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SAULT COLLEGE OP APPLIED ARTS & TECHNOLOGY

SAULT STE. **MARIE,** ONTARIO

COURSE OUTLINE

Course Title:	Metallurgy
Code No.:	MET 112-2
Program:	Machine Shop
Semester:	Two
Date:	1987 05 01
Author:	Dennis Socchia

New: Revision: XX

APPROVED:

Chairperson Date

Metallurgy **MET** 112-2

Course Name **Course Number**

PHILOSOPHY/GOALS t

When the student has successfully completed this course of study, he/she should have a reasonable understanding of the material presented. The intention (therefore) is to provide students with sufficient background to assist others in the solution of work related (metallurgical) problems.

METHODS OF ASSESSMENT (GRADING METHOD):

3 Theory Tests	70%
1 Lab Report	20%
Attendance/Attitude	10%

(with **NO** incompletes)

TEXTBOOK(S)

"Technology of Machine Tools" (Section 19)
3rd Edition, McGraw-Hill, Ryerson

OBJECTIVESS

The basic objective is to develop within the student an understanding of the concepts and procedures involved with this course of study as well as an ability to use them in the solution of problems. Theory tests and lab exercises are designed with this in mind.

The basic level of competency demanded is an over-all course average of 55% with no incompletes.

SPECIFIC OBJECTIVES

for

METALLURGY - NET 112-2

INTRODUCTION AND ORIENTATION - 2 HRS. - Handouts

The student should be given an opportunity to:

1) Identify and list the topics covered in this course outline.
2) Identify and list the general objectives of this course outline.
3) Identify and list the various methods of evaluation used in this course outline.
4) Identify the grading system used in this course outline with respect to A, B, C, R, I, X.
5) Identify the policy of this course with respect to:
   a) attendance
   b) attitude
   c) due dates
   d) re-writes
   e) testing policies
   f) partial course credit
   g) employed students

PRODUCTION OF IRON AND STEEL - 2 HRS.

The student should be given the opportunity to:

1) List (by name) the raw materials that are charged into a blast furnace.	Text p471
2) Explain briefly how the coke and iron ore react to produce metallic iron.	
3) Explain briefly how the limestone and impurities reat to produce a "slag free" iron.	
4) Name the furnace used to produce raw pig iron.	
5) Define the term "REDUCTION" with respect to the production of metallic iron.	Notes
6) List the four major types of cast iron, and describe how each is made.	Text p472
7) List the three (3) major steelmaking furnaces in use today.	Text p472 -474
8) Identify cast irons, cast steels, plain carbon steels, low alloy steels, stainless steels and tool steels according to their approximate carbon content, significant alloys and minor constituents	Handout
9) Explain the SAE - AISI steel numbering systems.	Text p484
10) State the difference between the SAE and the AISI systems.	
11) Identify the basic chemical content of a given SAE steel using a combination of the SAE numbers and the appropriate SAE classification chart.	Text p485

3) THE IRGB: **IRON-CARBIDE SYSTEM** - 5 **HRS.**

The student should be given an opportunity to:

1) Develop a general understanding of the iron: iron-carbide system for steels with respect to:
   a) lower critical temperature
   b) upper critical temperature — 1 1/2 **hrs.** — Text p488
   c) eutectoid point and composition
   d) existing equilibrium structures
2) Explain the changes in eutectoid, hypoeutectoid and hypereutectoid steels when they are heated from room temperature to above the upper critical temperature. — 2 **hrs.** — Handout
3) Identify and select the proper temperature ranges for the following heat treating operations: — Text p491
   anneal
   normalize
   harden
   temper — 1/2 hr
4) List the three requirements necessary to successfully harden steels, — Notes
5) Explain the formation of martensite.
6) State the theory that explains whys martensite has such a high hardness.

4) SURFACE TREATMENTS - **2 HRS.**

The student should be given an opportunity to:

1) State the purpose for which carburizing operations are carried out.
2) State the 3 main carburizing processes. — Notes
3) State the initial carburizing content of steels used in carburizing operations. — & Text p491
4) Describe the effects of the carburizing process on: — to 493
   a) The **"final"** carbon content of the steels.
   b) The **"final"** microstructure and hardness of the steels.
5) State the purpose for which flame hardening and induction hardening are carried out.
6) State the initial carbon content of steels used in the flame and induction hardening processes.
7) Describe the effects of flame and induction hardening processes on:
   a) The **"final"** carbon content of the steels.
   b) The **"final"** microstructure and hardness of the steels.

5) NON-FERROUS METALS - **1** HR.

The student should be given the opportunity to:

1) Develop a general understanding of the aluminum-copper system with respect to: Handout
   a) The aluminum-rich end.
   b) Temperature zone for solution treating.
   c) The temperature(s) for aging and artificial agin.
2) List the three requirements necessary to harden aluminum-copper alloys.
3) Describe or explain the following terms:
   a) solution treat
   b) aging
   c) artificial aging

NOTE: Course objectives are subject to change due to such variables as:

i) field trips
ii) holidays
iii) equipment

TOPIC HO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
		INTRODUCTION & ORIENTATION	
		- course topics - general objectives - methods of evaluation - grading system - teaching methods - policy regarding a) attendance b) attitude c) due dates d) re-writes e) testing f) partial course credits g) employed students	Handout
		PRODUCTION OF IRON & STEEL - SAE and AISI designation systems - iron production via blast furnace reduction - types of steelmaking furnaces - general types of commercial and chemical analysis	Text S.19 p471-485 Handout
		THEORY TEST # 1 FOR TOPICS 1 & 2	
	5	**THE IRON: IRON-CARBIDE SYSTEM**	
	10-L	- general understanding of the iron: iron-carbide system for steels - changes in steels as they are heated - temperature ranges for heat treatment - requirement to harden steels - formation and hardness of martensite	Text S.19 p488-491 Handout Notes
	2	**THEORY TEST # 2 FOR TOPIC # 3**	

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
		SURFACE TREATMENTS	
		- purpose and methods of carburizing	Text S.19
		- effects of carburizing on steels	p491-493
		- purpose of flame and induction hardening	Notes
		- effects of flame and induction hardening on steels	
		NON-FERROUS METALS	
		- general understanding of the aluminum-copper system	Handout
		- requirements to harden aluminum-copper alloys	
		- general steps of hardening process	
	2	**THEORY TEST # 3 FOR TOPICS 4 & 5**	

LAB EXPERIMENTS/OBJECTIVES

for

METALLURGY - NET 112-2

1) ROCKWELL HARDNESS - 2 HRS Handouts

The student should be given an opportunity to:

a) Prepare and test steels for their initital hardness*
b) Explain the initial hardness of a steel in relation to its carbon content and the P.F.C.S. chart.
c) Estimate the initial microstructure.

3 SAMPLES/GROUP REQUIRED

2) QUENCH HARDENING - 3 HRS Handouts

The student should be given an opportunity to:

a) Determine the proper soaking time and temperature for his/her steel-
b) Heat treat steels for the purpose of changing their microstructure and increasing their initial hardness,
c) Prepare and test samples for their quenched hardness.
d) Recognize and explain an increase in hardness due to water and oil quenching,
e) Prepare and examine samples for micro-structure,
f) Explain the increased hardness of a steel in relation to its carbon content, new microstructure and the P.F.C.S. chart.
g) Name the new microstructure.

3 **SAMPLES/GROUP REQUIRED**

3) TEMPERING - 3 HRS Handouts

The student should be given an opportunity to:

a) Determine the proper tempering time and temperature for his/her steel.
b) Heat treat steels for the purpose of reducing their quenched hardness,
c) Prepare and test samples for reduced hardenss.
d) prepare and examine samples for micro-structure.
e) Explain the steel's reduced hardness in relation to carbon content, micro-structure and P.F.C.S. chart.
f) Name the "new" microstructure.

3 SAMPLES/GROUP REQUIRED

4) HEAT TREAT REVIEW - 2 HRS Handout

The student should be given an opportunity to:

a) Review, compare and discuss the lab data.
b) Discuss changs in hardenss and microstructure with respect to:
   - P.F.C.S.chart
   - iron-carbon system
   - continuous cooling transformation phase diagrams
c) Define the terms Notes
   - normalize
   - quench harden
   - temper
d) Discuss lab reports and format.

NOTE: Lab experiments and objectives are subject to change based on such variables as:

i) field trips
ii) holidays
iii) equipment failure