SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	Metallurgy
Code No.:	MET 112-2
Program:	Machine Shop
Semester:	Two
Date:	June, 1988
Author:	Dennis Socchia

New Revision

APPROVED:

Chairperson Date

Metallurgy	MET
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):

2 Theory Tests	70%
1 Lab Report	20%
Attendance/Attitude	10%
TOTAL	100%

TEXTBOOK(S)

"Technology of Machine Tools" (Section 19)
3rd Edition, McGraw-Hill, 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 55% with a maximum of one "R" grade. ("R" grades = 54% or less)

SPECIFIC OBJECTIVES

for

METALLURGY - MET

1) INTRODUCTION AND ORIENTATION 2 HRS.

The student should be given an opportunity to identify the following:

1) Topics covered;
2) General Objectives;
3) Methods of Evaluation;
4) Grading System with respect to A+, A, B_f C, R, X.
5) Course policies with respect to:
   a) attendance
   b) attitude
   c) due dates
   d) re-writes
   e) course credits
   f) employed students
6) Required Texts
7) Schedule of Tests

NOTE: Course objectives and experiments are subject to change due to:
a) field trips
b) holidays
c) equipment failure

2) METAL IDENTIFICATION AND ANALYSIS 6 HRS.

The student should be given an opportunity to:

1) List and describe the five principle types of cast irons according to their approximate carbon content, method of production, properties and use.	Text p471 - 472 + Handout
2) List and describe plain carbon steels and low alloy steels according to their approximate carbon content, properties and use.	Text p477 + Handout
3) List and describe the four main classifications of tool steel according to their method of quenching and use.	Text p483 - 484
4) List and describe the four (4) major problems that can arise in the selection and heat treatment of tool steels.	Text p483
5) Explain and use the SAE-A1S1 classification systems for plain carbon and low alloy steels.	Text p484 - 485

HEAT TREATMENT OF STEELS **6 HRS.**

The student should be given an opportunity to:

1) List the various crystalline structures and properties of plain carbon steels at room temperature.
2) List the changes in structure that occur in plain carbon steels when heat to/above the Al and A3 critical temperature.
3) Explain how the successful heat treatment of a steel is dependant upon:
   a) carbon content
   b) soaking temperature
   c) soaking time
   d) cooling rate
4) Identify and select the proper temperature ranges for the following heat treatments:
   a) Anneal
   b) Normalize
   c) Harden
   d) Temper
5) State the theory that explains why martensite has such a high hardness.
6) Define "tempering" and describe its effects on fully hardened steel.

Fe-FeC3
+
Handout

SAME

Module
MFG
Unit #5

Text
p491

Notes

Text
p489 • 490

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.
3) State the initial carbon content of steels used in carburizing operations.
4) Describe the effects of the carburizing process on:
   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 and cast irons 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

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
1	2	**INTRODUCTION & ORIENTATION** - course topics - general objectives - methods of evaluation - grading system - policy regarding a) attendance b) attitude c) due dates d) re-writes e) course credits f) testing schedule	Handout
NOTE:		Course objectives and experiments are subject to change due to: a) field trips b) holidays c) equipment failure	
2	6	**METAL IDENTIFICATION & ANALYSIS** - cast irons; types, properties - plain carbon and low alloy steels; properties, use - tool steels; quenching and use - SAE, AlSl classification system for steel	Text p471-485
		THEORY TEST # 1 and REVIEW - COVERS TOPIC t 2	
		HEAT TREATMENT OF STEELS - properties and crystalline structures of steel at room temperature - changes in properties and crystalline structures of steel during heat treatment - requirements for successful heat treatment - temperature ranges for heat treating operations - hardness of martensite - tempering process	Handouts + Text p489 to p491

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 p491-493
		THEORY TEST #2 AND REVIEW **- COVERS TOPICDS #3 AND #4**	
	10	**LAB EXPERIMENTS** - Rockwell hardness - quench hardening - tempering - review	Handout + Lab Demos

LAB EXPERIMENTS/OBJECTIVES

for

METALLURGY - MET

1) ROCKWELL HARDNESS - 2 HRS Handouts

The student should be given an opportunity to:
1) Prepare and test steels for their initial hardness.
2) Explain the initial hardness of a steel in relation to its carbon content, and the P.F.C.S. chart.
3) Estimate the initial microstructure.

6 SAMPLES/GROUP REQUIRED

2) QUENCH HARDENING - 3 HRS Handouts

The student should be given an opportunity to:
1) Determine the proper soaking time and temperature for his/her steel.
2) Heat treat steels for the purpose of changing their microstruture and increasing the hardness.
3) Prepare and test samples for their quenched hardness.
4) Recognize and explain an increase in hardness due to water and oil quenching.
5) Prepare and examine samples for microstructure.
6) Explain the increased hardness of a steel in relation to its carbon content, new microstructure and the P.F.C.S. chart.
7) Name and describe the new microstructure.

3 SAMPLES/GROUP FROM EXPERIMENT f 2

3) TEMPERING - 3 **HRS** Handouts

The student should be given an opportunity to:
1) Determine the proper tempering time and temperature for his/her steel.
2) Heat treat steels for the purpose of reducing their quenched hardness.
3) Prepare and test samples for reduced hardness.
4) Prepare and examine samples for microstruture.
5) Explain the steels reduced hardness in relation to its carbon content, microstructure and P.F.C.S. chart.
6) Name and describe the "new" microstructure.

3 SAMPLES/GROUP FROM EXPERIMENT # 3

4) HEAT TREAT REVIEW - **2 HRS** Handouts

The student should be given an opportunity to:
1) Review, compare and discuss the lab data.
2) Discuss changes in hardness and microstructure with respect to:
   - P.F.C.S. chart
   - Iron-carbide system
   - continuous cooling transformation phase diagrams.
3) Define the terms:
   - normalize
   - quench harden
   - temper
4) Discuss lab reports and format.

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

i) field trips
ii) holidays
iii) equipment failure.