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Course Outline for WLDT 72C

ADVANCED LASER WELDING

Effective: Spring 2018

I. CATALOG DESCRIPTION:

WLDT 72C — ADVANCED LASER WELDING — 2.00 units

This course will cover the application of modern laser welding of metals and materials. The hands-on use of the laser in the manufacturing environment will be performed. Utilization of tools for monitoring their performance will be explored. The safe and proper use continuous power laser welding and pulsed laser welding as well as the equipment and supplies will be covered. Direct measurement of temporal and spatial characteristics of the laser beam will be performed. Welding as well as metallurgy and joint configurations will be employed. Inspection, as well as defect detection, as well as their cause and corrective action will be demonstrated. Utilization of codes and specifications for industrial laser welding applications will be applied as well as welding safety requirements and personal protective equipment. Calculation of laser beam welding parameters.

2.00 Units Lab

Prerequisite

WLDT 72B - Intermediate Laser Welding
with a minimum grade of C

Grading Methods:

Letter or P/NP

Discipline:

- Welding

	MIN
Lab Hours:	108.00
Total Hours:	108.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. WLDT72B

1. Describe laser welding hazards, safety and personal protective equipment use ;
2. Locate and identify components of the beam delivery optics;
3. Describe tools and equipment used to measure power of the laser beam;
4. Describe tools and equipment used to measure spot size;
5. Describe welds of typical joint configurations used for laser welding;
6. Demonstrate methods for laser weld inspection, before, during and after welding;
7. Demonstrate the role of shielding gas and the gasses used for laser welding and cutting;

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

- A. Demonstrate laser welding hazards, safety and personal protective equipment use;
- B. Demonstrate tools and equipment used to measure spot size;
- C. Demonstrate use of tools and equipment used to measure power of the laser beam;
- D. Utilize tools and equipment used for measuring the temporal features of a laser beam;
- E. Utilize tools and equipment used for measuring the spatial features of a laser beam;
- F. Utilize tools and equipment used for measuring the caustic of a laser beam;
- G. Demonstrate pulsed laser welding and its advantages, disadvantages and applications
- H. Demonstrate continuous power laser welding and its applications;
- I. Demonstrate welding of typical joint configurations used for laser welding
- J. Demonstrate welding of metals and materials that can be processed with lasers;
- K. Identify the types of weld defects encountered in laser welding;
- L. Describe the cause and corrective action for typical defects seen in laser welds
- M. Demonstrate techniques to troubleshoot and identify laser welding problems;
- N. Demonstrate calculation of basic laser beam welding parameters used in laser welding;
- O. Utilize the Codes and Standards that are for different welding applications;
- P. Demonstrate the process of Equipment Qualification (EQ);
- Q. Demonstrate the process of Welding Procedure Qualification (WPQ);

R. Demonstrate the process of Welding Operator Qualification (WOQ);

V. CONTENT:

- A. Laser welding hazards, safety and personal protective equipment use
- B. Tools and equipment used to measure spot size
- C. Tools and equipment used to measure power of the laser beam
- D. Tools and equipment used for measuring the temporal features of a laser beam
- E. Tools and equipment used for measuring the spatial features of a laser beam
- F. Tools and equipment used for measuring the caustic of a laser beam
- G. Pulsed laser welding and its advantages, disadvantages and applications
- H. Continuous power laser welding and its advantages, disadvantages and applications
- I. Welding of typical joint configurations used for laser welding
- J. Metals and materials that can be processed with lasers
- K. Weld defects encountered in laser welding
- L. Cause and corrective action for typical defects seen in laser welds
- M. Techniques to troubleshoot and identify laser welding problems
- N. Calculation of basic laser beam welding parameters used in laser welding
- O. Codes and Standards that are used for different welding applications
- P. Process of Equipment Qualification (EQ)
- Q. Process of Welding Procedure Qualification (WPQ)
- R. Process of Welding Operator Qualification (WOQ)

VI. METHODS OF INSTRUCTION:

- A. Visual aids
- B. **Observation and Demonstration** -
- C. **Field Trips** -
- D. One-on-one, hands-on instruction

VII. TYPICAL ASSIGNMENTS:

- A. Lectures
 - 1. The typical joint configurations used for laser welding .
 - 2. How to measure laser spatial profile.
- B. Reading assignment:
 - 1. Read the textbook chapter on welding inspection
 - 2. Locate and read an article off the internet authored in the last 90 days on the subject of laser materials processing, write a summary of what you read
- C. Homework:
 - 1. Read the textbook chapter measuring laser beam parameters
- D. Class and group discussions:
 - 1. Class discussion: What is the purpose of shielding gas in a laser welding environment?
 - 2. Group discussion: When would we use computer controlled manufacturing techniques and processes? What are the advantages of computer controlled processing? What are the disadvantages?
- E. Audio-visual materials:
 - 1. Video of laser welding in research and development applications
- F. Field trip:
 - 1. Visit a local laser welding company
- G. Research project:
 - 1. You are leader of your own manufacturing company. You just got an order to make 1000 of this laser welded item. The drawing gives you the material required. What setup and equipment would you select, and explain in detail how you would make the item. Prepare a presentation and describe your method for manufacturing to the class.

VIII. EVALUATION:

A. **Methods**

- 1. Exams/Tests
- 2. Quizzes
- 3. Class Participation
- 4. Class Work
- 5. Home Work
- 6. Lab Activities

B. **Frequency**

- 1. Midterm and Final Examinations middle and end of semester
- 2. Weekly Quizzes
- 3. Class participation daily
- 4. Class work as assigned
- 5. Weekly homework evaluation
- 6. Lab activities daily

IX. TYPICAL TEXTS:

- 1. Duvall, B.J., & Hillis, D.R. (2012). *Manufacturing Processes* (3rd ed.). Tinley Park, IL: Goodheart-Wilcox.
- 2. American Welding Society (2017). *Process Specification and Operator Qualification for Laser Beam Welding* (C7.4M ed.). Miami, Florida: American Welding Society.
- 3. Engel, S.L. (2017). *Laser Welding Technology Student Learning Manual* (1st ed.). Elk Grove, CA: HDE Technologies.
- 4. Engel, S.L. (2017). *Laser Welding Technology Shop Practice Manual* (1st ed.). Elk Grove, CA: HDE Technologies.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

- A. Calculator
- B. Safety Glasses (ANSI Z81)