WELDENG 4201 (Approved): Engineering Analysis for Design and Simulation

Course Description

Fundamentals of engineering analysis of heat flow, thermal and residual stresses, and fracture and fatigue with applications to design and simulation in welding and manufacturing.

Prior Course Number: 620, 621
Transcript Abbreviation: Eng Anal Des & Sim
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad
Student Ranks: Junior, Senior
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 4.0
Repeatable: No
Time Distribution: 3.0 hr Lec, 3.0 hr Lab
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 300 or 3001, Math 255 or 415 or 2177, ME 420 or 440 or 2040, or permission of instructor. Open to WE or MSE majors only.
Exclusions: Not open to students with credit for WE 620 and 621.
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.9999
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
WELDENG	Welding Engineering

Course Goals

Obtain fundamental understanding of heat flow including heat conduction with moving heat sources.
Obtain basic understanding of causes for and development of thermal stresses, residual stresses and distrotion.
Obtain basic understanding of linear elastic fracture mechanics including ability to apply fracture criteria.
Obtain basic understanding of high cycle fatigue, effect of mean stress using Goodman diagram, and life prediction for a variety of structures inculing welded structures.
Ability to analyze and design simple welded joints.

Obtain basic understanding of and ability to apply finite difference and finite element modeling to simple heat flow, stress analysis and fracture mechanics problems.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to heat flow including steady state conduction.	6.0							
Finite difference and finite element modeling of heat flow.	5.0							
Heat flow with moving heat sources including Cooling rates and peak temperature equations.	5.0							
Introduction to thermal stresses, residual stresses and distortion.	4.0							
Three-bar analogy analysis for residual stresses and distrotion.	5.0							
Residual stress measurement, stress relieving, and distortion analysis.	6.0							
Introduction to fracture mechanics, stress intensity factors and fracture toughness.	4.0							
Introduction to high cycle fatigue, Goodman diagaram, and fatigue of welded structures.	4.0							
Welded joint analysis and design.	3.0							
Matlab programming and application to heat flow and finite difference modeling.			12.0					
Abaqus modeling of steady state and transient heat flow.			9.0					
Ababqus analysis of elastic, thermo-elastic and thermo-elastic-plastic problems.			12.0					
Abaqus analysis of fracture.			9.0					

Grades

Aspect	Percent
Homework and quizzes	20%
Exam 1	25%
Exam 2	25%
Final exam	30%

Representative Textbooks and Other Course Materials

Title	Author
Lecture and Lab Notes	A. Benatar

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and 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.

Course Contribution		College Outcome
*	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 context.
**	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.

WELDENG ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	l	an ability to select and design welding materials, processes and inspection techniques based on application, fabrication and service conditions
*	m	an ability to develop welding procedures that specify materials, processes and inspection requirements
*	n	an ability to design welded structures and components to meet application requirements

Prepared by: Avraham Benatar