The University of Michigan
College of Engineering
Curriculum Committee

Agenda
November 10, 2009
1:30-3:00 p.m.
GM Room Fourth Floor
Lurie Engineering Center

1. Approval of Minutes from 10-27-09
2. Course Approvals
3. Aerospace Program Changes
4. Proposed Change to CoE EE Minor

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday October 27, 2009
1:00-3:00 p.m.
Lurie Engineering Center GM Room

Minutes

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

Members Present: M. Epelman, J. Barker, L. Bernal, J. Holloway, M. Lapp, E. Larsen, S. Montgomery, J. Pan T. Perakis, R. Robertson, F. Terry, F. Ward

Members Absent: J. Everett, E. Gulari, A. Hunt, E. Kannatey-Asibu, L. Meadows

Guests: Jason McCormick sitting in for J. Everett, Michael Liemohn, Kathleen Vargo

The minutes of the last meeting (September 27, 2009) were approved

Commission on Undergraduate Engineering Education—Next Steps—James Holloway

James Holloway talked about the Commission on Undergraduate Engineering Education—Next Steps. The presentation is attached as a PDF to the meeting packet for 11-10-09.

Changes to Rackham Degree Offerings in AOSS

Information regarding this was included in the meeting packet.
Michael Liemohn presented this information to the Committee. The AOSS department requested approval for a change in the Rackham MS and PhD degree offerings from their department. Currently they have four PhD programs and three MS programs through Rackham. The proposed changes are meant to consolidate their degree programs. The AOSS faculty unanimously voted to approve these changes.

A motion was asked for to approve this proposal. Moved and Seconded. This was approved and will be presented at the Faculty Meeting on December 1.

Course Approval Forms

Marina Epelman called for a motion to approve the following courses. This was moved and seconded.

These Courses Were Tabled

EECS 402 New Course

ENGR 407 Modification – Adding X-Listing with SI 509

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

Next Meeting November 10, 2009 GM Room – Fourth Floor LEC

COURSE APPROVAL FORM

For November 10, 2009 CoE CC Meeting

EECS 411 Modification—Changing Pre Req from:enforced: EEECS 330 or graduate Standing ***to: enforced: EECS 311 or EECS 330 or graduate standing or permission of instructor***

ME 438 Modification—Changing Pre-Req from: ME 336 or PI ***to: ME 235 ;ME 336 recommended***

ME 453 Deletion

ME 454 Deletion

NAME 550 (X-Listed with AOSS 550) Modification—Changing Title from: Offshore Engineering Analysis II ***to: Offshore Engineering I***; Changing Description; Changing Level of Credit from: 3 ***to: 4***

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

Form Number: 2050
Date: 4/23/2009
Effective Term: Fall 2010
Course Offer Freq: ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department:	Home Department: EECS Elec Engin & Computer Sci
Course Number:	Course Number: 411
Cross Listed Course Information:	Cross Listed Course Information:
Course Title:	Course Title: Microwave Circuits I
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	M-Wave Circ I
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	M-Wave Circ I
Course Description:	Course Description for Official Publication (Max = 50 words): Transmission-line theory, microstrip and coplanar lines, S-parameters, signal-flow graphs, matching networks, directional couplers, low-pass and band-pass filters, diode detectors. Design, fabrication, and measurements (1 -10GHz) of microwave-integrated circuits using CAD tools and network analyzers.
PROGRAM OUTCOMES: ☐a ☐c ☐e ☐g ☐i ☐k ☐b ☐d ☐f ☐h ☐j	PROGRAM OUTCOMES: ☐a ☒c ☒e ☒g ☐i ☐k ☒b ☐d ☐f ☐h ☐j
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective
Prereq: EECS 330 or Graduate Standing; ◉ Enforced ○ Advised	Prereq: EECS 311 or EECS 330 or graduate standing or permission of Instructor; ◉ Enforced ○ Advised
Credit Restrictions:	Credit Restrictions:
Level of Credit: ☐ Undergrad only ☐ Reckham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ R	Level of Credit: ☐ Undergrad only ☐ Reckham Grad ☐ Non-Rckhm Grad ☒ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ I
Credit Hours Min Max:	Credit Hours Min: 4 Max: 4
Contact Hrs/Wk:	Contact Hrs/Wk: 4
Number of Wks:	Number of Wks: 14

C.

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

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

Cognizant Faculty Member: Amir Mortazawi — Title: Prof.
Grad Course: Attach nomination if Cognizant Faculty Is not a regular graduate faculty

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

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept. Name, Department / Signature
Home Dept. EECS
Cross-listed Dept(s).

Form Number

2050

SUPPORTING STATEMENT

EECS330 has been traditionally the prerequisite for EECS411 to make sure that students in EECS411 are familiar with the Electromagentics (EM) concepts. However we usually find it necessary to review some important EM concepts like transmission line theory in EECS411. Another important prerequisite for EECS411 is students' familiarity with low frequency transistor amplifier design and operation which is covered in EECS311. We also find it necessary to review this topic in EEC411. Therefore changing the prerequisite requirement to either EECS330 or EECS311 can allow a larger number of our undergraduates to take EECS411 without any detrimental effect on student's progress in the course since both EM and Solid State Circuit concepts are reviewed in EECS411.

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

Detail the Special requirements

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

Form Number 2039
Date 3/13/2009
Effective Term Fall ~~2009~~ 2010
Course Offer Freq ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department:	Home Department: MECHENG Mechanical Engineering
Course Number:	Course Number: 438
☐ Cross Listed Course Information:	Cross Listed Course Information:
☐ Course Title:	Course Title: Internal Combustion Engines
TITLE ABBREVIATION — Time Sched Max = 19 Spaces:	IC Engines
TITLE ABBREVIATION — Transcript Max = 20 Spaces:	IC Engines
☐ Course Description:	Course Description for Official Publication (Max = 50 words): Analytical approach to the engineering problem and performance analysis of internal combustion engines. Study of thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency, and emissions. Design and operating characteristics of different types of engines. Computer assignment. Engine laboratories.
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	**PROGRAM OUTCOMES:** ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j
Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	**Degree Requirements** ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective
Prereq: ME336 or PI	Prereq: ME235; ME336 recommended
X ○ Enforced ◉ Advised	○ Enforced ◉ Advised
☐ Credit Restrictions:	Credit Restrictions:
Level of Credit ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types	**Level of Credit** ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☒ All Credit types
Credit Hours Min Max:	Credit Hours Min: 4 Max: 4
Contact Hrs/Wk:	Contact Hrs/Wk: 4
Number of Wks:	Number of Wks: 14

C.

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

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

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

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

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

Cognizant Faculty Member: D. Assanis — Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department — Signature
Home Dept. Mechanical Engineering — E Bgalla
Cross-listed Dept(s).

Form Number

2039

SUPPORTING STATEMENT

Material from ME336 is reviewed in the first few weeks of the class so there is no need to require ME336 as a prerequisite, however, the course is recommended.

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

Detail the Special requirements

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

Form Number 1899
Date 5/5/2009
Effective Term Fall 2009
Course Offer Freq ☐ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department: MECHENG Mechanical Engineering — Course Number: 453	Home Department: — Course Number:
☐ Cross Listed Course Information	Cross Listed Course Information
☐ Course Title: Electronics Circuits Laboratory - Self Paced	Course Title
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: — Transcript Max = 20 Spaces:	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: — Transcript Max = 20 Spaces:
☐ Course Description: Students will design, build, and test useful electronic circuits and come to understand how most simple electronic circuits function. This will enable them to find resources to improve their circuit design skills. Topics include basic circuit design and assembly techniques; analog & digital circuits and embedded microcontrollers; data acquisition and electromechanical systems.	Course Description for Official Publication (Max = 50 words)
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	**PROGRAM OUTCOMES:** ☒ a ☒ c ☒ e ☐ g ☒ i ☒ k ☒ b ☐ d ☐ f ☐ h ☐ j
Degree Requirements ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	**Degree Requirements** ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ◉ Tech Elective
☐ Prereq EE314 ◉ Enforced ○ Advised	Prereq ○ Enforced ○ Advised
☐ Credit Restrictions	Credit Restrictions
☐ **Level of Credit** ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☒ All Credit types — Credit Hours Min 1 Max 3 — Contact Hrs/Wk 1-3 — Number of Wks 14	**Level of Credit** ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types — Credit Hours Min Max — Contact Hrs/Wk — Number of Wks

C.

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

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

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

Grading ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

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

Course Is Y Graded ☐

Cognizant Faculty Member: R. Dennis — Title: Asst. Professor

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

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

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

	Name, Department	Signature
Home Dept.	Mechanical Engineering	[signature]
Cross-listed Dept(s).		

Form Number

1899

SUPPORTING STATEMENT

Faculty member left the University. No other faculty interested in taking it on. Has not been taught since 2004.

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

Detail the Special requirements

24/7 access to electronics lab in 1113 GGB

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

Form Number 2015
Date 2/4/2009
Effective Term Fall 2009
Course Offer Freq ☐ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING

Home Department: MECHENG Mechanical Engineering
Course Number: 454

Cross Listed Course Information:

Course Title: Computer Aided Mechanical Design

TITLE ABBREVIATION
Time Sched Max = 19 Spaces: CAD Design
Transcript Max = 20 Spaces: CAD Design

Course Description:
Introduction to the use of the digital computer as a tool in engineering design and analysis of mechanical components and systems. Simulation of static, kinematic and dynamic behavior. Optimal synthesis and selection of elements. Discussion and use of associated numerical methods and application software. Individual projects.

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

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

Prereq: Engin101, ME360
○ Enforced
◉ Advised

Credit Restrictions:

Level of Credit
☐ Undergrad only ☒ Ugrad or Rckhm Grad ☐ R
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

B. REQUESTED LISTING

Home Department:
Course Number:

Cross Listed Course Information:

Course Title:

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

Course Description for Official Publication (Max = 50 words)

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

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

Prereq:
○ Enforced
○ Advised

Credit Restrictions:

Level of Credit
☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

C.

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

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

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

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

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

Cognizant Faculty Member: S. Kota
Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept.: Mechanical Engineering
Cross-listed Dept(s).:

Form Number

2015

SUPPORTING STATEMENT

No longer active

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

Detail the Special requirements

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

Form Number 2072
Date 11/3/2009
Effective Term
Course Offer Freq ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: NAVARCH Naval Arch & Marine Engin / Course Number: 550
☐ Cross Listed Course Information	Cross Listed Course Information: AOSS Atmos, Oceanic & Space Sci 550
☒ Course Title: Offshore Engineering Analysis II	Course Title: Offshore Engineering I
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Offshr Eng Anal II	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Offshr Eng I
TITLE ABBREVIATION — Transcript Max = 20 Spaces: O.E. Anal II	TITLE ABBREVIATION — Transcript Max = 20 Spaces: O.E. Eng I
☒ Course Description: Design and analysis requirements of offshore facilities. Derivation of hydrodynamic loads on rigid bodies. Loads on long rigid and flexible cylinders. Viscous forces on cylinders, experimental data, Morison's equation, Stokes wave theories. Shallow water waves. Selection of appropriate wave theory. Diffraction of waves by currents. Hydrodynamic loads on risers, cables, pipelines, and TLP's.	Course Description for Official Publication (Max = 50 words): Design and analysis requirements of offshore engineering structures. Hydrodynamic loads on offshore platforms and slender bodies. Marine riser mechanics: dynamics and structural stability. Mooring dynamics: nonlinear stability and design. Vortex induced vibrations: analysis and model testing. Marine renewable energy. Hydrokinetic energy harnessing using the VIVACE Converter.
PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k	PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k
Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other	Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other
Prereq: ○ Enforced ◉ Advised	Prereq: NA/AOSS 420 ○ Enforced ◉ Advised
☐ Credit Restrictions	Credit Restrictions
☒ Level of Credit: ☐ Undergrad only ☒ Rackham Grad ☒ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work	Level of Credit: ☐ Undergrad only ☒ Rackham Grad ☒ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work
Credit Hours Min 3 Max 3; Contact Hrs/Wk 3; Number of Wks 14	Credit Hours Min 4 Max 4; Contact Hrs/Wk 4; Number of Wks 14

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

C.

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

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

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

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

Cognizant Faculty Member: Michael M. Bernitsas
Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department — Signature

Home Dept. Naval Arch & Marine Engin
Cross-listed Dept(s). Atmos, Oceanic & Space Sci

12

Form Number

2072

SUPPORTING STATEMENT

This course has not been taught for 15 years. The material has changed dramatically since then and some of the material from the old NA550 has been moved to other courses. We have kept it in the books because it is an important course and about 1/3 of our graduate students end up working for the offshore industry. About ¾ of the material in the course is totally new.

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

Detail the Special requirements

The Low Turbulence Free Surface Water Channel and the resources of the Marine Renewable Energy Laboratory (MRELab) will be used to conduct vortex induced vibration testing and hydrokinetic energy harnessing. Depending on availability, the Towing Tank of the Marine Hydrodynamics Laboratories (MHL) may be used.

OFFSHORE ENGINEERING I

NA550 (4) Winter 2010 Rm 138 Tue & Thu 2pm-4pm

I. Offshore Engineering Facilities

Design and analysis requirements of offshore engineering structures. Types of platforms and major components.

II. Hydrodynamic Loads

Hydrodynamic loads on offshore platforms. Selection of wave theory. Loads on large structures. Loads on slender bodies.

III. Marine Risers, Cables, Pipelines

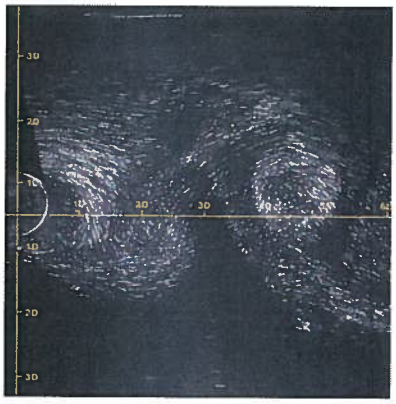
Marine riser mechanics. Structural dynamic model. Hydrodynamic loads. Global buckling. Asymptotics of long columns. Buckling in tension.

IV. Mooring Systems

Single point mooring. Spread mooring systems. Slow motion dynamics. Nonlinear stability and mooring system design. Effect of slowly varying wave drift forces on resonance and dynamic bifurcations.

V. Vortex Induced Vibrations

Analysis and model testing of VIV. Synchronization, branches, damping, correlation length, vortex structures, frequency of oscillation, hysteresis. Testing in the Low Turbulence Free Surface Water Channel.

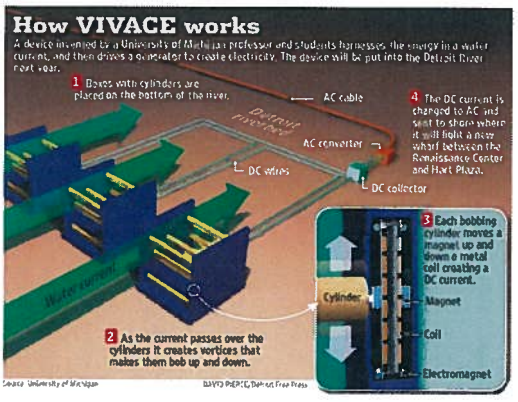


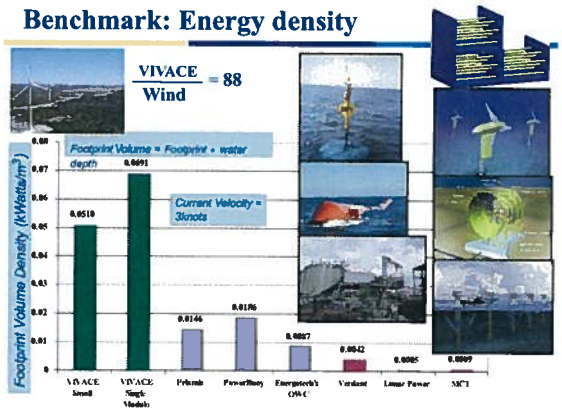
VI. Marine Renewable Energy

Renewable and conventional sources of energy. How much is there and in what form. Availability with present technology. Types of marine energy converters. Design requirements.

VII. Hydrokinetic Energy Harnessing

Vertical and horizontal hydrokinetic energy. Enhancement of VIV with passive turbulence control. Soft and hard galloping. High-damping VIV and galloping. Hydrokinetic energy harnessing using the VIVACE Converter.





To: College of Engineering Curriculum Committee

From: Luis Bernal, Chair
Undergraduate Committee

Harris McClamroch, Professor
Department of Aerospace Engineering

Date: October 26, 2009

Subject: Submission of requests for course changes and changes in degree requirements

This memo requests approval of the following items:

- Addition of three new Aerospace Engineering courses: AE 201 (3 credits), AE 347 (3 credits) and AE 348 (3 credits)

- Deletion of two current Aerospace Engineering courses: AE 245 (4 credits) and AE 345 (4 credits)

- Changes in the Aerospace Engineering undergraduate degree requirements consistent with these course changes: technical electives are reduced by 1 credit and the sample schedule is adjusted

Course approval forms, detailed course outlines, and the course profile forms are attached for each of these requested course changes. Detailed descriptions and the motivation for introducing each of the proposed new courses are given in this material. A new sample schedule and student outcomes mapping table are attached that reflect the proposed change in degree requirements.

These changes have been under discussion in the Aerospace Engineering Department for several years. This is a unified set of changes that should be considered as a single package. These changes have the support of the Department Undergraduate Committee and the support of the Department faculty.

We have a specific plan for transition from the current degree requirements to the new degree requirements; the requested effective term in which a course is added or dropped as indicated on the individual course approval forms enables this transition:

- Winter term, 2010: teach AE 245 while incorporating some elements of the new AE 201; teach AE 345;

- Fall term, 2010: teach AE 201 for the first time; teach AE 345; AE 245 is dropped and no longer offered;

- Winter term, 2011: teach AE 201; teach AE 347 for the first time; teach AE 345;

- Fall term, 2011: teach AE 201, teach AE 347, teach AE 348 for the first time; AE 345 is dropped and no longer offered

Although motivation is given in the course approval forms and the supporting documentation for the proposed course changes, it is suitable to summarize here the overall reasons for requesting approval of the proposed course changes.

Motivation for AE 201:

AE 245 has been the initial course taken by most Aerospace Engineering majors since 1999. The course was originally developed to cover steady aircraft flight and performance and the foundations of orbital mechanics. AE 245 was not originally developed as an introductory course into aerospace engineering; it is not surprising that it has not served that role very well. The new course AE 201 is intended to provide a broad introduction to the field as well as to cover aircraft steady flight and performance (but not orbital mechanics). This change should better meet the needs of students as they embark on their undergraduate studies in Aerospace Engineering.

AE 245 has included technical communications content, approximately 5 lecture hours or less than 0.5 credits. This content has emphasized teamwork and technical writing, thereby duplicating coverage in ENGR 100, AE 305 and AE 405. It is proposed to delete this technical communications content from AE 201. Additional individual writing emphasis was added recently to AE 285, the required aerospace undergraduate seminar course.

Motivation for AE 347 and AE 348:

The proposed courses AE 347 and AE 348 represent a significant rearrangement and streamlining of the material currently taught in AE 245 (the orbital mechanics part) and AE 345. There is some new material on space flight dynamics and control; but the overwhelming majority of the material is already being taught in AE 245 and AE 345.

The rationale for this rearrangement is the realization that basic dynamics ideas that support both aircraft and space flight dynamics are most efficiently developed within the space flight context without the complication of aerodynamics. By introducing dynamics ideas that complement what is taught in ME 240 (required for Aerospace undergraduate students) we can apply these ideas in the proposed AE 347 to both spacecraft orbits and spacecraft attitude dynamics. This increased efficiency allows us to include a limited amount of new material on open-loop attitude control in AE 347.

The dynamics foundation laid in AE 347 then allows us to efficiently develop analogous ideas in AE 348, where now the aircraft dynamics necessitate aerodynamic constitutive properties. Once these concepts are introduced we can move on directly to linearized flight models and then to closed-loop control of small perturbation motion.

An illustrative example of the efficiency of this rearrangement of material is given by the fact that Euler angles apply to all three spheres, namely, right ascension of the ascending node, inclination, and argument of periapsis for orbits; precession, nutation, and spin for spacecraft; and yaw, pitch and roll for aircraft. This is one example of the efficiencies and enhanced understanding that will emerge from this unified pedagogical approach.

In summary, the rearrangement of AE 245 and AE 345 into AE 347 and AE 348 provides a more efficient and streamlined treatment of dynamics, which can then be applied to orbital dynamics, attitude dynamics, aircraft dynamics and related control topics. Students will be able to see how the same ideas are applicable to all three contexts, which will allow them to appreciate and take advantage of these connections throughout their careers as students and professionals.

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

Form Number 2070
Date 10/22/2009
Effective Term Fall 2010
Course Offer Freq ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department / Course Number	Home Department: AEROSP Aerospace Engineering / Course Number: 201
Cross Listed Course Information	Cross Listed Course Information
Course Title	Course Title: Introduction to Aerospace Engineering
TITLE ABBREVIATION — Time Sched Max = 19 Spaces	Intro Aero
TITLE ABBREVIATION — Transcript Max = 20 Spaces	Intro Aero
Course Description	Course Description for Official Publication (Max = 50 words): Introduction to aerospace engineering. Flight vehicles in the atmosphere and in space. Flight technologies, including structures, materials, propulsion, aerodynamics, vehicle dynamics, flight control, flight information systems, and systems integration. An overview of aeronautics. Steady aircraft flight and performance. An overview of astronautics.
PROGRAM OUTCOMES: ☐ a ☐ c ☐ e ☐ g ☐ i ☐ k ☐ b ☐ d ☐ f ☐ h ☐ j	PROGRAM OUTCOMES: ☒ a ☐ c ☒ e ☐ g ☐ i ☒ k ☐ b ☐ d ☒ f ☒ h ☒ j
Degree Requirements: ○ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective	Degree Requirements: ◉ Degree Requirement ○ Free Elective ○ Other ○ Core Course ○ Tech Elective
Prereq: ○ Enforced ○ Advised	Prereq: ◉ Enforced ○ Advised — Preceded by Engr 100, Engr 101, and Physics 14, 0/141 and Math 116
Credit Restrictions	Credit Restrictions
Level of Credit: ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types	Level of Credit: ☒ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types
Credit Hours Min Max; Contact Hrs/Wk; Number of Wks	Credit Hours Min 3 Max 3; Contact Hrs/Wk 3; Number of Wks term

C.

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

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

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

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

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

Cognizant Faculty Member: Ella Atkins — Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept. Aerospace Engineering
Cross-listed Dept(s).

Form Number

2070

SUPPORTING STATEMENT

This new course provides a broad introduction to aerospace engineering, thereby better preparing students for subsequent courses in the field. It will be the first required course in the aerospace engineering undergrad curriculum.

About 75% of the proposed material in AE 201 is currently taught in AE 245. The overview of aerospace engineering in AE 201 is a new emphasis, while space flight material that was formerly covered in AE 245 will now be covered in the proposed course AE 347. This repacking of material should better inform students about the aerospace engineering discipline, while preparing them for their subsequent course work.

AE 245 has integrated technical communications into the technical material that has been taught. Our experience since 2000 has been that students find much of this redundant to what they did in Engr 100. In addition, the Aero faculty instructors of AE 245 believe that the emphasis on teams, which now occurs in numerous courses in the curriculum, has not provided much opportunity for individual students to improve their technical communications skills. The proposed AE 201 will NOT include lectures from technical communications staff. The required aerospace seminar AE 285 will expand its emphasis on the development of individual technical communication skills.

There will be a primary faculty member who teaches AE 201 each term. At the same time, it is expected that additional faculty will give course lectures on specific topics within their particular areas of expertise.

The Aerospace Engineering faculty have considerable experience in teaching AE 245 since 2000. Although AE 201 is significantly different in its objectives, there is about 75% overlap in technical content. The major challenge is to reorganize the presentation of certain topics to provide a broad overview of aerospace engineering.

Our plan to transition from AE 245 to AE 201 is to teach AE 245 in Winter, 2010, as a trial run for AE 201. The relatively smaller enrollment in Winter is an important factor. This transition term should provide us with valuable experience as we prepare to teach AE 201 for the first time in Fall, 2010.

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

Detail the Special requirements

Aero 201: Introduction to Aerospace Engineering

COURSE #: AE **201**	**COURSE TITLE: INTRODUCTION TO AEROSPACE ENGINEERING**
TERMS OFFERED: Fall/Winter	**PREREQUISITES: Eng 100 and 101, Phys 140/141, Math 116**
INSTRUCTOR(S): Atkins	**SCIENCE/DESIGN CREDITS: 3/0 (required course)**
CATALOG DESCRIPTION: An introduction to aerospace engineering. Flight vehicles in the atmosphere and in space. Flight technologies, including structures, materials, propulsion, aerodynamics, vehicle dynamics, flight control, flight information systems, and systems integration. An overview of aeronautics. Steady aircraft flight and performance. An overview of astronautics.	**COURSE TOPICS**: 1. Introduction to atmospheric flight 2. Aircraft systems 3. Aircraft steady flight and performance. 4. Space flight 5. Space vehicle systems

COURSE OBJECTIVES	1. To provide students with an introduction to the aerospace field. (Leads to 1, 2, 5) 2. To teach students about the fundamentals of vehicle flight in the atmosphere. (Leads to 1, 2, 3, 4, 5) 3. To teach students about the fundamentals of vehicle flight in space. (Leads to 1, 2, 5) 4. To provide students with an understanding of performance trades in aircraft flight. (Leads to 1, 2, 4, 5) 5. To provide students with engineering background suitable for subsequent course work in aerospace engineering (leads to 5)
COURSE OUTCOMES	**On completion of Aero 201, students can:** 1. Understand range of subject matter covered in aerospace engineering. (Assessed by: 1,2,3) 2. Understand important physical features of aircraft and space flight systems. (Assessed by: 1,2,3) 3. Be able to apply basic principles of mechanics to steady and unsteady flight. (Assessed by: 1,2,3) 4. Develop equations that characterize aircraft performance in steady flight; solve those equations for flight conditions. (Assessed by: 1,2,3) 5. Integrate and apply system level understanding of complex aerospace systems
ASSESSMENT TOOLS	1. Hourly exams. 2. Individual homework. 3. Final exam

Generated: October 26, 2009

AE 201 Topics Outline

Specified lecture topics: 36 hours

Part 1: Overview of aeronautics (16 hours)

Aeronautics and the history of aeronautics (1 hr)
- The quest to fly: 19th century and earlier
- 20th century human flight
  - Success with powered flight!
  - Rise of the commercial transport
  - Military aviation
  - Other operations: From barnstormers to business jets
- 20th century uninhabited aviation
  - Remotely-piloted and model aircraft
  - Drones and missiles
  - UAS

Flight Vehicle Configuration, Design, and Operation (1.5 hrs)
- Mission-centric aircraft design
  - Payload constraints: mass, volume, (piloted and autonomous vehicles)
  - Design factors: Performance, safety, reliability, efficiency, environment
  - Multidisciplinary design optimization
    - (payload, design factors) → (structure, aero, avionics)
  - Military operations: Fighters, transports, munitions
  - Civilian operations: Passenger/cargo transport, business jet, general aviation
- Components and configurations
  - Fixed-wing aircraft: fuselage, wings, vertical tail, horizontal tail, control surfaces
  - Other flight vehicle configuration:
    - Short take off and landing vehicles
    - Vertical take off and landing vehicles
    - Blended wing-body
  - Avionics and communication systems (piloted and autonomous vehicles)
  - Propulsion system: jet, propeller-driven, fuel tanks/batteries, etc.

Aircraft Materials and Structure Design (2 hours)
- Aircraft materials
  - Light weight materials
  - Composite materials
- Aircraft structural features
  - Critical structural components
  - Aerodynamics, propulsive and gravitational loads
  - Stresses and strains

- Models using beams, plates, shells, etc
- Possible failure mechanisms
- Structural constraints that limit flight

Aerodynamics (4 hours)

- Standard atmosphere
  - Ideal gas law and hydrostatic equations
  - Derivation of standard atmospheric model
    - Troposphere
    - Tropopause
    - Stratosphere
  - Variations of atmospheric temperature, pressure and density with altitude
- Aircraft Wing Design
  - Airfoils and dimensions
  - Definition of axes (body, wind, inertial)
  - Lift and drag forces
- Aerodynamic Forces and Moments
  - Lift force
    - Airfoils, camber and angle of attack
    - The Kutta condition
  - Drag force
    - Parasite drag
    - Lift induced drag
  - Aerodynamic shapes
  - Dynamic pressure
  - Lift coefficients, drag coefficients, moment coefficients
    - Drag polars
    - Dependence of lift coefficient on angle of attack
    - Stall as a constraint that limits flight
    - Dependence of pitch moment coefficient on angle of attack
  - Compressibility effects
    - Transonic and supersonic aerodynamics

Propulsion systems (2.5 hrs)

- Thrust development mechanisms
- Ideal jet engines
  - Maximum thrust constraints
  - Thrust-specific fuel consumption rate
- Propeller driven by ideal internal combustion engines
  - Maximum power constraints
  - Power-specific fuel consumption rate
- Thrust/power models for propulsion systems
  - Maximum thrust/maximum power
    - Dependence on speed and altitude
  - Fuel consumption rate
    - Dependence on speed and altitude

- Other propulsion systems
  - Ramjets and scramjets
  - Rocket propulsion systems

Avionics and Control Systems (4 hrs)

- Control actuation
  - Fixed-wing aircraft control mechanisms
    - Throttle (single and multi-engine)
    - Primary aerodynamic control surfaces
      - Elevator
      - Ailerons
      - Rudder
    - Secondary aerodynamic control surfaces
      - Flaps, slats, spoilers
  - Other control actuators
    - Retractable gear, brakes, climate control, payload
  - Alternative flight vehicle controls:
    - Thrust vectoring
    - STOL/VTOL and helicopters
    - Wing morphing
- Electronic and sensor systems
  - Inertial Navigation Systems: global positioning system, inertial measurement systems, sensors, filters
  - Power systems, communication systems, fly-by-wire glass cockpits
  - Integrated payloads (from munitions to autonomous vehicle)
- Flight automation and software systems
  - Commercial flight management systems
    - Lateral and vertical autopilot systems
    - Performance prediction/optimization
    - Pilot interfaces: fly-by-wire controls, control display units
  - Unmanned aircraft systems flight management
    - Onboard flight control / payload management
    - Remote control/supervision through a ground station link
  - Avionics/software certification (validation and verification)

Aircraft operations in the National Air Space (1 hr)

- FAA airworthiness certification (manned and unmanned)
- Air traffic management
  - Airspace classes, flight planning and clearance
    - Instrument and visual flight rules
    - Scheduled and unscheduled
    - Special use airspace
  - Separation assurance and traffic collision avoidance systems
  - Wind/weather data integration

Part 2: Steady fixed-wing aircraft flight and performance (14 hrs)

Aircraft kinematics (1 hr)
- Aircraft translational velocity vector
  - Angle of attack, side slip angle
  - Fight path angle, heading angle
- Aircraft attitude
  - Roll angle, pitch angle, yaw angle
- Longitudinal flight
- Lateral flight

Aircraft cruise: steady level flight (3 hrs)
- Force and moment equations
- Equilibrium flight conditions
- Steady level flight conditions
  - Thrust and air speed relations
  - Power and air speed relations
  - Conditions on angle of attack and elevator deflection
  - Review of jet and propeller-driven aircraft propulsion
- Constraints on steady level flight
  - Engine thrust or power constraints
  - Stall constraints
- Steady level flight envelopes
  - Steady level flight in terms of altitude and air speed
- Steady level flight performance measures
  - Maximum speed
  - Minimum speed
  - Flight ceiling

Aircraft range and endurance in steady level flight (3 hrs)
- Fuel consumption assumptions
- Range equations for propeller aircraft
- Endurance equations for propeller aircraft
  - Maximal range and endurance
  - Flight conditions
- Range equations for jet aircraft
- Endurance equations for jet aircraft
  - Maximal range and endurance
  - Flight conditions

Aircraft steady longitudinal climbing or descending flight (2 hrs)
- Equilibrium flight conditions
- Steady longitudinal flight conditions
  - Flight path angle/climb rate, thrust and air speed relations
  - Jet powered aircraft
  - Propeller driven aircraft
- Constraints on steady climbing flight

- Engine thrust or power constraints
- Stall constraints
- Steady climbing or descending flight envelopes
- Steady climbing or descending flight performance measures
  - Maximum flight path angle/climb rate
  - Maximum air speed and minimum air speed
- Steady longitudinal gliding flight (no thrust)

Steady aircraft turns (2.5 hrs)

- Advantages of banked turns over side slipping turns
- Banked level turns
  - Steady level turning flight conditions
    - Thrust, air speed, bank angle relations
    - Jet powered aircraft
    - Propeller driven aircraft
  - Constraints on steady level turns
    - Engine thrust or power constraints
    - Stall constraints
    - Wing loading constraints
  - Steady level turning flight envelopes
  - Steady level turning flight performance measures
    - Maximum air speed and minimum air speed
    - Minimum radius turns
- Banked turns in climb or descent
  - Summary of a few results as time permits
  - This is the most general form of steady flight
  - Aircraft moves along a helical path with vertical axis

Aircraft maneuvers (0.5 hr)

- Maneuvers that arise from step change in aircraft inputs
- Selection of aircraft input to achieve a specified maneuver

Aircraft flight planning (1 hr)

- Flight plan defined by a sequence of waypoints
- Flight plans and way point specifications
- Steady flight maneuvers between waypoints

Take-off and landing considerations (0.5 hr)

- Take-off phase
- Landing phase
- Performance measures

Flight properties of other atmospheric flight vehicles (0.5 hr)

- Helicopters
- Harrier
- Flapping wing vehicles

Missiles
Blimps and airships
Hovercraft, quad rotor vehicles, etc.

Part 3. Overview of astronautics (6 hrs)

History of astronautics (0.5 hr)

Beyond the atmosphere (0.5 hr)
The upper atmosphere
The solar system
The space environment
Vacuum of space
Gravity
Magnetic fields
Radiation

Categories of space flight vehicles (0.5 hr)
Rockets
Ballistic missiles
Reentry vehicles
Launch vehicles
Communication satellites
Scientific satellites
Interplanetary spacecraft
Piloted spacecraft
Spacecraft formations
Space Robotics

Components of spacecraft (0.5 hrs)
Payload and instrument packaging
Solar panels, antennas, tethers
Propulsion for orbit changes and maneuvers

Spacecraft materials and structures (0.5 hr)
Spacecraft deformations
Thermal and radiation protection
Human protection

Spacecraft avionics and software (0.5 hrs)
Navigation: IMU (review), star trackers, etc.
Onboard software
Command, control, payload data handling
Communication systems including relays, blackouts
Attitude control
Ground station

Orbit determination, maneuver calculation
Spacecraft safing and fault management
High-stakes missions and automation: trust, efficiency, safety

Spacecraft propulsion (1 hr)
High thrust propulsion (chemical engines)
Low thrust propulsion (electric, nuclear, etc)

Spacecraft orbits (1 hr)
Newtonian gravity
Two-body orbital models
Three-body orbital models
Orbital maneuvers
Gravity assist maneuvers

From the atmosphere into orbit and return (0.5 hr)
Launch vehicles
Multiple stage rockets
Single stage rocket
Reentry from space into the atmosphere
Thermal management

Spacecraft missions (0.5 hr)
Mission objectives and design
Mission operations
Ground testing

Comments:

1. Regular homework assignments

2. Typical course grading policy:

Homework	20%
2 Exams	50%
Final Exam	30%

3. Possible textbooks (or references):

Part 1: R. S. Shevell, Fundamentals of Flight, Prentice Hall, 1988.
Part 2: N. H. McClamroch, Steady Aircraft Flight and Performance, Princeton University Press, 2010.
Part 3: W. Lee, To Rise from Earth: An Easy-to-Understand Guide to Spaceflight, Fact On File, Inc., New York, 1995.

4. The course will have a primary instructor but it is expected that several faculty will present lectures on topics within their particular expertise.

5. Visual aids, including photographs and video clips, will be extensively utilized throughout the course.

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

Form Number 1867
Date 10/22/2009
Effective Term Fall 2010
Course Offer Freq ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

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

Course Description

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

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

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

B. REQUESTED LISTING

Home Department: AEROSP Aerospace Engineering | Course Number: 347

Cross Listed Course Information

Course Title: Space Flight Mechanics

TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Spaceflight Mechanics | Transcript Max = 20 Spaces: Space Mechanics

Course Description for Official Publication (Max = 50 words)

Introduction to space flight mechanics. The two-body problem. Orbital transfers, maneuvers and orbital analysis. Ground tracks and relative motion in orbit. Gravity assist trajectories. Spacecraft attitude and rotational dynamics. Euler's and Poisson's equations. Stability analysis. Open loop attitude control and momentum management using thrusters and reaction wheels.

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

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

Prereq: Preceded by ME 240, Math 216, and AE 201
◉ Enforced
○ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

C.

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

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

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

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

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

Cognizant Faculty Member: D. S. Bernstein | Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept. Aerospace Engineering
Cross-listed Dept(s).

☐ Cross listed Unit 2

Form Number

1867

SUPPORTING STATEMENT

This course is part of a repackaging of two courses totaling eight credits (AE 245 and AE 345) into three courses totaling nine credits (AE 201, AE 347, AE 348).

AE 347 will consist of the orbital mechanics material that was previously treated in the second half of AE 245 and new material applied to space vehicle dynamics, some of which was previously treated in the beginning part of AE 345. This repackaging is efficient in the sense that it covers all of the flight dynamics and control material that was previously taught, but it allows for an explicit focus on dynamics and control of space flight vehicles that was not previously covered. This means that students electing AE 347 will be much better prepared to move into the space systems capstone design course AE 483.

Although this course has not been taught exactly in the form proposed, the course material on orbital mechanics is exactly taken from the second half of AE 245; the material on attitude dynamics and control has been taught in several graduate level courses and will be suitably reorganized for undergraduates.

Consequently Aerospace faculty have had much experience of teaching this material on a regular basis since 2000. Hence the faculty expect no difficulties in the transition to this new course and in teaching this course on a regular basis.

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

Detail the Special requirements

COURSE #: AE 347	**COURSE TITLE: SPACEFLIGHT MECHANICS**
TERMS OFFERED: Fall/Winter	**PREREQUISITES: Math 216, ME 240, and AE 201**
INSTRUCTOR(S): Bernstein	**SCIENCE/DESIGN CREDITS: 3/0 (required course)**
CATALOG DESCRIPTION: Introduction to space flight mechanics. The 2-body problem. Orbital transfers, maneuvers, and orbital analysis. Ground tracks and relative motion in orbit. Gravity-assist trajectories. Spacecraft attitude and rotational dynamics. Euler's and Poisson's equations. Stability analysis. Euler angles for orbits and attitude. Open-loop attitude control and momentum management using thrusters and reaction wheels.	**COURSE TOPICS:** 1. Orbital dynamics 2. Orbital transfers and maneuvers 3. Open loop orbital control 4. Spacecraft attitude concepts 5. Spacecraft attitude and rotational dynamics 6. Open loop attitude and rotational control

COURSE OBJECTIVES	1. Teach students the basic concepts of orbital mechanics (Leads to 1, 2, 3, 4, 5) 2. Familiarize students with the assumptions and techniques upon which the equations of motion for spaceflight orbital and rotational motions are based. (Leads to 1, 2) 3. Teach students how to analyze orbital dynamics and rotational dynamics. (Leads to 3, 4, 5) 4. Introduce students to basic concepts of open loop control for orbital maneuvers and attitude control. (Leads to 4, 5)
COURSE OUTCOMES	**On completion of Aero 347, students** 1. Are able to use Matlab and STK for system simulation of orbits and rotational dynamics. (Assessed by 1) 2. Understand the basic assumptions upon which spacecraft dynamics models are based. (Assessed by 1, 2, 3) 3. Understand the fundamentals of two-body orbits; are familiar with multi-body orbits. (Assessed by 1, 2, 3) 4. Understand principles of open loop control for design of orbit transfers and maneuvers. (Assessed by 1, 2, 3) 5. Understand the fundamentals of spacecraft rotational dynamics and control. (Assessed by 1, 2, 3)
ASSESSMENT TOOLS	1. Individual Homework. 2. Hourly Exams. 3. Final Exam.

Generated: October 26, 2009

AE 347 Topics Outline

- Orbital Dynamics
  - Orbital dynamics and space flight
    - Motivation and importance of the subject
    - Mathematical and engineering aspects of the subject
  - N-body problem
  - 2-body problem
    - Orbital differential equations
      - Conservation of energy and angular momentum
      - Different orbit types and important relationships
      - Time of flight in orbit
      - Classical orbital elements defined via Euler rotations
  - Orbital transfers and control
    - Orbit planning and design
    - Hohmann transfers
    - Non-Hohmann transfers
    - Plane change maneuvers
    - Low thrust orbit transfers
  - Orbit mechanics in rotating reference frames
    - Ground tracks
    - Relative motion in orbit
    - Introduction to Satellite Toolkit (STK)
  - Launch and orbital analysis
    - Rocket equation and launch vehicles
    - Launch inclination
    - Achieving LEO, GEO, and escape
    - Simple orbit determination
  - 3-body problem
    - Gravity assists
    - Restricted 3-Body problem
    - Libration points

- Spacecraft Attitude Dynamics and Control
  - Attitude dynamics and space flight
    - Motivation and importance of the subject
    - Mathematical and engineering aspects of the subject
  - Attitude definition
    - Euler angles
    - Relation between angular velocity and Euler angle rates
    - Attitude determination
  - Rotational angular momentum
    - Conservation of rotational angular momentum
    - Angular momentum and torque
  - Euler's Equations and Poisson's Equations
    - Solutions for torque-free rotation

Principal axis rotations
Stability analysis
Symmetric spinners
Solutions with external torque
Constant torque
Gravity gradient
Attitude control (open loop) and angular momentum management
Using thrusters
Using reaction and momentum wheels
Using control moment gyros

Comments:

1. Regular homework assignments

2. Some homework assignments require use of Matlab, the Satellite Toolkit, and other computer software tools.

3. Particular historical spacecraft orbit and attitude dynamics issues are used for illustration

4. Typical course grading policy:

Homework	20%
2 Exams	50%
Final Exam	30%

5. Possible textbook: H. Curtis, Orbital Mechanics: for Engineering Students. Elsevier, 2004 (second edition, 2009).

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

Form Number 1868
Date 10/22/2009
Effective Term Fall 2010
Course Offer Freq ☒ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING

Home Department | Course Number

Cross Listed Course Information

Course Title

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

Course Description

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

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

Prereq
○ Enforced
○ Advised

Credit Restrictions

Level of Credit
☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

B. REQUESTED LISTING

Home Department: AEROSP Aerospace Engineering | Course Number: 348

Cross Listed Course Information

Course Title: Aircraft Dynamics and Control

TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Aircraft Dy Control | Transcript Max = 20 Spaces: Aircraft Dyn Control

Course Description for Official Publication (Max = 50 words)

Introduction to the dynamics and control of atmospheric flight vehicles. Nonlinear equations of motion. Stability derivatives and linearized equations for longitudinal and lateral flight dynamics. Concepts from linear systems: state equations, transfer functions, stability, time response, frequency response. Fundamentals of feedback control, including root locus and Nyquist analysis applied to flight control.

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

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

Prereq: Preceded by AE 347
◉ Enforced
○ Advised

Credit Restrictions

Level of Credit
☒ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

C.

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

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

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

Grading
☒ A-E
☐ CR/NC
☐ P/F
☐ S/U

Course Is Y Graded ☐

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

Cognizant Faculty Member: D. S. Bernstein | Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept. Aerospace Engineering
Cross-listed Dept(s).

☐ Cross listed Unit 2

Form Number

1868

SUPPORTING STATEMENT

This course is part of a repackaging of two courses totaling eight credits (AE 245 and AE 345) into three courses totaling nine credits (AE 201, AE 347, AE 348).

AE 348 will consist of the last three fourths of AE 345 that treats aircraft dynamics and control. By building on the background material from AE 201 and AE 347, it will be possible to cover all of the important topics on aircraft flight dynamics and control that was previously covered in four credits in AE 345. Students electing AE 348 will be better prepared to move into the aircraft capstone design course AE 481.

Although this course has not been taught exactly in the form proposed, it effectively represents a subset of topics taught in AE 345; consequently the faculty have had experience of teaching this material each fall and winter term since 2000. Hence the faculty expect no difficulties in the transition to this new course and in teaching this course on a regular basis.

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

Detail the Special requirements

Aero 348: Aircraft Dynamics and Control

COURSE #: AE 348	**COURSE TITLE: AIRCRAFT DYNAMICS AND CONTROL**
TERMS OFFERED: Fall/Winter	**PREREQUISITES: AE 347**
INSTRUCTOR(S): Bernstein	**SCIENCE/DESIGN CREDITS: 3/0 (required course)**
CATALOG DESCRIPTION: Introduction to the dynamics and control of atmospheric flight vehicles. Nonlinear equations of motion. Stability derivatives and linearized equations for longitudinal and lateral flight dynamics. Concepts from linear systems: state equations, transfer functions, stability, time response, and frequency response. Fundamentals of feedback control, including root locus and Nyquist analysis applied to flight control.	**COURSE TOPICS:** 1. Dynamics equations of motion 2. Linear systems theory 3. Aircraft longitudinal flight dynamics 4. Aircraft lateral flight dynamics 5. Aircraft flight control systems

COURSE OBJECTIVES	1. Teach students the basic concepts of linear systems theory including time-and frequency-domain analysis. (Leads to 1, 3, 4, 5, 6) 2. Familiarize students with the assumptions and techniques upon which the equations of motion for aircraft are based. (Leads to 2, 3) 3. Teach students how to linearize the equations of motion of aircraft and how to interpret and analyze the linearized equations by applying linear systems techniques. (Leads to 1, 2, 3, 4, 5, 6) 4. Introduce students to basic concepts of feedback control system analysis and design. (Leads to 6)
COURSE OUTCOMES	**On completion of Aero 348, students** 1. Are able to use Matlab for aircraft system simulation. (Assessed by 1) 2. Understand the basic assumptions upon which aircraft dynamics models are based (rigid bodies, aerodynamic models, mass distribution, stability derivatives). (Assessed by 1, 2, 3) 3. Are able to linearize nonlinear models about operating points. (Assessed by 1, 2, 3) 4. Understand the fundamental concepts of linear systems (free and forced response, poles and zeros, frequency response). (Assessed by 1, 2, 3) 5. Understand factors governing aircraft stability. (Assessed by 1, 2, 3) 6. Understand principles of feedback control system design. (Assessed by 1, 2, 3)
ASSESSMENT TOOLS	1. Individual Homework. 2. Hourly Exams. 3. Final Exam.

Generated: October 26, 2009

AE 348 Topics Outline

- Aircraft dynamics and control
  - Importance and motivation of the subject
  - Mathematical and engineering aspects of the subject
  - Standing assumptions: fixed-wing aircraft, etc.
  - Terminology and notation

- Summary of aircraft flight equations
  - Earth, aircraft, stability, and wind frames
  - Translational and rotational kinematics
  - Translational and rotational dynamics
  - Control surface moments
  - Trimmed steady flight conditions
  - Perturbations from steady flight
  - Analytical evaluation of stability derivatives
  - Longitudinal flight dynamics
  - Lateral flight dynamics
  - State space equations
  - Analysis of linearized flight modes
    - Longitudinal flight: phugoid and short period modes
    - Lateral flight: roll, Dutch roll and spiral modes
  - Flight simulation

- Linear systems
  - State space models
    - Eigensystem analysis
  - Laplace transforms
    - Transfer functions
    - Poles and zeros
  - Block-diagram algebra
  - Time domain performance
  - Frequency response performance

- Feedback control
  - Basic servo problem
  - Potential benefits of feedback
  - Costs of feedback
  - PID control and system type (integrator order)
  - Stability analysis
    - Routh-Hurwitz criterion
    - Root locus method
  - Frequency response methods
    - Magnitude-phase (Bode) plots
    - Nyquist stability criterion
    - Gain and phase margins

Effect of delay
Performance specifications using the final value theorem
Command following
Disturbance rejection
Design of flight control systems
Feedback control structures
Achieving time domain specifications
Achieving frequency response specifications

Comments:

1. Regular homework assignments are given; short projects may be given, perhaps integrated with the homework assignments.

2. Some homework assignments require use of Matlab, Simulink, and other computer software tools.

3. Particular historical aircraft dynamics and control issues are used for illustration

4. Typical course grading policy:

Homework + short projects	20%
2 Exams	50%
Final Exam	30%

5. Possible textbook: D. S. Bernstein, *Aircraft Flight Dynamics and Control* (draft)

Sample Schedule

B.S.E. (Aerospace Engineering)

Credit Hours		Terms							
		1	2	3	4	5	6	7	8
Subjects required by all programs (55 hrs.)									
MATH 115, 116, 215, and 216	16	4	4	4	4	-	-	-	-
ENGR 100, Intro to Engr	4	4	-	-	-	-	-	-	-
ENGR 101, Intro to Computers	4	-	4	-	-	-	-	-	-
CHEM 125/126 and 130, or 210 and 211[1]	5	5	-	-	-	-	-	-	-
Physics 140 with Lab 141; Physics 240 with Lab 241[2]	10	-	5	5	-	-	-	-	-
Humanities and Social Sciences	16	4	4	-	-	-	-	4	4
Related Technical Core Subjects (12 hrs.)									
MECHENG 240, Intro to Dynamics and Vibrations	4	-	-	-	4	-	-	-	-
MATSCIE 220, Intro to Materials	4	-	-	4	-	-	-	-	-
EECS 314, Cct Analysis and Electronics	4	-	-	-	-	4	-	-	-
Aerospace Science Subjects (29 hrs.)									
AEROSP 201, Introduction to Aerospace Engineering	3	-	-	3	-	-	-	-	-
AEROSP 215, Intro to Solid Mechanics and Aerospace Structures	4	-	-	-	4	-	-	-	-
AEROSP 225, Intro to Gas Dynamics	4	-	-	-	4	-	-	-	-
AEROSP 315, Aircraft and Spacecraft Structures	4	-	-	-	-	4	-	-	-
AEROSP 325, Aerodynamics	4	-	-	-	-	-	4	-	-
AEROSP 335, Aircraft and Spacecraft Propulsion	4	-	-	-	-	4	-	-	-
AEROSP 347, Space Flight Mechanics	3	-	-	-	-	3	-	-	-
AEROSP 348, Aircraft Dynamics and Control	3	-	-	-	-	-	3	-	-
Aerospace Engineering Subjects (13 hrs.)									
AEROSP 285, Aero Engineering Seminar	1	-	-	1	-	-	-	-	-
AEROSP 305, Aerospace Engr Lab I	4	-	-	-	-	-	4	-	-
AEROSP 405, Aerospace Engr Lab II	4	-	-	-	-	-	-	4	-
AEROSP 481, Aircraft Design or Aero 483, Space System Design	4	-	-	-	-	-	-	-	4
Electives (19 hrs.)									
Technical Electives[3]	10	-	-	-	-	-	-	7	3
General Electives	9	-	-	-	-	-	5	-	4
Total	128	17	17	17	16	15	16	15	15

Candidates for the Bachelor of Science degree in Engineering (Aerospace Engineering) - B.S.E (Aerospace E.) - must complete the program listed above. This sample schedule is an example of one leading to graduation in eight terms.

Notes:

[1]If you have a satisfactory score or grade in Chemistry AP, A-Level, IB Exams or transfer credit from another institution for Chemistry 130/125/126 you will have met the Chemistry Core Requirement for CoE.

[2]If you have a satisfactory score or grade in Physics AP, A-Level, IB Exams or transfer credit from another institution for Physics 140/141 and 240/241 you will have met the Physics Core Requirement for CoE.

[3] Technical electives must total at least 10 credits of approved upper division courses (that is, 300 level or above). At least 3 credits must be approved mathematics or sciences course, at least 3 credits must be Aerospace Engineering courses, a maximum of 3 credits is allowed for directed study and a maximum of 2 credits is allowed for seminar courses. Recommended courses that satisfy the mathematics or science technical electives are described in a document that can be obtained from the Department or on the Department website.

Mapping of required Aerospace Engineering courses to Program Outcomes

Program Outcomes	Aero 201	Aero 215	Aero 225	Aero 285	Aero 305	Aero 315	Aero 325	Aero 335	Aero 347	Aero 348	Aero 405	Aero 481	Aero 483
(a) ability to apply knowledge of mathematics, science and engineering	XX	XX	XX		XX	XX	XX	XX	XX	XX	XX	XX	XX
(b) ability to design and conduct experiments, analyze and interpret data					XX						XX		
(c) ability to design a system, component, or process					Y			Y	Y	Y	XX	XX	XX
(d) ability to function on teams					Y			Y			XX	XX	XX
(e) ability to identify, formulate and solve engineering problems	XX	XX	XX		XX	XX	XX	XX	XX	XX	XX	XX	XX
(f) understanding of professional and ethical responsibility	Y			Y								XX	
(g) ability to communicate effectively				Y	XX			Y			XX	XX	XX
(h) broad education necessary to understand the impact of engineering solutions in a global/societal context	Y			XX				Y				Y	Y
(i) recognition of the need/ability to engage in life-long learning				XX	Y			Y			Y	Y	Y
(j) knowledge of contemporary issues	XX			XX				Y	Y	Y	Y	XX	XX
(k) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Y	Y	Y		XX	Y	Y	Y	Y	Y	Y	XX	XX
(l) knowledge of aerodynamics, aerospace materials, structures, aircraft and rocket propulsion, flight mechanics, orbital mechanics, aircraft stability and control	XX	XX	XX	Y	Y	XX	XX	XX	XX	XX	Y	XX	XX
(m)Competence in the integration of aerospace science and engineering topics and their application in aerospace vehicle design	Y			Y					Y	Y	Y	XX	XX

XX: *strong relationship (significant focus in this course)* Y**:** *modest relationship (some focus in this course)*

Approved by Aero Faculty - 2 November 2009.

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

Form Number 1871
Date 10/26/2009
Effective Term Fall 2010
Course Offer Freq ☐ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING

Home Department: AEROSP Aerospace Engineering
Course Number: 245
Cross Listed Course Information:
Course Title: Performance of Aircraft and Spacecraft
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Air & Spacecraft
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Air & Spacecraft
Course Description:
An introduction to the aerospace field. Introduces students to steady motion of aircraft and spacecraft and to methods for evaluating performance of aircraft and spacecraft systems. Students learn basic aerodynamics, propulsion, and orbital mechanics. Involves team projects that include written reports.

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

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

Prereq: Preceded by Eng 100 and 101, Physics 140/141 and Math 116
◉ Enforced ○ Advised

Credit Restrictions:

Level of Credit
☒ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

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

B. REQUESTED LISTING

Home Department: AEROSP Aerospace Engineering
Course Number: 245
Cross Listed Course Information:
Course Title: Performance of Aircraft and Spacecraft
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Air & Spacecraft
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Air & Spacecraft
Course Description for Official Publication (Max = 50 words)

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

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

Prereq
○ Enforced ○ Advised

Credit Restrictions:

Level of Credit
☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I
☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad
☐ Non-Rckhm Grad ☐ All Credit types

Credit Hours Min Max
Contact Hrs/Wk
Number of Wks

C.

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

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

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

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

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

Cognizant Faculty Member: N. H. McClamroch
Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept. Aerospace Engineering
Cross-listed Dept(s).

Form Number

1871

SUPPORTING STATEMENT

The two current required flight dynamics and control courses (AE 245 and AE 345) totaling eight credits are repackaged into three courses (AE 201, AE 347, AE 348) totaling nine credits. This repacking allows (1) providing a broader introduction to aerospace engineering in AE 201 and (b) coverage of additional material on orbital and attitude dynamics of spacecraft in AE 347, material which has not previously been covered in the undergraduate curriculum. This will better prepare students for the space systems capstone design course AE 483. All material on aircraft flight dynamics and control will be covered in the new sequence. This efficiency is achieved through reorganization of the topics and by requiring Math 216 as a prerequisite for AE 347.

To implement these changes, AE 245 is to be dropped. Material in the first half of AE 245 will be covered in AE 246; the second half of AE 245 will be covered in AE 347.

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

Detail the Special requirements

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

Form Number 1872
Date 10/26/2009
Effective Term Fall 2011
Course Offer Freq ☐ Indefinitely ☐ One term only

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

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

A. CURRENT LISTING

Home Department: AEROSP Aerospace Engineering
Course Number: 345
Cross Listed Course Information:
Course Title: Flight Dynamics and Control
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Flight Dyn&Control
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Flight Dyn&Control
Course Description:
An introduction to dynamics and control of aircraft. Introduces concepts from linear systems theory (state equations, transfer functions, stability, time and frequency response). Aircraft longitudinal and lateral flight dynamics and control systems.

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

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

Prereq: Preceded by Math 216 and ME 240
○ Enforced ◉ Advised

Credit Restrictions:

Level of Credit: ☒ Undergrad only ☐ Ugrad or Rckhm Grad ☐ R ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types

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

B. REQUESTED LISTING

Home Department: AEROSP Aerospace Engineering
Course Number: 345
Cross Listed Course Information:
Course Title: Flight Dynamics and Control
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Flight Dyn&Control
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Flight Dyn&Control
Course Description for Official Publication (Max = 50 words)

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

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

Prereq:
○ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ Ugrad or Rckhm Grad ☐ I ☐ Rackham Grad ☐ Ugrad or Non-Rckhm Grad ☐ Non-Rckhm Grad ☐ All Credit types

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

C.

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

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

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

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

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

Cognizant Faculty Member: D. S. Bernstein
Title: Professor

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

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

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Department | Signature

Home Dept.: Aerospace Engineering
Cross-listed Dept(s).:

Form Number

1872

SUPPORTING STATEMENT

The two current required flight dynamics and control courses (AE 245 and AE 345) totaling eight credits are repackaged into three courses (AE 201, AE 347, AE 348) totaling nine credits. This repacking allows (1) providing a broader introduction to aerospace engineering in AE 201 and (b) coverage of additional material on orbital and attitude dynamics of spacecraft in AE 347, material which has not previously been covered in the undergraduate curriculum.

Essentially all material on aircraft flight dynamics and control that is currently taught in AE 345 (4 credits) will be covered in the new course AE 348 (3 credits). This efficiency is achieved through reorganization of the topics and by requiring Math 216 as a prerequisite for AE 347.

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

Detail the Special requirements

Motion: Proposed Changes in Rules and Description of EE Minor

The ECE Division would like to propose changes in the definition of the CoE EE Minor program. This document contains the current CoE Bulletin description of the minor and then the proposed changes (highlighted in yellow). The major change is to reduce the required credit hours for the minor from 16 to 15. There wording changes for clarity (no substantive changes) in some of the other rules. As currently defined, the EE minor would allow paths such as 215-230-330-530. The sequence represents very substantial training in electromagnetic theory from an EE perspective; however, this path is not sufficient for the minor as EECS 530 is 3 credit hours, making this path only 15 credit hours (and thus insufficient under rule 5 of the minor). Similar possibilities could occur for interested students in Systems and Optics (and perhaps other fields).

We would like to get CoE Curriculum Committee approval at the November 10, 2009, meeting and (hopefully) CoE approval at the December 1, 2009, Faculty Meeting.

I will be submitting the matter to the LSA Curriculum Committee before December 11, 2009, for approval for LSA undergraduates to take the EE minor. The proposed revisions, including the reduction to 15 credit hours, meet the published requirements of LSA Minors. For consistency, the CoE and LSA minor definitions should be the same.

Fred L. Terry, Jr., Chair, ECE Division Undergraduate Academics Committee 11/2/09

Current Engineering Bulletin:

Minor in Electrical Engineering (EE)

As the lines between engineering and scientific disciplines become increasingly blurred, many students are forced to make tough decisions about which major to choose. Traditionally there has been no formal mechanism within the College of Engineering to expose students to substantial academic preparation in more than one department, other than a double-major option, which generally entails a substantial investment of time. A Minor in Electrical Engineering (EE), offered through the EECS Department, is designed to fill this void by providing an avenue for a diverse education for students outside of the EECS department. Due to the extensive breadth of EE discipline areas, students seeking a Minor in EE have a spectrum of choices for the program paths they choose. Path options include Applied Electromagnetics, Circuits, Communications, Control Systems, Optics, Signal Processing, and Solid State.

The EE Minor is open to all students across campus as long as the eligibility requirements stated below are met:

1. Students must have an average of 2.0 or higher at time of declaring the EE minor

2. Students must have completed all Math and Physics prerequisites with a grade of C or better
3. Students pursuing a major in Electrical Engineering (EE), Computer Engineering (CE) and Computer Science (CS -- including LSA/CS) are not eligible for the EE minor

Minimum Program Requirements

1. EECS 215
2. One of the following program core courses: 216, 230, 270, 320
3. Two electives from among the following courses: 216, 230, 270, 320, 311, 312, 330, 334, 370, 373, 411, 413, 414, 420, 421, 423, 425, 427, 429, 430, 434, 451, 452, 455, 460, 461, 470, 530.
4. At least one elective must be at the 400-level or higher
5. Total 16 or more credits
6. All courses for the EE Minor must be completed with a grade of C or better

Suggested Program Options

1. Systems: Communications, Control, Signal Processing
2. Electromagnetics and Optics
3. Circuits and Solid State

Sample Paths

Paths Option	Required Core	Path Preparation Core	Elective (1)	Elective (2)
1. Systems	215	216	451, 455, 460	451, 452, 455, 460, 461 (no duplicates)
2. Electromagnetics and Optics	215	230	330,334	411, 430, 434, 438, 530
3. Circuits & Solid State	215	216	311, 312, 320	411, 413, 414, 420, 421, 423, 425, 427, 429

Proposed Revisions:

Minor in Electrical Engineering (EE)

As the lines between engineering and scientific disciplines become increasingly blurred, many students are forced to make tough decisions about which major to choose. Traditionally there has been no formal mechanism within the College of Engineering to expose students to substantial academic preparation in more than one department, other than a double-major option, which generally entails a substantial investment of time. A Minor in Electrical Engineering (EE), offered through the EECS Department, is designed to fill this void by providing an avenue for a diverse education for students outside of the EECS department. Due to the extensive breadth of EE discipline areas, students seeking a Minor in EE have a spectrum of choices for the program paths they choose. Path options include Applied Electromagnetics, Circuits, Communications, Control Systems, Optics, Signal Processing, and Solid State.

The EE Minor is open to all students across campus as long as the eligibility requirements stated below are met:

1. Students must have an average of 2.0 or higher at time of declaring the EE minor
2. Students must have completed all Math and Physics prerequisites with a grade of C or better
3. Students pursuing a major in Electrical Engineering (EE), Computer Engineering (CE) and Computer Science (CS -- including LSA/CS) are not eligible for the EE minor

Minimum Program Requirements

1. EECS 215
2. One of the following program core courses: 216, 230, 270, 320
3. Two electives from among the following courses: 216, 230, 270, 320, 311, 312, 330, 334, 370, 373, 411, 413, 414, 420, 421, 423, 425, 427, 429, 430, 434, 451, 452, 455, 460, 461, 470, 530. Other EECS classes may be used with the prior approval of the EE Chief Program Advisor. These classes must be of similar level to this defined list. Classes which lie principally in the discipline of Computer Science will not be allowed. Students with these interests are referred to the LSA CS Minor.
4. At least one elective must be at the 400-level or higher
5. Total 15 or more credits
6. All courses for the EE Minor must be completed with a grade of C or better

Suggested Program Options

1. Systems: Communications, Control, Signal Processing
2. Electromagnetics and Optics

3. Circuits and Solid State

Sample Paths

Paths Option	Required Core	Path Preparation Core	Elective (1)	Elective (2)
1. Systems	215	216	451, 455, 460	451, 452, 455, 460, 461 (no duplicates)
2. Electromagnetics and Optics	215	230	330,334	411, 430, 434, 438, 530
3. Circuits & Solid State	215	216	311, 312, 320	411, 413, 414, 420, 421, 423, 425, 427, 429