Las Positas College
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Course Outline for DSNT 75

DESIGN MATERIALS TECHNOLOGY

Effective: Fall 2002

I. CATALOG DESCRIPTION:
DSNT 75 — DESIGN MATERIALS TECHNOLOGY — 2.00 units

Introduction to physical and mechanical characteristics and behavior of materials used in design and engineering applications. Emphasis will be on material processing of metals, ceramics, and polymers; basics of metallurgy, tension testing, hardness testing, and heat treatment.

1.00 Units Lecture 1.00 Units Lab

Strongly Recommended
CHEM 31 - Intro to College Chemistry

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	18.00
Lab Hours:	54.00
Total Hours:	72.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering this course, it is strongly recommended that the student should be able to:

A. CHEM31

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. develop a solid platform of information upon which informed material decisions could be made;
B. demonstrate knowledge of all testing equipment in the laboratory;
C. apply safety principles to laboratory experimental activities;
D. be conversant with metallurgical terminology involving ferrous and non-ferrous metals;
E. describe the steel-making process and a system of analysis to identify a type of steel;
F. discuss some of the properties of plastics, wood, and concrete;
G. perform basic materials characterization tests;
H. analyze basic materials failure issues and recommend solutions to correct service failures;
I. interpret phase and equilibrium diagrams;
J. perform metallographic specimen preparation;
K. apply physical and metallurgical basics involved in limited material selection;
L. demonstrate appropriate scientific methodology in writing a technical report.

V. CONTENT:
A. Materials Selection Principles and Laboratory Procedures
B. Extracting Metals from Ores
    1. Principles involved in producing pig iron
    2. Steel-making processes
    3. Nonferrous metal production
C. Identification and Selection of Iron Alloys
    1. Using shop tests for ferrous metal identification
    2. Commercial methods for determining AISI chemical analysis
D. Manufacturing of Steel Products
    1. How steel is formed into various shapes and products
    2. Advantages of some processes over others for a given product
E. Physical and Mechanical Properties of Metals
    1. Mechanical testing terms and machines
    2. Preparation of tensile and shear test specimens

3. Calculation of stress, elastic limit, yield point, ultimate tensile strength, percent elongation and percent reduction in area

F. Identification of Nonferrous Metals
   1. Classification of nonferrous metals by numerical and testing methods criteria
   2. Appearance and use of various nonferrous metals

G. Crystal Structure of Metals

H. Phases of crystalline structure of metals
   1. Solidification space lattices
   2. Metcalf experiment to determine approximate grain size in steel samples

I. Hardness Testing
   1. Common industrial hardness testers
   2. Calibrating a hardness tester
   3. Difference between loads and indenters
   4. Conduct hardness testing with a Brinell, Rockwell, and/or microhardness tester

J. Non-Destructive Testing
   1. Methods and purposes of testing
   2. Testing equipment and inspection

K. Phase Diagrams
   1. Identification of parts
   2. Determining relative carbon content by microscopic examination
   3. Microscopic identification of cast iron compositions

L. Heat Treatment
   1. Annealing, Stress Relieving, and Normalizing
      a. Various kinds of annealing processes
      b. how heat treatments effect machinability and welding
   2. Hardening and Tempering of Steel
      a. Procedure
      b. Relationship between tempering temperature and hardness change
   3. Hardenability of Steels
      a. Evaluating the depth of hardening of various steels
      b. Using the mechanical properties chart
   4. Heat Treating Equipment
      a. Furnaces
      b. Quenching media
   5. Heat Treating of Nonferrous Metals
      a. Processes of solution heat treatment and precipitation hardening

M. Welding Processes for Iron and Iron Alloys
   1. Effects of welds on microstructure and properties
   2. Types of welding
   3. Effects of slags and fluxes
   4. Metallurgy of Welds: Nonferrous Metals
   5. Weld structure
   6. Effects on metallurgical condition of the weld

N. Powder Metallurgy
   1. Methods of manufacturing used
   2. Measuring density by microscopic examination

O. Composite Materials

P. Ceramic Materials

Q. Corrosion of Materials

R. Failure Analysis
   1. Common causes of industrial problems that lead to failures
   2. Corrective measures for solution of industrial problems that lead to failures
   3. Methods and practices of metallurgical failure analysis

S. Casting Processes
   1. Different methods of casting
   2. Design requirements and disadvantages
   3. Specific product pairings with appropriate casting process

T. Plastics and Elastomers

VI. METHODS OF INSTRUCTION:

A. **Demonstration** - Lecture and Laboratory demonstration
B. **Audio-visual Activity** - Videos
C. Collection and interpretative evaluation of data
D. Group problem-solving
E. **Lab** - Laboratory experiments
F. Overhead presentations

VII. TYPICAL ASSIGNMENTS:

A. Reading: 1. Read and be prepared to discuss Chapter 5 on the Identification and Selection of Iron Alloys. List at least four properties of steel that should be considered when you select the material for a job. 2. If your shop stocked the following steel shafting, how would you determine the content of an unmarked piece of each, using shop tests as related in Chapter 5 of Practical Metallurgy and Materials of Industry B. Laboratory reports: 1. Follow the instructions for Lab #2 in learning to use the tensile testing machine and calculate elongation, reduction in area, and unit stress of a pulled specimen. Record your results. Do you think this was a ductile metal? Why? 2. Perform material characterization tests on the provided material samples and determine what material each specimen is? Report your results, including what sources of error were encountered. What could be done to improve the quality of the data? C. Group discussion of written assignments and lectures: 1. Case Problem: The Brittle Dune Buggy Parts A mechanic who was building a lightweight dune buggy needed some high-strength aluminum parts. Sine he had access to a heat-treating furnace, he decided to do the solution heat-treating and aging process himself. He obtained 2024 aluminum bars and made the parts. Then he heated the parts in a furnace to 1200?F, quenched them, and then allowed them to age naturally. He noticed they had small blisters all over their surfaces and when he began to hammer one in place, it broke in two places. What did he do wrong? Could the parts be salvaged in any way? 2. How can some metals such as stainless steel, which are normally resistant to corrosion, rust under a washer, a crevice, or a pile of sand?

VIII. EVALUATION:

A. **Methods**

B. **Frequency**

1. Frequency:
    a. Reading assignments and/or laboratory reports per each topic
    b. Weekly participation in laboratories in safe manner
    c. One semester-long technical report
    d. Quizzes as needed
    e. Final presentation of technical research

IX. TYPICAL TEXTS:

1. Neely, John E. and Bertone, Thomas J. *Practical Metallurgy and Materials of Industry*. 5th ed., Prentice-Hall, Inc., 2000.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Safety glasses
B. Calculator
C. Report writing materials