SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: WELDING METALLURGY

Code No.: MET 110-2

Program: WELDING & FABRICATING

Semester: ONE

Date: AUGUST 22, 1983

Author: DENIS SOCCHIA

New: Revision

APPROVED:

Chairperson Date

WELDING METALLURGY — Course Name
MET 110-2 — Course Number

PHILOSOPHY/GOALS:

The course is designed to give students a general overview of the many practical considerations demanded of today's tradesman in the application of his talents.

Therefore, students should have a reasonable understanding of the subject areas so to be able to assist in the selection of:

1. Base Materials
2. Welding Procedures
3. Post-Weld Heat Treatment

In short, it is intended that the student will be constantly relating the subject areas to his shop practices while in training.

TEXTBOOK(S):

Metals and How to Weld Them — Lincoln
Modern Welding - Althouse, Turnquist, Bowditch
The Principles of Cold Cracking Control in Welds — Graville
Metallurgy for Engineers — Library
Welding Metallury (VI = Fundamentals; V2 = Technology) — Library
Weldability of Steels — Library

COURSE OUTLINE FOR WELDING METALLURGY

SUBJECT AREAS	TIME
1. Introduction & Course Outline	2 hours
2. Mechanical Properties of Metals	4 hours
3. The Metals We Use	4 hours
4. Classification of Construction Grade Steels	4 hours
5. Iron, Iron Carbide System	4 hours
6. Heat Treatment Techniques	4 hours
7. Cold Cracking of Welded Joints	4 hours
TOTAL INSTRUCTION TIME	26 hours
TOTAL TESTING TIME	2 hours
TWO WRITTEN REPORTS	Homework
FINAL TOTAL (1 Semester)	28 hours

WELDING METALLURGY

SUBJECT OUTLINE

1. Introduction and Course Outline — 2 hours

   - explanation of marking system and overall evaluation methods (i.e., tests, spot tests, reports)
   - texts used in course and required by student
   - resource materials available in library
   - summary of major topic areas
   - brief overview on the production of iron & steel
   - major differences between iron and steel in terms of
     a) chemical composition b) possible use

2. Mechanical Properties of Metals — 4 hours

   - development and explanation of stress-strain curve
   - development and definition of:
     a) yield point and yield strength
     b) ultimate tensile strength
     c) ductility as % elongation and % reduction of area
     d) toughness as a combination of ductility and thermal conductivity
     e) hardness vs. ductility
     f) hardness vs. tensile strength
     g) impact strength

3. The Metals We Use — 4 hours

   - explanation of the following common groups of metals based on
     a) chemical analysis b) mechanical properties
   - provide some general uses for these metals:
     COMMON METALS
     plain carbon steels, low alloy steels, tool steels, stainless steels, cast irons, aluminum

4. Classification of Construction Grade Steels — 4 hours

   - explain and define the three major classification systems in current use

     a) S.A.E. System: Based on chemical analysis
     b) A.S.T.M. System: Based on Mechanical Properties
     c) C.S.A. System: Based on Mechanical Properties

   - explain general application of above systems when ordering or specifying base metals

Iron, Iron-Carbide System 4 hours

- explain and develop the theoretical relationship between iron and carbon for various temperatures and composition
- define and explain the following phase changes in relation to the over-all iron, iron carbide system:
  a) melting , freezing points
  b) F.C.C. and B.C.C. structures
  c) Austenite, Pearlite, Cementite, Ferrite, Martensite

- develop a general understanding of the iron, iron-carbide system as it will be involved in welding and heat treating

Heat Treatment Techniques 4 hours

- define and explain the following heat treatment terms:

  a) anneal b) normalize c) spheordize d) quench harden
  e) temper f) stress relieve

- relate the above terms to the iron, iron-carbide system as well as the welding of carbon steels and cast irons
- demonstrate normalize, quench harden and temper in shop and relate to hardness and ductility

Cold Cracking of Welded Joints 4 hours

- define and explain the following points:
  a) welding as a crude form of heat treatment
  b) how heat imput is calculated
  c) how cooling rates are calculated

- explain how cold cracking in welded structures can result from:
  a) microstructure
  b) hydrogen
  c) admixture
  d) residual stresses