TO: The Faculty of the School of Mechanical Engineering

FROM: Thomas Siegmund

DATE: November 16, 2015

RE: New Permanent Course, ME 48300 Introduction to Finite Element Analysis – with Laboratory

The Faculty of the School of Mechanical Engineering is asked to consider approval of the following new permanent course (technical elective), effective Spring Semester 2016.

ME 48300 INTRODUCTION TO FINITE ELEMENT ANALYSIS with LABORATORY
Sem. 1 and 2. Class 3, cr. 3
Prerequisite: ME 32300

Course Description: Introduction to finite element analysis (FEA) with focus on linear elasticity and heat transfer. Matrix analysis and assembly of solutions. Strong form and weak form as a general solution process for differential equations. Formulation of finite elements and interpolation functions. Overall solution processes with the finite element method. Survey of advanced topics (such as nonlinear problems and dynamic loading). MATLAB used for coding. Presentations for practitioners in industry. Two-hour lecture component complemented by one-hour laboratory component. Use of a modern (commercial) finite element code.

Reason: This course has been offered several times on an experimental basis. All domains of mechanical engineering do require students and mechanical engineering graduates to have some sense of the use of numerical methods, and in particular, the use of the finite element analysis. This course prepares students to not use FE codes as black boxes but rather aims to introduce to the fundamental theory concepts on which such codes are based. Only equipped with such knowledge is it possible to make sound analysis and judgement of solutions. While the content of this course addresses topics similar to those in ABE 450 (Finite Element Method in Design and Optimization), what distinguishes this course is that ME 483 focuses on analysis in both the mathematical foundation and engineering application since ME students are exposed to design and optimization in other required ME courses. Furthermore, applications examples are ME centric and the course includes a laboratory component to provide students with a practical hands-on experience to complement the theoretical foundation of finite element analysis.

4/15/16

James Jones
Associated Head, School of Mechanical Engineering

Approved for the faculty of the Schools of Engineering by the Engineering Curriculum Committee
ECC Minutes #3 Date 10-18-16
Chairman ECC

Office of the Registrar
FORM 40 REV. 5/11

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

Print Form

DEPARTMENT Mechanical Engineering

EFFECTIVE SESSION Fall 2016

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

- [X] 1. New course with supporting documents
- [ ] 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 (department head signature only)
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	ME	Subject Abbreviation	
Course Number	48300	Course Number	
Long Title	Introduction to Finite Element Analysis		
Short Title			

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

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

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 [ ]

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. Fees: [ ] Coop [ ] Lab [ ] Rate Request
Include comment to explain fee
6. Registration Approval Type
Department [ ] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

ScheduleType	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	2	16	100
Recitation				
Presentation				
Laboratory	50	1	16	100
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):
Prerequisite: ME 32300
Introduction to finite element analysis with focus on linear elasticity and heat transfer. Matrix analysis and assembly of solutions. Strong form and weak form as a general solution process for differential equations.

*COURSE LEARNING OUTCOMES:

Calumet Department Head	Date	Calumet School Dean	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date
North Central Faculty Senate Chair	Date	Vice Chancellor for Academic Affairs	Date
West Lafayette Department Head Amit Bagg/DOG	4/15/16 Date	West Lafayette College/School Dean	Date
		West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

ME 48300
INTRODUCTION TO FINITE ELEMENT ANALYSIS

Course Outcomes

1. Introduce concepts of finite element analysis
2. Learn the use of matrix methods for solution of truss structures
3. Learn strong and weak form for the solution of differential equations
4. Learn how to define finite elements and finite element approximations
5. Learn how to solve weak form formulations as a finite element approximation
6. Apply these concepts to linear elastic and heat transfer problems
7. Apply a commercial finite element code to linear elastic and heat transfer problems
8. Understand the use of the Finite Element Analysis in engineering practice

Fundamentals (3 wks)

1. Review of Linear Elasticity
2. Review of Heat Transfer
3. 1D Bar Problems
4. 2D Bar Problems
5. Assembly and Global Solution

Strong and Weak Form (4 wks)

1. Strong Form
2. Weak Form
3. Example Problems with Weak Form in Scalar Problems

FE Approximations (4 wks)

1. Definition of finite elements in 1D
2. Definition finite elements in 2D
3. Weak Form Statement and Finite Element Approximation
4. Thermal Stress Analysis
5. Numerical Examples

Computations (4 wks)

1. Matrix Method 1D (MATLAB)
2. Finite Elements 1D (MATLAB)
3. Model Building
3. A Commerical Finite Element Code: Examples

Laboratories (1-4)

1. Truss Structures
2. Planar modeling and meshes
3. Heat Transfert - Conduction
4. Convergence

Laboratories (5-8)

1. Patch Test
2. Elasticity analysis
3. Stress concentration
4. Modeling approaches: what can go wrong?