

1.	Title of the course	Welding Metallurgy
2.	Course number	ME508L
3.	Structure of credits	3-0-0-3
4.	Offered to	PG
5.	New course/modification to	Modification To ME5030/5
6.	To be offered by	Department of Mechanical Engineering
7.	To take effect from	July 2022
8.	Prerequisite	Nil
9.	Course Objective(s):	To develop in-depth understanding on the weld metal solidification, microstructure of the as-solidified weld metal, and post solidification transformations in the weld bead. Further to develop understanding on various transformations in the heat affected zone before going to realize the importance of learning various metallurgical issues in the weld joint.
10.	Course Content:	Fundamentals of physical metallurgy: Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, Phase transformations in Fe-C system, TTT diagram and CCT diagram, Carbon equivalent. Metal strengthening approaches: introduction, solid solution strengthening, grain refinement, precipitation hardening, transformation hardening, dispersion hardening, work hardening, strain aging. Heat treatment of weld joint: Need, annealing, normalizing, quenching, tempering, austempering, martempering and stress relieving of steel, precipitation hardening of Al and copper alloys. Solidification of weld metal: the principle of solidification of weld metal, modes of solidification, the effect of welding parameters on weld structure, grain refinement principle of weld metal, the method of weld metal refinement: inoculation, arc pulsation, external excitation. Heat affected zone and weld metal: transformations in HAZ of steel, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool: gas metal reaction, slag metal reaction. Metallurgical issues in weld joint: Mechanisms, causes, and remedy of cold cracking
11.	Textbook(s):	1. Lancaster J F, <i>Metallurgy of Welding</i> , Woodhead publishing (1999). 2. Sindo Kou, <i>Welding Metallurgy</i> , Wiley-Interscience (2002).
12.	Reference(s):	1. Esterling K, <i>Introduction to Physical Metallurgy of Welding</i> , Elsevier (2002). 2. Gene Mathers, <i>Welding of Aluminium and alloys</i> , Elsevier (2002).