

I. COURSE DESCRIPTION:

The general objective of this course is to give students destined for the mechanical trades a basic understanding of metals and alloys they will be working with in heavy industry. A heavy emphasis is placed on the iron-carbon system and the physical metallurgy of steel including heat treating and welding. Some laboratory work on heat treating steel is included to witness the effect heat treating has on the microstructure and harness of carbon steel.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. INTRODUCTION TO METALLURGYPotential Elements of the Performance:

Define:

- i. Extractive Metallurgy
- ii. Mechanical Metallurgy
- iii. Physical Metallurgy

2. ATOMIC STRUCTURE OF METALSPotential Elements of the Performance:

Explain the differences between the atomic order of:

- i. Gases
 - ii. Liquids
 - iii. Solids
- Describe the atomic and crystalline structures of iron as a function of temperature.
 - Describe how carbon can be in solid solution with iron.

3. IRON-CARBON EQUILIBRIUM DIAGRAMPotential Elements of the Performance:

- Demonstrate an understanding of the iron carbon diagram.

4. TIME/TEMPERATURE/TRANSFORMATIONPotential Elements of the Performance:

- Describe what happens when iron-carbon alloys are cooled from the austenitic temperature region to room temperature in real time.
- Describe how differing cooling rates affect the structure of iron-carbon alloys.
- Describe what happens to the time/temperature diagram when

the carbon content is varied and when other alloying elements are added.

- Determine and demonstrate a plain carbon steel hardening process as assigned.
- Identify certain microstructures using a microscope.

5. *STEEL ALLOYING AND PROCESSING (ROLLING/FORGING)*

Potential Elements of the Performance:

To describe the effect that alloying and mechanical working has on:

- i. The crystal structure of steel
- ii. The mechanical properties of steel

6. *HEAT TREATING*

Potential Elements of the Performance:

To describe the processes and reasons for:

- i. Normalizing
- ii. Quenching and tempering
- iii. Case hardening
- iv. Annealing
- v. Stress relieving

7. *MECHANICAL PROPERTIES AND TESTING OF STEEL*

Potential Elements of the Performance:

- Explain the procedures and interpretation of hardness testing for Rockwell hardness
- Explain how elevated temperatures affect strength.
- Explain the procedure and interpretation of toughness testing and how low temperature affect toughness.
- Explain the phenomena of fatigue and creep.

8. *WELDING*

Potential Elements of the Performance:

To describe metallurgical effects of welding on the structure and properties of weldments.

9. *INTRODUCTION TO STEEL SPECIFICATIONS*

Potential Elements of the Performance:

- Explain what a standard is
- Explain what a specification is
- Explain how the numbering system in the AISI/SAE steel specification relates to chemical content of steel alloys.

III. TOPICS:

1. INTRODUCTION TO METALLURGY
2. ATOMIC STRUCTURE OF METALS
3. IRON-CARBON EQUILIBRIUM DIAGRAM
4. TIME/TEMPERATURE/TRANSFORMATION
5. STEEL ALLOYING AND PROCESSING (ROLLING/FORGING
6. HEAT TREATING
7. MECHANICAL PROPERTIES AND TESTING OF STEEL
8. WELDING
9. INTRODUCTION TO STEEL SPECIFICATIONS

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Will be supplied by the instructor.

OPTIONAL RESOURCE:

John E Neely, Thomas J Bertone, PRACTICAL METALLURGY AND MATERIALS OF INDUSTRY, Sixth Edition. Prentice Hall, New Jersey. ISBN:0-13-094580-3.

V. EVALUATION PROCESS/GRADING SYSTEM:

Attitude, Attendance & Participation – 20%

Assignments 10%

Quizzes 20%

3 Tests 50%

100 %

Attendance -1% (per Hour)

(late = 1 hour)

Safety Violations -1% (per Occurrence, see notes below)

No Cell Phones are Permitted in The Classroom

The following semester grades will be assigned to students:

Grade	<u>Definition</u>	<i>Grade Point Equivalent</i>
A+	90 – 100%	4.00
A	80 – 89%	3.00
B	70 - 79%	2.00
C	60 - 69%	1.00
D	50 – 59%	0.00
F (Fail)	49% and below	
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

VI. SPECIAL NOTES:

Course Outline Amendments:

The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Retention of Course Outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Prior Learning Assessment:

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question. Please refer to the Student Academic Calendar of Events for the deadline date by which application must be made for advance standing.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.

Substitute course information is available in the Registrar's office.

Disability Services:

If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Disability Services office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

Communication:

The College considers **WebCT/LMS** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the **Learning Management System** communication tool.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Code of Conduct*. A professor/instructor may assign a sanction as defined below, or make recommendations to the Academic Chair for disposition of the matter. The professor/instructor may (i) issue a verbal reprimand, (ii) make an assignment of a lower grade with explanation, (iii) require additional academic assignments and issue a lower grade upon completion to the maximum grade “C”, (iv) make an automatic assignment of a failing grade, (v) recommend to the Chair dismissal from the course with the assignment of a failing grade. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Student Portal:

The Sault College portal allows you to view all your student information in one place. **mysaultcollege** gives you personalized access to online resources seven days a week from your home or school computer. Single log-in access allows you to see your personal and financial information, timetable, grades, records of achievement, unofficial transcript, and outstanding obligations, in addition to announcements, news, academic calendar of events, class cancellations, your learning management system (LMS), and much more. Go to <https://my.saultcollege.ca>.

Electronic Devices in the Classroom:

Students who wish to use electronic devices in the classroom will seek permission of the faculty member before proceeding to record instruction. With the exception of issues related to accommodations of disability, the decision to approve or refuse the request is the responsibility of the faculty member. Recorded classroom instruction will be used only for personal use and will not be used for any other purpose. Recorded classroom instruction will be destroyed at the end of the course. To ensure this, the student is required to return all copies of recorded material to the faculty member by the last day of class in the semester. Where the use of an electronic device has been approved, the student agrees that materials recorded are for his/her use only, are not for distribution, and are the sole property of the College.

Attendance:

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

It is the departmental policy that once the classroom door has enclosed, the learning process has begun. Late arrivers will not be granted admission to the room.>

Safety:

Sault College recognizes that the Health and Safety of the Students and Staff is of the utmost importance. Recognizing that safety is everyone's responsibility and there is never a reason to compromise safety, is an important step in reducing accidents. To minimize potential hazards in the shop and various labs, safety rules will be strictly enforced.

Students must continuously wear all Sault College required **Personal Protective Equipment (PPE)** while working in the shop or lab as required by the Instructor. Students are required to wearing their required PPE prior to entering the lab. Failure to do this will result in the expulsion from the shop or lab activity and a zero attendance mark will be recorded. A student who repeatedly neglects to wear PPE as required is in violation of the Sault College Academic code of Conduct and may be sanctioned accordingly.(see Student Code of Conduct & Appeal Guidelines). For instance, first violation-verbal warning, second violation –written warning and the third violation-suspension from the Shop or Lab. For each infraction a 1% penalty is applied (as per the Evaluation/Grading System above.)