



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Fabrication Technology

Course / Subject Code: DI03055021

Course / Subject Name: Welding Technology-1

w.e.f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	PCC

Prerequisite:	-
Rationale:	<p>Welding is one of the leading manufacturing process which is extensively used in fabrication industries. A fabrication engineer has to work in the field of production, operation and maintenance of fabrication, chemical & petrochemical industries. It is necessary for the fabrication engineer to have in depth knowledge of most advance metal joining process like welding. This subject develops capability to understand the art and science of welding. The main focus of this subject is to give in depth knowledge about most widely used arc welding processes like SMAW & SAW. The students become capable to select appropriate welding power source & electrodes for these processes. This subject develops quality consciousness regarding production of sound weld joint for different fabrication applications. This is key course for fabrication engineers. This course develops safety consciousness in student during working in welding shop/laboratory.</p>

Course Outcomes:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Describe basics of welding, weld joint with nomenclature and welding position for given welding process.	U
02	Select suitable equipment and electrodes for SMAW & SAW processes.	A
03	Use shielded metal arc welding process for a job as per given specification.	A
04	Use submerged arc welding process for a job as per given specification.	A
05	Describe arc physics of welding.	U

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



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to welding 1.1 Introduction of welding 1.2 Definition of welding 1.3 Classification of welding 1.4 Advantages & disadvantages of welding. 1.5 Welding v/s Casting v/s Riveting 1.6 Application of welding 1.7 General safety consideration in welding 1.8 Weld joint nomenclature 1.9 Welding symbol 1.10 Welding position (as per applicable code & standards in fabrication industry)	05	12
2.	Arc welding equipment and electrodes 2.1 Introduction 2.2 Arc welding power source 2.3 Selection factor for power source 2.4 DC power source 2.4.1 DC generator set 2.4.2 AC DC rectifier 2.4.3 Thyristor controlled rectifier 2.5 AC power source 2.5.1 AC generator 2.5.2 AC transformer 2.1 Other equipment required for arc welding e.g., cables, connections, holders etc. 2.2 Weld bead cleaning accessories 2.3 Hand shields and helmets and protective clothing 2.4 Definition of welding electrodes 2.5 Classification of welding electrodes 2.6 Non-consumable or refractory electrodes 2.7 Electrode shape, polarity and its effects 2.8 Consumable electrodes 2.9 Electrode coating, ingredients and their function 2.10 Manufacture of welding electrodes 2.11 Selection of welding electrodes 2.12 Care and storage of welding electrodes	10	22



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	2.13 Classification & coding of consumable electrodes		
3.	Shielded metal arc welding (SMAW) 3.1 Definition 3.2 Principle of operation 3.3 Typical edge preparation for butt joint 3.4 Striking (ignition) method 3.5 Relationship between electrode diameter and welding current 3.6 Weaving technique 3.7 Advantages, limitations and applications of SMAW process 3.8 Defects in welds	10	22
4.	Submerged arc welding (SAW) 4.1 Definition 4.2 Principle of operation 4.3 Operation/Procedure 4.4 Equipment 4.5 Joint preparation 4.6 Weld backing 4.7 Advantages, disadvantages and application 4.8 Compare SMAW with SAW	10	22
5.	Arc physics 5.1 Introduction of arc physics 5.2 Welding arc definition, arc initiation, arc structure and mechanism 5.3 Arc characteristics 5.4 Arc stability 5.5 Arc blow 5.6 Metal transfer & its types 5.7 Weld bead geometry	10	22
Total		45	100

Suggested Specification Table with Marks (Theory) :

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30 %	56 %	14 %	-	-	-

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



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distribution of marks and marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Welding Technology	Dr. O.P. Khanna	Dhanpatrai Publications
2	Welding Processes and Technology	Dr. R.S. Parmar	Khanna Publishers ISBN:81-7409-126-2
3	Welding Engineering and Technology	Dr. R.S. Parmar	Khanna Publishers ISBN:81-7409-028-2
4	Modern Arc Welding Technology	S.V. Nadkarni	Oxford & IBH Publishing co., Latest edition
5	Welding Technology for Engineers	Baldev Raj, V Shankar, A K Bhaduri	Narosha Publishing House ISBN:978-81-7319-607-2
6	Welding Technology & Design	V.M. Radhakrishnan	New age international publisher ISBN (10): 81-224-1672-1 ISBN (13): 978-81-224-1672-5
7	Welding and Welding Technology	Richard L Little	Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-099409-9
8	Welding	A.C. Davies	Cambridge University Press (Tenth Edition), ISBN:0 521 56702 5
9	Material Science & Technology	Dr. O.P. Khanna	Dhanpatrai Publications

(b) Open-source software and website:

1. <https://www.aws.org>
2. <https://iiwindia.com>
3. <https://www.britannica.com/technology/welding>
4. <https://weldingproductivity.com/>
5. <https://www.thefabricator.com/thewelder/about>
6. <https://weldguru.com/welding-processes/>
7. <https://www.welding-world.com/>
8. <https://www.lincolntech.edu/news/skilled-trades/welding-technology/types-of-welding-procedures>



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9. <https://www.themanufacturer.com/articles/different-types-of-welding-and-what-they-are-used-for/>
10. <https://youtube.com/playlist?list=PLwdnzlV3ogoUQnGO8eFFygVBTjF0xyYMq>
11. <https://www.youtube.com/watch?v=K-nJIqnmAfw&t=219s>
12. <https://www.youtube.com/watch?v=Zc3Fu1AVCjc>

Suggested Course Practical List:

Sr. No.	List of Practical	No. of Hours
1	Demonstrate various personal protective equipment and safe operating procedure for arc welding.	02
2	Identify different arc welding equipment, tools & accessories with their specification.	02
3	Draw different weld joint design, weld joint symbols and weld positions.	02
4	Demonstration of welding power source and arc initiation in SMAW process.	02
5	Perform SMAW process on given job in 1G position (flat), which includes plate cutting, marking, weld edge preparation, tacking, welding operations.	06
6	Perform SMAW process on given job in 2G position (horizontal), which includes plate cutting, marking, weld edge preparation, tacking, welding operations.	06
7	Perform SMAW process on given job in 3G position (vertical) / 4G position (overhead), which includes plate cutting, marking, weld edge preparation, tacking, welding operations.	04
8	Prepare SAW job as per given specification in a group.	04
9	Identify different welding defects and suggest its remedies.	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	Hand gloves, Welding face guard, Safety goggles, Hand sleeve, Leg guard etc.
2	Welding transformer three phase, Welding motor generator
3	Welding rectifier three phase, Inverter type power source



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4	Welding electrodes/consumables
5	Submerged arc welding machine
6	Tri square, Scriber, Hacksaw blade& frame, Flat files, Hand files, Half round file, Triangular file, Rough files, Smooth files, Bevel protractor, Hammer, Chisels, Bench vice, C-clamp, Power cable, Earthing clamp, Electrode holder, chisels, Wire brush, Chipping hammer, Tong tester, Speed glass, Digital weighing scale etc.

Suggested Project List:

1. **Creating Digital Portfolio:** Students should observe and collect photographs and images of industrial/domestic components/items/equipment etc. and make a report on it.
2. **Chart making:** Prepare chart / drawing of different types welding process with its principle, advantages, disadvantages, and applications, illustration of welding symbols, safety precautions for arc welding work etc. given by the subject teacher.
3. **Model Making:** Students should build 3D model of various object as per shape and dimension from thermocol, hardboard scrap, wooden scrap, plastic or metal scrap or drawing sheet etc.
 - Prepare a model of different types of welding processes set-up.
 - Prepare a model of different types of welding joint design.
4. **Video Preparation:** Student have to prepare his/her video on demonstrating different types of welding processes, shielded metal arc welding, submerged arc welding, preparation of weld joint design, welding tools-equipment and consumable selection, welding process set-up preparation, any other activities performed in laboratory etc. given by the subject teacher.
5. **E-learning projects:** Students have to use internet and other online resources for preparation of report and/or download video on the topic given by the subject teacher within the syllabus or beyond the syllabus.
6. **Report preparation:** Student has to use different books, technical magazine, journals etc. for preparation of a report on the topic given by the subject teacher within the syllabus or beyond the syllabus.
7. **Power point presentation:** Students has to 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. In the end of presentation student has to ask at least 3 to 5 MCQ based question to identify the gain of listeners at the end presentation.
8. **Collect and study brochure** of different types of welding machines, welding tools, equipment, consumables and accessories from local vendor/ online vendor.
9. Draw different joints used for structural fabrication.
10. Prepare special tools/projects/fixtures/models using arc welding.
11. Prepare a typical programme used for arc welding in Microsoft excel or suitable software.
12. Survey/Visit nearby vendor, prepare sample specifications of manual metal arc welding equipment.



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Suggested Activities for Students:

1. Prepare solutions of different assignments given by subject faculty.
2. Prepare a list of specifications for various tools/equipment/machines used in the arc welding.
3. Visit the local metal trader/ fabricator and collect all relevant information regarding SMAW electrodes and prepare the detail report on it.
4. Download videos showing correct practices for shielded metal arc welding & submerged arc welding processes.
5. Student will visit the respective discipline industry / site and will prepare the list of welding technology related equipment/machineries used by that industry / site.
6. Prepare a chart on various joint designs/weld symbols/weld positions.
7. Collect some industrial weld component, identify type of weld in it & justify welding process used to manufacture that component.
8. Collect videos, animation showing arc physics.
9. Prepare power point presentation on SMAW or SAW process.

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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 Technology-1 (_____)

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.

Particulars:

Programme : _____
 Batch No. : _____
 Enrollment No.: _____

Student Signature
