SAULT COLLEGE OF APPLIED ARTS & TECHNlXOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: Welding Metallurgy

Code No.: MET 110--2

Program: Welding and Fabricating

Semester: One

iA: 1987 06 08

Author: Dennis Socchiia

New: _j^_____Revision:____XXX

APPROVED: Chairperson

Date n/r?

Metallurgy MET 110-2

^J **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 a general overview of the many practical considerations demanded of today's tradesman.

METHODS OF ASSESSMENT (GRADING METHOD):

3 Theory Tests	90%
Attendance/Attitude (with NO incompletes)	10%

TEXTBOOK(S)

f2) Module MFG: "Welding Metallurgy"
2) W.I.C. Module #8 "Basic Metallurgy and Mat'l Spec
3) Text: Modern Welding"

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 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

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METALLURGY - MET 110-2

1) 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_p B, C_r R_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

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2)**-MECHANICAL PROPERTIES OF METALS - 6 HRS.**

The student should be given an opportunity to:

1) Develop a basic understanding of the stress-strain curve.
2) Define and develop an understanding of the following properties:
   a) yield point and yield strength
   b) ultimate tensile strength — Module
   c) ductility as % elongation and % reduction of area — MFG Unit # 2
   d) toughness and impact strength — p 11-52
   e) hardness vs ductility and ultimate tensile strength

3) ANALYSIS AMD CLASSIFICATION OF CONSTRUCTION GRADE STEELS - 6 HRS.

The student should be given an opportunity to:

1) identify cast irons, cast steels, plain carbon steels, stainless steels and tool steels according to their approximate carbon content, significant alloys and minor constituents. — Module MFG Unit # 3
2) Explain how the S.A.E., A.S.T.M. and C.S.A. classification systems are used to identify the chemical analysis and/or mechanical property requirements of "customer" steels. — same

4) THE IRON: IRON-CARBIDE SYSTEM - 4 HRS.

Ache student should be given an opportunity to:

1)	Develop a general understanding of the 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	Module MFG Unit # 4 p 17-19
2)	Explain the changes that take place in eutectoid, hypoeutectoid and hypereutectoid steels when they are slowly cooled from above the upper critical temperature to room temperature*	same p 20-27

5) HEAT TREATMENT TECHNIQUES - 2 HRS.

The student should be given an opportunity to:

1)	List the three requirements necessary to successfully harden steels.	Module MFG Unit # 4 p 31-35
2)	Explain the formation of martensite.	
3)	State the theory that explains why martensite has such a high hardness.	
f)	Identify and select the proper temperature ranges for the following heat treating operations: a) anneal b) normalize c) harden d) temper e) stress relieve	Module MFG Unit # 5 p 8-10
5)	Use time-temperature graphs to explain the following heat treating processes a) anneal b) normalize c) harden d) temper e) stress relieve	Module MFG Unit # 5 p 8-10

6) COLD CRACKING OF WELDED JOINTS - 4 HRS

The student should be given an opportunity to:

1)	Define the following terms: a) heat affected zone b) weld bead c) base metal d) weldment	Module MFG Unit # 5 p 11-13
	List the two general catagories of heat affected zones.	
3)	List the factors affecting the extent of change in crystalline structure for a given heat affected zone.	same P 14
4)	List and identify the individual zones found in the heat affected zone of a weldment at room temperature.	same p 16

5)	Explain the concepts of heat input and carbon equivalent,	same p 18,19,,23,24
)	Explain the relationship between carbon equivalent/ hydrogen content and crack sensitivity.	same p 28,29,:30
7)	List and explain the four major factors that control cooling rates in weldment.	same p 32--35
8)	State how each of these factors affects the cooling rate of a given weldment.	same p 32--35

NOTE: Course objectives are subject to change due to the following variables:
a) field trips
b) holidays

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TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
		INTRODUCTION & ORIENTATION - course topics - general objectives - methods of evaluation - grading system - policy regarding a) attendance b) attitude c) due dates d) re-writes e) testing f) partial course credits g) employed students	**Handout**
		MECHANICAL PROPERTIES OP METALS - stress/strain diagram - yield point & yield strength - ultimate tensile strength - ductility - toughness & impact strength - hardness	**Nodule MFG Unit f 2 p 11-12**
		THEORY TEST # 1 AND REVIEW **TEST COVERS MATERIAL FROM TOPICS # 1 AND | 2**	**Handout**
		ANALYSIS AND CLASSIFICATION OF CONSTRUCTION GRADE STEH.S - identification of cast irons, cast steels, plain carbon steels, stainless and low alloy steels etc.• - the S.A.E., A.S.T.M. and C.S.A. classification systems - using classification systems to identify steel by chemical analysis and/or mechanical property requirements.	**Module MFG Unit # 3 p 3-21** **W.I.C.** **Module # 8 p 28-36**
		THE IRON: IRON-CARBIDE SYSTEM - general understanding of iron carbide system and the existing equilibrium structures - changes in equilibrium structures upon slow cooling	**Module MFG Unit # 4 p 17-19 & 20-27**
		THEORY TEST # 2 AND REVIEW **TEST COVERS MATERIAL FROM TOPICS # 3 AND # 4**	**Handout**

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
		HEAT TREATMENT TECHNIQUES - quenching and hardening steels - formation of martensite - temperature ranges used for heat treating - explanation of heat-treatment via time-temperature curves	**Nodule MFG Unit # 4 p 31-35 same Unit # 5 p 8-10**
		COLD CRACKING OF WELDED JOINTS - define and explain the concepts involved with heat affected zones. - understand and explain heat input, carbon equivalent hydrogen content and crack sensitivity - factors that control cooling rates in a weldment	**Nodule MFG Unit # 5 p 11-35**
		THEORY TEST # 3 AND REVIEW TEST COVERS MATERIAL FROM TOPICS # 5 AND # 6	**Handout**

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NOTE: COURSE OBJECTIVES ARE SUBJECT TO CHANGE DUE TO POSSIBLE FIELD TRIPS AND HOLIDAYS,