Wisconsin Indianhead Technical College

32806300 Applied Materials Science

Course Outcome Summary

Course Information

Description	This is a one-semester course consisting of a study of the chemical and physical properties of industrial materials. Areas of study include properties of metals, plastics, and ceramics with the primary emphasis being on metals.
Instructional Level	Two-Year Technical Diploma
Total Credits	2.00
Total Hours	48.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom Presentation (Lecture/Demonstration/Discussion)	1/16
On Campus Lab and/or Shop Experience	1/32

Course History

Revised By	Erin Winesburg (15237468)

Course Competencies

1. Apply the concepts of the general properties of matter
Domain *Cognitive* ***Level*** *Synthesis* ***Status*** *Active*

Assessment Strategies

1.1. in the classroom and laboratory
1.2. verbally and/or in writing
1.3. in individual and group problem-solving exercises

Criteria

Criteria - Performance will be satisfactory when:

1.1. learner performs calculations for variables in the density formula within the precision and accuracy of given data
1.2. learner describes the general physical and chemical properties of the three phases of matter in agreement with available scientific references
1.3. learner applies thermal concepts to determine properties and physical changes in matter in agreement with available scientific references
1.4. learner describes general trends in the properties of the chemical elements in agreement with

information located on the periodic table

1.5. learner uses characteristics of atomic structure to determine properties of specific elements in agreement with information located on the periodic table

1.6. learner describes and gives examples of the three types of chemical bonds in agreement with available scientific references

Learning Objectives

1.a. Define weight and mass
1.b. Calculate density, weight, or volume
1.c. Describe the general properties of solids, liquids, and gases
1.d. Define melting point, freezing point, boiling point, and condensation
1.e. Define heat of fusion and heat of vaporization
1.f. List thermal properties of selected elements and compounds
1.g. Apply thermal concepts to analysis of phase diagrams for selected elements and compounds
1.h. Describe the electrical charge and relative masses of the three major subatomic particles
1.i. Describe the general structure of the periodic table and determine properties of specific elements found on the table
1.j. Describe ionic, covalent, and metallic bonding
1.k. Apply concepts of bonding to determine properties of selected elements and compounds

2. Use concepts of crystalline structure to determine properties of metals

Domain *Cognitive* ***Level*** *Synthesis* ***Status*** *Active*

Assessment Strategies

2.1. in the classroom and laboratory
2.2. verbally and/or in writing
2.3. in individual and group problem-solving exercises

Criteria

Criteria - Performance will be satisfactory when:

2.1. learner identifies major classifications of solid materials in agreement with available scientific references
2.2. learner determines properties of major classifications of solid materials in agreement with available scientific references
2.3. learner chooses a material for an application using as a standard the structure - process - property model
2.4. learner performs laboratory tests of metal properties with results in agreement with the precision and accuracy of equipment used
2.5. learner identifies major types of crystalline lattice structures in agreement with available scientific references
2.6. learner calculates the relationship between atomic radius and lattice parameter in agreement with available scientific references
2.7. learner predicts changes in metal properties resulting from imperfections in crystalline structures to examples of metal properties in agreement with available scientific references
2.8. learner relates imperfections in crystalline structures and orientations to load resistance in agreement with available scientific references

Learning Objectives

2.a. Identify general properties of metals, ceramics, polymers, semiconductors, and composites
2.b. Choose a material for a specific application using the structure - process - property model
2.c. Perform Rockwell hardness tests of various metals and interpret the results
2.d. Perform tensile tests of various metals and interpret the results
2.e. Perform impact tests of various metals and interpret the results
2.f. Describe the unit cell structure of common metals
2.g. Describe point, line, and surface defects in metal crystal structures and identify properties associated with each
2.h. Determine, numerically, the relationship between atomic radius and lattice parameter in common metallic crystalline structures
2.i. Define the concept of slip in metallic crystalline structure and relate the concept to properties of solids
2.j. Describe the relationship between shear stress and slip for metallic crystalline structures
2.k. Discuss methods for controlling slip in metals

3. Use metallurgical methods to alter the properties of metals

Domain *Cognitive* ***Level*** *Synthesis* ***Status*** *Active*

Assessment Strategies

3.1. in the classroom and laboratory
3.2. verbally and/or in writing
3.3. in individual and group problem-solving exercises

Criteria

Criteria - Performance will be satisfactory when:

3.1. learner identifies the process and applications of strain hardening in agreement with available scientific references
3.2. learner identifies the processes and applications of tempering and annealing in agreement with available scientific references
3.3. learner interprets the information found on phase diagrams in agreement with available scientific references
3.4. learner predicts results of solid solution strengthening in agreement with available scientific references based on knowledge of atomic radii
3.5. learner interprets the process of phase equilibrium in the formation of alloy grain structure in agreement with available scientific references
3.6. learner performs heat treatment of metals conforming to standard industry procedures
3.7. learner performs mechanical tests of heat treated samples with results to be compared to nontreated samples

Learning Objectives

3.a. Define strain hardening
3.b. Describe the principles of strain hardening
3.c. Identify the industrial processes that cause strain hardening
3.d. Define annealing
3.e. Describe the principle of annealing
3.f. Describe the relationship between annealing temperature and applications
3.g. Describe the process of grain growth as a metal solidifies
3.h. Determine the general relationships between grain size and strength
3.i. Give a detailed definition of the concept of phase
3.j. Interpret the information given on a unary phase diagram
3.k. Interpret the information given on a binary phase diagram
3.l. Describe the principles of limited and unlimited solubility including examples of each
3.m. Relate cooling curves to binary phase diagrams
3.n. Define dispersion strengthening
3.o. Describe characteristics of dispersion strengthening related to metal strength
3.p. Give definitions of the special points found on complex phase diagrams
3.q. Interpret the information given on a complex phase diagram
3.r. Apply the information found on complex phase diagrams to examples
3.s. Describe the cause and effect relationship between solid solution strengthening and the properties of metals
3.t. Perform the process of heat treating selected samples of metals
3.u. Perform the processes of tempering and annealing selected samples of metals
3.v. Test heat treated samples for hardness, tensile strength, and impact strength

4. Acquire a working knowledge of polymers

Domain *Cognitive* ***Level*** *Synthesis* ***Status*** *Active*

Assessment Strategies

4.1. in the classroom and laboratory
4.2. verbally and/or in writing
4.3. in individual and group problem-solving exercises

Criteria

Criteria - Performance will be satisfactory when:

4.1. learner describes the general differences between thermoplastics and thermosets in agreement with available technical references
4.2. learner describes structure and properties of common polymers in agreement with available technical references
4.3. learner determines mechanical properties of common polymers in agreement with available technical references
4.4. learner describes the effects of cross linking on the properties of polymers in agreement with available technical references
4.5. learner describes vulcanization techniques and describe the results
4.6. learner tests mechanical properties of common polymers in agreement with the accuracy and precision of test equipment
4.7. learner creates a polymer and is able to describe the resulting properties

Learning Objectives

4.a. Describe the process of polymerization
4.b. Identify chemical elements commonly found in polymers
4.c. Describe the molecular structure of common polymers
4.d. Define the terms thermoplastic and thermoset
4.e. Identify common thermoplastic and thermoset polymers
4.f. Identify applications of common polymers
4.g. Identify the major material properties of polymers
4.h. Compare material properties of common polymers
4.i. Define cross linking including examples of applications
4.j. Perform a vulcanization techniques lab exercise
4.k. Perform lab tests of mechanical properties of selected polymers
4.l. Identify applications of polymer combinations and combinations of polymers with other materials

5. Acquire a working knowledge of ceramics

Domain *Cognitive* ***Level*** *Synthesis* ***Status*** *Active*

Assessment Strategies

5.1. in the classroom and laboratory
5.2. verbally and/or in writing
5.3. in individual and group problem-solving exercises

Criteria

Criteria - Performance will be satisfactory when:

5.1. learner describes the atomic crystalline structure of common ceramics in agreement with available technical references
5.2. learner describes the dependence of properties on the structure for common ceramic materials in agreement with available technical references
5.3. learner determines material properties of common ceramics in agreement with reference tables
5.4. learner identifies applications of ceramic materials in agreement with available technical references
5.5. learner researches methods of combing ceramics with other materials to achieve desired properties

Learning Objectives

5.a. Identify combinations of chemical elements found in ceramics
5.b. Describe the tetrathedral structure of clay-based ceramics
5.c. Explain the firing of ceramics and how firing changes the properties of ceramics
5.d. Describe the properties of ceramics and the differences between ceramic properties and properties of metals and polymers
5.e. Describe applications of common ceramic materials