SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	Metallurgy
Code No,:	MET 112
Program	Machine Shop
Semester:	Two
Date:	1986 05 14
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New XX Revision

APPROVED J.P. Angiletta Chairperson

7 - OP -,7t Date

Metallurgy | Met 112

Course Name | **Course Number**

PHILOSOPHY/GOALS;

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" (ch 12)
2nd edition, McGraw-Hill$_r$ Ryerson

OBJECTIVES:

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 60% with no incompletes.

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
	1 1/2	**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	Handout
		PRODUCTION OF IRON & STEEL - iron ore minerals, chemical formula and gangue materials - iron production via blast furnace reduction - types of steelmaking furnaces - general types of commercial metals and chemical analysis	Text Ch 17 P397-401
		THEORY TEST # 1 FOR TOPICS 1 & 2	
16-L	**5**	**THE IRON; IRON-CARBIDE SYSTEM** - 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 CH 17 P409-413 Handout
	2	THEORY **TEST** # 2 **FOR** TOPIC # 3	

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
		SURFACE TREATMENTS	
		- purpose and methods of carburizing effects of carburizing on steels purpose of flame and induction hardening effects of flame and induction hardening on steels	Text CH 17 P413-416
		NON-FERROUS METALS	
		- general understanding of the aluminum-copper system - requirements to harden aluminum-copper alloys - general steps of hardening process	Handout
		THEORY TEST # 3 FOR TOPICS 4 & 5	
		LAB EXPERIMENTS	
		ROCKWELL HARDNESS & MICROSTRUCTURE(S)	
		- prepare and test samples for hardness - recognize hardness of samples with respect to carbon content and initial condition of sample - prepare and observe samples for initial microstructure - recognize microstructure with respect to initial condition of sample - develop an understanding of the term NORMALIZE - 6 SAMPLES REQUIRED/GROUP	Handout

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
2	4	ANNEALING & HARDENING - heat treat samples for the purpose of changing their hardness and microstructure - prepare and test samples for hardness - recognize changes in hardness with respect to annealing and hardening - prepare and test samples for microstructure - recognize changes in microstructure with respect to annealing and hardening - develop an understanding of the terms ANNEAL/HARDEN - 6 SAMPLES REQUIRED FROM # 1	Handout
3	4	TEMPERING - heat treat samples for the purpose of changing their "hardened" microstructure - prepare and test samples for hardness - recognize changes in hardness with respect to tempering - develop an understanding of the term TEMPER - 3 SAMPLES REQUIRED/GROUP FROM # 2	Handout
4	4	HEAT TREAT REVIEW - review and discuss lab data - discuss changes with respect to iron-carbide system - discuss the terms: NORMALIZE, ANNEAL, HARDEN, TEMPER - complete lab reports	Handout

NOTE: Course objectives and lab topics are subject to change with advance notice.

SPECIFIC OBJECTIVES

for

METALLURGY - 112

INTRODUCTION AND ORIENTATION - 1 1/2 HRS.

The student should be given an opportunity to:

a) Identify and list the topics covered in this course outline.
b) Identify and list the general objectives of this course outline,
c) Identify and list the various methods of evaluation used in this course outline.
d) Identify the grading system used in this course outline with respect to A, B, C, R, I, X.
e) Identify the policy of this course with respect to:
   i) attendance
   ii) attitude
   iii) due dates
   iv) re-writes
   v) testing policies
f) Identify and list the various teaching methods used in this course outline.

PRODUCTION OF IRON AND STEEL - 2 HRS.

The student should be given the opportunity to:

a) Name 4 iron ore minerals found i nature.
b) Write the chemical formula that represents each of the iron ore minerals.
c) List the various impurities and gangue materials found in iron ores.
d) Name the furnace used to produce pig iron.
e) Define the term **"reduction"** with respect to the blast furnace operation.
f) List 3 major steelmaking furnaces in use today.
g) List the general types of cast irons, cast steels and rolled steel sections in use today.
h) Give the approximate carbon content, significant alloys and minor constituents found in cast irons, cast steels and rolled steel sections.

THE IRON; IRON-CARBIDE SYSTEM

The student should be given the opportunity to:

a) Develop a general understanding of the iron; iron-carbide system for steels with respect to:
   i) lower critical temperature
   ii) upper critical temperature
   iii) eutectoid point and composition
   iv) existing equilibrium structures 1 1/2 HRS
b) Explain the changes in eutectoid, hypoeutectoid and hypereutectoid steels when they are heated from room temperature to above the upper critical temperature, 2 HRS,
c) Identify and select the proper temperature ranges for the following heat treating operations:
   anneal
   normalize
   harden
   temper 1/2 HR.
d) List the three requirements necessary to successfully harden steels. 1/2 HR.
e) Explain the formation of martensite. 1/2 HR.
f) State the theory that explains why martensite has such a high hardness.

SURFACE TREATMENTS - 2 HRS.

The student should be given the opportunity to:

a) State the purpose for which carburizing operations are carried out.
b) State the 3 main carburizing processes.
c) State the initial carbon content of steels used in carburizing operations.
d) Describe the effects of the carburizing process on:
   i) The **"final"** carbon content of the steels*
   ii) The **"final"** microstructure and hardness of the steels.
e) State the purpose for which flame hardening and induction hardening are carried out.
f) State the initial carbon content of steels used in the flame and induction hardening processes.
g) Describe the effects of flame and induction hardening processes on:
   i) The **"final"** carbon content of the steels,
   ii) The **"final"** microstructure and hardness of the steels.

5) NON-FERROUS METALS - 1 HR.

The student should be given the opportunity to:

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

NOTE: SUBJECT TO CHANGE.