WELDENG 7101 (Proposed): Welding Metallurgy I

Course Description

Application of physical metallurgy principles to nonequilibrium thermo-mechanical conditions associated with welding in structural alloys and focus on carbon steels - Graduate Level

Prior Course Number: WE610 & 611
Transcript Abbreviation: WEENG7101
Grading Plan: Letter Grade
Course Deliveries: Greater or equal to 50% at a distance
Course Levels: Undergrad
Student Ranks: Junior, Senior
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
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: Permission of the instructor for graduate students
Exclusions: WE610
Cross-Listings:

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:
Subsidy Level:

Programs

Abbreviation	Description
WELDENG	Welding Engineering

General Information

This is a graduate level course of WE4101

Course Goals

First part of the course introduces the fundamental concepts of welding/joining metallurgy. This will build upon physical metallurgy principles from prerequisite MSE courses.
Topics presented include regions of fusion and solid-state welds, weld solidification, HAZ phenomena, weld defects, and weldability testing.

This course provides the foundation for the second part of the class, as well as, subsequent required and elective courses to be offered in related welding/joining metallurgy courses.
This second part of the course is intended to provide basic understanding of the nature of iron and its allotropic form. In addition, the effect of alloying elements on the solid state transformation of iron alloys (steels) will be discussed.
Heat treatment of carbon and low-alloy steels is discussed and related to the effect of welding thermal cycles on resulting structure and properties of steels in the heat-affected-zone and weld metal.
in the third part of the course, welding procedures, steel and filler metal classification systems, and post-weld heat treatments are described.
Weldability and weldability testing are discussed. Major emphasis is placed on the toughness characteristics of steel weldments and the influence of hydrogen in producing HAZ and weld metal cracks.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to Welding Metallurgy	1.0							
Regions of a Weld in Fusion and Solid-State Weld	1.0							
Weld Solidification Principles	3.0							
Fusion Zone	2.0							
Unmixed-Zone and Partially Melted Zone	2.0							
Heat-Affected-Zone	3.0							
Classification of Defects and Discontinuities	1.0							
Weldability	5.0							
Weldability Testing	2.0							
Introduction to Steels	1.0							
Steel Making and Processing	2.0							
Physical Metallurgy of Steels	4.0							
Weld Microstructure Evolution	4.0							
Consumables and Selection	2.0							
Welding Fume	1.0							
Weldability of Steels (General)	2.0							
Hydrogen Cracking	3.0							
Post-weld Heat Treatment and High-Temperature Properties of Steel Welds	2.0							
Fracture and Fatigue Behavior	1.0							

Representative Assignments

Home work problems are assigned from the text book and notes distributed in the class; Detailed computational modeling will be expected for graduate level using tools in the EJTC computer laboratory
Home work may also include review of papers and computational tools that will be made available to to the students

Grades

Aspect	Percent
Midterm 1	30%
Midterm 2	30%
Final Exam	40%

Representative Textbooks and Other Course Materials

Title	Author
Welding Metallurgy	Sindo Kou
Welding Metallurgy: Fundamentals (v. 1)	G. E. Linnert
Welding Metallurgy and Weldability of Structural Steels, Class Notes; Copyright 2007	J.C. Lippold and B.T. Alexandrov

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 course is for graduate students

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