



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

w. e. f. Academic Year:	2025-26
Semester:	4 th
Category of the Course:	Professional Elective-II

Prerequisite:	-
Rationale:	<p>Welding is becoming essential joining process in fabrication and manufacturing industry. In process equipment fabrication industry, structural fabrication industry, piping industry, ship construction industry etc. welding is essential process for metal joining. Quality of weld joint depends on proper preparation of WPQ, WPS and PQR. So, it is compulsory for a fabrication engineer to prepare and interpret the WPQ, WPS and PQR. Welding is very complex metal joining process due to its very fast heating and cooling cycle. There may be many discontinuities found in welding. Welding inspector must have knowledge and skill to identify these discontinuities. He / She have the ability to identify the defects, its sources and probable remedies. Mechanical properties like tensile strength, yield strength, ductility, hardness, impact strength, chemical properties etc., are essential to be evaluated for judging the quality of weld joint. Many destructive testing processes are used for finding strength, homogenization and mechanical properties of weld joint. Many codes and standards are applicable in fabrication industry for these destructive testing procedure and sample preparation. Destructive testing is performed on production test coupon. But on actual production weld joint non-destructive tests are performed to discover the defects. It is necessary for fabrication engineer to have the knowledge of these non-destructive processes and its applicable codes and standards. This course is designed to develop these essential qualities of welding inspector in students.</p>

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Describe importance of welding inspection, testing & weld metal discontinuities.	U
02	Prepare basic PQR/WPS/WPQ as per applicable code used in fabrication industry.	A
03	Describe various destructive testing used for weld joint testing.	U
04	Use appropriate visual inspection, liquid penetrate testing and magnetic particle testing for a given application.	A



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

05	Describe various non-destructive test like (ultrasonic test, radiography test, eddy current test, leak test, phased array) used for weld joint.	U
----	-------------------------------------------------------------------------------------------------------------------------------------------------	---

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Basics of welding inspection, testing & discontinuities. 1.1 Scope, Definition, Application 1.2 Comparison of Welding Symbol with written explanation. 1.3 Basic elements of Testing Symbols as per AWS A2.4 1.4 Examples of typical NDT symbols. 1.5 Basic Testing Symbols 1.6 Illustration of Welding & Testing Symbols. 1.7 Ethical and essential requirements for the Welding Inspector. 1.8 Quality Assurance for WI&T. 1.9 Classification of welding related discontinuities 1.10 Desirable, acceptable and unacceptable fillet weld profiles. 1.11 Acceptable and unacceptable Butt weld profiles. 1.12 Weldment & related discontinuities.(Porosity, slag Inclusion, tungsten inclusions, incomplete fusion, inadequate Joint Penetration, undercut, cracks)	8	18
2.	Welding and welder qualifications. 2.1 Introduction to Welding Procedure and Qualification 2.1.1 Purpose of standardization in welding. 2.1.2 Codes and standards (ASME, AWS, ISO, EN, IS). 2.1.3 Terminologies and definitions: WPS, PQR, WPQ, WQT. 2.2 Welding Procedure Specification (WPS) 2.2.1 Concept and importance of WPS. 2.2.2 Essential, supplementary essential, and non-essential	9	20



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

	<p>variables.</p> <p>2.2.3 Content of WPS: (QW401- QW410) joint design, base metals, filler metals, positions, preheat, PWHT, shielding gas, etc.</p> <p>2.2.4 Steps of making WPS.</p> <p>2.2.5 Sample WPS formats and interpretation.</p> <p>2.3 Procedure Qualification Record (PQR)</p> <p>2.3.1 Purpose of PQR: establishing a qualified welding procedure.</p> <p>2.3.2 Steps to prepare and qualify a PQR.</p> <p>2.3.3 Required mechanical and non-destructive tests: tensile, bend, impact, hardness, macro/micro examination, radiography, ultrasonic.</p> <p>2.3.4 Review and approval process.</p> <p>2.4 Welder Performance Qualification (WPQ)</p> <p>2.4.1 Purpose: verifying welder's skill.</p> <p>2.4.2 Test coupons, positions (1G to 6G), test methods.</p> <p>2.4.3 Acceptance criteria based on codes.</p> <p>2.4.4 WPQ record preparation and renewal.</p> <p>2.5 Practical Applications & Documentation</p> <p>2.5.1 Reading and interpreting WPS and PQR.</p> <p>2.5.2 Preparing simple WPS and PQR for common processes (SMAW, GMAW, GTAW).</p> <p>2.5.3 Role of WPS/PQR/WPQ in QA/QC, fabrication, and inspection.</p>		
3.	<p>Destructive tests</p> <p>3.1 Tensile test: Introduction, preparation of test specimen, test procedure, result</p> <p>3.2 Bend test: Introduction, purpose, types of tests, specimens & Procedure.</p> <p>3.3 Impact test: Introduction, types, procedure, results</p> <p>3.4 Nick break test: Purpose, test specimen, procedure</p> <p>3.5 Hardness test: Purpose, types, machines, procedure</p> <p>3.6 Etch test: Introduction, types, concept & purpose, preparation of test specimen</p>	7	16
4.	<p>NDT Methods (VT, LPT, MPT)</p> <p>4.1 Comparison of destructive & nondestructive test</p> <p>4.2 Visual inspection: basic principle, defects detected, optical aids, application</p> <p>4.3 Liquid penetrant testing: principle, procedure, testing materials, testing methods, sensitivity, application, advantages, limitation, codes & standards.</p>	9	20



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

	4.4 Magnetic particle testing: definition & principle, magnetizing techniques, procedure, equipment, sensitivity, advantages, limitation, codes & standards. 4.5 Comparison of LPT v/s MPT.		
5.	NDT Methods (UT, ET, RT, LT, Phased array) 5.1 Ultrasonic testing: Introduction, principle, properties of sound beam, transducers, classification of UT techniques, techniques for normal beam inspection, techniques for angle beam inspection, equipment's, modes of display, advantages, limitations, application, codes & standards. 5.2 Eddy current testing: principle, metal properties & its effect, instrumentation, techniques, sensitivity, advantages, limitations, applications. 5.3 Radiographic testing: principle, radiation sources, effect of radiation on film, procedure, inspection techniques, advantages, limitations, application, typical examples. 5.4 Leak testing: measurement of leakage, bubble leak testing, helium leak detection. 5.5 Phased array testing (Introduction, principle, advantages & disadvantages) 5.6 Comparison of NDT methods 5.7 Selection of NDT of methods 5.8 Codes & standards for NDT: Meaning of codes, standard, specification, procedures, national & international standards for NDT	12	26
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
23 %	56%	21%	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks and marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Welding Inspection	AWS Committee	American Welding Society
2	Practical Non Destructive Testing	Baldev Raj T.Jaykumar M.Thavasimuthu	Narosa Publishing House
3	NDT Hand Book Vol.1&3	ASNT Committee	American Society of Non Destructive Test.
4	Non Destructive Testing Techniques	Ravi Prakash	New Age Science Publication
5	ASME Sec-II,V,VIII,X	ASME Committee	American Society of Mechanical Engineers
6	Welding Technology	O.P.Khanna	Dhanpatrai publication
7	Welding Engineering & Technology	Dr. R.S.Parmar	Khanna Publishers
8	Mechanical Design and Fabrication of Process Equipment	B C Bhattacharya	Oscar Publication
9	Welding Technology for Engineers	Baldev raj	Narosha Publishing House
10	Welding Technology & design	V.M. Radhakrishnan	NEW AGE INTERNATIONAL PUBLISHERS
11	Video Series on Welding and its Testing	-----	BHEL Trichi and NITTTR Bhopal

(b) Open source software and website:

1. <https://isnt.in/>
2. <https://asnt.org/>
3. <https://www.youtube.com/watch?v=5cNWF61Tmj0&list=PLyAZSyX8Qy5AePdV6vbGP4OJQOpbga-0Q>
4. <https://www.youtube.com/watch?v=sfjK1GZ2W9A&t=134s>
5. <https://www.youtube.com/watch?v=ZMJ7O4vs-Q8>
6. <https://www.youtube.com/watch?v=1AH8hm580Zg>
7. https://www.youtube.com/watch?v=7oR_18nXdmo
8. <https://www.youtube.com/watch?v=qpgcD5k1494>
9. <https://www.youtube.com/watch?v=8I1onrUqjDA&t=8s>
10. <https://www.youtube.com/watch?v=oriFJByl6Hs&t=23s>



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

Suggested Course Practical List:

Sr. No.	List of Practical	No. of Hours
1	Draw basic welding symbols & their location significance with examples.	02
2	Draw basic testing symbols & their standard location with examples.	02
3	Draw Desirable, acceptable and unacceptable fillet weld & butt weld profiles.	02
4	Demonstrate various welding discontinuities.	02
5	Prepare typical sample procedure qualification record (PQR) from the given data.	02
6	Prepare typical sample welding procedure specification (WPS) from the given data.	02
7	Prepare sample welder performance qualification (WPQ) from the given data.	02
8	Perform Rockwell hardness test on given a job.	02
9	Demonstrate tensile test on a given job.	02
10	Demonstrate impact test on a given job.	02
11	Demonstrate liquid penetrant test on a given job.	04
12	Demonstrate magnetic particle test on a given job.	02
13	Demonstrate ultrasonic test on a given job/calibration block.	02
14	Identify weld discontinuity by inspecting radiography film.	02
TOTAL		30

Note

- i. More **Practical Exercises** can be designed and offered and can be changed by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. Boiler suit, safety shoes, other safety items & hand tools are compulsory while attending laboratory and has to be brought by students.

List of Laboratory/Learning Resources Required:

No.	Equipment Name
1	Drawing instruments.
2	Test pieces/samples of jobs welded with different welding processes.
3	Rockwell hardness testing machines, calibration block, suitable indenter, test pieces/samples.
4	Universal testing machines, tensile test specimen
5	Charpy/Izod impact test machines, impact test specimen
6	Cleaner, penetrate, developer of solvent removable method, cotton waste.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

7	AC electromagnetic yoke machine, dry/wet application magnetic particles, pie field indicator.
8	Digital ultrasonic flaw detector, IIW V1/V2 calibration block, reference block.
9	Radiography film viewer, sample radiographs of welded jobs.

Suggested Project List:

1. Prepare solutions of different assignments given by subject faculty.
2. Prepare a list of specifications for various tools/equipment/machines used for welding inspection & testing
3. Visit the local metal trader/ fabricator and collect all relevant information regarding LPT & MPT tools/equipment.
4. Download videos showing correct practices for destructive testing and non-destructive testing.
5. Collect videos, animation showing welding discontinuities, PQR/WPS/WPQ, destructive tests & non-destructive tests.

Suggested Activities for Students:

1. Prepare report on the topic given by the subject teacher within the syllabus or beyond the syllabus from different books, technical magazines, journals etc.
2. Prepare video on demonstrating different destructive tests/non-destructive tests.
3. Prepare sample WPS/PQR from the given situation/data/drawing.
4. Prepare a power point presentation of 10 to 15 slides on the topic given by the subject teacher within the syllabus or beyond the syllabus.
5. Prepare report and/or download video on the topic given by the subject teacher within the syllabus or beyond the syllabus from internet or any other online resources.
6. Perform one of the NDT methods on existing machines/parts & prepare report on it.
7. Prepare charts/posters of welding inspection & testing related topics.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

ANNEXURE-1: SAMPLE SAFETY CONTRACT

(To be filled by the students and submitted to concerned faculty/staff)

-- Use for reference purposes only --

1. You have to read and sign the safety contract.
2. The safety contract says that you understand that safety is your responsibility.
3. The safety contract to be signed before you carry out any work in the laboratory and if you don't observe and obey the safety rules, you will not be allowed in the laboratory.

.....

Safety Contract

Date: _____

Name of Institute: _____

Name of Course with Code: Welding Inspection & Testing (_____)

Name of Faculty/Staff with Designation: 1. _____
2. _____
3. _____

I RECOGNIZE THAT:

1. Safety is my responsibility when using a tool.
2. Safety regulations have been provided to me.
3. The possibility of accident and injury increases if I do not follow all the safety guidelines.
4. I must act responsibly to ensure my own safety & the safety of others in the work area.

I AGREE TO:

1. Never work in the shop without my faculty's/ Instructor's supervision.
2. Read and practice all the safety regulations that have been distributed to me in this course or have been posted in the work areas.
3. Act in a responsible manner at all times in the laboratory.
4. Follow all instructions given by the faculty/Instructor.
5. Immediately report any unsafe condition or activity to my faculty/Instructor.
6. Wear eye protection at all times when working with tools or working anywhere near someone who is using tools.
7. Cut or Tie back long hair, remove jewellery, secure loosed clothing, and wear boiler suit & safety shoes in the laboratory.
8. Clean all work areas and put equipment away before leaving the laboratory.

I, _____, have read and agree with all the safety instructions.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fabrication Technology

Subject Code: DI04055071

Subject Name: Welding Inspection & Testing

Particulars:

Programme : _____

Student Signature

Batch No. : _____

Enrolment No.: _____
