GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN FABRICATION TECHNOLOGY

SEMESTER: V

Subject Name: **Welding metallurgy**

Sr. No.	Course Content
1	**Weldability Of Metals:** 1.1 General metallurgy • FCC, BCC, HCP • Phase diagram • I.C. phase diagram • TTT diagram • Tempering of martensite • Grain refinement • Precipitation hardening 1.2 Welding metallurgy • Weld metal • Structure • Resistance to cleavage • Micro-alloyed weld metal • Resistance to Microvoid Coalescence • WI Scheme • Heat affected zone
2	**Basic Concept and Physical Metallurgy of Welding:** 2.1 Basic concept. 2.2 Fundamentals of welding. 2.3 Role of interfaces in welding. 2.4 The welding arc. 2.5 Effect of electrode polarity. 2.6 Effect of magnetic field. 2.7 Energy input and distribution. 2.8 Dissipation of welding heat. 2.9 Physical metallurgy aspects. 2.10 Development of the weld puddle shape. 2.11 Fusion zone. 2.12 Various zones in a weldment. 2.13 Microsegrigation. 2.14 Hot cracking. 2.15 Partially melted zone: liquation cracking. 2.16 Weld pool convection- weld penetration. 2.17 Heat affected zone microstructure.

3	**Welding Metallurgy of Steels:** 3.1 Introduction. 3.2 Hot cracking. 3.3 Cold cracking. 3.4 Lamellar tearing. 3.5 Reheat cracking. 3.6 Strain age embitterment and temper embitterment. 3.7 Weldability of different FE-C alloys. 3.8 Carbon and C-Mn steels. 3.9 Microalloyed or HSLA steels. 3.10 Cr-MO steels. 3.11 Ni steels. 3.12 Maraging steels. 3.13 WPS, WPR and WPQ- ASME Sec-IX 3.14 PWHT as per UCS 56 3.15 Example and calculation
4	**Weldability of Austenitic Stainless Steels:** 4.1 Introduction. 4.2 Welding of austenitic stainless steels. 4.3 Welding metallurgy of austenitic stainless steels. 4.4 Weldability problems in austenitic stainless steels. 4.5 Welding recommendations for specific grades of stainless steels. 4.6 Embitterment of stainless steel welds. 4.7 Autogenously welding of stainless steels. 4.8 Post- weld heat treatment of stainless steel welded components. 4.9 Welding of super austenitic stainless steels. 4.10 Schaeffer diagram 4.11 Delong diagram 4.12 Measurement of ferritic
5	**Welding of Ferritic, Martensitic, Duplex, Ph Stainless Steels:** 5.1 Welding of ferritic stainless steels. 5.2 Welding of martensitic stainless steels. 5.3 Welding of duplex stainless steels. 5.4 Welding of DSS. 5.5 welding of precipitate hardnable stainless steel
6	**Welding of Cast Iron:** 6.1 Types and Clasiification 6.2 Properties of cast iron 6.3 Weldibility of cast iron and PH
7	**Weldability of Aluminum and Titanium Alloys:** 7.1 Welding of aluminum and its alloys. • Introduction. • Special characteristics of aluminum alloys. • Types of aluminum alloys.

	• Welding processes. • Gas tungsten arc welding. 7.2 Welding of titanium alloys. • Properties of titanium • Principal titanium alloys • Welding of titanium • Weldability of titanium • Hot cracking
8	**Dissimilar Metal Welding and Cladding:** 8.1 Dissimilar metal welding 8.2 Factors influencing joint integrity • Weld metal • Dilution • Melting temperature • Thermal conductivity • Coefficient of thermal expansion 8.3 Welding consideration • Welding process • Selection of filler metal • Buttering • Joint design • Preheat and posy weld heat treatments 8.4 Service consideration • Property consideration • Carbon migration • Corrosion and oxidation resistance 8.5 Specific dissimilar metal combination with stainless steels • Stainless steel to carbon or low alloy steels • Nickel base alloys to steels • Cobalt base alloys to steels • Copper base alloys to steels • Aluminum base alloys to steels 8.6 Weld cladding • Application considerations • Composition control of stainless steel weld overlays ▪ Control of dilution • Procedures for stainless steel weld cladding ▪ Submerged arc welding ▪ Self shielded flux cored wire ▪ Plasma hot wire process ▪ Electro slag overlays • weld overlays other than stainless steels
9	**Residual Stresses in Weldment and Destortion Control:** 9.1 Introduction 9.2 Basic mechanism 9.3 Types of residual stresses 9.4 Factors influencing residual stresses • Material properties

	• Specimen dimension • Welding processes • Welding sequences • Different sources of residual stress • Effects of residual stress on performance • Methods of residual stresses • Techniques of residual stress measurement 9.5 Types of Distortion 9.6 Causes and remidies of distortion control

Reference Books:

Sr.No.	Book Name	Author Name
1.	Modern Arc Welding Technology	S.V. Nadkarni
2.	Welding Technology for Michanical Engineer	Baldevraj
3.	Aws Hand Book	Aws
4.	Welding Technology	O.P.Khanna
5.	Welding Process	R.S. Parmar