

22MTE29	WELDING METALLURGY	L	T	P	C
		3	0	0	3
Course Objectives:					
1.	To know the concepts of different materials joining and allied processes.				
2.	To understand the metallurgical aspects of welding.				
UNIT I	WELDING METALLURGY PRINCIPLES	9	+	0	
Thermal cycles in welding: basic heat transfer equations, temperature distributions and cooling curves, dependence of cooling rate on heat input, joint geometry, preheat and other factors. Comparison of welding processes based on these considerations.					
UNIT II	PHYSICAL METALLURGY OF WELDING:	9	+	0	
Welding of ferrous materials: Iron-carbon diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat-affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.					
UNIT III	WELDING OF ALLOY STEELS	9	+	0	
Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron.					
UNIT IV	WELDING OF NON-FERROUS METALS	9	+	0	
Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions. Dissimilar welding: Metallurgical problems – Calculation of dilution – methods of controlling dilution – techniques of dissimilar welding.					
UNIT V	WELDABILITY AND TESTS	9	+	0	
Concepts of weldability, carbon equivalent, and concept of preheat and post weld heat treatment, cold cracking, and role of hydrogen. Phenomenon of hot cracking, reheat cracking and lamellar tearing. Weldability tests – cold cracking and hot cracking tests. Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case.					
Total (L+T) = 45 Hours					
Course Outcomes:					
Upon completion of this course, the students will be able to:					
CO1	:	Understand the working principle, merits and demerits of different conventional welding processes.			
CO2	:	Understand the working principle, merits and demerits of different solid state welding processes.			
CO3	:	Understand the working principle, merits and demerits of different special welding processes.			
CO4	:	Understand the working principle and importance of allied processes in metals joining.			
C05	:	Solve welding heat flow related problems. Learn weldability and welding related problems of different materials.			

Text Books:	
1.	Parmar, R.S., -Welding Engineering and Technology, Khanna Publishers, New Delhi, 2003.
2.	Lancaster J.F. -Metallurgy of Welding, George Allen & Unwin. Boston. 1980.
Reference Books:	
1.	Linnert. G.E. -Welding Metallurgy. Vol. 1 and 2. 4 th edition. A W S. USA, 1994.
2.	Sindo Kou, Welding Metallurgy, John Wiley & Sons, 1987.
3.	Granjon. H, -Fundamentals of Welding Metallurgy, Jaico Publishing House, New Delhi, 1994.
4.	Nadkarni S.V., "Modern Arc Welding Technology", Oxford & IBH Publishing Co., 1988.
5.	Schwartz M.M., "Metals Joining Manual", McGraw- Hill Inc., 1979.
6.	ASM Metals Handbook, Vol. 6, "Welding Brazing & Soldering", ASM International, Metals park, Ohio, USA, 2001.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2	3	2	0	3	3	2	3	2	3	3	3	
CO2	2	3	2	3	3	2	2	0	2	1	3	2	3	3	3	
CO3	2	2	3	3	2	1	0	0	0	3	3	2	2	2	3	
CO4	2	2	0	0	3	3	3	2	0	2	3	3	3	1	3	
CO5	2	3	3	3	3	0	1	0	1	2	3	2	3	3	3	1
Total	2	2.2	2.2	2.2	2.8	1.6	1.2	1	1.2	2	3	2.2	2.8	2.4	3	0.2

1- Faintly,

2- Moderately,

3- Strongly