

Welding Engineering - Web course

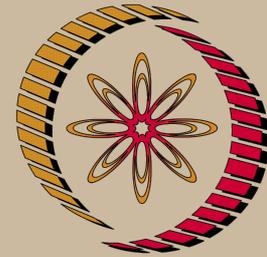
COURSE OUTLINE

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 of arc welding processes, weld joint design, metallurgical aspects in welding of steel, and assessing the quality and suitability of weld joints. Topics related with weldability of metals (steel, cast iron and aluminium alloys of commercial importance) shall also be covered to equip the students technological input for handling the problems in welding of selected metals and alloys.

Contents: Fundamentals of arc welding processes, physics of arc, arc forces, arc blow, selection of power sources for different arc welding processes, principles of weld joint design, welding symbols, metallurgical aspects in welding of steel, heat flow in welding and its effect on the performance of weld joints, residual stress and distortion in weld joints and assessing the quality and suitability of weld joints, destructive and non-destructive testing method.

COURSE DETAIL

Sl. No	Topic	Hours
1.	Introduction: Evolution of welding; classification of welding processes; heat sources and shielding methods.	2
2.	Physics of Welding Arc Welding arc; voltage distribution along the arc; thermionic and non-thermionic cathodes; theories of cathode and anode mechanism; arc characteristics and its	4



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Mechanical Engineering

Pre-requisites:

- Understanding of basic concept of welding.
- UG course on Basic Manufacturing Processes.

Additional Reading:

- AWS welding handbooks

Coordinators:

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	relationship with power source; arc efficiency; heat generation; effect of type of shielding gas on arc; isotherms of arcs.		
3.	<p>Welding Power Sources</p> <p>Conventional welding power sources; constructional features; static and dynamic characteristics; duty cycle; influence of inductance on arc and power source characteristics; internal and external regulation; specific power source requirements; special welding power sources.</p>	2	
4.	<p>Arc Welding Processes</p> <p>Consumable electrode welding processes. Manual metal arc (MMA) welding; Gas metal arc welding; pulsed MIG welding; Submerged arc welding, Significance of flux-metal combination; Electroslag welding: heat generation; principle; Gas tungsten arc welding; selection of polarity, Plasma arc welding; transferred and nontransferred plasma arc welding; selection of gases; welding parameters; keyhole technique.</p>	8	
5.	<p>Heat flow in welding</p> <p>Effect of welding parameter on heat distribution; calculation of peak temperatures; thermal cycles; cooling rate and solidification; Residual stresses and their distribution in welds; influence of residual stresses in static and dynamic loading, distortion</p>	5	
6.	<p>Design of weld joints</p> <p>Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading, Weld Calculations in lap, butt and fillet welds; design for fatigue loading, Introduction to Fatigue; nature of the fatigue process; fatigue strength; factors affecting fatigue</p>	6	

	life; improvement methods for fatigue strength; reliability analysis and safety factors applied to fatigue design.	
7.	<p>Testing and inspection of weld joints</p> <p>Chemical tests; Metallographic tests; Hardness tests; Mechanical test for groove and fillet welds-full section, reduced section and all-weld- metal tensile tests, root, face and side bend tests, fillet weld break tests, creep & fatigue testing. Non-Destructive Testing of Weldments; Visual inspection; Dye-penetrant inspection; Magnetic particle inspection; Ultrasonic inspection-principle of ultrasonic testing, Radiographic inspection –principle of radiography, X-ray tubes, gamma-ray sources, defect discernibility; Eddy current inspection; Leak tests: N.D.T. Standard procedure for specification and qualification of welding procedure; WPS and PQR, WPQ</p>	6
8.	<p>Weldability of metals</p> <p>Solidification of weld metal; heat affected zone (HAZ), factors affecting properties of HAZ; gas-metal, slag-metal and solid state reactions in welding and their influence on soundness of weld joint; lamellar tearing and hydrogen damage; weldability; definition, factor affecting the weldability of steel Carbon equivalent. weldability of steel, cast iron and aluminium alloys of commercial importance, failure analysis of welded joints.</p>	7

References:

1. The Metallurgy of Welding, 6th Edition , Lancaster, William Andrew Publishing, NY.
2. Principles of Welding (Processes, Physics, Chemistry and Metallurgy), Robert and Messler, Wiley Interscience Publishers.
3. Welding Hand Book Vol. 5; 7th edition, AWS, 1984.
4. Welding METALLURGY, S Kou, John Wiley, USA, 2003.