

Semester Spring 2021

Course Number Technical Elective
Course Title Application of Finite Element Analysis (FEA) for Mechanical Design

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Office Hours Tuesday 13:00-17:00
Thursday 13:00-17:00

Lecture Time Classroom Wednesday 13:50-16:25
Zone 4-212

Prerequisites Engr 0135 Statics and Mechanics of Materials 1
Engr 0145 Statics and Mechanics of Materials 2
MESE1028 Mechanical Design 1 (Recommended)

References ANSYS Workbench User's Guide
(https://ansyshelp.ansys.com/account/secured?returnurl=/Views/Secured/corp/v201/en/wb2_help/wb2_help.html%23wb2_help)

ANSYS Mechanical User's Guide
(https://ansyshelp.ansys.com/account/secured?returnurl=/Views/Secured/corp/v201/en/wb_sim/ds_Home.html)

ANSYS Element Reference
(https://ansyshelp.ansys.com/account/secured?returnurl=/Views/Secured/corp/v201/en/ans_elem/Hlp_E_LIBRARY.html)

Course Description This course is a 3 credit hour class.

The learning objective of the course is to provide students the knowledge of applying FEA technique in structural analysis of mechanical components. The ultimate goal is for students to develop a proper protocol while using FEA to assess the failure risks of a mechanical component.

- The teaching will consist the following elements:
- hands-on training of using ANSYS Mechanical for structural analysis,
 - frequent discussions for validity of the developed FEA model, and
 - Interpretation of FEA analysis results and risk assessment against presumed failure modes.

Date	Course Outline	In-Class Workshop	Homework/Assignment
Mar 11	0. Course Introduction		
Mar 18	01. Discrete Model for Finite Element Analysis	WS.01 Uniaxial Tensile Test	Reading Assignment 01
Mar 25	02. Introduction of ANSYS Workbench (WB)		Lab Assignment 01

			Reading Assignment 02
Apr 01	03. ANSYS WB Mechanical Basics 03A. Failure Assessment	0301 Uniaxial Tensile Test	Lab Assignment 02
Apr 08	04. General Preprocessing/Post-processing	0401 Coordinate System 0402 Named Selection	Lab Assignment 03
Apr 15	Section Exam 01		
Apr 22	05. Mesh Control in ANSYS Mechanical	0501 Hex/Tet Mesh Control 0502 Convergence Test	Lab Assignment 04
Apr 29	06. Error Estimation and Stress Singularity	0601 2D Triangular Plate Simulation 0602 2D Simulation (Stress Concentration)	Lab Assignment 05
May 06	07. Static Structural Analysis (Loads and Supports)	0701 2D Triangular Plate Simulation 0702 Round Bar (Moment/Torque) 0703 Bearing Bar	Lab Assignment 06
May 13	08. Remote Displacement and Force	0801 Remote Force Behavior Control 0802 Beam Bending + Axial Tension	Lab Assignment 07
May 20	Section Exam 02		
May 27	09. Line Modeling for Beam Analysis	0901 Cantilever Beam	Lab Assignment 08
May 25	10. Line Modeling for Truss Analysis	1001 2D Truss Analysis	Lab Assignment 09
Jun 03	11. Connection Modeling Using Contacts	1101 Bearing-Pin Contact Analysis 1102 Press-Fit Cylinders	Lab Assignment 10
Jun 10	12. Submodeling		Lab Assignment 11
Jun 17	13. Modal Analysis		Lab Assignment 12
Jun 24	Section Exam 03		
	14. Thermal Modeling (Optional)		

In-Class Workshops	Hands-on practices assigned to students in class to promote discussions and keep students in-sync with course material during lecturing
Homework	Problem sets will be distributed each week after the class. Each problem set is designed to build upon the material covered in the preceding lectures and recitations. Homework assigned in a particular class is due at 8 AM on the day of the next class period, unless otherwise posted. <u>Late HW will not be accepted.</u>
Exams	No midterm and final exams. Replaced by four section exams given throughout the semester. The section exams will be in-class and hands-on type of testing to benchmark individual's proficiency in conducting a mechanical analysis using ANSYS Mechanical. All section exams will be comprehensive. <u>No make-up will be given for the missing exam.</u> Exams missed due to unpredictable events will be dealt with on a case-by-case basis.

Final Project	<p>Each student will select a mechanical system of their own interest and work independently to conduct structural analysis using the learned ANSYS knowledge.</p> <p>Each student will submit a brief proposal to introduce the modeled system as well as to outline their project objective, technical approach and expected outcome.</p> <p>Tentative proposal deadline: Nov 12, 2020.</p> <p>Final project will be graded per technical challenges of the modeled problem, modeling skills, analysis details, and final report quality.</p>																																																
Grades	<p>In-Class Workshops: 15%</p> <p>Homework & Lab Assignments: 30%</p> <p>Section Exams: 40%</p> <p>Final Project: 15%</p> <p>Grades will be assigned per following scales: 附件：等级成绩和百分成绩、绩点对照表</p> <table border="1" data-bbox="375 737 1276 1020"> <tr> <td>字母等级</td> <td>A</td> <td>A-</td> <td>B+</td> <td>B</td> <td>B-</td> <td>C+</td> <td>C</td> <td>C-</td> <td>D+</td> <td>D</td> <td>F</td> </tr> <tr> <td>中文等级</td> <td colspan="2">优秀</td> <td colspan="2">良好</td> <td colspan="2">中等</td> <td colspan="3">合格</td> <td colspan="2">不合格</td> </tr> <tr> <td>百分制</td> <td>100-90</td> <td>89-85</td> <td>84-80</td> <td>79-76</td> <td>75-73</td> <td>72-70</td> <td>69-66</td> <td>65-63</td> <td>62-61</td> <td>60</td> <td><60</td> </tr> <tr> <td>绩点</td> <td>4</td> <td>3.7</td> <td>3.3</td> <td>3</td> <td>2.7</td> <td>2.3</td> <td>2</td> <td>1.7</td> <td>1.3</td> <td>1</td> <td>0</td> </tr> </table>	字母等级	A	A-	B+	B	B-	C+	C	C-	D+	D	F	中文等级	优秀		良好		中等		合格			不合格		百分制	100-90	89-85	84-80	79-76	75-73	72-70	69-66	65-63	62-61	60	<60	绩点	4	3.7	3.3	3	2.7	2.3	2	1.7	1.3	1	0
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Class Attendance	<p>Students are expected to attend every class period.</p> <p>Early is on time, on time is late. As a courtesy to your fellow classmates, be punctual and arrive no later than the class starting time.</p>																																																
Academic Honesty	<p>All of us are equally responsible for ensuring a fair and positive learning environment. Students are permitted to discuss homework assignments together, but should do their own work when preparing a problem solution.</p> <p>All exams are to be completed without unauthorized assistance. Any student caught cheating on an assignment or exam will receive disciplinary action, up to and including receiving a grade of "F" for the course.</p>																																																