4237 - Welding Technology - I

4	4	8	25	50	3Hrs	100	50		225
Pre-requisite		Source	Semester	Theory	Test	Total	TW	PR	Gr Total
4231		FAB		75	25	100	50	50	200

RATIONALE: The Welding Technology has given a fillip to the fabrication Industry. Hence, the study of Welding Technology is very much essential. The topics are divided over two courses. Welding Technology-I covers the advantages of welding as a fabrication process, the safety aspects in gas and arc welding equipment, processes and techniques. Welding of ferrous and non-ferrous metals in various positions, Manual metal arc welding, equipment, processes and techniques in various positions. Soldering and brazing have also been included.

COURSE CONTENTS	Hrs	Mks
1. WELDING- A FABRICATION PROCESS Introduction. Historical background. Classification of welding processes. Commonly welded base metals. Advantages of welding as a means of fabrication. Disadvantages. Practical application of welding.	2	4
2. TERMINOLOGY Terms used in welding- Base metals or parent metals, weld bead, molten pool or weld puddle or molten puddle, heat affected zone, fusion zone, reinforcement, penetration, weld face, weld root weld toes, edge preparation, root gap, root face, bevel angle, included angle, weaving, electrode angles, speed of welding, run or pass, flux, slag, heat input, distortion, etc. Types of welded joints and their symbols. Welding positions based on weld slope and weld rotation. Types of edge preparations, and its need. Back gauging, filling and its need.	4	4
3. GAS WELDING Definition. Oxy-acetylene welding- Gas welding equipment- Oxygen gas cylinder, acetylene gas cylinder, anti-flash back device or flash back arresfer, manifolding system for gas welding-advantages of using manifolds, oxygen and acetylene pressure regulator-single stage regulator, two-stage regulator, difference between oxygen and acetylene pressure regulators. Hose pipes, hose clamps (clips) and hose couplers, welding torch or blowpipe- low pressures welding torch, high pressure welding torch, welding nozzles or tips, gas welding trolleys. Principle of operation- Lighting the torch, flame adjustment, types of welding flames, chemistry of oxy- acetylene flame, to extinguish the flame and stop welding. Gas welding techniques -Base metal preparation, leftward technique, rightward technique, comparison of welding techniques, vertical welding, overhead welding, all position rightward welding, Linde welding, block welding. Welding filler metal rods, filler metal, data of filler metal. Advantages, disadvantages and applications of gas welding. Weld defects and rectification. Other oxy-fuel gas welding- Oxy-hydrogen, oxy-propane, oxy-butane, oxy-natural gas, air-acetylene welding (Principle of operation and applications). Safety recommendations for gas welding- Introduction. Safety recommendations for installation and operation of gas welding and cutting equipment. Gas cylinders. Manifolding of gas cylinders. Torches and tips. Pressure regulators. Hose or gas tubing. Other general precautions. Explosion, fire and other hazards. Explosion. Fire hazards. Over heating hazards. Protection of welders- Protection from welding rays, protection of welders from sparks, spatters and welding fumes. Ventilation and health protection.	15	24

4. ARC WELDING 18 28

Definition of arc -welding.

Physics of welding- Welding Arc- Definition, methods of arc initiation, arc structure and mechanism, cathode drop zone, arc plasma column, anode drop zone.

Arc characteristics-volt-ampere characteristics, volt-arc length characteristics.

Arc blow- Factors affecting arc blow, types of arc blow, mechanism of arc blow, effects of arc blow, remedies for arc blow.

Metal transfer- Introduction, types of metal transfer, free flight transfer, short circuiting or dip transfer, forces affecting metal transfer, effect of arc current and voltage on drop transfer rate.

Arc welding equipment- Introduction. Arc welding power sources. D.C power sources- D.C. generator sets, A.C-D.C rectifiers, engine driven generator, polarity and its effects. A.C power sources- A.C transformers. Characteristics of power sources- Constant current or drooping characteristics, constant voltage on flat characteristics, rising voltage characteristics, advantages and disadvantages of each type of power sources, selection factors for power source.

Other accessories required for arc welding, welding cables, lugs and cable connectors, ground connections, electrode holder, chipping hammer and wire brush, hand shield and helmets, protective clothing.

Welding electrodes. Types of welding electrodes- Non- consumable electrodes.

Consumable electrodes- Bare electrodes, flux covered electrodes-Detailed of types and classification, electrode coatings and their functioning, deposition efficiency of electrodes. Manufacture of electrodes, selection of electrodes, care, storage and reconditioning of covered electrodes in general. Care, storage, and special precautions for low hydrogen electrodes. Classification and coding of mild steel and low alloy steel electrodes-American (AWS-ASTM) system, British (BS) system, Bureau of Indian Standards (BIS) System.

Arc welding positions- Flat position- Lap joint, fillet joint, butt joint.

Vertical position- Position and movement of electrodes, welding a vertical lap joint, welding a vertical butt joint, welding a vertical Tee joint.

Horizontal vertical welding.

Overhead position-Position for overhead welding, welding a lap joint, welding a Tee joint, welding a butt joint.

Welding of round bars and pipes.

Weld bead geometry.

Weld defects-Types of defects, their causes and remedies. Cracks, distortion, incomplete penetration, sladge inclusions, porosity and blow holes, poor fusion, poor weld bead appearance, spatter, undercutting, overlapping, defective weld geometry.

Safety recommendations for arc welding. Safety recommendations for installation and operation of arc welding and cutting equipment. Arc welding machines, electrode holders.

Explosion, fire and other hazards- Explosion, fire hazards, over heating hazards.

Protection of welders- Protection from welding rays, protection of welders from sparks spatters and welding fumes. Ventilation and health protection. Welding and heat treatment-Pre-heating inter-pass temperature, post weld heat treatment.

5. BRAZING 6 8

Definition, principle of operation, brazing procedure, surface cleaning, brazing joint design.

Base metals brazed-Aluminium and its alloys, magnesium and its alloys, copper and its alloys, low carbon and alloy steels, stainless and heat resisting steels, cast iron, nickel and high nickel alloys.

Brazing alloys (filler metals)- Aluminium – silicon, magnesium, copper and copper zinc, copper, phosphorus, gold, nickel, silver brazing alloys, selection of filler

material.
Advantages and disadvantages of brazing.
Brazing processes (Advantages and limitations of each process)- Torch brazing, furnace brazing, vacuum brazing, induction brazing, dip brazing, resistance brazing, carbon arc brazing.
Silver brazing- Introduction, brazing alloys, flux, methods, joint clearance, advantages and limitations, applications.
Difference between brazing and braze welding.

6. SOLDERING 6 10

Introduction, definition, comparison of soldering, brazing and welding, principles of good soldering process, soldering joint design.
Soldering alloys- Tin-lead solders, tin-antimony-lead solders, tin-zinc solders, lead-silver solders, cadmium-zinc solders, cadmium-silver solders, zinc-aluminium solders, indium-tin solders, fusible alloys, factors for selecting a solder alloy.
Cleaning the base metal surface- Mechanically, chemically.
Soldering methods- Soldering iron method, torch method, dip and wave method, induction method, resistance method, oven and hot plate method, spray method, ultrasonic method.
Soldering of various metals- Carbon and low alloy steels, cast iron, stainless steels, copper and its alloys, aluminium and its alloys.
Limitations of soldering.

7. HARD FACING, STELLITING AND METAL SPRAYING 7 12

Hard facing- Definition and concept- Surfacing, hard-facing.
Objectives of hard-facing
Principles of operation, steps involved.
Hard facing alloys-Low alloy ferrous materials, high alloy ferrous materials, nickel-based alloys, cobalt-based alloys, copper-based alloys, stainless steels and carbides.
Base metals.
Surfacing methods- (Process, advantages, limitations and applications), oxy-acetylene process, shielded metal arc welding.
Heat treatment of surfaced deposits.
Finishing of surfaced deposits.
Stelliting- Introduction, stelliting steel, stelliting cast iron, heat treatment for depositing stellite.
Metal spraying or metallizing - Introduction, definition, classification of thermal spraying based on heat source and surface material form, surface preparation, flame spraying process, wire spraying process, powder spraying process, electric arc spraying, advantages and disadvantages of sprayed coating, applications of sprayed coatings

8. WELDING OF METALS AND ALLOYS 6 10

Welding of steel, mild steel, low, medium and high carbon alloy steels. Welding of stainless steel. Welding of cast iron. Welding of aluminium & its alloys. Welding of copper and its alloys. Welding of nickel and its alloys. Welding of dissimilar metals.

Total 64 100

TERM WORK

A) Manual Metal Arc Welding MMAW- Study of Arc welding equipment: Flat position: Weld Pad building, square butt joint, V-butt joint, lap joint, Tee joint, corner joint. Pipe to plate (with rotation). Pipe to pipe (with rotation). Vertical position: V-Butt joint, lap joint, Tee joint, corner joint. Vertical-horizontal position: Tee-joint. Pipe to plate. Over head position: V- Butt joint.

B) Oxy-acetylene flame welding. Study of oxy-acetylene flame welding equipment. Practice to open the set, adjust pressures, lighting the torch, adjusting the flame, putting off the torch and closing the set. Flat position: Fusion runs. Butt joints without filler. Running beads. Butt joint with filler.

C) Composite job

Notes: The term-work shall consist of the above mentioned practical jobs and a journal in which the equipment used, procedure adopted, inspection of the job done, etc. should be systematically recorded. Practical examination will be of 3 hours duration on a composite job involving arc and flame welding in flat, vertical and vertical-horizontal position.

REFERENCE BOOKS

Latest editions of recommended reference books are to be made available in the library.

1. A Text-Book of Welding Technology by Dr. O.P Khanna Dhanpat Rai & Sons, Delhi
2. The Science and Practice of Welding, Vol II, The Practice of Welding by A.C Davies Cambridge University Press
3. Metals Handbook, American Society for Metals (ASM), Volume 6 –Welding and Brazing
4. Welding Skills and Technology by Dove Smith Gregg Division McGraw Hill Book Company
5. Modern Welding by A. D. Althouse, C. H. Turnquist and W.A. Bowditch The Goodheart- Willeox Co
6. Welding and Welding Technology by Richard. L Little Tata McGraw Hill Publishing Company Ltd
7. AWS Code book (Concised edition)
8. Welding Journals (Indian Institute of Welding and American Welding Society)
9. Welding Hand- book Vol. I – V American Welding Society 550,N. W. Le Jeune Road P. O. Box 351040