☐ Cross listed Unit 2

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

Name, Signature & Department

Home Dept.

Cross-listed Dept(s).

Change in prerequisite... Students can take IOE.333 if they are also taking or have taken IOE.265.....

Change in prerequisite... Students can take IOE.333 if they are also taking or have taken IOE.265.....

[illegible]

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039

☐ Yes ☒ No

☐ Yes ☒ No

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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

Date 10/8/2003

Effective Winter 2004

A. CURRENT LISTING

B. REQUESTED LISTING

Home Department		Div #	Course Number
Industrial and Operations Engineering		272	836
Cross Listed Course Information			
Course Title			
SEM IN HUMAN PERFORMANCE			
TITLE	Time Sched	SEM HUMAN PERFORM	
ABBRE-	Max = 19 Spaces		
VATION	Transcript	SEM HUMAN PERFORM	
	Max = 20 Spaces		
Course Description			
Case studies of research techniques used in the human performance and safety fields. Speakers actively engaged in research will discuss their methods and results.			
PROGRAM OUTCOMES:			
<input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e <input type="checkbox"/> f <input type="checkbox"/> g <input type="checkbox"/> h <input type="checkbox"/> i <input type="checkbox"/> j <input type="checkbox"/> k			
Degree Requirements <input type="radio"/> Degree Requirement <input type="radio"/> Free Elective <input type="radio"/> Other <input type="radio"/> Core Course <input type="radio"/> Tech Elective			
Prerequisites <input type="radio"/> Enforced <input type="radio"/> Advised			
Credit Restrictions			
Level of Credit		Credit Hours	Contact
<input type="checkbox"/> Undergrad only <input type="checkbox"/> Ugrad or Non-Rckhm Grad		Min Max	Hrs/Wk
<input checked="" type="checkbox"/> Rackham Grad <input type="checkbox"/> All Credit types		1 2	Number
<input type="checkbox"/> Non-Rckhm Grad <input type="checkbox"/> Rckhm Grad w/add'l Work			of Wks
<input type="checkbox"/> Ugrad or Rckhm Grad			
Repeatability (Indi Research, Dir. Study, Dissertation):			
Is this course repeatable? <input type="radio"/> Yes <input checked="" type="radio"/> No			
Maximum Hours? Maximum Times?			
Can it be repeated in the same term? <input type="radio"/> Yes <input type="radio"/> No			
Class Type(s)	Graded Section	Grading	Location
<input type="checkbox"/> Lec <input type="checkbox"/> Rec <input checked="" type="checkbox"/> Sem <input type="checkbox"/> Lab <input type="checkbox"/> Dis <input type="checkbox"/> Ind <input type="checkbox"/> Other	<input type="checkbox"/> Lec <input type="checkbox"/> Rec <input checked="" type="radio"/> Sem <input type="checkbox"/> Lab <input type="checkbox"/> Dis <input type="checkbox"/> Ind <input type="radio"/> Other	<input type="checkbox"/> A-E <input type="checkbox"/> CR/NC <input type="checkbox"/> S/U <input checked="" type="checkbox"/> P/F <input type="checkbox"/> Y	<input checked="" type="checkbox"/> Ann Arbor <input type="checkbox"/> Biological Station <input type="checkbox"/> Camp Davis <input type="checkbox"/> Extension
Terms & Freq. of Offering <input checked="" type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> IIIa <input type="checkbox"/> IIIb <input type="checkbox"/> III <input type="checkbox"/> Yearly <input type="checkbox"/> Alter Years <input type="checkbox"/> Even Years <input type="checkbox"/> Odd Years			
Half term <input type="checkbox"/> 1st <input type="checkbox"/> 2nd			
Cognizant Faculty Member: Don Chaffin Title Professor			
Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty			

Approval

☐ Curriculum Comm.

- ☐ Faculty
☐ Rackham
☐ Cross listed Unit 1
☐ Cross listed Unit 2

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

Name, Signature & Department

Home Dept.

Cross-listed Dept(s):

This change is to make this course offering 1 credit only. In the past the course was differently designed. This is an effort to ensure students only register for 1 credit.

[illegible]☐ Yes ☒ No
