UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, February 11 – Email Vote Email Vote

Attending:

Call to Order:

Adjourned:

AGENDA

1. 02.28.20 Meeting Minutes Approval

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
4	BIOMEDE	479	MOD	Modification to enforced prerequisites	WN 2021	C-	X	Revision was made to include honor courses for enforced prerequisites after confusion of handwritten edits	
7	NAVARCH	515	NEW	No changes to prerequisites	FA 2020		X	There was an abstention and a no vote. No vote due to "approval of a course that is not a part of a program change and was not	

								offered twice previously as a special topics course. This would violate a previous precedent and set a new precedent. Recommends discussion". Abstention due to course last being taught in Winter 2014. Recommended discussion of an upper limit on how old the first offering of a course can be.	
24	SPACE	371	NEW	change to enforced prerequisites	WN 2021	C-	X	One abstaining vote One comment from yes voter – class is very small and there are few data points in teaching evaluation	

Curriculum Committee Member Comments:

Ed Durfee: "I believe that by approving NA515 the committee is violating previous precedent (thus establishing a new precedent) by approving as a permanent course a course that is not part of a program change and was not offered *twice* previously as a special topics course. In fact, arguably it has *never* been previously offered as a special topics course in its planned form (to appeal to students from across engineering programs). While the committee of course is able to set a new precedent, I don't think we should do so without a discussion."

Christina Rice: I agree the CARFs meet the requirements for approval so vote yes based on that - I think hearing people discuss courses gives us a better feel but we also aren't commenting on content directly.

Yavuz Bozer:

1. Bio Med 479, a modification: Course numbers were written by hand into the CARF. Is the proposed change as follows: (math 216 or math 286 or math 396) and Biomed 331? If the answer is no, then I don't understand what the intended prereq structure is. If the answer is yes, then my vote is yes BUT I don't understand why the supporting statement is left blank. The department should at least explain to the CCC in one or two sentences why this change is required.

2. Nav Arch 515, new course:
I'm going to abstain. It was last taught in Winter 2014! Is there an upper limit on how old the first offering can be before it is proposed as a new course? If there is no upper limit, we should discuss placing an upper limit. I personally think 6 years is too long.

3. Space 371, new course:
Small class; very few data points in the teaching evaluation but I'll vote "yes."

UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, February 11– Email Vote
Email Vote

Attending:

Call to Order:

Adjourned:

AGENDA

1. 1.28.20 Meeting Minutes: APPROVED

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
4	BIOMEDE	479	MOD	Modification to enforced pre-requisites	WN 2021	C-			
7	NAVARCH	515	NEW	No change to enforced pre-requisites	FA 2020				
14	SPACE	371	NEW	Change to enforced prerequisites	WN 2021	C-			

UNIVERSITY OF MICHIGAN
College of Engineering
Curriculum Committee Meeting
Tuesday, January 28 – Email Vote
Email Vote

Attending:

Call to Order:

Adjourned:

AGENDA

1. 1.14.20 Meeting Minutes: APPROVED

CARF SUMMARIES

PAGE	SUBJECT	COURSE #	ACTION	SUMMARY	EFFECTIVE TERM	MIN. GRADE REQ. FOR ENF. PREPREQ	APPROVED	NOTES & REVISIONS	TABLED
3	EECS	440	NEW	Modification of course description	FA 2020	C	X	No suggestions made	
25	EECS	494	MOD	Change to enforced prerequisite	FA 2020	C	X	No suggestions made	

Faculty Meeting Guidelines

Following the December 2019 Faculty Meeting, Kathleen Grimes outlined new guides for the Curriculum Committee's participation in faculty meetings. Here they are:

1. Only items that require a vote will appear on the agenda;
2. There will be a maximum of 3 items allowed;
3. Materials for informational items should still be submitted along with materials for items to be voted on, but they are only for faculty review and will not be presented or discussed at the meeting;
4. If slides are used, a maximum of 3 slides per item will be allowed.

Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

☑ CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested
- ☐ New Course
- ☑ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2020-01-17
Effective Term: Winter 2021

☑	Course Offered ☑ Indefinitely ☐ One term only	RO USE ONLY Date Received: Date Completed: Completed By:

	CURRENT LISTING	REQUESTED LISTING
☐	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 479	Dept (Home): Biomedical Engineering Subject: BIOMEDE Catalog: 479
☐	☐ Course is Cross-Listed with Other Departments	☐ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
☐	Course Title (full title) Biotransport	Course Title (full title) Biotransport
☐	Abbreviated Title (20 char) Biotransport	Abbreviated Title (20 char) Biotransport
☑	Course Description (Please limit to 50 words and attach separate sheet if necessary) Fundamentals of mass transport as it relates to biomedical systems. Convection, diffusion, osmosis and conservation of momentum, mass and energy will be applied to cellular and organ level transport. Examples of diffusion combined with reaction will also be examined.	
☑	Full Term Credit Hours Undergraduate Min: 4 Graduate Min: 4 Undergraduate Max: 4 Graduate Max: 4	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Undergraduate Student, Rackham Graduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject: Biomedical Engineering Catalog: 479

☑ Grading Basis
- ☑ Graded (A – E)
- ☐ Credit/No Credit
- ☐ Satisfactory/Unsatisfactory
- ☐ Pass/Fail
- ☐ Business Administration

Grading
- ☐ Not for Credit
- ☐ Not for Degree Credit
- ☐ Degree Credit Only

Add Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

Drop Consent
- ☐ Department Consent
- ☐ Instructor Consent
- ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☑	Advisory Prerequisite (254 char) Math 216 AND Biomede 331	Advisory Prerequisite (254 char)
☑	Enforced Prerequisite (254 char) Minimum grade requirement: C-	Enforced Prerequisite (254 char) Math 216 AND Biomede 331 or math 2810 or Math 3960 Minimum grade requirement: C-
☐	Credit Exclusions	Credit Exclusions

☑ Course Components
- ☑ Lecture
- ☐ Seminar
- ☐ Recitation
- ☐ Lab
- ☐ Discussion
- ☐ Independent Study

Graded Component
- ☑
- ☐
- ☐
- ☐
- ☐
- ☐

Terms Typically Offered
- Fall
- ☑ Winter
- ☐ Spring
- ☐ Summer
- ☐ Spring/Summer

Cognizant Faculty Member Name: David Nordsletten Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Rachel Patterson Email: rjpatt@umich.edu Phone: 3-5290

Curriculum Committee Member: [signature] Print: Xueding Wang Date: 1/29/2020

Curriculum Committee Chair: Print: Date:

Home Department Chair: [signature] Print: Rachael Schmedlen Date: 1/22/20

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description Fundamentals of mass transport as it relates to biomedical systems. Convection, diffusion, osmosis and conservation of momentum, mass and energy will be applied to cellular and organ level transport. Examples of diffusion combined with reaction will also be examined.	Course Description Fundamentals of mass transport as it relates to biomedical systems. Convection, diffusion, osmosis and conservation of momentum, mass and energy will be applied to cellular and organ level transport. Examples of diffusion combined with reaction will also be examined.
Class Length Full term	Class Length Full term
Contact hours (lecture): 4	Contact hours (lecture): 4
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:
BIOMEDE 479 fulfills requirements for the Biochemical and Biomechanical concentrations.

ABET departmental program outcomes for undergraduate courses:
1

Special resources of facilities required for this course:

Supporting statement:

Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148

☑CHECK APPROPRIATE BOXES FOR ALL CHANGES

Action Requested
- ☑New Course
- ☐Modification of Existing Course
- ☐Deletion of Existing Course

Date of Submission: 2020-01-28
Effective Term: Fall 2020

☑	Course Offered ☑ndefinitely ☐ne term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	REQUESTED LISTING
☑	Dept (Home): Subject: Catalog:	Dept (Home): Naval Arch & Marine Engin Subject: NAVARCH Catalog: 515
☐	☐Course is Cross-Listed with Other Departments Department / Subject / Catalog Number	☐Course is Cross-Listed with Other Departments Department / Subject / Catalog Number
☑	Course Title (full title)	Course Title (full title) Residual Stresses & Distortions in Modern Manufacturing
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) Res Stress & Distort
☑	Course Description (Please limit to 50 words and attach separate sheet if necessary) Modern approaches to residual stress and distortion control are presented with a focus on design and manufacture of lightweight structures, involving plate processing, laser cutting/forming, welding/joining, and 3D printing. Basic thermo-plasticity phenomena are treated through a series of 1D analytical models and followed by modern finite element simulation procedures.	
☑	Full Term Credit Hours Undergraduate Min: Graduate Min: 3 Undergraduate Max: Graduate Max: 3	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Rackham Graduate Student	
☐	Repeatability ☐Course is Repeatable for Credit Maximum number of repeatable credits:	☐Course is Y graded ☐Can be taken more than once in the same term

Subject:	Catalog:

☑	Grading Basis ☑Graded (A – E) ☐Credit/No Credit ☐Satisfactory/Unsatisfactory ☐Pass/Fail ☐Business Administration Grading ☐Not for Credit ☐Not for Degree Credit ☐Degree Credit Only	Add Consent ☐Department Consent ☐Instructor Consent ☑No Consent	Drop Consent ☐Department Consent ☐Instructor Consent ☑No Consent

	CURRENT LISTING	REQUESTED LISTING
☑	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char) Mechanics of materials or strengths of materials courses recommended.
☐	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) Minimum grade requirement:
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑Lecture ☐Seminar ☐Recitation ☐Lab ☐Discussion ☐Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑Fall ☐Winter ☐Spring ☐Summer ☐Spring/Summer

Cognizant Faculty Member Name: Pingsha Dong	Cognizant Faculty Member Title: Professor

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Warren Noone Email: nooner@umich.edu Phone: 4-6471

Curriculum Committee Member: [signature] Print: D. KARR Date: 1/28/20

Curriculum Committee Chair: Print: Date:

Home Department Chair: [signature] Print: JING SUN Date: 1/30/2020

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

Cross-Listed Department Chair: Print: Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description	Course Description Modern approaches to residual stress and distortion control are presented with a focus on design and manufacture of lightweight structures, involving plate processing, laser cutting/forming, welding/joining, and 3D printing. Basic thermo-plasticity phenomena are treated through a series of 1D analytical models and followed by modern finite element simulation procedures.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:
This new course presents contemporary modeling approaches to residual stress and distortion control for achieving effective modular design and manufacture of multi-materials lightweight structures. This course complements existing manufacturing related course offerings, e.g., NA 461, ME 452, ME 482, ME 487, ME 584, MFG 502, MFG 588, ME 587, NA 513 by offering modern integrated computational modeling approaches to quantitatively inter-relate design features with manufacturing processes for developing optimum assembly processes. This course will better prepare future ME, NAME, and MFG graduate students to take on the modern challenges in structural design and manufacturing of future multi-materials lightweight structures involved in the future transportation systems.

ABET departmental program outcomes for undergraduate courses:

Special resources of facilities required for this course:
None

Supporting statement:
There is no course offering within the CoE on modeling approaches addressing residual stress and distortion problems that are uniquely associated with design and manufacture of modern lightweight structures. After an initial offering (NA 599), the feedback from students has been very positive. Since then, there have been numerous inquiries and requests received by the instructor from NAME, MSF, ME, ISD, and AE about a regular offering of this course.

Course Title:	NA 515 Residual Stress and Distortion in Modern Manufacturing
Course Level:	Graduate level
Cognizant Faculty:	P. Dong
Credit Hours:	3 credits
Schedule:	Fall Term (every other fall semester starting Fall 2020)
Prerequisites:	Prerequisite: None
Short Description:	Modern approaches to residual stress and distortion control are presented with a focus on design and manufacture of lightweight structures, involving plate processing, laser cutting/forming, welding/joining, and 3D printing. Basic thermo-plasticity phenomena are treated through a series of 1D analytical models and followed by modern finite element simulation procedures.
Text:	Lecture notes and selected book chapters

Outline and Time Allocation — Lecture unit (1.5 hrs)

I. Major challenges in residual stress and distortion control in manufacture of modern lightweight structures — 1

II. Material behaviors in thermal manufacturing — 2

III. Basic thermos-plasticity phenomena in manufacturing and 1D modeling: — 6
- Temperature-dependent stress-strain relationship
- Localized thermo-mechanical deformation modeling
  - 1-bar model
  - 3-bar model
  - n-bar model
- Local plastic zone characterization and implications on distortions

IV. Local plastic zone based distortion modeling — 2
- Shrinkage force method
- Shrinkage strain method

V. Applications — 4
- Plate rolling
- Thermal cutting
- Mechanical bending/thermal forming
- Arc welding
- Solid state joining processes
- 3D printing

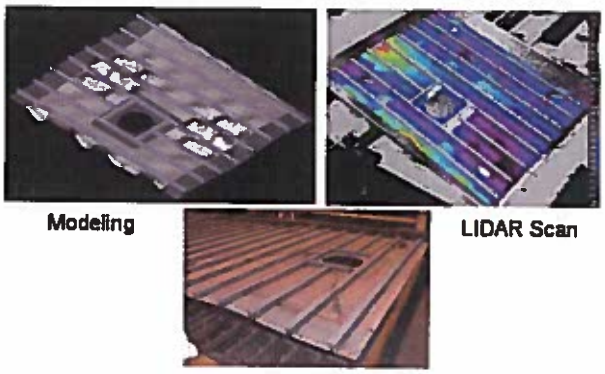
VI.	Finite element modeling • Heat source modeling • Plastic zone modeling • Residual stress and distortion modeling • Buckling distortion modeling	5
VII.	Residual stress and distortion control • Principles of interim product definitions • Principles of residual stress and distortion mitigation techniques • Buckling distortion control	2
VIII.	Real-world applications: • Marine structures • Aerospace and automotive structures	1
IX.	Course review	1

A New Graduate Course NA/MSG/ISD 599
Winter 2014

RESIDUAL STRESSES AND DISTORTIONS IN MODERN MANUFACTURING (3 Hrs)

Instructor: Prof. Pingsha Dong (dongp@umich.edu)

Class Schedule: MW: 4PM -5:30PM Rm: 107 GFL

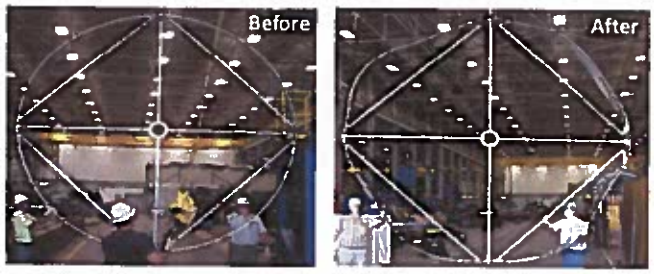


Course Description

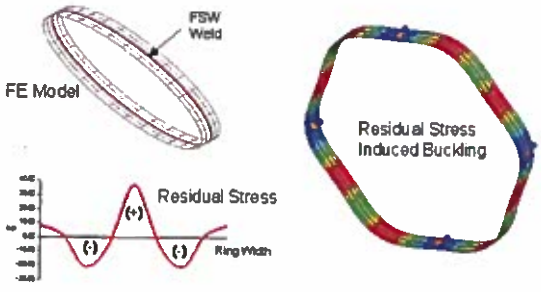
This course starts with an introduction of some of the challenges in manufacture of modern metallic structures to meet increasingly stringent structural performance and manufacturing/life-cycle cost requirements. Residual stresses and distortions caused by modern manufacturing processes, such as laser forming, thermal cutting, welding (including recent developments in friction stir welding and computer-controlled rapid metal deposition or "3D printing") have become increasingly a concern both for dimensional accuracy control in modular construction and for ensuring construction quality as well as structural integrity. This new course will introduce a series of novel first-principle based approaches to solving residual stress and distortion problems associated with plate/sheet processing, thermal cutting, welding, friction-stir, and rapid metal deposition processes. Real world examples (aerospace, automotive, and shipbuilding) will be used to demonstrate the problem solving process and effective mitigation techniques. More advanced methods such as numerical and finite element modeling techniques will be discussed for solving more complex engineering problems. Then, effects of residual stresses and distortions on structural strength (static and buckling), fatigue, as well as unstable fracture will be discussed, particularly, in terms of fracture mechanics treatment of residual stress in the context of fitness-for-service (FFS) or engineering-critical assessment (ECA) applications.

Course Topics

1. Modern manufacturing challenges, small-lot versus mass-production; manufacturability versus structural performance
2. Group technology concept and interim-product definition requirements
3. Simple thermo-plasticity modeling of:
   - Plate/sheet processing
   - Thermal cutting
   - Thermal forming (e.g., line heating)
   - Welding/joining including friction stir welding and surface processing
   - Rapid metal deposition, e.g., "3D printing"
4. "1-bar", "3-bar", and "n-bar" models
5. Angular distortions and control
6. Buckling distortions and control
7. Symmetry principles for interim product definitions and optimum assembly sequencing
8. Residual stress and distortion control techniques
9. Various industrial examples and problem solving
10. Advanced modeling methods and procedures
11. Residual stress and distortion effects on:
    - Static strength
    - Buckling
    - Fatigue
    - Unstable fracture



Distortion After Friction Stir Welding (FSW)



Bucking Distortion Modeling

University of Michigan
Office of the Registrar - Evaluations
ro.umich.edu/evals/

Winter 2014 Final
7 students responded out of the total enrolled 7

Instructor Report

2014-04-10 - 2014-04-24 Report ID: MSR04732

Instructor: Dong,Pingsha
NAVARCH 599 060

		Responses from your Students**							Other Users of This Item*					
									University Wide			School/College		
		5 SA	4 A	3 N	2 D	1 SD	NA	Your Median	75% Above	50% Above	25% Above	75% Above	50% Above	25% Above
1	Overall, this was an excellent course.	6	0	1	0	0	0	4.92	3.93	4.30	4.70	4.17	4.50	4.75
2	Overall, the instructor was an excellent teacher.	6	0	1	0	0	0	4.92	4.14	4.58	4.83	4.27	4.69	4.83
3	I learned a great deal from this course.	6	0	1	0	0	0	4.92	4.00	4.38	4.71	4.30	4.58	4.79
4	I had a strong desire to take this course.	7	0	0	0	0	0	5.00	3.67	4.17	4.63	4.17	4.50	4.75
120	I learned a good deal of factual material in this course.	6	0	1	0	0	0	4.92	3.92	4.25	4.64			
121	I gained a good understanding of concepts/principles in this field.	5	0	1	0	0	0	4.90	3.98	4.21	4.55			
160	I participated actively in class discussion.	5	2	0	0	0	0	4.80	3.93	4.20	4.50			
203	The instructor stressed important points in lectures/discussions.	6	1	0	0	0	0	4.92	4.17	4.56	4.80			
207	The instructor appeared to have a thorough knowledge of the subject.	7	0	0	0	0	0	5.00	4.50	4.80	4.92			
216	The instructor acknowledged all questions insofar as possible.	6	1	0	0	0	0	4.92	4.33	4.67	4.83			
220	The instructor gave individual attention to students in the class.	6	0	1	0	0	0	4.92	4.25	4.63	4.83			
222	One real strength of this course was the classroom discussion.	4	2	1	0	0	0	4.63	3.62	4.14	4.67			
226	The instructor kept students informed of their progress.	6	0	1	0	0	0	4.92	4.00	4.41	4.79			
259	The coursepack covered material from diverse perspectives.	6	0	0	1	0	0	4.92	n/a	n/a	n/a			
320	Writing assignments made students think.	6	0	1	0	0	0	4.92	4.00	4.19	4.54			
340	The textbook made a valuable contribution to the course.	5	1	0	0	0	1	4.90	3.33	4.00	4.38			
341	The textbook was easy to read and understand.	4	2	0	0	0	1	4.75	3.68	4.00	4.25			
356	Examinations covered the important aspects of the course.	6	0	1	0	0	0	4.92	4.00	4.29	4.63			
362	The exams were returned in a reasonable amount of time.	6	1	0	0	0	0	4.92	4.17	4.33	4.61			
363	The examinations were graded very carefully and fairly.	6	1	0	0	0	0	4.92	4.17	4.50	4.70			
365	Grades were assigned fairly and impartially.	6	1	0	0	0	0	4.92	4.00	4.33	4.63			

* The quartiles are calculated from Winter 2014 data. The university-wide quartiles are based on all UM classes in which an item was used. The school/college quartiles in this report are based on graduate level students in College of Engineering.

** SA - Strongly Agree, A - Agree, N - Neutral, D - Disagree, SD - Strongly Disagree, NA - Not Applicable.

Course Approval Request Form

Office of the Registrar, University of Michigan

1210 LSA Building
500 S. State Street
Ann Arbor, MI 48109-1382
Phone: 734.763.2113
Fax: 734.936.3148
ro.curriculum@umich.edu
ro.umich.edu

☑ **CHECK APPROPRIATE BOXES FOR ALL CHANGES**

Action Requested
- ☑ New Course
- ☐ Modification of Existing Course
- ☐ Deletion of Existing Course

Date of Submission: 2020-01-10
Effective Term: Winter 2021

☑	Course Offered ☑ Indefinitely ☐ One term only	**RO USE ONLY** Date Received: Date Completed: Completed By:

	CURRENT LISTING	REQUESTED LISTING
☑	Dept (Home): Subject: Catalog:	Dept (Home): Space Science & Engineering Subject: SPACE Catalog: 371
☐	☐ Course is Cross-Listed with Other Departments	☐ Course is Cross-Listed with Other Departments
	Department / Subject / Catalog Number	Department / Subject / Catalog Number
☑	Course Title (full title)	Course Title (full title) Space Engineering to Solve Society's Challenges
☑	Abbreviated Title (20 char)	Abbreviated Title (20 char) Space Engin Challeng
☑	Course Description (Please limit to 50 words and attach separate sheet if necessary) This course explores how to implement a successful space mission given a set of science objectives. Space science, spacecraft design, error analysis, and signal detection are integrated through a series of case studies. Example space, planetary, astrophysical, and earth science missions will be discussed and explored to illustrate these topics.	
☑	Full Term Credit Hours Undergraduate Min: 3 Graduate Min: Undergraduate Max: 3 Graduate Max:	Half Term Credit Hours Undergraduate Min: Graduate Min: Undergraduate Max: Graduate Max:
☑	Course Credit Type Undergraduate Student	
☐	Repeatability ☐ Course is Repeatable for Credit Maximum number of repeatable credits:	☐ Course is Y graded ☐ Can be taken more than once in the same term

Subject:	Catalog:

☑	Grading Basis ☑ Graded (A – E) ☐ Credit/No Credit ☐ Satisfactory/Unsatisfactory ☐ Pass/Fail ☐ Business Administration Grading ☐ Not for Credit ☐ Not for Degree Credit ☐ Degree Credit Only	Add Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent	Drop Consent ☐ Department Consent ☐ Instructor Consent ☑ No Consent

	CURRENT LISTING	REQUESTED LISTING
☑	Advisory Prerequisite (254 char)	Advisory Prerequisite (254 char) SPACE 310, SPACE 370
☑	Enforced Prerequisite (254 char) Minimum grade requirement:	Enforced Prerequisite (254 char) CLIMATE 320/SPACE 320, CLIMATE 324/SPACE 324 Minimum grade requirement: C-
☐	Credit Exclusions	Credit Exclusions

☑	Course Components ☑ Lecture ☐ Seminar ☐ Recitation ☐ Lab ☐ Discussion ☐ Independent Study	Graded Component ☑ ☐ ☐ ☐ ☐ ☐	Terms Typically Offered ☑ Fall ☐ Winter ☐ Spring ☐ Summer ☐ Spring/Summer

Cognizant Faculty Member Name: Justin Kasper	Cognizant Faculty Member Title:

SIGNATURES ARE REQUIRED FROM ALL DEPARTMENTS INVOLVED (Please Print AND Sign Name)

Contact Person: Email: Phone:

Curriculum Committee Member:		Print:	Date:
Curriculum Committee Chair:		Print:	Date:
Home Department Chair:		Print: Aaron Ridley	Date: 1-24-20
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:
Cross-Listed Department Chair:		Print:	Date:

DEPARTMENTAL/COLLEGE USE ONLY

Current:	Requested:
Course Description	Course Description This course explores how to implement a successful space mission given a set of science objectives. Space science, spacecraft design, error analysis, and signal detection are integrated through a series of case studies. Example space, planetary, astrophysical, and earth science missions will be discussed and explored to illustrate these topics.
Class Length	Class Length Full term
Contact hours (lecture):	Contact hours (lecture): 3
Contact hours (recitation)	Contact hours (recitation)
Contact hours (lab)	Contact hours (lab)

Additional Info:

Submitted by:
Home dept

Describe how this course fits with the degree requirements:
Tech Elective

ABET departmental program outcomes for undergraduate courses:
Not ABET accredited

Special resources of facilities required for this course:

Supporting statement:
This course was formerly a special topics course (CLIMATE/SPACE 405) that was successful and is now transitioning to a regularly scheduled class.

Engineering Solutions to Astrophysical Problems

Instructor

Prof. Justin C. Kasper

Phone

(734) 647 3350

Email

jckasper@umich.edu

Office Location

2435 SRB

Office Hours

Wednesday 11-12pm
Or by Appointment

Class Location

SRB 2236

Class Time

WF 1:30-3pm

F19 CLASP 405 / 001 Syllabus

Course Overview

In this course we learn how to implement a successful space mission given scientific objectives. Space science, spacecraft design, error analysis, and signal detection are integrated through a series of case studies.

The space age has transformed our understanding of the Universe. Just within the last few decades we have measured the age of the Universe and shown that the rate of expansion is accelerating, seen ten million degree solar flares rip through our Sun's atmosphere, discovered liquid water oceans on icy moons of Jupiter and Saturn, and detected thousands of planets orbiting other stars. These advances are all made possible through ever more capable spacecraft, either orbiting Earth as remote observatories, or directly exploring objects in our solar system and beyond. This class is for anyone interested in the intersection between the scientific problems we address with large space missions and the engineering solutions that are needed make these technical marvels possible. The course is geared to advanced undergraduates with exposure to thermodynamics, statistics, and simple differential equations. Material covered will include the Voyager interstellar mission, CYGNSS and hurricanes, Hubble and the expansion of the Universe, planet hunting with Kepler, the Solar Probe Plus mission to the atmosphere of our Sun, the SunRISE radio array, and the exploration of the water oceans of the Jovian moon Europa.

Coursework will consist of homework assignments, short reading assignments before lectures, and a final report analyzing the driving requirements of a mission.

Course Materials

- All course materials are available on the CLASP 405 Canvas web page.
- Copies of all papers and lecture notes are in individual folders

Prerequisites

Prerequisites: MATH 216 and PHYS 240 recommended. CLASP 310 introduces spacecraft

Assignments

• Bi-weekly supplemental readings

• Five bi-weekly homework assignments submitted online through Canvas and consisting of working through examples related to the lecture material or questions from assigned readings

• Final project working through the driving requirements for a mission

- Select an existing mission
- A write-up analyzing two or more driving requirements for the mission
- An in course final presentation of the mission and requirements

Course grade

• Homework: 60%

- Five written homework assignments including readings

• Final project: 25%

- Identify mission – 5%
- Reproduce three driving requirements – 10%
- Final presentation in class – 10%

• Class participation, including attendance and discussion 15%

Course Schedule

Class meets every Wednesday and Friday from 1:30-3pm **except** October 5, October 10, November 21, and November 22. Topics are as follows:

1. Introduction to class
    a. Survey of major space missions
    b. Challenges – rocket, gravity, spacecraft, instrument
    c. Course organization
2. Gravity and orbits
    a. Gravitational force and energy
    b. C3
    c. Properties of orbits
    d. Types of orbits
    e. Lagrange points
3. The Voyager Grand Tour
    a. Gravitational assists
    b. RTGs vs solar power
    c. Instruments
4. The outer planets and interstellar space
    a. Voyager planetary results
    b. Termination shock and interstellar space

5. Statistics and Detection
    a. Gaussian and Poisson statistics
    b. Error propagation
    c. Difference between random and systematic errors
6. Sources of light
    a. Atomic emission
    b. Black body emission
    c. Thermal equilibrium
7. Measuring photons
    a. CCDs, MCPs
8. Optical telescopes
    a. Refraction vs reflection
    b. Resolution
    c. Sensitivity
    d. Errors
    e. Current and planned launch vehicles and the limitations on apertures
9. The Superheated Sun
    a. Structure of the Sun
    b. Discovery of the million degree solar corona
    c. Formation of the solar wind
    d. Space weather
10. Sending a Solar Probe into the Sun
    a. Coping with megawatts of sunlight
    b. Solar power with intense light
    c. Navigation through extreme solar flares
11. Solar probe instruments
    a. Designing 1000C instruments for solar encounters
    b. Testing in extreme environments
12. A brief introduction to the Universe
    a. Age, expansion, size, open mysteries
13. Measuring the size and expansion of the universe
    a. Distance ladder
    b. Atomic emission
    c. Doppler shift
    d. Redshift
14. Hubble
    a. Optical capabilities of a space telescope
    b. Fine pointing system
    c. Mitigating thermal shocks in Earth orbit
15. From Pigeon droppings to the temperature of the Universe
    a. Thermal equilibrium
    b. Adiabatic expansion
    c. Surface of last scattering
16. Measuring the absolute temperature of the Universe
    a. Infrared receivers
    b. Absolve calibration of temperature measurements
    c. COBE FIRAS
17. Evidence for water moons in our solar system that could support life

    a. The Europa ocean magnetic Induction signal
    b. How do you heat an ocean?
18. Europa exploration and Europa Clipper mission
    a. Designing for multiple mega rad doses
    b. Remote measurements of water and ice with radar and plasma instruments
19. Hunting for planets beyond the solar system
    a. How many planets are there?
    b. Radial variation and Doppler shift
    c. Eclipses and dimming
    d. Potential biases
20. Kepler
    a. Staring at a wide field of stars
    b. Photometric stability
    c. Discoveries
21. Black Holes and other exotic objects
    a. Death of stars
    b. Supernovae, pulsars, and black holes
    c. Black hole accretion
22. Chandra and other X-Ray observatories
    a. Detecting x-rays
    b. Focusing x-ray optics and telescope challanges
23. Project presentations (2 days)

Monday	Wednesday	Friday
September 2	**September 4**	**September 6**
Labor Day	L1 Introductions	L2 Gravity and Orbits
September 9	**September 11**	**September 13**
	L3 Voyager	L4 Outer Planets and Interstellar Space
September 17	**September 18**	**September 20**
	L5 Statistics and Detection	L6 Light HW1 Due
September 24	**September 25**	**September 27**
Drop deadline	No class	L7 CYGNSS and Hurricanes
September 30	**October 2** No class	**October 4** No class HW2 Due

October 7	**October 9**	**October 11**
		L10 Coronal heating *Mission Concept Abstract Due*
October 14	**October 16**	**October 18**
Fall Study Break	L11 Parker Solar Probe	L12 Introduction to Universe *HW3 Due*
October 21	**October 23**	**October 25**
	L13 Hubble	L14 Hubble
October 28	**October 30**	**November 1**
	L15 Cosmic microwave background	L16 COBE and WMAP *HW4 Due*
November 4	**November 6**	**November 8**
	L17 Water moons	L18 Europa Clipper Mission *Mission Driving Requirements Due*
November 11	**November 13**	**November 15**
	L19 Exoplanets	L20 Kepler and TESS *HW5 Due*
November 18	**November 20**	**November 22**
	L21 Xrays	L22 Chandra
November 25	**November 27**	**November 29**
		No Class Thanksgiving Recess
December 2	**December 4**	**December 5**
	Student Presentations	*Student Presentations* Course review Last day of class

Honor Code

All students in the class are bound by the College of Engineering Honor Code. You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work. Any violation of the honor policies appropriate to each piece of course work will be reported to the Honor Council, and if guilt is established penalties may be imposed by the Honor Council and Faculty Committee on Discipline. Such penalties can include, but are not limited to, letter grade deductions or expulsion from the

University. If you have any questions about this course policy, please consult the course instructor. Specific policies for this course follow.

Homework (Limited collaboration): You may discuss homework assignments with your fellow students at the conceptual level, but must complete all calculations and write-up, from scrap to final form, on your own. Verbatim copying of another student's work is forbidden. You may not consult homework solutions from a previous term unless they are made available in a publicly accessible form (no unfair advantage can be sought). An important exception to this policy is the coordination of any software or programs developed to load, process, and display data for the assignments.

Group Project Work (Inter-group collaboration allowed): All group work is to be completed only within your own group. You may receive help from the course instructors and you may consult with members of other groups in the course, but you must complete your group's calculation and mid-term project write-up on your own.

Accommodations for Students with Disabilities

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate academic accommodations. SSD (734-763-3000; http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

Additional Student Resources

The CLASP department maintains a helpful list of additional student resources here:
http://clasp.engin.umich.edu/files/pages/student_resources.pdf

Fall 2018 Instructor Report of CLIMATE 405 003 - SPACE 405 003 for Justin Kasper

Project Title: **Central Campus Fall 2018 Evaluation**

Course Audience: **11**
Responses Received: **3**
Response Ratio: **27.3%**

Report Comments

This report is a summary that tabulates all quantitative ratings on a single page. Ratings are from the Fall 2018 teaching evaluations of CLIMATE 405 003 - SPACE 405 003.

Prepared by: **Office of the Registrar**
Creation Date: **Mon, Dec 31, 2018**

Responses to the University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median	School/College Median
This course advanced my understanding of the subject matter.	3	0	0	0	0	0	5.0	4.5	4.6
My interest in the subject has increased because of this course.	2	1	0	0	0	0	4.8	4.1	4.3
I knew what was expected of me in this course.	1	1	1	0	0	0	4.0	4.4	4.5
Overall, this was an excellent course.	2	1	0	0	0	0	4.8	4.2	4.3
I had a strong desire to take this course.	3	0	0	0	0	0	5.0	4.0	4.2
As compared with other courses of equal credit, the workload for this course was... (SA=Much Lighter to SD=Much Heavier)	0	2	1	0	0	0	3.8	3.0	2.9

Responses to the University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median	School/College Median
Overall, Justin Kasper was an excellent teacher.	3	0	0	0	0	0	5.0	4.5	4.6
Justin Kasper seemed well prepared for class meetings.	2	1	0	0	0	0	4.8	4.8	4.8
Justin Kasper explained material clearly.	1	2	0	0	0	0	4.3	4.6	4.6
Justin Kasper treated students with respect.	3	0	0	0	0	0	5.0	4.8	4.8

Responses to additional questions about the course:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median
The amount of work required was appropriate for the credit received. (Q239)	2	0	0	1	0	0	4.8	4.2
The amount of material covered in the course was reasonable. (Q240)	1	2	0	0	0	0	4.3	4.3
Writing assignments seemed carefully chosen. (Q318)	1	2	0	0	0	0	4.3	4.1
The laboratory was a valuable part of this course. (Q331)	0	0	0	0	0	3	N/A	4.3
Laboratory assignments required a reasonable amount of time and effort. (Q336)	0	0	0	0	0	3	N/A	4.1
Laboratory assignments were relevant to what was presented in class. (Q337)	0	0	0	0	0	3	N/A	4.2
The textbook made a valuable contribution to the course. (Q340)	0	0	0	0	0	3	N/A	3.7
Examinations covered the important aspects of the course. (Q356)	0	0	1	0	0	2	3.0	4.3
Grades were assigned fairly and impartially. (Q365)	1	1	0	0	0	1	4.5	4.4

Responses to additional questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median
Justin Kasper acknowledged all questions insofar as possible. (Q216)	3	0	0	0	0	0	5.0	4.7
Justin Kasper encouraged constructive criticism. (Q218)	3	0	0	0	0	0	5.0	4.5
Justin Kasper used class time well. (Q229)	2	1	0	0	0	0	4.8	4.6

The medians are calculated from Fall 2018 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are upper division with enrollment of 1 to 15 in College of Engineering.

University of Michigan
Fall 2019 Instructor Report With Comments
CLIMATE 405 003 - SPACE 405 003
Justin Kasper

4 out of 10 students responded to this evaluation.

Responses to the University-wide questions about the course:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median	School/College Median
This course advanced my understanding of the subject matter. (Q1631)	2	2	0	0	0	0	4.5	4.5	4.5
My interest in the subject has increased because of this course. (Q1632)	3	1	0	0	0	0	4.8	4.2	4.2
I knew what was expected of me in this course.(Q1633)	0	1	2	1	0	0	3.0	4.4	4.3
Overall, this was an excellent course.(Q1)	2	1	1	0	0	0	4.5	4.2	4.2
I had a strong desire to take this course.(Q4)	2	1	1	0	0	0	4.5	4.0	4.1
As compared with other courses of equal credit, the workload for this course was...(SA=Much Lighter to SD=Much Heavier) (Q891)	1	2	1	0	0	0	4.0	3.0	2.8

Responses to University-wide questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median	School/College Median
Overall, Justin Kasper was an excellent teacher.(Q2)	3	1	0	0	0	0	4.8	4.6	4.7
Justin Kasper seemed well prepared for class meetings.(Q230)	3	1	0	0	0	0	4.8	4.8	4.8
Justin Kasper explained material clearly.(Q199)	4	0	0	0	0	0	5.0	4.6	4.7
Justin Kasper treated students with respect.(Q217)	4	0	0	0	0	0	5.0	4.8	4.9

Responses to additional questions about the course:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median
The textbook made a valuable contribution to the course. (Q64)	0	0	0	0	0	4	N/A	3.6
The amount of work required was appropriate for the credit received. (Q239)	1	2	1	0	0	0	4.0	4.1
The amount of material covered in the course was reasonable. (Q240)	3	1	0	0	0	0	4.8	4.3
Writing assignments seemed carefully chosen. (Q318)	1	2	0	0	0	1	4.3	4.1
The laboratory was a valuable part of this course. (Q331)	0	0	0	0	0	4	N/A	4.3
Laboratory assignments required a reasonable amount of time and effort. (Q336)	0	0	0	0	0	4	N/A	4.1
Laboratory assignments were relevant to what was presented in class. (Q337)	0	0	0	0	0	4	N/A	4.3
Examinations covered the important aspects of the course. (Q356)	0	1	0	0	0	3	4.0	4.4
Grades were assigned fairly and impartially. (Q365)	0	2	1	0	0	1	3.8	4.4

Responses to additional questions about the instructor:

	SA	A	N	D	SD	N/A	Your Median	University-Wide Median
Justin Kasper acknowledged all questions insofar as possible. (Q216)	3	1	0	0	0	0	4.8	4.7
Justin Kasper encouraged constructive criticism. (Q218)	3	1	0	0	0	0	4.8	4.6
Justin Kasper used class time well. (Q229)	3	1	0	0	0	0	4.8	4.6

The medians are calculated from Fall 2019 data. University-wide medians are based on all UM classes in which an item was used. The school/college medians in this report are based on classes that are upper division with enrollment of 1 to 15 in College of Engineering.

Written Comments

Comment on the quality of instruction in this course. (Q900)

Comments
Although this class almost seemed on the back burner, this was one of the most interesting classes I have ever taken. Justin not only had the answer to every question but also he had interesting stories and real life examples to go with it. Some times it was hard to figure out what was expected of us or how to do some of the assignments, but Justin would always be right there to help if you needed direction. This stressed the importance of actually asking questions, paying attention, and visiting office hours.
Kasper is a great speaker, and addresses questions well. The final project was just a bit... dull.