Syllabus: Introduction to Non-Destructive Testing and QA/QC, NDTE 1010

Part 1: Course Information

Description

This course provides students a synopsis of non-destructive and destructive evaluation methods that are used in evaluation of welds. This includes understanding the basic principles of various NDT methods, fundamentals, discontinuities in different product forms, importance of NDT, applications, limitations of NDT methods and techniques and codes, standards and specifications related to non-destructive testing technology. Students also will be introduced to relevant quality assurance and quality control requirements in accordance with ASQ, ASME, and ANSI standards.

This course is designed to meet over a period of 14 weeks, 1 meeting per week, and 3 hours per meeting in a combined lecture-lab meeting.

Prerequisites

None

Required Materials, Tools to be used

See separate Excel Spreadsheet

Part 2: Course Learning Outcomes (CLOs)

The course learning outcomes are to have students:

General Objectives

Upon completion of this course, students will be able to

1. Be able to List and define different defects that occur in welding shown through Non-Destructive Examination/Destructive Testing.
2. Be able to identify the types of equipment used for each Non-Destructive and Destructive Examination.
3. Be able to explain the purpose of the Equipment, Application, and standard techniques required to perform major non-destructive and destructive examinations of welds.
4. Be able to go to specific Code, Standard, or Specification related to each testing method.
5. Have the knowledge and essential skills to identify strengths and weaknesses in materials used in fabrication.

Detailed Learning Objectives (DLOs)

1. Explain why NDT methods were initially developed
2. Explain why Codes and Standards were initially developed
3. Describe the uses of NDT
4. Name the various nondestructive test methods
5. Recognize the NDT method abbreviations
6. Briefly explain each NDT method
7. Describe the advantages and limitations of VT
8. Explain qualification and certification requirements for VT
9. Identify VT inspection tools
10. Explain the differences between direct and remote VT
11. Describe manufacturing processes for metals
12. Explain the discontinuities inherent in various manufacturing processes
13. Name the various welding discontinuities
14. Define the causes, prevention, and repair of those welding discontinuities
15. Explain the discontinuities inherent in various welding processes
16. Provide the purpose of welding and NDE symbols
17. Describe the various weld configurations and joint types
18. Name the basic elements of welding and NDE symbols
19. Explain the supplementary welding and NDE symbols
20. Describe how welds are measured for acceptable size and length
21. Name the six basic steps for PT testing
22. Explain the mechanics of liquid penetrant
23. Name the types of liquid penetrants
24. Name the removal methods and types of removers
25. Name the types of developers
26. Explain the advantages and disadvantages of PT
27. Describe the basic principles of MT
28. Name the four basic steps of MT
29. Explain the advantages and disadvantages of MT
30. Describe the types of MT equipment
31. Name the types of MT media
32. Explain the types of magnetizing current
33. Name the person that discovered X-rays
34. Name the types of radioactive sources used for RT
35. Explain radioactive half-life
36. Describe the various types of RT equipment
37. Describe the basic principles of gamma and X-ray generation
38. Name the three means of protection to help reduce exposure to radiation
39. Explain how radiation measuring devices are used and list the types of measuring devices
40. Describe the basics of producing a radiograph
41. Explain geometric unsharpness and other geometric principles

42. Name and describe the various types of RT
43. Identify, and accept or reject RT discontinuities based on acceptance criteria
44. Explain the advantages and disadvantages of RT
45. Explain the basic principles of sound
46. Name the four wave modes used for UT
47. Describe the function of a piezoelectric transducer
48. Explain how ultrasonic thickness gages measure thickness
49. Describe the various UT techniques for flaw detection
50. Explain why calibration is necessary for UT equipment
51. Describe the advantages and limitations of UT
52. Name and describe the three scan data presentation methods
53. Explain the phased array UT technique
54. Describe the types of alloy identification equipment
55. Explain the principles of alloy identification
56. Describe how ECT is performed
57. Explain the principles of ECT
58. Gain a greater understanding about an NDT lab

Part 3: Course Topics and Roadmap

Roadmap

The following roadmap is recommended for instructors

Week	• **Lecture Topics** • **DLOs**	**Main Concepts, Terms, and Skills**	• **Course Materials,** • **Homework & Projects**
	State the topic of the week and list the CLO's by number	Provide a bulleted list of 3-4 subtopics for the week	List PPT name or slide #'s, and any homework, quiz, exam or project.
1	• Introduction / History • 1,2,3	• What is NDT? • Historical disasters that affected the development of NDT • The birth of Codes and Standards • NDT Qualification and Certification	• NDT_Week_1_Intro-History.pptx • Lab
2	• NDT Methods • 4,5,6	• Basic overview of 13 NDT methods • Abbreviations of those methods	• NDT_Week_2_Methods.pptx • Lab
3	• Visual Testing (VT) Part 1 • 7 thru10	• Advantages and Limitations of VT • VT Qualification and Certification • Welding Gages for VT • Direct and Indirect VT	• NDT_Week_3_VT Part 1.pptx • Lab
4	• Visual Testing (VT) Part 2 - Discontinuities • 11 thru 15	• Discontinuities in manufacturing processes • Discontinuities in welding processes • Cause, prevention, and repair of welding discontinuities • Performing VT	• NDT_Week_4_VT Part 2.pptx • Lab
5	• Welding Symbols • 16 thru 20	• Purpose of welding and NDE symbols • Basic elements of welding and NDE symbols • Supplementary welding and NDE symbols • Practical application of welding symbols	• NDT_Week_5_Welding Symbols.pptx • Lab
6	• Liquid Penetrant Testing (PT) • 21 thru 26	• Basic steps of PT • Mechanics of PT • Types of penetrants, removers, and developers • Performing PT	• NDT_Week_6_PT.pptx • Lab
7	• Review for Mid-Term Exam	• Review previously covered topics for Mid-Term Exam	• NDT_Week_7_Mid-

			Term_Review.pptx
8	• Magnetic Particle Testing (MT) • 27 thru 32	• Basic principles of MT • Four steps of MT • MT equipment and media • Performing MT	• NDT_Week_8_MT.pptx • Lab
9	• Radiographic Testing (RT) Part 1 • 33 thru 39	• Types of RT sources • Radiation • RT equipment • RT Safety	• NDT_Week_9_RT Part 1.pptx • Lab
10	• Radiographic Testing (RT) Part 2 • 40 thru 44	• Producing a radiograph • RT image quality • RT discontinuities	• NDT_Week_10_RT Part 2.pptx • Lab
11	• Ultrasonic Testing (UT) Part 1 • 45 thru 51	• Principles of sound • UT equipment • UT measurements and flaw detection • UT calibration	• NDT_Week_11_UT Part 1.pptx • Lab
12	• Ultrasonic Testing (UT) Part 2 / Alloy Identification / Eddy Current Testing (ECT) • 52 thru 57	• Data scan presentation methods • Phased array UT • Alloy identification • Eddy Current Testing (ECT)	• NDT_Week_12_UT Part 2 and Alloy Identification .pptx • Lab
13	• Field Trip to Local NDT Lab • 58	• View lab equipment • Discuss careers in NDT	• NDT_Week_13_Field Trip.pptx
14	• Review for Final Exam	• Review previously covered topics for Final Exam	• NDT_Week_14_Final_Review.pptx

Note that my comments moved week 7 to the next page, making the table look better.
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Part 4: Grading and Assessment

Graded Assignments

Students will perform graded lab experiments on welded samples. Lab reports are submitted for grading. At the instructor's discretion, quizzes and tests may also be used.

Proposed Grading Schedule

- Lab Reports (13) 60%
- Midterm (1) 20%
- Final Exam (1) 20%

Part 5: Notes to Program Administrators

Resources

Listed in separate document

Instructor Qualification

- Bachelor's or higher degree in a qualifying field or
- Bachelor's or higher degree in any discipline and certifying credentials:
  - 30 undergraduate hours or 18 graduate hours of coursework in a qualifying field, or
- Bachelor's or higher degree with relevant supplemental experiential experience:
  - Two years professional employment or
  - Research or publications, or
- A.A.S. in a qualifying discipline and four years of relevant professional employment

Qualifying fields:

Metallurgical Engineering
Mechanical Engineering
Construction Technology
Quality Assurance/Quality Control Technology

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