The University of Michigan
College of Engineering
Curriculum Committee

Agenda
November 5, 2002
1:30-3:30 p.m.
GM ROOM
Fourth Floor Lurie Engineering Center

1. Approval of Minutes from October 1, 2002 Meeting

2. Presentation on CEE Concentrations – Revisited—Will Hansen

3. Discussion on Math & Science Liaisons

4. Discussion 400 & 500 Level Courses – Memo from Earl Lewis (Rackham Dean)

5. Course Approval Forms

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday, October 1, 2002
1:30-3:00 p.m.
Lurie Engineering Center GM Room
Minutes

Armin Troesch called the meeting to order at 1:40 p.m.

Members Present: A. Troesch, E. Chan, J. Fessler, P. Friedmann, W. Hansen, G. Herrin, J.Holloway, G. Hulbert, S. Montgomery, B. Noble, S. Pang, H. Peng, R. Robertson, P. Samson, S. Takayama

Members Absent: B. Martin (IOE)

Guest: Henia Kamil

Armin Troesch welcomed Brian Noble (EECS—Computer Science & Engineering)

Addition to Minutes of 9-17-02

The minutes of the last meeting were approved.
Armin Troesch noted that at the September 17 meeting it was decided to add the word 'otherwise' to the beginning sentence third item under **Definitions and Exceptions** College of Engineering Humanities and Social Sciences document, and to the minutes from that meeting.
The paragraph will read: **Otherwise**, courses that are designated as "BS", "CE", "MSA", "QR", "experiential", "directed reading or independent study", or course titles that include the terms or partial phrases "composition", "math", "outreach", "performance", "physics", "practicum", "statistics", studio", "tutor" may not be used to satisfy this requirement.

Will Hansen Presentation on CEE Concentrations—Revisited

Will Hansen passed out a paper noting concerns within the BSE CEE Degree Program:

Concentrations within the BSE CEE Degree Program
The student has the option to select from one of six concentrations offered in the undergraduate program. The concentration will appear on the student's transcript. The typical BSE degree requires the student to select 9 hours of Technical Electives consisting of two technical electives from the list (p.114). The remaining Technical Elective must be taken from the above list outside of the chosen ***focus*** area. A **Concentration** requires selecting one additional course in this sequence with a total of 12 credit hours in the Technical Concentrations list. The additional course reduces the requirements for Unrestricted Electives from 12 hours for the typical BSE degree to9 hours if a **Concentration** is selected, thereby maintaining a total of 128 credit hours required for the BSE degree.

Peretz Friedmann asked if this was giving students too much freedom. "Focus" is required – "Concentration" optional.
It was decided to not vote on this at this time, and Will Hansen was asked to go back to the CEE Department with this for revision.

SGUS Discussion with Stella Pang

Stella Pang passed out information on the Sequential Graduate Undergraduate Study Program. Stella noted that this information was presented to the CoE CC in 2000. This also was presented to the graduate chairs in May of this year. Nothing has changed in this proposal, she just wanted to clarify this. Unlike the old program, dual enrollment (undergrad and grad program) is not needed. Students need to be admitted to Rackham and pay the Rackham fee. The student applies during the last year of their undergrad study.
Stella would like the double counted courses to be on the student's transcript. Jeanne Murabito said that would be unlikely, since only one other school does that.
Discussion: Sequential VS Simultaneous – Stella said that sequential is a better description.
Since many courses are for 4 credit hours, not 3, should the maximum undergrad hours be changed from 6 to 8? This is hindering the student's progress in the SGUS Program.
Rackham is open to a proposal from the CoE Curriculum Committee and Stella will present a proposal to Rackham.
Jeanne Murabito said this could come to the CoE CC but the advisors should be the ones to make the proposal.
Armin Troesch said that at least eight students have had to get waivers from 6 to 8 credit hours. This could be worded as : 8 credit hours or two classes.

Additional Discussion Items

Levi Thompson has asked the CoE CC to become more pro-active with ABET assessment than in the past. He gave a handout and asked for comments to be entered in the minutes of the meeting.

1. **Discussion on Role of Math & Science Liaison**
    - **Should CoE support liaisons?**
      It would be good to hear from people who were liaisons in the past. The consensus was that the College of Engineering will recommend one or two liaisons after hearing opinions from Phil Savage and Nik Katapodes.

2. **Discussion of Increased Communication Between the Two Colleges**
    - **Value to CoE and LS&A?**
      The question was asked whether the College of Engineering receives LS&A CC minutes and vice versa? No, but this is a good first step. It was asked if there would be interest in the CoE CC if the LS&A minutes were available. It was suggested that Judy could post them on Work Tools or on the CoE CC Website.

3. **Department Level ABET Compliance Report**

- **How are term end course reports treated?**
  AOSS – No ABET program – efficient but informal assessment.
  BIO MED E – Questionnaire , and faculty gets together for yearly review.
  CEE –Recently created an assessment committee.
  CHEM E – Yearly and reviewed – gets assessments and undergrad committee reviews.
  CS (of EECS) – Forms are filled out by faculty members
  EE (of EECS) – Forms are filled out by faculty members
  IOE – Faculty peer inventory process. Sit in on classes and do assessment twice yearly.
  INTER PRO – not ABET / not academic department
  ME – Course leader and yearly report
  MSE – Faculty Committee
  NAVAL – Yearly
  NERS – Assessment is continuous.

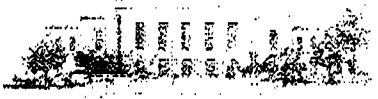
4. **Assessment of Math & Science Courses Consistent With CoE Implementation of ABET**
   - **Is this necessary?**
     Yes
   - **Who should do the assessment?**
     The liaison should do the assessment and report back to the CoE CC.
     This will be a discussion item at the Joint CC meeting with LS&A.

5. **How has ABET driven curriculum changes in your departments?**
   - **Has the ABET Process Made a Difference?**
     Some yes, some no. On the positive side: Consistency of courses has improved, ownership of courses, more conversations on teaching.

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

Next Meeting
Tuesday, October 22, 2002 – Joint Curriculum Committee Engineering and LS&A – 3-5 p.m.
Kuenzel Room, 1st Floor Michigan Union.

Tuesday, November 5, 2002
1:30-3:30 p.m.
GM Room-LEC



University of Michigan
Horace H. Rackham School of Graduate Studies

Memorandum

To: Department Chairs, Graduate Chairs, and Program Directors

From: Earl Lewis EL
Vice Provost for Academic Affairs – Graduate Studies and
Dean of the Rackham Graduate School

Date: May 21, 2002

Subject: 500 and 400 Level Courses

Rackham guidelines state that 500 level courses are primarily for first-year graduate students. Senior majors may take them, too, or others by special permission. It has come to my attention recently that in a number of Rackham departments, significant numbers of undergraduates have been enrolling in 500 level graduate classes. To illustrate, in Winter term, 2001, nineteen classes across ten departments, with class enrollments that ranged from16 to 56, were made up of between 50% and 100% undergraduates. In some cases, this may be due to a lack of familiarity with Rackham guidelines for graduate course approval. Also, it's fairly common for advanced undergraduates to enroll in 500 level classes. However, I am concerned at how the nature of a 500 graduate level course might be affected by the enrollment of large percentages of undergraduates and am writing because I assume you may share that concern.

In addition and on a related topic, I want to take this opportunity to reiterate Rackham guidelines with respect to allowing graduate students to earn credit for undergraduate courses. Classes at the 400 level are primarily for undergraduates. Many 400 level courses, however, have been approved for both undergraduate and graduate credit. Appropriately, Rackham entrusts the faculty with responsibility for ensuring that graduate level work will be required of all graduate students who enroll in such courses. In some cases, the course material is at the graduate level for all students. In other cases, graduate students are required to do additional work beyond what is required of undergraduates enrolled in the course.

The Rackham guidelines for course approval, which were recently reviewed and affirmed by the Rackham Executive Board, are available in their entirety at http://www.rackham.umich.edu/Departments/ (see *Guidelines for Graduate Course Approval*). Please share the information in this memo with department and program faculty. If you have any questions or concerns, please communicate them to Glenda Haskell, Assistant to the Dean for Academic Programs and Services (haskell@umich.edu or 647-7548).

COURSE APPROVAL FORMS

November 5, 2002

AERO 365	New Course
EECS 370	Modification – Changing Pre-Reqs
EECS 401	Modification—Credit Restrictions
EECS 470	Modification—Changing Pre-Reqs
EECS 514	New Course
EECS 515	New Course

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

Print

Form Number 949

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 5/2/2002
Effective Winter 2003

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Div # / Course Number	Home Department: Aerospace Engineering / Div #: 235 / Course Number: 365
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Case Studies of Aerospace Vehicles
TITLE ABBREVIATION — Time Sched Max = 19 Spaces	Aero Veh Case Study
TITLE ABBREVIATION — Transcript Max = 20 Spaces	Aero Veh Case Study
Course Description	Course Description for Official Publication (Max = 50 words): Case studies of notable aerospace vehicles and systems. An overview of the trade-diagrams and design drivers of air, launch and space vehicles. Aerospace system integration including organizational, business, economic, and environmental issues.
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: O Degree Requirement O Tech Elective O Core Course O Other O Free Elective	Degree Requirements: O Degree Requirement (•) Tech Elective O Core Course O Other O Free Elective
Prerequisites: ○ Enforced ○ Advised	Prerequisites: Preceded or accompanied by Aero 245 or permission of instructor ○ Enforced (•) Advised
Credit Restrictions	Credit Restrictions
Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min/Max; Contact Hrs/Wk; Number of Wks	Level of Credit: ☒ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min 3 Max 3; Contact Hrs/Wk 3; Number of Wks term
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	Printing Information (Optional): ☒ Print the course in the Bulletin ☒ Print the course in the Time Schedule
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	Terms & Freq. of Offering: ☐ I ■ II ☐ IIIa ☐ IIIb ☐ III ■ Yearly ☐ Alter Years ☐ Even Years ☐ Odd Years; Half term ☐ 1st ☐ 2nd
	Cognizant Faculty Member: C.W. Kauffman 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. I. Boyd Iain Boyd , Aero
Cross-listed Dept(s). _____

Form Number

949

SUPPORTING STATEMENT

The production of hardware is the final goal of practically all aerospace efforts. In the academic environment one may easily lose sight of this goal. It should be recognized that many entering students, at both the undergraduate and graduate levels, are here because of their love of aircraft, rockets or spacecraft. They are frequently seeking to engage in a hardware experience early in the curriculum. Aerospace 365 is a step in a hardware focused experience that both engages students in their technical passions and attempts to foster cross-fertilization between industrial and more scientific and academic aspects of engineering.

This course will be a 3 credit hour design related course that may be part of a potential design thread or concentration throughout the curriculum. It will introduce the area of preliminary design as well as examples of detailed design.

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

Detail the Special requirements

It is strongly recommended that the faculty members responsible for this course actually have industrial project experience relating to flight hardware and that a field trip to view such hardware be made a part of the course.

Aerospace Engineering 365

Case Studies of Aerospace Vehicles

Course Outline:

1. Aircraft (30%)
    a. Harrier
    b. Concorde
    c. X-15
2. Missiles and Launch Vehicles (30%)
    a. Sidewinder
    b. Nova
3. Spacecraft (30%)
    a. Pioneer
    b. Lunar Excursion Module
4. Other Vehicles and components (10%)
    a. Unmanned Air Vehicles (UAVs)
    b. Wing in Ground Effect (WIGs)
    c. Buoyant Vehicles, e.g. Balloons, Blimps
    d. Ejection Seats
    e. Manned Maneuvering Units (MMUS)
    f. Spacesuits

References and Reading Material:

1. "Harrier," Francis K. Mason, Naval Institute Press, Annapolis, MD, 1983, ISBN 0870218298, Media Union Library: UG1242.F5 M371 1983.

2. "X-15 Diary: The Story of America's First Space Ship," Richard W. Tregaskis, Dutton, New York, 1961, Graduate Library.

3. The X-15 Research Airplane," NASA, Washington, DC, 1961, Media Union Library: TL 789.8.U6X5 A4 1961.

4. "Concorde," Philip Birtles, Shepperon, Ian Allan, 2000, ISBN 0711027404, Media Union Library: TL685.7.B57 2000.

5. "Sidewinder: Creative Missile Development at China Lake," Ronald Westrum, Naval Institute Press, Annapolis, MD, 1999, ISBN 1557509514, Graduate Library: UG1312.A6W471 1999.

6. "A History of Project Nova, 1959-1969," Parts I-III, Quest (a Quarterly Journal), Vol. 1, No. 3, Vol. 2, No. 1, Vol. 2, No. 2. On reserve in the Aero Library.

7. "New Cosmic Horizons: Space Astonomy from the V2 to the Hubble Space Telescope," David Leverington, Cambridge University Press, Cambridge, UK, ISBN 052165397, Science Library QB 136.L481 2000.

8. "Moon Lander: How We Developed the Apollo Lunar Module," T.J. Kelly, Smithsonian Institution Press, Washington, DC, 2001, ISBN 156098998X, Undergraduate Library: TL 795.K451 2001.

9. Selected NASA Mission Reports (available in Aero Library), e.g.,
   a. Vangard — A History," Green and Lomask, NASA SP-4202
   b. "Gemini Summary Conference," NASA SP-138
   c. "MoonPort: A History of Apollo Launch Facilities and Operations," Benson and Faherty, NASA SP-4202
   d. "The Apollo Spacecraft: A Chronology," Ertel and Morse, NASA SP-4009

10. "Eject! Eject!," Bryan, Philpot Shepperton, Surrey, Ian Allen 1989, ISBN 0711018049, Media Union Library: TL 753.P5511 1989.

11. "Airship Technology," edited by Gabriel A. Khoury and J. David Gillet, Cambridge Aerospace Series 10, Cambridge University Press, Cambridge, UK 1999, ISBN 0-521-43074-7, Aero Library TL 660.A37 1999.

Course Topics:

1. Component/system level design trades
2. System integration
3. Organizational, business, economic, and environmental aspects of an aerospace project

Course Objectives:

1. Introduce students to historical component and system level trades
2. Expose students to specific business and environmental aspect of aerospace systems
3. Learn from past successes and mistakes

Course Outcomes:

1. List significant milestones in aerospace technology (Assessed by: 1,2)
2. Given a specification propose a potential derivative design (Assessed by: 1,2,3,4)
3. Describe business, economic and other implications of design derivative (Assessed by: 1,2,3,4)
4. Describe noticeable system failures (1,2)

Assessment Tools:

1. Report
2. Oral presentation
3. Project
4. Final exam

Aero 365: Case Studies or Aerospace Vehicles

COURSE #: 365	**COURSE TITLE: CASE STUDIES OF AEROSPACE VEHICLES**
TERMS OFFERED: Winter	**PREREQUISITES: Aero 245 or permission of instructor**
INSTRUCTOR(S): C.W. Kauffman	**SCIENCE/DESIGN: 1/2**
CATALOG DESCRIPTION: Case studies of notable aerospace vehicles and systems. An overview of the trade-diagrams and design drivers of air, launch and space vehicles. Aerospace system integration including organizational, business, economic, and environmental issues.	**COURSE TOPICS:** 1. Component/system level design trades 2. System integration 3. Organizational, business, economic, and environmental aspects of an aerospace project

COURSE OBJECTIVES*	1. Introduce students to historical component and system level trades 2. Expose students to specific business and environmental aspect of aerospace systems 3. Learn from past successes and mistakes
COURSE OUTCOMES*	**On completion of Aero 365, students can**: 1. List significant milestones in aerospace technology (Assessed by: 1,2) 2. Given a specification propose a potential derivative design (Assessed by: 1,2,3,4) 3. Describe business, economic and other implications of design derivative (Assessed by: 1,2,3,4) 4. Describe noticeable system failures (1,2)
ASSESSMENT TOOLS	1. Individual homework 2. Hourly exams 3. Project 4. Final exam

Approved by Aero faculty: September 26, 2002

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

Print

Form Number 966

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 9/27/2002
Effective Winter 2003

A. CURRENT LISTING

Home Department	Div #	Course Number
EECS	252	370

Cross Listed Course Information

CS	353	370

Course Title: Introduction to Computer Organization

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Intro Comp Organiz	
Transcript Max = 20 Spaces	Intr Comp Org	

Course Description
Basic concepts of computer organization and hardware. Instructions executed by a processor and how to use these instructions in simple assembly-language programs. Stored-program concept. Datapath and control for multiple implementations of a processor. Performance evaluation, pipelining, caches, virtual memory, input/output.

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

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

X Prerequisites: EECS 280 or EECS 283
○ Enforced ◉ Advised

Credit Restrictions

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

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
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

B. REQUESTED LISTING

Home Department	Div #	Course Number
EECS	252	370

Cross Listed Course Information

Course Title: Introduction to Computer Organization

TITLE ABBREVIATION	
Time Sched Max = 19 Spaces	Intro Comp Organiz
Transcript Max = 20 Spaces	Intr Comp Org

Course Description for Official Publication (Max = 50 words)
Basic concepts of computer organization and hardware. Instructions executed by a processor and how to use these instructions in simple assembly-language programs. Stored-program concept. Datapath and control for multiple implementations of a processor. Performance evaluation, pipelining, caches, virtual memory, input/output.

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

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

Prerequisites: (EECS 203 or EECS 270) and (EECS 280 or EECS 283)
◉ Enforced ○ Advised

Credit Restrictions

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

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

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: Papaefthymiou, M. Title Assoc. Professor
Tyson, G. Asst. 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. Jeff Fessler, EECS Jeff Fessler 2002-10-4
Cross-listed Dept(s). _____

Form Number

966

SUPPORTING STATEMENT

Students taking 370 need familiarity with Boolean algebra/logic which they can learn in either EECS 203 or EECS 270.

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

Print

Form Number 974

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 10/3/2002
Effective Winter 2003

A. CURRENT LISTING

Home Department	Div #	Course Number
EECS	252	401

Cross Listed Course Information:

Course Title: Probabilistic Methods in Engineering

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Prob Methods Engr
Transcript Max = 20 Spaces	Prob Methods Engr

Course Description:
Basic concepts of probability theory. Random variables: discrete, continuous and conditional probability distributions; averages; independence. Introduction to discrete and continuous random processes; wide sense stationarity, correlation, spectral density.

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

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

X Prerequisites: EECS 206 or EECS 212/316 and Junior standing. ◉ Enforced ○ Advised

Credit Restrictions: credit for only one of EECS 401 and EECS 501

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 4
Number of Wks 14

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

B. REQUESTED LISTING

Home Department	Div #	Course Number
EECS	252	401

Cross Listed Course Information:

Course Title: Probabilistic Methods in Engineering

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Prob Methods Engr
Transcript Max = 20 Spaces	Prob Methods Engr

Course Description for Official Publication (Max = 50 words)
Basic concepts of probability theory. Random variables: discrete, continuous and conditional probability distributions; averages; independence. Introduction to discrete and continuous random processes; wide sense stationarity, correlation, spectral density.

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

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

Prerequisites: EECS 306 or EECS 212/316 and Junior standing. ◉ Enforced ○ Advised

Credit Restrictions: credit for only one of EECS 401 and EECS 501

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 4
Number of Wks 14

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: W.E. Stark, Professor; D. Teneketzis, Professor; D.J. Anderson, 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. Jeff Fessler, EECS 2002-10-16
Cross-listed Dept(s). ____

Form Number

974

SUPPORTING STATEMENT

The continuous-time fourier transform covered in 306 is essential background for students taking EECS 401.

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

Detail the Special requirements

To: CoE Curriculum Committee
From: Jeff Fessler, Chair, EECS curriculum committee
Date: Tue Oct 15 17:16:29 EDT 2002

Please find attached a course change form for EECS 401
and an associated EE program change.

On Sep. 10, 2002, the ECE faculty voted to require EECS 306
(Signals and Systems II) as a prerequisite for EECS 401
(Probabilistic methods in Engineering), because the material
from EECS 306 is absolutely essential to EECS 401, and the
existing prerequisite (EECS 206) is inadequate. Students
need a junior level signals and systems course to be prepared
for EECS 401. (In the old curriculum, EECS 316 was the
prerequisite for EECS 401.)

However, EECS 306 is not a program subject in the EE degree,
but is one of several Core Electives. So for those students
who (for whatever reason) want to avoid both EECS 306 and EECS 401,
we need to provide some method for them to fulfill their
ABET probability requirement. We voted to allow students to
have the option of taking Math 425 (Probability). However,
Math 425 is not an EECS course and is only 3 credits, so to
maintain the same number of EECS required courses (11), we
voted on Oct. 15, 2002, to require that students who elect
to take Math 425 rather than EECS 401 must take some other
300-level or higher EE course instead (i.e, an Upper Level EE
elective). Here is a summary:

Current program (continues to be an option):

credits	category
4	EECS 401
11	Flexible technical electives
8	Upper level EE electives

Option for students who choose Math 425:

credits	category
3	Math 425
8	Flexible technical electives
12	Upper level EE electives

Essentially, students who choose Math 425 are using 3 of their
flexible technical elective credits, and must find some other
EE course to take instead of EECS 401.

It is our intention to also make it explicit in the bulletin
that students cannot receive credit for more than one of
EECS 401, Math 425, and IOE 265. This requires coordination
of many curriculum committees and is in the works.

OLD

Subjects req. by all programs (55 hrs.)	Hours	1	2	3	4	5	6	7	8
1 Mathematics 115, 116, 215, & 216	16	4	4	4	4	-	-	-	-
ENGR 100	4	4	-	-	-	-	-	-	-
Chemistry 125/130 OR Chemistry 210 /211	5	5	-	-	-	-	-	-	-
ENGR 101	4	-	4	-	-	-	-	-	-
Physics 140 with Lab 141; Physics 240 with Lab 241	10	-	5	5	-	-	-	-	-
Humanities & Social Sciences	16	4	4	4	4	-	-	-	-
Program Subjects (27 hrs.)									
EECS 206, Signals and Systems	4	-	-	4	-	-	-	-	-
EECS 215, Introduction to Circuits	4	-	-	-	4	-	-	-	-
EECS 230, Electromagnetics I	4	-	-	-	-	4	-	-	-
EECS 280, Prog. and Elem. Data Struct.	4	-	-	-	4	-	-	-	-
EECS 320, Intro to Semico. Device Theory	4	-	-	-	-	4	-	-	-
EECS 401, Probabilistic Methods in Engin.	4	-	-	-	-	-	4	-	-
2 TCHNCLCM 215	1	-	-	-	1	-	-	-	-
2 TCHNCLCM 496	2	-	-	-	-	-	-	-	2
Technical Electives (34 hrs.)									
3 Flexible Technical Electives	11	-	-	-	-	-	4	3	4
4 Core Electives	8	-	-	-	-	4	4	-	-
5 Upper Level EE Technical Electives	8	-	-	-	-	-	-	8	-
6 Major Design Experience	4	-	-	-	-	-	-	-	4
7 Engineering Breadth Elective	3	-	-	-	-	3	-	-	-
Free Electives (12 hrs.)	**12**	**-**	**-**	**-**	**-**	**-**	**4**	**4**	**4**
TOTAL	**128**	**17**	**17**	**17**	**17**	**15**	**16**	**15**	**14**

1 EE students are advised to take MATH 216 before MATH 215 since EECS 215 is to be preceeded or accompanied by MATH 216

2 Technical Communication: TCHNCLCM 215 must be taken with EECS 215. TCHNCLCM 496 must be taken with a Major Design Experience (MDE) course.

3 Flexible Technical Electives: The flexible technical elective requirement may be fulfilled by taking selected courses in EECS, other engineering departments, biology, business, chemistry, economics, math, or physics. See the Undergraduate Advising Office for the current list. All other courses must be approved by an EE program advisor.

4 Core Electives: A least 8 credits from at least two categories: Signals and Systems (306), Circuits (311, 312), Electromagnetics/optics (330) or Computers (270,370).

5 Upper Level EE Technical Electives: EECS courses at the 300-level or higher, excluding EECS 499; at least 4 credits must be at the 400-level or higher. Excludes theoretical CS and software courses. See the EECS Undergraduate Advising Office for the current list.

6 Major Design Experience: Pre-approved courses: EECS 411, 425, 427, 430, 438, 452, 470, 497; other courses may be acceptable with prior approval of a Program Advisor.

7 Engineering Breadth Elective: a 200-level course required by another program in Engineering or a 300-level course in Engineering.

A maximum of 4 credits of EECS 499 may be applied to Technical Elective Requirements and only in the area of Flexible Technical Electives. Anything beyond 4 credits will be applied toward Free Electives.

NEW

Subjects req. by all programs (55 hrs.)	Hours	1	2	3	4	5	6	7	8
1 Mathematics 115, 116, 215, & 216	16	4	4	4	4	-	-	-	-
ENGR 100	4	4	-	-	-	-	-	-	-
Chemistry 125/130 OR Chemistry 210 /211	5	5	-	-	-	-	-	-	-
ENGR 101	4	-	4	-	-	-	-	-	-
Physics 140 with Lab 141; Physics 240 with Lab 241	10	-	5	5	-	-	-	-	-
Humanities & Social Sciences	16	4	4	4	4	-	-	-	-
Program Subjects (27 hrs.)									
EECS 206, Signals and Systems	4	-	-	4	-	-	-	-	-
EECS 215, Introduction to Circuits	4	-	-	-	4	-	-	-	-
EECS 230, Electromagnetics I	4	-	-	-	-	4	-	-	-
EECS 280, Prog. and Elem. Data Struct.	4	-	-	-	4	-	-	-	-
EECS 320, Intro to Semico. Device Theory	4	-	-	-	-	4	-	-	-
8 EECS 401, Probabilistic Methods in Engin., or Math 425, Probability (3 cr)	4	-	-	-	-	-	4	-	-
2 TCHNCLCM 215	1	-	-	-	1	-	-	-	-
2 TCHNCLCM 496	2	-	-	-	-	-	-	-	2
Technical Electives (34 hrs.)									
3 Flexible Technical Electives	11	-	-	-	-	-	4	3	4
4 Core Electives	8	-	-	-	-	4	4	-	-
5 Upper Level EE Technical Electives	8	-	-	-	-	-	-	8	-
6 Major Design Experience	4	-	-	-	-	-	-	-	4
7 Engineering Breadth Elective	3	-	-	-	-	3	-	-	-
Free Electives (12 hrs.)	**12**	**-**	**-**	**-**	**-**	**-**	**4**	**4**	**4**
TOTAL	**128**	**17**	**17**	**17**	**17**	**15**	**16**	**15**	**14**

1 EE students are advised to take MATH 216 before MATH 215 since EECS 215 is to be preceeded or accompanied by MATH 216

2 Technical Communication: TCHNCLCM 215 must be taken with EECS 215. TCHNCLCM 496 must be taken with a Major Design Experience (MDE) course.

3 Flexible Technical Electives: The flexible technical elective requirement may be fulfilled by taking selected courses in EECS, other engineering departments, biology, business, chemistry, economics, math, or physics. See the Undergraduate Advising Office for the current list. All other courses must be approved by an EE program advisor.

4 Core Electives: A least 8 credits from at least two categories: Signals and Systems (306), Circuits (311, 312), Electromagnetics/optics (330) or Computers (270,370).

5 Upper Level EE Technical Electives: EECS courses at the 300-level or higher, excluding EECS 499; at least 4 credits must be at the 400-level or higher. Excludes theoretical CS and software courses. See the EECS Undergraduate Advising Office for the current list.

6 Major Design Experience: Pre-approved courses: EECS 411, 425, 427, 430, 438, 452, 470, 497; other courses may be acceptable with prior approval of a Program Advisor.

7 Engineering Breadth Elective: a 200-level course required by another program in Engineering or a 300-level course in Engineering.

8 Students who elect Math 425 (3cr) rather than taking EECS 401 are required to fulfill 8 credits of Flexible Technical Electives and 12 credits of Upper Level EE Technical Electives.

A maximum of 4 credits of EECS 499 may be applied to Technical Elective Requirements and only in the area of Flexible Technical Electives. Anything beyond 4 credits will be applied toward Free Electives.

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

Print

Form Number 967

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 9/30/2002
Effective Winter 2003

A. CURRENT LISTING

Home Department	Div #	Course Number
EECS	252	470

Cross Listed Course Information

CS (LSA)	353	470

Course Title: Computer Architecture

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Comp Architecture
Transcript Max = 20 Spaces	Comp Arch

Course Description
Basic Concepts of computer architecture and organization. Computer evolution. Design methodology. Performance evaluation. Elementary queuing models. CPU architecture instruction sets. ALU design. Hardwared and microprogrammed control. Nanoprogramming memory hierarchies. Virtual memory. Cache design. Input-output architectures. Interupts and DMA. I/O processors. Parallel processing pipelined processors. Multiprocessors.

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

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

X Prerequisites EECS 370 or Graduate Standing
◉ Enforced ○ Advised

Credit Restrictions none

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

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

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

B. REQUESTED LISTING

Home Department	Div #	Course Number
EECS	252	470

Cross Listed Course Information

CS (LSA)	353	470

Course Title: Computer Architecture

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Comp Architecture
Transcript Max = 20 Spaces	Comp Arch

Course Description for Official Publication (Max = 50 words)
Basic Concepts of computer architecture and organization. Computer evolution. Design methodology. Performance evaluation. Elementary queuing models. CPU architecture instruction sets. ALU design. Hardwared and microprogrammed control. Nanoprogramming memory hierarchies. Virtual memory. Cache design. Input-output architectures. Interupts and DMA. I/O processors. Parallel processing pipelined processors. Multiprocessors.

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

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

Prerequisites EECS 370, EECS 270 or Graduate Standing.
◉ Enforced ○ Advised

Credit Restrictions none

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

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

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: Tyson, G. Austin, T.
Title: Asst. Professor Asst. 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. Jeff Fessler, EECS Jeff Fessler 2002-10-4
Cross-listed Dept(s). _____

Form Number

967

SUPPORTING STATEMENT

Students taking 470 have always needed the material in 270. This background used to be automatic when 370 had 270 as a prerequisite. Now that 370 does not require 270 absolutely, the 270 prerequisite for 470 needs to be made explicit.

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

Print

Form Number 969

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 10/1/2002
Effective Winter 2003

A. CURRENT LISTING

Home Department | Div # | Course Number

Cross Listed Course Information

Course Title

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

Course Description

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

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

Prerequisites ○ Enforced ○ Advised

Credit Restrictions

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

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

B. REQUESTED LISTING

Home Department: EECS | Div #: 252 | Course Number: 514

Cross Listed Course Information

Course Title: Advanced MEMS Devices and Technologies

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

Course Description for Official Publication (Max = 50 words)
Advanced micro electro mechanical systems (MEMS) devices and technologies. Transduction techniques, including piezoelectric, electromagnetic, electrothermal, and resonant techniques. Chemical, gas, and biological sensors, microfluidic and biomedical devices. Micromachining technologies such as laser machining and microdrilling, EDM, materials such as SiC and diamond. Sensor and actuator analysis and design through CAD.

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

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

Prerequisites: EECS 414
◉ Enforced ○ Advised

Credit Restrictions: Four Credits Only, None

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

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
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: Professor Najafi, Professor Gianchandani, Professor Wise
Title: Professor, Assoc. Professor, 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. EECS Jeff Fessler Jeff Fessler 2002-10-4
Cross-listed Dept(s). ____

Form Number

969

SUPPORTING STATEMENT

This course is a continuation of EECS 414, which introduces students to the general area of micro electro mechanical systems. This course will cover advanced topics dealing with MEMS technologies, transduction mechanisms, and microfabricated sensors and actuators. Many emerging micromachining technologies such as laser and micromechanical machining, and non-conventional materials such as SiC and diamond will be discussed and reviewed. Transduction techniques, including electromagnetic, piezoelectric, resonant, electrothermal, electrostrictive, electro-hydrodynamic etc., will be discussed and reviewed. The course will review different types of sensors for measurement of physical parameters such as acceleration, rotation rate, pressure, and different micro actuators. Details on how these devices are fabricated, and analyzing their performance will be presented. The course will also review MEMS for use in microfluidics and in biomedical applications, and will review basic fundamental fluid mechanics and issues involved in microfluidic systems. It will review chemical and gas sensors, as well as biosensors.

Above topics will be presented in a complementary fashion to what is covered in EECS 414. The course will meet in lectures and will incorporate a major project where students will team up to design/analyze micromachined sensors/actuators using CAD tools.

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

Detail the Special requirements

EECS 514: Advanced MEMS Devices and Technologies

Pre-requisites: EECS 414
Term Offered: Winter, Yearly
Credits: Four

This course is a continuation of EECS 414, which introduces students to the general area of micro electro mechanical systems. This course will cover advanced topics dealing with MEMS technologies, transduction mechanisms, and microfabricated sensors and actuators. Many emerging micromachining technologies such as laser and micromechanical machining, and non-conventional materials such as SiC and diamond will be discussed and reviewed. Transduction techniques, including electromagnetic, piezoelectric, resonant, electrothermal, electrostrictive, electro-hydrodynamic etc., will be discussed and reviewed. The course will review different types of sensors for measurement of physical parameters such as acceleration, rotation rate, pressure, and different micro actuators. Details on how these devices are fabricated, and analyzing their performance will be presented. The course will also review MEMS for use in microfluidics and in biomedical applications, and will review basic fundamental fluid mechanics and issues involved in microfluidic systems. It will review chemical and gas sensors, as well as biosensors.

Above topics will be presented in a complementary fashion to what is covered in EECS 414. The course will meet in lectures and will incorporate a major project where students will team up to design/analyze micromachined sensors/actuators using CAD tools.

Course Syllabus

- **MEMS fabrication and materials (4 lectures)**

Review of micromachining with emphasis on new techniques; 3-D machining techniques, drilling, milling, EDM, laser machining; Non-silicon materials, SiC, poly-diamond, polymers, etc.

1) **Magnetic Electromagnetic transducers (4 lectures)**

Measurement of magnetic fields, Hall-effect sensors, magnetoresistive sensors, integrated magnetic sensors, flux-gate magnetometers, magnetic-field measurement using integrated transistor structures, other magnetic sensors, electromagnetic actuators

- **Piezoelectric transducers (4 lectures)**

Review of piezoelectric property and important characteristics; piezoelectric sensors, piezoelectric actuators

1) **Resonant devices (4 lectures)**

Introduction to mechanical resonance, basic review of analysis techniques, review of resonant modes, resonant sensors, review of resonant actuators, introduction to RF MEMS

1) **Other transduction techniques (2 lectures)**

Electrostrictive, electro-hydrodynamic, electrothermal, and other less frequently used techniques.

- **Chemical/gas and biological sensors (6 lectures)**

Chemical sensors, electrochemical transducers, implantable sensing systems, gas sensors, chemical analysis systems, biosensors, Palladium-gate hydrogen sensors; thin-film conductivity-based devices for gas measurement; Ion-sensitive FET ion concentration sensors;

- **Microfluidic microsystems (4 lectures)**

Introduction to fluid mechanics; Microfluidic devices such as inkjet heads, gene analysis chips, microfluidic system issues, fluidic valves, pumps, etc.

Cognizant faculty: Gianchandani, Najafi, Nguyen, Pang, Wise

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

Print

Form Number 970

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 10/1/2002
Effective Winter 2003

A. CURRENT LISTING

Home Department | Div # | Course Number

Cross Listed Course Information

Course Title

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

Course Description

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

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

Prerequisites ○ Enforced ○ Advised

Credit Restrictions

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

Approval
☐ Curriculum Comm. _____
☐ Faculty _____
☐ Rackham _____
☐ Cross listed Unit 1 _____
☐ Cross listed Unit 2 _____

B. REQUESTED LISTING

Home Department	Div #	Course Number
EECS	252	515

Cross Listed Course Information

Course Title: Integrated Microsystems

TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Integ. Microsystems; Transcript Max = 20 Spaces: Integ. Microsystems

Course Description for Official Publication (Max = 50 words)
Review of interface electronics for sense and drive and their influence on device performance, interface standards, MEMS and circuit noise sources, packaging and assembly techniques, testing and calibration approaches, and communication in integrated microsystems. Applications, including RF MEMS, optical MEMS, bioMEMS, and microfluidics. Design project using CAD and report preparation.

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

Degree Requirements ○ Degree Requirement ○ Tech Elective (●) Core Course ○ Other ○ Free Elective

Prerequisites EECS 414
(●) Enforced ○ Advised

Credit Restrictions Four Credits Only, None.

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

Credit Hours Min 4 Max 4

Contact Hrs/Wk 4

Number of Wks 14

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: Professor Najafi, Professor Gianchandani, Professor Wise
Title Professor, Assoc. Professor, Professor

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. EECS Jeff Fessler 2002-10-9
Cross-listed Dept(s). _____

Form Number

970

SUPPORTING STATEMENT

This course will cover advanced topics in micromachined sensors, actuators, and microsystems. It will concentrate on issues specific to microsystems, which include MEMS, interface electronics, noise sources, packaging, testing and communication. It will also discuss applications of microsystems, including RF MEMS, optical MEMS, bioMEMS. The course will specifically address some of the performance limits in microsystems: the influence of sensor performance and noise, the impact of interface electronic performance and noise, and the overall impact of system package and assembly on noise. The course will review different sensing circuits and their performance specifications. In addition, topics such as system architecture, packaging, testing and calibration, and wireless communication will be discussed in the context of several application areas. The course will discuss several of the emerging application areas and will review case studies of some of these application areas.

The course will meet in lectures and will also include a major design project where teams of students will carry out a project of their choice from beginning to end.

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

Detail the Special requirements

Courses in MEMS and Microsystems at Michigan

EECS 515: Integrated Microsystems

Pre-requisites: EECS 414, (EECS 311 is recommended)
Term Offered: Fall, Yearly
Credits: Four

This course will cover advanced topics in micromachined sensors, actuators, and microsystems. It will concentrate on issues specific to microsystems, which include MEMS, interface electronics, noise sources, packaging, testing and communication. It will also discuss applications of microsystems, including RF MEMS, optical MEMS, bioMEMS. The course will specifically address some of the performance limits in microsystems: the influence of sensor performance and noise, the impact of interface electronic performance and noise, and the overall impact of system package and assembly on noise. The course will review different sensing circuits and their performance specifications. In addition, topics such as system architecture, packaging, testing and calibration, and wireless communication will be discussed in the context of several application areas. The course will discuss several of the emerging application areas and will review case studies of some of these application areas.

The course will meet in lectures and will also include a major design project where teams of students will carry out a project of their choice from beginning to end.

Course Syllabus

- **Review of noise and loss mechanisms in MEMS (3 lectures)**

Electrical noise sources and analysis, dissipative processes, non-elecctrical noise sources

- **Readout circuits (4 lectures)**

For capacitive, piezoresistive, resonant, and other transducers. Comparison of different circuits, and impact of circuit on overall device performance, modulation and filtering techniques, etc.

- **Drive circuits (3 lectures)**

Review of circuits and systems needed in micro-actuators and closed-loop systems, feedback techniques

- **Detection limits (4 lectures)**

Analysis of fundamental limits in measurement systems, review of issues that affect system reliability, accuracy, and stability; temperature sensitivity issues.

- **Review of example micromachined instruments (3 lectures)**

Use examples such as micro-machined gas chromatography, spectrum analyzers, micromachined filters, etc.

- **Testing and Calibration (3 lectures)**

Review of issues related to sensors testing and calibration, compensation and trimming techniques, digital compensation and use of micro-controllers to improve overall performance, cost and yield analysis

- **Packaging (4 lectures)**

Review of packaging issues, and basic MEMS-based packaging techniques. Effect of package on device performance, packaging techniques to minimize impact on device performance,

- **System architecture, integration, and partitioning issues (4 lectures)**

System partitioning, overall performance and effects of packaging, standards, wireless communication

Cognizant faculty: Gianchandani, Najafi, Nguyen, Pang, Wise