



Western Technical College

## 10420119 Manufacturing and Engineering Materials

### Course Outcome Summary

#### Course Information

<b>Description</b>	Material selection is a critical component of the design and production process. If the properties of the material selected do not meet the specifications of the product, or if the material selected is not appropriate for the required manufacturing operations, product failure will be the result. This learning experience will introduce you to the properties, classifications, and applications of the materials used in the design and manufacture of a product. You will assess the characteristics of materials that impact the selection and utilization of materials in design and manufacturing through lab activities, problem solving, independent study and research.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	Associate Degree Courses
<b>Total Credits</b>	3
<b>Total Hours</b>	90

#### Textbooks

*Engineering Materials 1: An Introduction to Properties, Applications and Design*. 5th Edition. Copyright 2019. Jones, D. R. H. Publisher: Elsevier Science. **ISBN-13**: 978-0-08-102051-7. Required.

*Engineering Materials 2: An Introduction to Microstructures and Processing*. 4th Edition. Copyright 2013. Jones, D. R. H. Publisher: Elsevier Science. **ISBN-13**: 978-0-08-096668-7. Optional.

#### Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor**: Campus Shop. Required.

#### Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Increase Self-Awareness
3. Live Responsibly: Embrace Sustainability
4. Live Responsibly: Foster Accountability
5. Refine Professionalism: Act Ethically
6. Refine Professionalism: Participate Collaboratively
7. Refine Professionalism: Practice Effective Communication

## **Program Outcomes**

1. Analyze mechanic engineering problems
2. Produce and revise supporting engineering documentation
3. Evaluate manufacturing processes and materials for product development
4. Demonstrate awareness of product liability and industry standards
5. Meet design and production deadlines
6. Interpret and communicate technical concepts, designs, and documentation

## **Course Competencies**

### **1. Classify materials based on their structure and properties.**

#### **Learning Objectives**

- 1.a. Define terms associated with atomic structure and atomic theory.
- 1.b. Describe and use the periodic table of elements to determine chemical and physical properties of engineering materials.
- 1.c. Explain how the different atomic bonding act to hold atoms together.
- 1.d. Define the various structures and properties of materials in crystal lattice formation.
- 1.e. Describe the solidification process of crystalline materials.

### **2. Evaluate the physical, mechanical, chemical, and dimensional properties of ferrous and nonferrous metals used in design and manufacturing.**

#### **Learning Objectives**

- 2.a. Classify the major types of metals and alloys used in manufacturing.
- 2.b. Describe the physical and mechanical properties of the major classifications of metals.
- 2.c. Define terms related to the properties of metals.
- 2.d. Determine the stress/strain relationship of metals.
- 2.e. Utilize vendor catalogs to select metals subject to simple stress.
- 2.f. Determine the hardness of metals.
- 2.g. Explain the relationship of hardness to tensile strength.
- 2.h. Describe the effects of creep and fatigue on metals.
- 2.i. Describe and list the various ingredients and processes used to refine cast iron, steels, and stainless steels.
- 2.j. Describe the purpose of heat treatment of metals.
- 2.k. Describe the refinement process, major alloys, uses, and properties of copper, brasses, bronzes, magnesium, chromium, titanium, lead, zinc, gold, silver and platinum.
- 2.l. List and sketch the major shapes in which ferrous metal products are available.
- 2.m. Use standard numbering systems to identify ferrous and nonferrous metals.
- 2.n. List and explain the difference in properties between hot worked and cold worked metals.
- 2.o. Describe the process of galvanic corrosion in metals.
- 2.p. Summarize the primary uses of metals in industry.

### **3. Evaluate the physical, mechanical, chemical, and dimensional properties of polymers**

**commonly used in manufacturing.**

**Learning Objectives**

- 3.a. Identify the physical and mechanical properties of the major classifications of polymers.
- 3.b. Classify polymers commonly used in manufacturing.
- 3.c. Define terms related to the properties of polymers.
- 3.d. Compare the properties of polymers to other manufacturing materials.
- 3.e. Describe the production process of polymers.
- 3.f. Summarize the primary uses of polymers in industry.

**4. Evaluate the physical, mechanical, chemical, and dimensional properties of ceramics commonly used in manufacturing.**

**Learning Objectives**

- 4.a. Identify the physical and mechanical properties of ceramics.
- 4.b. Classify ceramic materials commonly used in manufacturing.
- 4.c. Define terms related to the properties of ceramics.
- 4.d. Compare the properties of ceramics to other manufacturing materials.
- 4.e. Determine the hardness of various ceramic materials.
- 4.f. Describe the production process of ceramics.
- 4.g. Compare the industrial applications of various types of ceramics.

**5. Evaluate the physical, mechanical, chemical, and dimensional properties of composites commonly used in manufacturing.**

**Learning Objectives**

- 5.a. Identify the physical and mechanical properties of composites.
- 5.b. Classify examples of composites commonly used in manufacturing.
- 5.c. Define terms related to the properties of composites.
- 5.d. Compare the properties of composites with those of other manufacturing materials.
- 5.e. Describe the production process of composites.
- 5.f. Describe the components and structures of various composite materials.
- 5.g. Summarize the primary uses of composites in industry.

**6. Assess the factors that impact the selection and utilization of materials in manufacturing.**

**Learning Objectives**

- 6.a. Define the material requirements of the product.
- 6.b. Describe the evaluation of materials throughout the design process (conceptual phase, functional phase, and production phase).
- 6.c. Apply the material characteristics with common manufacturing processes.
- 6.d. Identify the potential problems of various materials (product failure, environmental impact, final destination of product).
- 6.e. Describe the significance of industry standards on manufacturing and selection of materials.
- 6.f. Describe the impact of recyclability of materials on manufacturing.

**7. Resolve simple stress/strain problems.**

**Learning Objectives**

- 7.a. Utilize an engineering problem solving strategy.
- 7.b. Determine the appropriateness of materials subject to simple stress.
- 7.c. Perform calculations using stress, strain, and modulus of elasticity.

**8. Prepare clear and concise written reports.**

**Learning Objectives**

- 8.a. Organize information in a written format.
- 8.b. Communicate ideas at an appropriate level for a specific audience.

**9. Cooperate and establish a good working relationship with other students in the class.**

**Learning Objectives**

- 9.a. Help group members understand and complete assigned tasks.
- 9.b. Identify roles and responsibilities of individual group members.
- 9.c. Respect the ideas and opinions of others.

**10. Accept responsibility for attending class and completing all learning activities.**

**Learning Objectives**

- 10.a. Develop good work habits.
- 10.b. Fulfill job expectations and requirements.