OAN Number: **Board of Trustees Date: 05/22/08**
OAN Date: **Effective Date: 08/23/08**

CUYAHOGA COMMUNITY COLLEGE
OFFICIAL COURSE OUTLINE
Mapped

SUBJECT AREA TITLE
Mechanical Engineering Technology/Manufacturing Industrial Engineering Technology
COURSE TITLE
Engineering Materials and Metallurgy
SUBJECT AREA CODE-COURSE NUMBER
MET - 1300
COURSE CREDIT HOURS
3.00

I. DESCRIPTION OF COURSE:

A. CATALOG DESCRIPTION: Analysis of the behavior and characteristics of metals and other materials used in manufacturing including polymers, ceramics and composites: their structure, physical and mechanical properties. Examining and interpreting phase diagrams and crystallized microstructures of metals and alloys; heat treatment of ferrous and nonferrous metals; hardness, tensile and charpy impact tests.

B. LECTURE HOURS: 2.0

C. LAB HOURS: 3.00

D. OTHER REQUIRED HOURS: 00

E. PREREQUISITE(S): None

II. GENERAL EDUCATION OUTCOMES:

Upon satisfactory completion of MET 1300 - Engineering Materials and Metallurgy, the student should be able to perform the following outcomes and supporting objectives:

Outcome:

III. OUTCOMES/OBJECTIVES:

Upon satisfactory completion of MET 1300 - Engineering Materials and Metallurgy, the student should be able to perform the following outcomes and supporting objectives:

A. Outcome: Analyze the behavior and characteristics of metals and other materials used in manufacuring including polymers, ceramics, and composites: their structure, physical and mechanical properties.

Supporting Objectives:

B. Outcome: Describe the extraction of Metals from Ores

Supporting Objectives:

C. Outcome: List the various steps, basic material, and principle involved in iron making

Supporting Objectives:

D. Outcome: Identify various steelmaking processes

Supporting Objectives:

E. Outcome: Explain several processes used in producing metals

Supporting Objectives:

F. Outcome: Explain the methods of Casting of Metals

Supporting Objectives:

G. Outcome: Identify and list the various types of casting processes

Supporting Objectives:

H. Outcome: Describe each casting processes

Supporting Objectives:

I. Outcome: Select the appropriate casting processes for various manufactured products

Supporting Objectives:

J. Outcome: Describe the Physical and Mechanical Properties of Metals

Supporting Objectives:

K. Outcome: Correctly define and describe the mechanical properties of metals

Supporting Objectives:

L. Outcome: Describe the various mechanical testing machines and their uses

Supporting Objectives:

M. Outcome: Calculate stress, elastic limit, yield point, ultimate tensile strength, percentage elongation, percentage reduction in area of test specimen using the formulae provided

Supporting Objectives:

N. Outcome: Explain how Steel Products are manufactured

Supporting Objectives:

O. Outcome: Describe how steel is formed into various shapes and products

Supporting Objectives:

P. Outcome: List the advantages of some processes over others for a given product

Supporting Objectives:

Q. Outcome: Describe the methods used to manufacture P/M parts and some of their characteristics

Supporting Objectives:

R. Outcome: Describe the characteristics of metal matrix composite

Supporting Objectives:

S. Outcome: Explain the manufacture an application Plastics and Composites

Supporting Objectives:

T. Outcome: Explain the chemical structures of several plastic materials and the reason for their particular behavioral characteristics

Supporting Objectives:

U. Outcome: Describe the processes by which a sticky substance such as latex can be made elastic and resilient

Supporting Objectives:

V. Outcome: Identify kings of plastics and rubbers and some of their uses

Supporting Objectives:

W. Outcome: Examine and interpret phase diagrams microstructures of metals and alloys; heat treatment of ferrous and non ferrous metals; harness, tensile and Charpy Impact Tests.

Supporting Objectives:

X. Outcome: Describe the Crystalline Structure of Metals, Basic Phase Diagrams and the Metallographic Sample Preparation Laboratory

Supporting Objectives:

Y. Outcome: Describe the various phases of crystalline structures of metal

Supporting Objectives:

Z. Outcome: Describe the various aspect of solid solutions

Supporting Objectives:

[. Outcome: Demonstrate an understanding of phase diagrams by recognizing their parts

Supporting Objectives:

\. Outcome: Explain the methods of classifying, identifying and Selecting Iron Alloys on the shop floor

Supporting Objectives:

]. Outcome: Identify different types of ferrous metals by various means of shop testing

Supporting Objectives:

^. Outcome: Select several commercial methods of determining AISA numbers

Supporting Objectives:

_. Outcome: Identify and select Heat Treating Equipment

Supporting Objectives:

`. Outcome: Describe the head treatment equipment for through hardening

Supporting Objectives:

a. Outcome: Reorganize the physical differences between furnaces and their use

Supporting Objectives:

b. Outcome: Read the Iron-Carbon Phase Diagram

Supporting Objectives:

c. Outcome: Describe allotropic forms of iron, along with the crystalline structures formed when slowly heating and cooling various iron-carbon alloys

Supporting Objectives:

d. Outcome: Identify areas in the iron carbon diagram where phase changes occur

Supporting Objectives:

e. Outcome: Identify temperature ranges for the various heat treatments associated with iron-carbon alloys

Supporting Objectives:

f. Outcome: Recognize and describe the various iron-carbon compound formations and microstructures at room and elevated temperatures

Supporting Objectives:

g. Outcome: Read The Hardenability of Steels, I-T/T-T-T Diagrams and Cooling Curves

Supporting Objectives:

h. Outcome: Explain the methods of determining and evaluating the depth of hardening of various steels

Supporting Objectives:

i. Outcome: Demonstrate and measure the Hardenability of shallow-hardening steel

Supporting Objectives:

j. Outcome: Demonstrate the use of mechanical properties chart for predicting the hardness and strength of a hardened and tempered specimen

Supporting Objectives:

k. Outcome: Determine the Hardenability of steels and their quenching rates by using information gained form I-T diagrams

Supporting Objectives:

l. Outcome: Recognize certain microstructures of transformation products produced at various temperatures

Supporting Objectives:

m. Outcome: Describe the process of Annealing, Stress Relieving, Normalizing, Hardening and Tempering of Steels

Supporting Objectives:

n. Outcome: Explain the principles of and differences among the various kind of annealing processes

Supporting Objectives:

o. Outcome: Explain the relationship between tempering temperature and hardness change

Supporting Objectives:

p. Outcome: Explain how steels and alloys are hardened

Supporting Objectives:

q. Outcome: Explain the tempering of steel and its purpose

Supporting Objectives:

r. Outcome: Select and describe Welding Processes for Iron and Iron Alloys

Supporting Objectives:

s. Outcome: Describe the effect of welding on the microstructures and properties of several steel alloys

Supporting Objectives:

t. Outcome: Describe the changes in welds and heat affected zones because of heat of welding and the effects of these changes upon welded structure.

Supporting Objectives:

u. Outcome: Describe the effects of slag and fluxes in welding

Supporting Objectives:

v. Outcome: Explain the methods of Identification and Heat Treatment of Nonferrous Metals

Supporting Objectives:

w. Outcome: Classify some non-ferrous m

Supporting Objectives:

x. Outcome: etals by numerical system and identify others by testing methods

Supporting Objectives:

y. Outcome: Explain the processes of solution heat treatment and precipitation hardening in which hardening takes place

Supporting Objectives:

z. Outcome: List the use of various nonferrous metals

Supporting Objectives:

{. Outcome: Describe how oxygen in water affects the rate of corrosion of iron

Supporting Objectives:

|. Outcome: Composite Materials

Supporting Objectives:

}. Outcome: Explain techniques of Nondestructive Testing

Supporting Objectives:

~. Outcome: Name several non-destructive testing methods and explain the specific uses and operation of each

Supporting Objectives:

. Outcome: Explain which testing methods are best suited for nonferrous materials

Supporting Objectives:

. Outcome: Explain what defects that can be discovered by X-rays

Supporting Objectives:

. Outcome: Explain the differences between fluorescent penetrant and dye penetrant inspection

Supporting Objectives:

. Outcome: Describe the techniques of Hardness Testing

Supporting Objectives:

. Outcome: Explain the operation of common industrial hardness testers

Supporting Objectives:

. Outcome: Differentiate between load and indenters

Supporting Objectives:

. Outcome: Carryout hardness testing using Brinell and Rockwell testers

Supporting Objectives:

IV. COURSE CONTENT:

A. CONCEPTS

1. Extracting Metals from Ores
2. The Casting of Metals
3. The Physical and Mechanical Properties of Metals
4. The Crystal Structure of Metals, Basic Phase Diagrams and the Metallographic Sample Preparation Laboratory
5. Classification, Identification and Selection of Iron Alloys
6. The Manufacturing of Steel Products
7. Heat Treating Equipment
8. The Iron-Carbon Phase Diagram
9. The Hardenability of Steels, I-T/T-T-T Diagrams and Cooling Curves
10. Annealing, Stress Relieving, Normalizing, Hardening and Tempering of Steels
11. Welding Processes for Iron and Iron Alloys
12. Identification and Heat Treatment of Nonferrous Metals
13. Powder Metallurgy
14. Corrosion of Metals
15. Composite Materials
16. Nondestructive Testing
17. Plastics and Elastomers
18. Ceramic Materials
19. Hardness Testing

B. SKILLS

1. Select the appropriate casting processes for various manufactured products
2. Calculate stress, elastic limit, yield point, ultimate tensile strength, percentage elongation, percentage reduction in area of test specimen using the formulae provided
3. Identify different types of ferrous metals by various means of shop testing
4. Select several commercial methods of determining AISA numbers
5. Reorganize the physical differences between furnaces and their use
6. Identify areas in the iron carbon diagram where phase changes occur
7. Identify temperature ranges for the various heat treatments associated with iron-carbon alloys
8. Recognize and describe the various iron-carbon compound formations and microstructures at room and elevated temperatures
9. Recognize certain microstructures of transformation products produced at various temperatures
10. Classify some non-ferrous metals by numerical system and identify others by testing methods
11. Identify various nonferrous metals
12. Identify kings of plastics and rubbers and some of their uses
13. Perform hardness testing using Brinell and Rockwell testers

C. ISSUES

1. Equipment unavailability and Failure
2. Safe use of testing Equipment
3. Theory to practice transition
4. Equipment updates

V. METHODS OF STUDENT EVALUATION MAY INCLUDE ANY OF THE

FOLLOWING:

A. Quizzes and tests
B. Lab experiments and reports
C. Foundry and welding projects
D. Final examination

VI. RESOURCES MAY INCLUDE ANY OF THE FOLLOWING:

A. Bruce, R. Gregg et al.. *Modern Materials and Manufacturing Processes*. 3rd Ed. Upper Saddle River, NJ., 2004.
B. Jacobs, James and Thomas Kilduff. *Engineering Materials Technology: Structures, Processing, Properties and Selection.* 5th Ed. Upper Saddle River, NJ., 2005.
C. Kalpakjian, Serope and Steven Schmid. *Manufacturing Processes for Engineering Materials*. 5th Ed. Upper Saddle River, NJ., 2008.
D. Neely, John and Thomas Bertone. *Practical Metallurgy and Materials of the Industry*. 6th Ed. Upper Saddle River, NJ., 2003.
E. Elsevier, B.V.. "All." *Materials & Design* 10-01-2007. current New York, Elsevier Science, 1996-.
F. Elsevier, B.V.. "All." *Materials Science & Engineering* 10-01-2007. 1991 to present New York: Elsevier Science, 1994-.

VII. ADDITIONAL RESOURCES:

Algor - FEA Software Package.
Metallographic Equipment