MSE-311 Joining of Materials

Credit Hours: 2-0

Pre-requisites: Nil

Course Description

This is a specialized course that discusses various methods and techniques used to effectively join different materials. This multidisciplinary course emphasizes the understanding of fundamental principles, practical applications, and advanced trends in joining processes. Starting with traditional joining methods such as welding, brazing, and soldering, students will also learn modern joining processes.

Course Contents

- Introduction to Joining Processes and Classification. Fusion Welding: Arc Welding Processes; Resistance Welding processes; Special Welding processes.
- Solid State Welding: Brazing, Soldering, Adhesive Bonding, Friction stir welding, etc.
- Metallurgy of Welding: Weld-ability of Ferrous and Non-ferrous Alloy Systems, Stresses in Welds, Testing and Non-Destructive Evaluation of Welds.
- Formulation of WPS, WPQ and WPR, Fabrication and Repair procedures for Weld Assemblies, Welding of Dissimilar Materials with special emphasis on Metal-Ceramic and Ceramic-Ceramic Joining, recent Trends in Joining Technologies.
- Polymers as joining materials, glasses as joining materials, Joining of Polymers, Joining of Ceramics.

Weekly Plan

Week	Topics
1	Introduction to Joining Processes
2	Classification of joining and Processes
3	Challenges in joining structures
4	Fusion Welding: Arc Welding Processes
5	TIG welding, MIG Welding
6	Plasma Arc welding, SMAW
7	Resistance Welding, Spot Welding, Seam, welding, Projection welding
8	Solid State Welding: Brazing, Soldering
9	**Mid-Semester Exams**

10	Formulation of WPS, WPQ and WPR, Fabrication and Repair procedures for Weld Assemblies,
11	Dissimilar Materials with special emphasis on Metal-Ceramic and Ceramic-Ceramic Joining,
12	Recent Trends in Joining Technologies.
13	Polymers as joining materials, glasses as joining materials,
14	Joining of Polymers, Joining of Ceramics
15	Joining of Composite structure and materials
16	Importance of joining in industry application
17-18	**End Semester Exams**

Course Outcomes

At the end of the course the students are expected to have learned the following:

- Classify and distinguish various industrial fusion and non-fusion welding processes.
- Apply fabrication knowledge to formulate joints via brazing, soldering, and adhesive bonding.
- Analyze the basic metallurgical changes during welding processes.
- Evaluate fabricated joints for soundness and defects free structures according to governing specifications.

Suggested Books

- Welding: Principles and Applications, L. Jeffus. 9th ed. Cengage Learning (2020)
- Principles of Welding: Processes, Physics, Chemistry and Metallurgy by R. W. Messler, Jr. 1st ed. Wiley-VCH (2015)
- Joining of Materials and Structures: From Pragmatic Process to Enabling Technology, Robert W. Messler. 1st ed. Butterworth-Heinemann, (2004)
- Metallurgy of Welding by J. F. Lancaster. 6th ed. Woodhead Publishing (1999)
- Advanced Joining Processes: Welding, Plastic Deformation, and Adhesion edited by L. D. Silva, M. El-Zein, P. Martins. Elsevier (2021)
- Friction Stir Welding and Processing: Fundamentals to Advancements edited by S. Rathee, M. Srivastava, J. P. Davim. Wiley (2024).