20MD017 DESIGN AND METALLURGY OF WELDED JOINTS

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Course Description and Objectives:

Welding is one most the most commonly used fabrication techniques. For successful application of welding to produced sound weld joints, it is utmost important to understand the science and technology behind the welding. This course is aimed at familiarizing the students with the fundamentals weld joint design, metallurgical aspects in welding of steel, and assessing the quality and suitability of weld joints. Topics related with weldability of metals shall also be covered to equip the student's technological input for handling the problems in welding of selected metals and alloys.

Course Outcomes:

Upon successful completion of this course student will be able to:

- Understand the concept of static design of joints.
- Design of welded joints and static and dynamic loading.
- Evaluate the metallurgical and thermal aspects of welding joints of metals acquire
- knowledge about the cooling transformation curves of welded joints
- acquire knowledge about destructive and non-destructive tests of weldments

SKILLS:

- Evaluate the static stresses in loaded welded structures
- Evaluate the developed dynamic stresses in the welding structures
- Understand heat flow through the welding joints
- Understand the CCT of weldments
- Understand the destructive and non-destructive tests of the weldments

UNIT – I **L-12**

Introduction: Welded joints, symbols, welded defects; Design considerations; Joint efficiency; Factor of safety, Types of loading; Permissible stress; Computation of stresses in welds; Weld size calculation; Code requirement for statically loaded welded structures.

UNIT – II **L-12**

Dynamic Behaviour of Welded Joints and Failure Theories: Design for fluctuating and impact loading; Dynamic behavior of welded joints; Stress Concentrations; Fatigue analysis; Fatigue improvement techniques; Permissible stress- life prediction; Concept of stress intensity factors - LEFM and EPFM concepts; Brittle fracture; Transition temperature approach, Application of fracture mechanics to fatigue.

UNIT - III **L-12**

Welding Metallurgy: Thermal effect of welding on parent metal; Structure of fusion welds; Effect of cooling rate; Weld metal solidification and heat affected zone; Heat flow - temperature distribution cooling rates; Influence of heat input; Joint geometry; Plate thickness; Preheat; Significance of thermal severity number; Epitaxial growth - weld metal solidification - columnar structures and growth morphology effect of welding parameters; Absorption of gases - gas/metal and slag/metal reactions.

UNIT - IV **L-12**

Phase Transformations: Weld CCT diagrams - carbon equivalent-preheating and post heating weldability of low alloy steels; Welding of stainless steels use of Schaffler and Delong diagrams;

UNIT – V **L-12**

Weldability testing: Types of weldability test, Varestraint test, Cast pin tear test, hot ductility test, Strain to fracture test, reheat cracking test, tests for Hydrogen induced cracking

TEXT BOOKS:

1. Design of Weldments; W. B. Omer; James. F. Lincoln; Arc Welding Foundation; 1991.
2. Deformation and Fracture of Mechanics of Engineering Materials; R. W. Hertzberg; John Wiley;1996.
3. Welding Metallurgy; Volume I and II; 4th Edition; G. E. Linnert; AWS; 1994
4. The Metallurgy of Welding, 6th Edition , Lancaster, William Andrew Publishing, NY

REFERENCE BOOKS:

1. Rational Welding Design; T. G. E. Gray; Butterworths; 1982.
2. Mechanical Metallurgy; G. Dieter; Tata McGraw Hill; 1988.
3. Weldment Design; M. Bhattacharya; Association of Engineers;1991.
4. Fundamentals of Welding Metallurgy; H. Granjon; Jaico Publishing House; 1994.
5. Introduction to Physical Metallurgy of Welding; 2nd Edition; Easterling Kenneth; Butterworth Heinmann; 1992.