4240 – WELDING TECHNOLOGY –II

Teaching Schedule Per Week			Progressive Assessment		Examination Schedule (Marks)			
					Theory		Practical Ex.	Total
Lectures	Practical	Credits						
4	4	8	25	50	3Hrs	100	100	275

Pre-requisite	Source
4237	FAB

Semester	Theory	Test	Total	TW	PR	Gr Total
	75	25	100	50	100	250

RATIONALE- This subject is a continuation of Welding Technology-I, which covered the Gas and Manual Metal Arc Welding processes. The contents included in this subject would enable the student to understand the commonly used welding processes like GTAW, GMAW, submerged arc welding and electro slag welding. Principles of modern welding processes have been included to enable the students to keep abreast with the latest development in the welding technology. Control of distortion has been given due importance besides the topics on welding Jigs and Fixtures. Repairs welding have been included in order to enable the fabrication technician to carry out repairs of components.

COURSE CONTENTS	Hrs	Mks
1. GAS TUNGSTEN ARC WELDING (GTAW)	6	12
Definition. Principle of operation. Equipment. Base metals welded. Joint design. Shielding gases- Comparison of argon and helium as shielding gases, shielding gas mixtures, purity of shielding gases, variables influencing minimum effective amount of shielding gas flow. Accessory equipment- Welding fixtures, weld backing, automatic welding, longitudinal seamers, pedestal boom manipulators, water hoses. Filler metals- Forms, size and use, storage and preparation. Manual GTAW techniques. Applications. Advantages and limitations. GTAW spot welding- Equipment, use of filler metal wire. Use of consumable inserts. Safety practices.		
2. GAS METAL ARC WELDING (GMAW)	6	10
Definition. Principle of operation- Self-adjusted arc, self- controlled arc. Equipment- Power source, welding torch, wire feed mechanism. Metal welded. Shielding gases- Gases used, gas mixtures, cost, supply and storage of shielding gases, need of gas pre-heater in CO_2 gas shielding. Holding and handling work-pieces. Joint design.		

Comparison of GMAW and Alternative welding processes. Applications. Advantages and limitations. Safety practices.

3. SUBMERGED ARC WELDING (SAW) 6 8

Definition. Principle of operation. Advantages and limitations. Suitable work metals. Equipment. Joint design. Weld backing- Backing strips, backing weld, copper backing, flux backing, gas backing. Arc starting. Operating variables. Effect of welding position on joint design and welding conditions. Causes and prevention of weld porosity. Causes and prevention of weld cracking. Comparison of SAW with other arc welding processes. Safety practices.

4. FLUX CORED ARC WELDING (FCAW) 5 8

Definition. Applicability. Process fundamentals. Power supply. Electrode holders. Wire feed systems. Shielding gas. Holding and handling of work pieces. Effects of operating variables. Comparison with other processes.

5. ELECTRO SLAG WELDING 5 8

Definition. Applicability- Thickness range, length of joint, types of joints welded, specific applications. Principles of operation- Conventional electro-slag welding, electro slag welding by the consumable guide tube system. Equipment- Guide-tube (conventional system), Guide-tube (consumable guide tube system), dams, wire feed system, oscillator mechanism. Electrode wire. Fluxes. Preparation of work piece. Operating procedure- Start up, oscillation, number of electrode wires, control of vertical travel. Advantages and disadvantages. Applications.

6. BASICS OF SPECIAL WELDING 8 12

Plasma arc welding. Laser welding. Ultrasonic welding. Thermit welding. Atomic Hydrogen welding. Electron beam welding. Underwater welding

7. RESISTANCE WELDING 9 12

Definition. Fundamentals of resistance welding. Advantages and disadvantages. Applications. Resistance spot welding- Definition. Spot welding cycle. Procedure. Heat shrinkage in spot welding. Heat balance in spot welding. Spot weldable metals. Spot welding methods. Advantages and limitations. Applications. Resistance seam welding- Definition, principle of operation, advantages and disadvantages, applications. Projection welding- Principle of operation, advantages and disadvantages, applications. Resistance Butt welding- Upset Butt welding- Principle of operation, applications; Flash Butt welding- Principle of operation, difference between flash and upset welding, advantages and disadvantages, applications. High frequency welding of tubes.

8. DISTORTION & RESIDUAL STRESSES IN WELDED FABRICATION 6 10

Concept of distortion. Types of distortion- Longitudinal, transverse, angular, bowing. Causes of distortion- Heat input, restraint, inherent stresses in parent metal. Control of distortion- Joint design, assembly procedure- pre-setting method; restrained method, welding procedure, welding process, type and size of electrode welding rod and wire, number and sequence of runs, size of deposit and welding position- welding current and welding speed, welding sequence and techniques. Correction of distortion- Manual, use of press, local heating- Hot shrinkage, use of heat strip, use of heat triangle. Concept of residual stresses. Distortion in cutting- Factors causing distortion, examples of distortion in cutting. Distortion control techniques in cutting- Immersion in water, flushing behind the cut, simultaneous cutting, wedging, step cutting, welding behind the cut, locking the scrap.

9. WELDABILITY OF METALS 4 6

Definition and concept. Physical properties of metals. Mechanical properties of metals (strength, hardness, ductility and impact resistance). Carbon equivalent and its importance in welding. Weldability tests- Hot-cracking tests, root cracking tests,

cold cracking tests.

10. WELDING JIGS & FIXTURES Introduction. Welding jigs. Welding fixtures. Principles governing design of good welding jigs and fixtures. Various types of jigs and fixtures- 'C' clamps, Vee cradle or Rest, rotating fixture, turn table, turn over fixtures, positional, manipulators, quick acting clamps.	4	6
11. REPAIR AND MAINTENANCE WELDING Importance. Steps involved- Preparation for welding, welding procedure, post-welding operations. Factors influencing the procedure of maintenance welding. Precautions in welding. Examples of repair works- Repair of hair-line crack in a casting, rebuilding of worn-out shafts, hard-facing of worn-out surfaces.	5	8
Total	64	100

TERMWORK-

MMAW- a) Vertical position- V-butt, fillet. b) Overhead position- Pad building, V-butt, fillet. c) All position- Pipe to plate, pipe to pipe.

2. GMAW- Flat position- Running beads, V-butt, fillet.
3. GTAW- Flat position- Running fusion runs (without filler), Running beads (with filler), Butt joint of thin plates without filler, Butt joint of thin plates with filler, Fillet.
4. Demonstration of other welding processes- Resistance welding, Distortion control in welding operation, Repair welding, Distortion control in cutting operation.
5. One industrial visit to study other welding processes and applications.

PRACTICAL EXAMINATION (3hrs)

This consists of welding exercises similar to those in Sr. No. 1,2,3 of termwork

TEXT-BOOKS

1. A Text-book of Welding Technology by O. P. Khanna Dhanpat Rai
2. The Science & Practice of Welding Vol- I & II by A. C. Davis Cambridge University Press

REFERENCE BOOKS

1. Metals Handbook- Vol. VI ASM (Welding, brazing & soldering)
2. Control of distortion in welding fabrications, 2nd Edition, Welding Institute, London
3. Welding Handbook AWS, Section-I
4. Modern Arc Welding Technology by S V Nadkarni (Advani- Oerlikon Ltd.)
5. Pipe Welding- Conventional Welding and Store Pipe Technique
6. A.W.S Code book (Concised edition)
7. Welding Journals (Indian Institute of Welding and American Welding Society)
8. Welding Hand-book Vol I – V American Welding Society 550,N. W. Le Jeune Road P. O. Box 351040 Miami, FL33135