PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE
(50000-69999 LEVEL)

DEPARTMENT: Engineering  EFFECTIVE SESSION: Spring 2012

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/teaching
- [ ] 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: Advanced FEA
Course Number: ME 54500
Long Title: Finite Element Analysis: Advanced Theory and Applications
Short Title: Advanced FEA

EXISTING:

Subject Abbreviation: 
Course Number: 
Long Title: 
Short Title: 

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

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

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

<table>
<thead>
<tr>
<th>CREDIT TYPE</th>
<th>COURSE ATTRIBUTES: Check All That Apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fixed Credit: Cr. Hrs. 3</td>
<td></td>
</tr>
<tr>
<td>2. Variable Credit Range: To</td>
<td></td>
</tr>
<tr>
<td>3. Equivalent Credit: Yes</td>
<td></td>
</tr>
<tr>
<td>4. Thesis Credit: No</td>
<td></td>
</tr>
<tr>
<td>1. Pass/Not Pass Only</td>
<td></td>
</tr>
<tr>
<td>2. Satisfactory/Unsatisfactory Only</td>
<td></td>
</tr>
<tr>
<td>3. Repeatable</td>
<td></td>
</tr>
<tr>
<td>4. Credit by Examination</td>
<td></td>
</tr>
<tr>
<td>5. Special Fees</td>
<td></td>
</tr>
<tr>
<td>6. Registration Approval Type</td>
<td></td>
</tr>
<tr>
<td>7. Variable Title</td>
<td></td>
</tr>
<tr>
<td>8. Honors</td>
<td></td>
</tr>
<tr>
<td>9. Full Time Privilege</td>
<td></td>
</tr>
<tr>
<td>10. Off Campus Experience</td>
<td></td>
</tr>
</tbody>
</table>

Schedule Type:
Lecture
Recitation
Presentation
Laboratory
Lab Prep
Studio
Distance
Clinic
Experiential
Research
Ind. Study
Pract/Observ

Minutes Per Hrs: 75
Meetings Per Week: 2
Weeks Offered: 15
% of Credit Allocated

OFFICE OF THE REGISTRAR

Calumet Department Head
Date

Ft. Wayne Department Head
Date

Indy Department Head
Date

North Central Faculty Senate Chair
Date

West Lafayette Department Head
Date

Graduate Area Committee Chair
Date

Calumet Undergrad Curriculum Committee Date
Fort Wayne Chairperson Date
Undergraduate Curriculum Committee Date
Date Approved by Graduate Council
Graduate Council Secretary Date
West Lafayette Registrar Date
Supporting Document for a New Graduate Course

To: Purdue University Graduate Council
From: Zhuming Bi
Department: Engineering
Campus: Fort Wayne
Date: 03/28/2011
Subject: Proposal for New Graduate Course-Documentation Required by the Graduate Council to Accompany ME 54500 's Form 40G

For Reviewer's comments only (Select One)

Reviewer:
Comments:

Contact for information if questions arise:
Name: Zhuming Bi
Phone Number: 260-481-5711
E-mail: biz@ipfw.edu
Campus Address: 2101 E. Coliseum Blvd., Fort Wayne, IN 46805

Course Subject Abbreviation and Number: Mechanical Engineering, ME 54500
Course Title: Finite Element Analysis: Advanced Theory and Applications
Supporting Documents

A. Justification of The Course

This course is for (i) graduate students who are interested in using numerical solutions in their design projects and (ii) senior undergraduate students who have completed an introductory course of finite element analysis, have a good academic standing, and have a strong interest in learning an advanced theory for finite element modeling.

Knowledge and skills of using software tools such as ANSYS and ABAQUS to obtain numerical solutions to various engineering applications are very crucial to the success of graduate students in many engineering areas. This course is designed for graduate students who have or have not taken an introductory course on Finite Element Analysis. This course reviews the fundamentals of basic FEA and then introduces advanced topics which are not covered in sufficient detail in an introductory course. Interested undergraduate students that have sufficient programming skills and have taken an introduction course in finite element analysis can take this course.

B. Learning Outcomes and Method of Evaluation or Assessment

Course Objective:

To review the fundamentals of basic FEA and to introduce advanced topics which are not covered in sufficient detail in an introductory course of FEA. Particular emphasis is given to the mathematical foundations of the FEA method, to numerical algorithms for software implementation, and to the analysis of problems with materials and geometric nonlinear behavior. The course aims at giving students a chance to investigate in detail practical problems in the areas of solid mechanics, heat transfer, fluid dynamics, and electromagnetism.

Course Evaluation:

Homeworks: 20%
Exam 1: 20%
Exam 2: 20%
Final Exam: 20%
Project: 20%
Letter Grades: A 90-100%; B 80-89%; C 70-79%; D 60-69%; F 0-59%

Student Learning Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

[1]. An ability to perform complete FE formulations for engineering analysis
[2]. An ability to write computer codes for a finite element model
[3]. An ability to use commercial FEA software to solve engineering problems
[4]. An ability to apply finite element methods in design engineering components or systems
[5]. An ability to write technical reports and convey engineering message efficiently.
Method of Instruction:

- Lecture
- Computer labs
- Independent Design Project

C. Prerequisites

- Matlab or other programming skills for graduate students,
- ME 480 Finite Element Analysis or equivalent course, and Matlab or other programming skills for undergraduate students

D. Course Instructor

Dr. Zhuming Bi, Assistant Professor of Mechanical Engineering
Department of Engineering, IPFW

E. Course Outline

1. Overview of Basic FEA and Nonlinearity
   - Mathematical preliminaries
   - Finite element analysis preliminaries
   - Material nonlinearities
   - Dynamic problems
   - Various formulations
   - Solution procedures for linear and nonlinear algebraic equations

2. Programming and Software tools of FEA
   - Finite element analysis using ABAQUS
   - Finite element analysis using ANSYS
   - MATLAB Programs for finite element analysis

3. Solid Mechanics Problems
   - Finite element formulations of solid continua
   - Nonlinear heat transfer and other field problems in one-dimension
   - Nonlinear bending of beams
   - Nonlinear bending of elastic plates
   - Dynamic Analysis

4. Heat Transfer Problems
   - Nonlinear heat transfer and other field problems in one-dimension
   - Nonlinear heat transfer and other field problems in two-dimensions

5. Fluid Mechanics Problems
   - Flow of viscous incompressible fluids
• Nonlinear analysis of transient problems
• Compressible flows
• Solid-fluid interactions

6. Electromagnetic Problems
• Steady-state problems
• Poisson's Equation
• Transient Field Problems.

F. Reading List

Textbook:

References:

G. Library Resources


H. Course Syllabus

Please see next page.
ME 545: Finite Element Analysis: Advanced Theory and Applications
Spring 2012

Lectures: 3 Credit Hours. Two meeting per week, 75 minutes per meeting

Pre-requisites: Matlab or other programming skills for graduate students, ME480 Finite Element Analysis or equivalent course, and Matlab or other programming skills for undergraduate students

Instructor: Dr. Zhuming Bi
Email: biz@lpfw.edu
Office: ET321D
Phone: 260-481-5711
Office Hours: TBD

Course Description: The course covers fundamentals of advanced finite element analysis of non-linear and dynamic problems in two and three dimensions. Applications discussed in this course include advanced subjects in solid mechanics, heat transfer, fluid dynamics, and electromagnetic. Commercial FEA packages such as ANSYS and/or Abaqus are used to solve engineering problems. Students are required to accomplish an independent project in their areas of interest.

Course Objective: To review the fundamentals of basic FEA and to introduce advanced topics which are not covered in sufficient detail in an introductory course of FEA. Particular emphasis is given to the mathematical foundations of the FEA method, to numerical algorithms for software implementation, and to the analysis of problems with materials and geometric nonlinear behavior. The course aims at giving students a chance to investigate in detail practical problems in the areas of solid mechanics, heat transfer, fluid dynamics, and electromagnetism.


References:


Grading Policy:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homeworks</td>
<td>20%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>20%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20%</td>
</tr>
<tr>
<td>Project(s)</td>
<td>20%</td>
</tr>
<tr>
<td>Letter Grades</td>
<td></td>
</tr>
<tr>
<td>A 90-100%</td>
<td></td>
</tr>
<tr>
<td>B 80-89%</td>
<td></td>
</tr>
<tr>
<td>C 70-79%</td>
<td></td>
</tr>
<tr>
<td>D 60-69%</td>
<td></td>
</tr>
<tr>
<td>F 0-59%</td>
<td></td>
</tr>
</tbody>
</table>

Course Policy:

- Homeworks are due by the time specified in the assignment statement. No late homeworks will be accepted. The solutions will be posted on the course homepage after the due date.
- Make-up exam is allowed ONLY as permitted by the university policy and arrangements should be made well in advance.
- Do all the homeworks and exams on your own. Any copying or cheating will result in an "F" for the final grade.

Course Contents:

1. Overview of Basic FEA and Nonlinearity
   - Mathematical preliminaries
   - Finite element analysis preliminaries
   - Material nonlinearities
   - Dynamic problems
   - Various formulations
   - Solution procedures for linear and nonlinear algebraic equations

2. Programming and Software tools of FEA
   - Finite element analysis using ABAQUS
   - Finite element analysis using ANSYS
   - MATLAB Programs for finite element analysis

3. Solid Mechanics Problems
   - Finite element formulations of solid continua
   - Nonlinear heat transfer and other field problems in one-dimension
   - Nonlinear bending of beams
   - Nonlinear bending of elastic plates
   - Dynamic Analysis

4. Heat Transfer Problems
   - Nonlinear heat transfer and other field problems in one-dimension
   - Nonlinear heat transfer and other field problems in two-dimensions
5. Fluid Mechanics Problems
   - Flow of viscous incompressible fluids
   - Nonlinear analysis of transient problems
   - Compressible flows
   - Solid-fluid interactions

6. Electromagnetic Problems
   - Steady-state problems
   - Poisson's Equation
   - Transient Field Problems.

Course Outcomes:
A student who successfully fulfills the course requirements will have demonstrated:

[1]. An ability to perform complete FE formulations for engineering analysis [a, k]
[2]. An ability to write computer codes for a finite element model [a, k]
[3]. An ability to use commercial FEA software to solve engineering problems [a, k]
[4]. An ability to apply finite element methods in design engineering components or systems [a, c, e, k]
[5]. An ability to write technical reports and convey engineering message efficiently [g]

ABET Program Outcomes:

a. an ability to apply knowledge of mathematics, science, engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global and societal
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
Zhuming Bi’s Curriculum Vitae

RESEARCH EXPERIENCES

EDUCATION
• Ph.D. Mechanical Engineering, University of Saskatchewan, Canada (2002).
• Ph.D. Mechatronic Control and Automation, Harbin Institute of Technology, China (1994).
• B. Sci. Manufacturing Engineering, Harbin Univ. of Science & Technology, China (1987).

WORK EXPERIENCE
Assistant Professor, 08/2009-current, Indiana University – Purdue University Fort Wayne, Fort Wayne, IN
Senior Design Engineer, 05/2008-08/2009, Queen’s University Belfast, UK
Instructor (Part-Time) 2007, University of Ontario Institute of Technology, Canada
Research Scientist, 12/2002-12/2007, National Research Council, Canada
NSERC Post-Doctoral Fellow, 06/2002-12/2002, College of Engineering, Simon Fraser University, Canada
Associate Professor, 06/1994-06/1999, Nanjing University of Science and Technology, China

PATENT

PUBLICATIONS
I. INVITED BOOK CHAPTERS

II. REFEREED JOURNAL PUBLICATIONS


III. SELECTED CONFERENCE PRESENTATIONS


IV. SELECTED CHINESE REFEREED JOURNAL PUBLICATIONS


HONORS, AWARDS & SCHOLARSHIPS


PROFESSIONAL ACTIVITIES

Licensed Professional Engineer (P. Eng)
Organizing Committee Member of 2011 World Congress on Engineering and Technology (CET)
Program Committee Member of 2011 IEEE International Conference on Mechatronics and Automation
Program Committee Member of 2010 IEEE International Conference on Information and Automation
Program Committee Member of 2009 IEEE International Conference on Information and Automation
Reviewer for a variety of the international conferences including ICIA2010, ICIA 2009, ReMAR 2009, ASME-DETC, and ISFA.
Active Reviewer for 19 of refereed international journals including

- IEEE Transactions on Industrial Electronics (Impact factor based on ISI: 5.468)
- IEEE Transactions on Industrial Informatics (Impact factor based on ISI: 2.356)
- ASME Journal of Mechanical Design (Impact factor based on ISI: 1.532)
- Computer-Aided Design (Impact factor based on ISI: 1.474)
- Mechanism and Machine Theory (Impact factor based on ISI: 1.437)
• Robotics and Computer Integrated Manufacturing (Impact factor based on ISI: 1.371)
• Robotica (Impact factor based on ISI: 0.781)
• International Journal of Production Research (Impact factor based on ISI: 0.774)
• International Journal of Advanced Manufacturing Technologies (Impact factor based on ISI: 0.743)
• ASME Journal of Manufacturing Science and Engineering (Impact factor based on ISI: 0.74)
• Advanced Robotics (Impact factor based on ISI: 0.737)
• Measurement (Impact factor based on ISI: 0.662)
• International Journal of Systems Science (Impact factor based on ISI: 0.634)
• Concurrent Engineering: Research and Application (Impact factor based on ISI: 0.611)
• Artificial Intelligence for Engineering Design, Analysis and Manufacturing (AI EDAM) (Impact factor based on ISI: 0.477)
• European Journal of Industrial Engineering (N/A)
• International Journal of Manufacturing Technology and Management (Impact factor: N/A)

RESEARCH PROJECTS

1. Principal Investigator, Visualization and verification of wireless sensor networks, College of Engineering, Indiana University Purdue University Fort Wayne, Wireless Faculty Award, $4,000, 2010.