WELDENG 7115: Computational Analysis of Welding Processes and Welded Materials

Course Description

Fundamental understanding of temperature, stress, deformation, microstructure and property evolutions in welds using an integrated computational modeling approach

Prior Course Number: WE 715
Transcript Abbreviation: Comp Analysis Weld
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: MS, PhD
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Weeks
Credits: 3.0
Repeatable: No
Time Distribution: 3 x 55 min Lec per week
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: WE 601 or WE 7002 or WE 4002 and grad standing, or permission of instructor.
Exclusions: Not open to students with credit for WE 715 or WE 7115.
Cross-Listings:

Course Rationale: Existing course.

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

Subject/CIP Code: 14.9999
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
WELDENG	Welding Engineering

General Information

Introduction of advanced materials makes the welding and joining process a high-value added step in the overall manufacturing life cycle. As a result, there is a need to reduce the number of trial and error experimental welding/joining process developments to maximize the cost savings and accelerate the introduction of these advanced materials. Various computational models have been developed to describe the interaction of various physical processes to predict the residual stress, distortion, final microstructure and properties of welds. This approach is currently being adopted by automotive, aerospace, chemical, energy, microelectronics, and medical industries. This course will allow students develop and implement these models to solve welding problems.

Course Goals

Understand physics and corresponding governing partial different equations implemented in computational weld models.
Able to pose practical problem in terms of computational weld modeling framework.
Able to perform calculations and analyze and describe solutions.
Understand the limitations of these models and quantify the uncertainties in simulated results using sensitive study.
Ability to use industry-standard finite element codes and material modeling software to solve practical welding problems.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Heat Flow and Temperature Distribution in Welding	6.0							
Finite Element Modeling of Weld Residual Stresses	5.0							
Introduction to Computational Thermodynamics	2.0							
Applications of Thermodynamics Calculations in Welds	3.0							
Introduction to Computational Kinetics	3.0							
Diffusion Controlled Phase Transformations	2.0							
Other Topics in Weld Microstructure Modeling	3.0							
Performance Modeling of Welded Structures	2.0							
Integrated Weld Modeling	2.0							
Experimental Validation	2.0							

Representative Assignments

Homework problems assigned from the textbook by Grong, class notes and research papers.

Grades

Aspect	Percent
Attendance	5%
Assignments	45%
Group Project	15%
Mid Term #1	15%
Final Exam	20%

Representative Textbooks and Other Course Materials

Title	Author
Metallurgical Modeling of Welding (IIM Publication)	O. Grong

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.
	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

Additional Notes or Comments

This process will draw upon different concepts introduced during welding design, processes and metallurgy in other courses

Prepared by: Wei Zhang(.3978)