SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: *Metallurgy*

CODE NO.: M&-T 2o7 ~3

PROGRAM: *Mechanical (Drafting) Technician*

SEMESTER: *Four*

DATE: *1986 05 ?4*

AUTHOR: *Dennis Socchia*

NEW: >C ***REVISION:***

APPROVED: ^ ^ ^ ^ / 2 z % *

Chairperson <s ***Date***

METALLURGY

MECHANICAL (DRAFTING) TECHNICIAN

CALENDAR DESCRIPTION

A combination of lab and theory designed to provide Mechanical Drafting Technicians with the basics of metallurgy.

More specifically, it deals with the production of iron and steel; heat treating methods end surface treatments; the shaping and forming of metal; as well as the properties of metals.

METALLURGY

MECHANICAL (DRAFTING) TECHNICIAN

Metallurgy

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.

METHOD OF ASSESSMENT (GRADING METHOD):

3 Theory Tests	70%
7 Lob Report	*20%*
Attendance/ Attitude	J0%
(with NO incompletes)	

TEXTBOOK(S):

"Metallurgy" by John and Weeks
(5th edition) American Technical Publishers

OBJECTIVES:

The basic objective is to develop within the student an understanding of the concepts and procedures involved with this course of study as weif os 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	2 - T	INTRODUCTION AND 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	
2	4 - T	PRODUCTION OF IRON AND STEEL -iron ore minerals, chemical formula and gangue materials - iron production via blast furnace reduction - types off steelmaking furnaces - general types of commercial ferrous metals and their chemical analysis - grades of ingot poured steels	
		THEORY TEST # 1 - TOPICS 7, 2	
3	8 - T	HEAT TREATMENT - general understanding of the iron; iron-carbide system for steels - changes in steels as they are heated - temperature ranges for heat treatment - requirements to harden steels - formation and hardness of martensite - comparative hardness of ferrous crystalline structures	
4 .	2 - T	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	
		THEORY TEST # 2 - TOPICS 3, 4	

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
5	5 - T	SHAPING AND FORMING OF METALS - purpose of hot rolling and hot forging - roll configurations for two-high reversing, universal and four- high mills - hot working, forging and recrystallization - changes in internal structure resulting from hot working - purpose and effects of cold rolling - classes of cold working operations - deformation of aggregates	
6	3 - T	PROPERTIES OF METAL - definitions of identified mechanical properties and strengths - mechanical properties of metals - carbon content and commercial use of selected steels - relationship between carbon content and properties of hot-worked metals - susceptibility to corrosion	
		THEORY TEST # 3 - TOPICS 5, 6	
		LAB EXPERIMENTS	
1	4	ROCKWELL HARDNESS AND MICROSTRUCTURES - 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 conditon of sample - develop an understanding of the term NORMALIZE (12 SAMPLES REQ'D/GROUP)	

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
2	4	ANNEALING AND 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 REQ'D/GROUP FROM # 1)	
3	4	TEMPERING - heat treat samples for the purpose of changing their "hardened" microstructures - prepare and test samples for hardness - recognize changes in hardness with respect to tempering - develop an understanding of the term "TEMPER" (3 SAMPLES/GROUP REQ'D FROM # 2)	
4	4	QUENCH MEDIA - harden samples by quenching in various cooling media, for the purpose of inducing a variety of hardness and microstructure changes - prepare and test samples for hardness and microstructure - recognize changes in hcrdness and . microstructure - develop on understanding of the effect of quenching media (6 SAMPLES/GROUP REQ'D FROM # 1)	

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
5	4	HEAT TREAT REVIEW - review and discuss lab data - discuss changes with respect to o) iron-carbide system b) I.T. and C.C.T. diagrams - discuss the terms, NORMALIZE, ANNEAL, HARDEN, TEMPER - discuss the effects of QUENCH MEDIA - complete lab reports	

NOTE: LAB TOPICS AND OBJECTIVES ARE SUBJECT TO CHANGE WITH ADVANCE NOTICE.

SPECIFIC OBJECTIVES

for

METALLURGY - MET -3

INTRODUCTION AND ORIENTATION - 2 HRS.

The student should be given an opportunity to :

1) *identify and list the topics covered in this course.*
2) *Identify and list the general objectives of this course.*
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,* 8, *C,* R, *I, X.*
5) *Identify the policy of this course with respect to:*
   a) *attendance*
   b) *attitude*
   c) *due dotes*
   d) *re-writes*
   e) *testing policies*
6) *Identify and list the various teaching methods used in this course outline.*

PRODUCTION OF IRON AND STEEL - 4 HRS.

The student should be given an opportunity to:

1) *Name* 4 *iron ore minerals found in nature.*
2) *Write the chemical formula that represents each of the iron ore minerals.*
3) *List the various impurities and gangue materials found in iron* ores.
4) *Name the furnace used to produce pig iron.*
5) *Define the term "reduction" with respect to the blast furnace operation.*
6) *List 3 major steelmaking furnaces in use today.*
1) *Compare the* ***"quality"*** *of steels produced by the various steelmaking furnaces.*
8) *List the general types of cost irons, cost steels and rolled steels in use todoy.*
9) *Give the approximate carbon content, significant alloys ond minor constituents found in cast irons, cost steels and rolled steel sections.*
10) *State the main metallurgical reason for pouring molten steel into ingots.*
11) *List and describe (briefly) the various grades of ingot poured steels.*
12) *List the major defects found in ingot poured steels.*

HEAT TREATMENT - 8 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*
   c) *Eutectoid Point and Composition*
   d) *Existing Equilibrium Structures*
   e) *The effects of Heating and Cooling with respect to Critical Tempeatures.*
2) *Explain the changes in eutectoid, hypoeutectoid ond hypereutectoid steels when they are heated from room temperature to obove the upper critical temperature.*

3) *Identify and select the proper temperature ranges for the following heat treating operations:*
   - *anneal*
   - *normalize*
   - *harden*
   - *temper*

4J *List the three requirements necessary to successfully harden steels.*

5) *Explain the formation of martensite as a non-equilibrium structure.*

6) *State the theory that explains why martensite hcs such a high hardness.*

1) *Compare the hardness for the following ferrous crystalline structures:*
   - *ferrite*
   - *peorlite*
   - *martensite*
   - *cementite*

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 carburizing process on:*
   a) *The **"find**[11] 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 operations are carried out.*
6) *State the initial carbon content of steels used in the flame and induction hardening processes.*
1) *Describe the effects of the flame and induction hardening processes* on;
   a) *The **"final"** carbon content of the steels.*
   b) *The **"final"** microstructure and hardness of the steels.*

SHAPING AND FORMING OF METALS - 5 HRS.

The student should be given the opportunity to:

1) *State the reason for placing ingots into soaking pits prior to rolling.*
2) *State the two purposes served by hot rolling and hot forging operations.*
3) *Draw the roll configuratiaons for:*
   o) *Two-high reversing mill*
   b) *Universal mill*
   c) *Four-high mill*
4) *State how the roils used to produce structural shapes differ from those used to produce flat sheet.*
5) *Define the terms:*
   a) *Hot working*
   b) *Forging*
6) *List* 4 *changes of internal structure in metals resulting from hot working.*
7) *Define the term **"recrystaUization".***
8) *State the most practical way to bring about recrystaUization and grain refinement.*

9) *Describe the effects of plastic deformation on the dendritic structure and segregated impurities of ingot steels.*
10) ***State the purpose** and effects of cold rolling operations.*
11) *State **and** describe the two broad classes of cold working operations.*
12) *Describe the deformation of aggregates in steels and other aggregates as a result of:*
    a) *Cold Working*
    b) *Hot working*

PROPERTIES* OF *METALS* - 3 *HRS.

The student should be given an opportunity to:

1) *Define the following terms:*
    a) *Yield Strength*
    b) *Ultimate Tensile Strength*
    c) *Fatigue Strength*
    d) *Elasticity*
    e) *Ductility*
    f) *Toughness*
    g) *Hardness*
2) *Identify, list and compare selected mechanical properties of identified ferrous and non-ferrous metals.*
3) *Identify and list the carbon content and commercial use of selected carbon steels.*
4) *Explain the relationship between carbon content end the properties of hot worked steel.*
5) *Explain the susceptibility to corrosion of metals with respect to their relative position on the electrochemical series.*

NOTE: SUBJECT TO CHANGE