

COURSE OUTLINE

Metallurgy

Course Description

WE 220. Metallurgy. 3 hours credit. Prerequisite: A score at a pre-determined level in reading, writing, and math on a diagnostic instrument selected by the department. This course will enable the student to develop basic metallurgy skills with both ferrous and non-ferrous metals. The student will explore properties of metals, hardness testing, heat treating, quenching, annealing, normalizing, tempering and surface hardening.

Course Relevance

The principles learned in this course will allow the student to understand how the knowledge of specific properties and characteristics of different metals will help prepare them for a career in welding.

Required Materials

Brandt, D., & Warner, J. (2005). *Metallurgy fundamentals*. Tinley Park, IL: Goodheart-Wilcox Company, Inc.

Learning Outcomes

The intention is for the student to be able to:

1. Demonstrate the ability to properly identify the different classifications of metals through classroom exercises
2. Demonstrate, through process analysis, an understanding of the manipulations and control of the various properties of metal
3. Explain the fundamentals theories of metallurgy through written and/or classroom exercises

Primary Learning PACT Skills that will be DEVELOPED and/or documented in this course

Through the student's involvement in this course, he/she will develop his/her ability in the following primary PACT skill areas:

1. Critical Thinking
 - Through the analysis of metals and their specific properties, the student will recognize and understand the role that metallurgy plays in obtaining a high quality weld.
2. Problem Solving
 - Through the analysis of the metals and their specific properties the student will be able to identify strengths and/or limitations of the different classifications of metals, while making decisions regarding their application.
3. Field-Related Technology

- Through the use of current industry standards and technology the student will have a basic understanding of metallurgy theory, principles and its' relevance to the welding industry.

Secondary skills (developed but not documented):

Listening
Reading
Analytical Thinking Skills

Major Summative Assessment Task(s)

These learning outcomes and the primary Learning PACT skills will be demonstrated by:

1. Classifying metal according to specific characteristics showing understanding of the relationship of heat to the different properties of metal

Course Content

- I. Themes - Key recurring concepts that run throughout this course:
 - A. Metal properties
 - B. Welding process
- II. Issues - Key areas of conflict that must be understood in order to achieve the intended outcome:
 - A. The proper identification of the different classifications of metals
 - B. The relationship of heat to the different types of metals
 - C. The understanding of specific properties unique to the different classifications of metals
- III. Concepts – Key concepts that must be understood to address the issues:
 - A. The principles and theories of metallurgy
 - B. Metallurgy terminology
 - C. Welding process analysis
- IV. Skills/Competencies - Actions that are essential to achieve the course outcomes:
 - A. Properly identify the different classifications of metals
 - B. Identify specific properties and characteristics of the different classifications of metal
 - C. Recognize critical factors in the relationship of heat to specific properties of metals

Learning Units

- I. Introduction to metallurgy
 - A. Practical applications of metallurgy
 - B. Metallurgical and chemical terminology
- II. Properties of metals
 - A. Hardness
 - B. Material properties

III. Ferrous metallurgy

- A. What is steel?
- B. Manufacture of iron and steel
- C. Crystal structure
- D. Failure and deformation of metal
- E. Iron-carbon phase diagram
- F. Microstructural analysis
- G. Heat treating and quenching
- H. Annealing and normalizing
- I. Isothermal transformation diagrams
- J. Tempering
- K. Surface hardening

IV. Non-ferrous metallurgy

- L. Processing non-ferrous metals
- M. Aluminum and aluminum alloys
- N. Copper, bronze, and brass
- O. Magnesium, zinc, tin, and specialty metals

Learning Activities

Learning activities will be hands on exercises in both booth and shop. Classroom lecture is designed to enable the student to understand the key principles in process analysis, welding fundamentals, process and electrode classification analysis, and correct use of associated equipment.

Grade Determination:

The student will be graded on completion of assessment tasks, learning activities, adequate participation (discussion), and the final project.