MATERIALS 4LS2 – Physical Metallurgy of Steels

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Course Objectives: At the conclusion of the steel section, the student should have:

- An overall view of key materials processing methods used in industry.
- Practical experience with the processing methods of low alloy steels.
- A professional and systematic approach to research and report writing.

Description:

This course will examine the most common thermal and thermo-mechanical processing roots for medium-carbon, low alloy steels. We will look at the production of steels with ferrite/pearlite microstructure, dual phase steels and steels with martensitic microstructure. Thermomechanical processing to produce fine grained steels will also be examined. The structure-property relationships will be established for each group of steels through the use of extensive mechanical testing, optical metallography and electron microscopy. All groups will work on the same steel, 4140.

The course consists of a series of 1 hour lectures, and 3 hour labs, each week. A series of presentations will be given in the lectures that parallel the laboratory sessions, to illustrate many of the engineering and basic science principles that underpin the laboratory work. The schedule of the laboratory is flexible, and it is left to each group to work out their own priorities with the teaching assistants and technical staff.

Lectures: Virtual Classroom, Friday 1:30-2:20 pm
No class on October 15th.

Laboratories: Thursdays, 8:30 to 11:30 am and 2:30 to 5:30 pm in the Materials wing of JHE

Textbook: This is a practical course, with no set textbook. Some useful references would be

- "*Mechanical Behaviour of Materials*" by William F. Hosford
- "*Phase transformations in metals and alloys*" by David A. Porter, K. E. Easterling
- "*Physical Metallurgy Principles*" by Robert E. Reed-Hill, Reza Abbaschian
- "*Materials Science and Engineering, an Introduction*" by William D. Callister
- "*Steels: Heat Treatment and Processing Principles*" by George Krauss
- **Finally, attend the LECTURES!**

Method of Assessment:

- Final Exam 50%
- Project Report 50%

Approximate Outline of Laboratories (also refer to the lab manual):

Week 1 – Prepare specimens and perform chemical analysis on the steel.
Week 2 – Austenize and quench the samples for the hardenability tests, tempering, and ferrite/pearlite transformation samples.
Weeks 3,4,5 – Optical microscopy on all samples heat treated in Week 2, Hardness testing, Tensile Testing.
Week 6 – Catch-up week and start SEM if ready
Weeks 7,8,9,10 – Repeat above process for dual phase steels and bainitic steels

Note – although students are divided into groups of 4, the groups will share information since there is not enough SEM time, nor samples, for every group to do every temperature/test combinate.

Note – a detailed lab manual exists and has been placed on Avenue.

Disclaimer:

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.

- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY/PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection so ftware must inform the Inst ruct or before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

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Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/ software during tests or exams. This software may be required to be installed before the test/exam begins.

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McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

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Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the *RISO* policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

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