



Best Technology Solutions (BTS)

Metallurgy for Non-Metallurgists Training program

Course Description

This training course is designed to give a semi-detailed discussion of the subject of Engineering Metallurgy with emphasis on the physical metallurgy aspect. In order for the course material to suit participants with or without a metallurgical background, the course will be delivered such that most of technical terms and concepts will be clarified by both scientific definition and examples. The course is divided into six main areas: Basic physical and chemical aspect, Alloying metallurgy and phase diagrams, introduction to carbon steels and cast irons, Strength of Materials, Mechanical Properties and Mechanical Testing and metallographic techniques. The course is designed such that no previous background in metallurgy is necessary. The course can, also, be tailored for specific needs if required by certain participants.

At Course Completion

Upon successful completion of this course, participants will be able to:

- Appreciate the meanings of different technical terms and concepts used in engineering metallurgy
- Understand the difference between metals and alloys and the need for alloying
- Be able to choose the appropriate material for a certain application
- Carry out mechanical testing
- Choose the right metallographic examination for a specific microstructural examination.



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- Relate type of material and microstructure to chemical composition and thermal and mechanical (thermo-mechanical) history of the material.
- Relate different mechanical properties to material's microstructure and thermo-mechanical history.

Training Methodology

Training will be delivered mainly through lectures with emphasis on practical examples and case studies. Practical sessions would be provided when and wherever possible.

Who Should Attend

Design engineers, process engineers, manufacturing engineers, product development engineers and managers, mechanical engineers with or without experience in metallurgy, Inspection people, quality control engineers and technicians and people involved in welding, fabrication and heat treatment.

Course Objectives:

By the end of this course delegates will learn about:

- To familiarize participants with the main concepts and technical terms of engineering metallurgy.
- To introduce participants to the concepts of process-structure-property interrelationships.
- To explain to participants the main requirements for alloying and different types of alloy systems
- To explain to participants the main mechanical properties and how they are measured.



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- To introduce participants to different types of metallic component failures.
- To explain to participants how to conduct a metallographic examination and carry out a microstructural characterization.
- Carry out a metallurgical failure analysis and understand the types of failure encountered in engineering applications

Course Outline

- **Structure of metals and alloys**
 - Nature of metallic bonding
 - Crystal structure of metals
 - Structure of alloys
 - Imperfections in crystals
 - Experimental study of structure
- **Formation of alloys**
- **Major requirements for alloying**
- **Main types of phases present in metallic alloys and their formation**
- **Strengthening mechanisms in alloys**
- **Thermal equilibrium diagrams (Phase diagrams)**
 - The phase rule
 - Binary Equilibrium diagrams
 - Microstructural changes during cooling
 - Ternary equilibrium diagrams
- **Introduction to ferrous metallurgy (steel and iron)**
 - Introduction to Fe-C phase diagram
 - Introduction to Carbon steels
 - Introduction to cast irons
 - Basic heat treatment and hardening of steels



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- **Strength of Materials**

- Definitions and technical terms used in strength of materials
- Strengthening mechanisms in metals and alloys
- Tensile strength
- Impact strength and shock resistance
- Fatigue Strength
- Fracture strength
- Wear resistance
- Hardness
- Strength-Deformation relationships
- Ductile and brittle materials

- **Mechanical properties and mechanical testing**

- The tensile test
- Stress – Strain curves
- Fatigue life and fatigue testing
- Hardness testing
- Creep resistance and creep testing
- Wear testing
- Impact testing
- Plastic deformation mechanisms
- Fracture of materials

- **Practical metallography**

- **Metallurgical principles of the joining of metals**

- **introduction to metallurgical failure analysis**