EHD49-06

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF A GRADUATE COURSE
(500-600 LEVEL)

Graduate Council Doc. No. 08-27b

DEPARTMENT: Mechanical Engineering   EFFECTIVE SESSION: ~~Summer 2000~~ Fall 2009

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

☑ 1. New course with supporting documents (complete proposal form)	☐ 7. Change in course attributes
☐ 2. Add existing course offered at another campus	☐ 8. Change in instructional hours
☐ 3. Expiration of a course	☐ 9. Change in course description
☐ 4. Change in course number	☐ 10. Change in course requisites
☐ 5. Change in course title	☐ 11. Change in semesters offered
☐ 6. Change in course credit/type	☐ 12. Transfer from one department to another

PROPOSED:

Subject Abbreviation: ME

Course Number: ~~612~~ 61200

Long Title: Continuum Mechanics

Short Title: Continuum Mechanics

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

EXISTING:

Subject Abbreviation:

Course Number:

TERMS OFFERED
Check All That Apply:
☐ Summer   ☒ Fall   ☐ Spring

CAMPUS(ES) INVOLVED
☐ Calumet   ☐ N. Central
☐ Cont Ed   ☐ Tech Statewide
☐ Ft. Wayne   ☑ W. Lafayette
☐ Indianapolis

CREDIT TYPE

1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To ☐ Or ☐
   Maximum Cr. Hrs
3. Equivalent Credit: Yes ☐ No ☒
4. Thesis Credit: Yes ☐ No ☒

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only ☐
2. Satisfactory/Unsatisfactory Only ☐
3. Repeatable ☐
   Maximum Repeatable Credit: ☐
4. Credit by Examination ☐
5. Designator Required ☐
6. Special Fees ☐

7. Registration Approval Type ☐
   Department ☐   Instructor ☐
8. Variable Title ☐
9. Remedial ☐
10. Honors ☐
11. Full Time Privilege ☐
12. Off Campus Experience ☐

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)
Lecture	50	3	16		Syn	Live
Recitation						
Presentation						
Laboratory						
Lab Prep						
Studio						
Distance						
Clinic						
Experiential						
Research						
Ind. Study						
Pract/Observ						

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

ME 612 Continuum Mechanics, Sem. 1. Class 3, cr. 3. Prerequisites: Graduate standing.

A unified and exact mathematical treatment of the mechanics of solids and fluids. Cartesian tensor algebra and calculus; stress tensor, principle stresses and invariants; material and spatial coordinates, deformation gradient, strain and stretch tensors; balance of mass, momentum, and energy; constitutive equations of elasticity, hyperelasticity, viscous fluids and viscoelasticity.   Professors Subbarayan, Nauman, and Koslowski

Calumet Department Head Date	Calumet School Dean Date	Calumet Undergrad Curriculm Committee Date
Fort Wayne Department Head Date	Fort Wayne School Dean Date	Fort Wayne Chancellor Date _(signature)_ 4/23/08
Indianapolis Department Head Date	Indianapolis School Dean Date	Undergrad Curriculm Committee Date __APPROVED 10/16/08__
North Central Department Head _E. Daniel Hirleman_ Date	North Central Chancellor Date	Date Approved by Graduate Council _Marilyn D. Geist_ 12/10/08
West Lafayette Department Head Date	West Lafayette College/School Dean Date	Graduate Council Secretary Date
Graduate Area Committee Convener Date	Graduate Dean Date	West Lafayette Registrar 12/23/08 Date

OFFICE OF THE REGISTRAR

12/23/08

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE
(500-600 LEVEL)

DEPARTMENT: Mechanical Engineering

EFFECTIVE SESSION: Summer 2008

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [x] 1. New course with supporting documents (complete proposal form)
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:

Subject Abbreviation: ME

Course Number: 612

Long Title: Continuum Mechanics

Short Title: Continuum Mechanics

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

EXISTING:

Subject Abbreviation:

Course Number:

TERMS OFFERED Check All That Apply:
- [ ] Summer
- [ ] Fall
- [ ] Spring

CAMPUS(ES) INVOLVED
- [ ] Calumet
- [ ] Cont Ed
- [ ] Ft. Wayne
- [ ] Indianapolis
- [ ] N. Central
- [ ] Tech Statewide
- [x] W. Lafayette

CREDIT TYPE

1. Fixed Credit: Cr. Hrs.   3
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One)   To [ ]   Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ]   No [ ]
4. Thesis Credit: Yes [ ]   No [ ]

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
   Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Designator Required [ ]
6. Special Fees [ ]
7. Registration Approval Type
   Department [ ]   Instructor [ ]
8. Variable Title [ ]
9. Remedial [ ]
10. Honors [ ]
11. Full Time Privilege [ ]
12. Off Campus Experience [ ]

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)
Lecture	50	3	16		Syn	Live
Recitation						
Presentation						
Laboratory						
Lab Prep						
Studio						
Distance						
Clinic						
Experiential						
Research						
Ind. Study						
Pract/Observ						

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

ME 612 Continuum Mechanics, Sem. 1. Class 3, cr. 3. Prerequisites: Graduate standing.

A unified and exact mathematical treatment of the mechanics of solids and fluids. Cartesian tensor algebra and calculus; stress tensor, principle stresses and invariants; material and spatial coordinates, deformation gradient, strain and stretch tensors; balance of mass, momentum, and energy; constitutive equations of elasticity, hyperelasticity, viscous fluids and viscoelasticity.

	Date		Date		Date
Calumet Department Head		Calumet School Dean		Calumet Undergrad Curriculm Committee	
Fort Wayne Department Head		Fort Wayne School Dean		Fort Wayne Chancellor	
Indianapolis Department Head		Indianapolis School Dean		Undergrad Curriculm Committee	4/23/08
North Central Department Head		North Central Chancellor		Date Approved by Graduate Council	
West Lafayette Department Head *E. Daniel Hirleman*	4/21/0	West Lafayette College/School Dean	4/2	Graduate Council Secretary	
Graduate Area Committee Convener		Graduate Dean		West Lafayette Registrar	

OFFICE OF THE REGISTRAR

TO:	Purdue University Graduate Council

From: Faculty Member: Jim Jones

From: Department: Mechanical Engineering

            Campus: West Lafayette

Date:

Subject: Proposal for <u>New Graduate Course</u> –Documents Supporting Registrar's Form 40

Contact information if questions arise	Name:	Jim Jones
	Phone Number:	45691
	E-mail:	jonesjd@purdue.edu
	Campus Address:	ME 222B

Course Number: ME 612

Course Title: Continuum Mechanics

A.   Justification for the Course

Explain how this course relates to other courses offered in the department or other departments and how this course fulfills a recognized need.

This course deals with advanced topics in Continuum Mechanics, specifically in the areas of cartesian tensors, kinematics, balance laws, and constitutive equations and their applications. This course provides a more advanced treatment of this subject than other courses in ME.

This course is intended primarily for students   **Choose One**

from within this department

B.   Level of the course:

Justify request for graduate course level by indicating anticipated enrollments of undergraduate and graduate students.

Anticipated Undergraduate Student Enrollment: **Choose One:**

50-75%

Anticipated Graduate Student Enrollment: **Choose One:**

25-50%

C.   Prerequisites: (If none, please explain reasons for absence)

Graduate Standing

D.   Course Instructor:

Instructor's Name: Ganesh Subbarayan, Eric Nauman, Marisol Koslowski

E1.   Course Outline:

(An outline of topics to be covered and an indication of the relative emphasis or time devoted to each topic is necessary. If laboratory or field experience is involved, the nature of this component should be explained as well). - See Attached EFD.

E2.   Method of Evaluation or Assessment:

See Attached EFD.

F.   Reading List:

A reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material. See attached EFD.

TO: The Engineering Faculty

FROM: The Faculty of the School of Mechanical Engineering

RE: New Course Approval ME 612 Continuum Mechanics

The Faculty of the School of Mechanical Engineering has approved the following course for a permanent course number. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ME 612 Continuum Mechanics, Sem. 1. Class 3, cr. 3. Prerequisites: Graduate standing.

> A unified and exact mathematical treatment of the mechanics of solids and fluids. Cartesian tensor algebra and calculus; stress tensor, principle stresses and invariants; material and spatial coordinates, deformation gradient, strain and stretch tensors; balance of mass, momentum, and energy; constitutive equations of elasticity, hyperelasticity, viscous fluids and viscoelasticity.

Reason: This course deals with advanced topics in Continuum Mechanics, specifically in the areas of cartesian tensors, kinematics, balance laws, and constitutive equations and their applications. The course has been offered three times with enrollments of 17 students in fall 2004, 7 students in fall 2005, 12 students in fall 2006.

> Details of the course are provided in the attached course map and description.

James D. Jones
Associate Professor and Associate Head
School of Mechanical Engineering

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes _# 4_
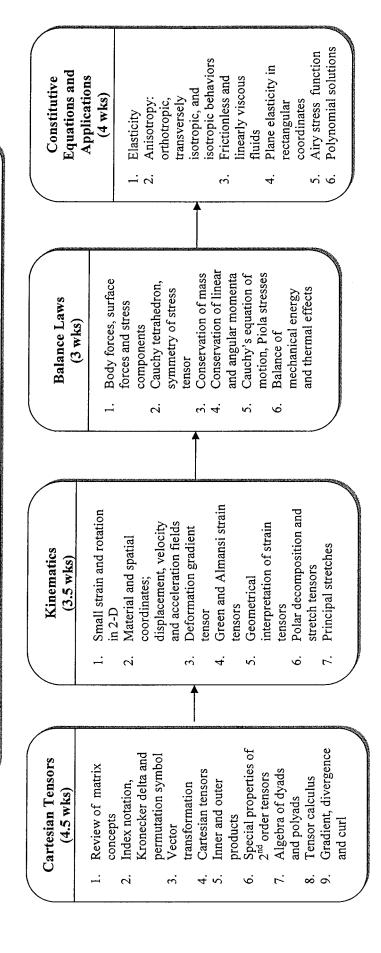
Date _10-15-07_

Chairman ECC

ME 612
CONTINUUM MECHANICS

Course Outcomes

1. Learn the *unified and exact mathematical basis* as well as the *general principles* of stress and deformation in solids and fluids.
2. Extend and generalize the understanding of *two-dimensional elasticity theory.*
3. Prepare the student for advanced studies in *viscoelasticity, viscous fluids, fracture mechanics and plasticity.*

Cartesian Tensors
(4.5 wks)

1. Review of matrix concepts
2. Index notation, Kronecker delta and permutation symbol
3. Vector transformation
4. Cartesian tensors
5. Inner and outer products
6. Special properties of 2nd order tensors
7. Algebra of dyads and polyads
8. Tensor calculus
9. Gradient, divergence and curl

Kinematics
(3.5 wks)

1. Small strain and rotation in 2-D
2. Material and spatial coordinates; displacement, velocity and acceleration fields
3. Deformation gradient tensor
4. Green and Almansi strain tensors
5. Geometrical interpretation of strain tensors
6. Polar decomposition and stretch tensors
7. Principal stretches

Balance Laws
(3 wks)

1. Body forces, surface forces and stress components
2. Cauchy tetrahedron, symmetry of stress tensor
3. Conservation of mass
4. Conservation of linear and angular momenta
5. Cauchy's equation of motion, Piola stresses
6. Balance of mechanical energy and thermal effects

Constitutive Equations and Applications
(4 wks)

1. Elasticity
2. Anisotropy: orthotropic, transversely isotropic, and isotropic behaviors
3. Frictionless and linearly viscous fluids
4. Plane elasticity in rectangular coordinates
5. Airy stress function
6. Polynomial solutions

COURSE TITLE: Continuum Mechanics

COURSE NUMBER: ME 612

REQUIRED COURSE OR ELECTIVE COURSE: Elective

TERMS OFFERED: Fall (Alternate Years)

TEXTBOOK/REQUIRED MATERIAL: L.E. Malvern, *Introduction to the Mechanics of a Continuum Medium*, Prentice-Hall, 1969.

PRE-REQUISITIES: Graduate Standing

COORDINATING FACULTY: G. Subbarayan

COURSE DESCRIPTION: A unified and exact mathematical treatment of the mechanics of solids and fluids. Cartesian tensor algebra and calculus; material and spatial coordinates, deformation gradient, strain and stretch tensors; stress tensor, Cauchy tetrahedron, principle stresses and invariants; balance of mass, momentum, and energy; constitutive equations of hyperelasticity, viscous fluids and viscoelasticity.

COURSE OUTCOMES:

1. Learn the *unified and exact mathematical basis* as well as the *general principles* of stress and deformation in solids and fluids.

2. Extend and generalize the understanding of *two-dimensional elasticity theory*.

3. Prepare the student for advanced studies in *viscoelasticity, viscous fluids, fracture mechanics and plasticity*.

ASSESSMENTS TOOLS:

1. Weekly deliverables.
2. Two projects.
3. Two one-hour exams.
4. One comprehensive final exam.

RELATED ME PROGRAM OUTCOMES: N/A

PROFESSIONAL COMPONENT:

1. Engineering Topics: Engineering Science – 3.0 credits (100%)

NATURE OF DESIGN CONTENT: N/A

COMPUTER USAGE: Students are required to carryout symbolic calculations as part of project using either matlab or mathematica.

COURSE STRUCTURE/SCHEDULE:

1. Lecture – 3 days per week at 50 minutes.

PREPARED BY: G. Subbarayan

REVISION DATE: April 17, 2007