

**Course:** MTL5 2B03

**Title:** Introduction to the Thermodynamics of Materials

**Instructor:**

Leili Tafaghodi

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**Schedule:**

Lectures: Thursday 8:30-10:20

Office Hours: Tuesday & Thursday: 10:30-11:30

Tutorials: Thursday 12:30-14:20

Labs: Tuesday 8:30-10:20

All activities take place on MS Teams. You have already been enrolled into the Team "MATLS 2B03: Lectures, Tutorials and Labs". If you do not see this Team on your MS Teams profile, you can join using the following link:

**Teaching Assistants:**

- Jonas Wagner
- Qinfu (Heyfer) Zhao
- Pardis Mohammadpour

**Calendar Description:**

First and Second Laws. Reversible and irreversible processes. State functions, variables, relations among them. The Third Law. Thermodynamics of reactions. Unary systems. Real gases. Electrochemistry.

Two lectures, Two Tutorials, one lab (two hours, EOW); first term

Prerequisite(s): CHEM 1A03 or 1E03.

### Course Topics:

- Week 1: Significance of thermodynamics.
- Week 2: First law of thermodynamics.
- Week 3: Second law of thermodynamics.
- Week 4: Auxiliary Functions.
- Week 5: Heat Capacity, Enthalpy & Entropy.
- Week 6: Reading Week.
- Week 7: Third law of thermodynamics.
- Week 8: Equilibrium in one component systems.
- Week 9: Behavior of gases.
- Week 10: Gas-Solid Reactions.
- Week 11: Electrochemistry.
- Week 12: Formation cells, concentration cells.
- Week 13: Review.

### Course Objectives:

At the conclusion of this course, the student should be able to:

- a) Describe changes in state with special emphasis on isothermal and adiabatic pathways. Calculate heat, work, enthalpy, entropy and internal energy changes for an ideal gas undergoing these changes of state. Describe the first law of thermodynamics qualitatively and quantitatively.
- b) Distinguish between state functions and path dependent quantities.
- c) Understand the concepts of enthalpy and entropy.
- d) Describe the second law of thermodynamics and relate it to reversible and irreversible processes and the efficiency of a process.
- e) Be able to analyze and construct P-T diagrams of unary systems and use information they contain for solving engineering problems.
- f) Ability to describe gases in terms of the ideal gas law and van der Waals equation.
- g) Ability to split an electrochemical reaction to anodic and cathodic processes and calculate its thermodynamic characteristics.
- h) Identify equilibrium conditions for simple gas reactions.

### Professional Development:

MATLS 2B03 is an important part of your training as an engineer. In particular items (a-h) will contribute to your specialized engineering knowledge (CEAB attribute 1.4). Many courses will build on the knowledge gained in this course, including MATLS 2D03, 3B03, 3C03, 3T04, 4C03 and 4D03.

### Primary Textbook:

D. Gaskell and Laughlin, Introduction to the Thermodynamics of Materials, 6<sup>th</sup> edition, CRC Press.

### Other useful Resources:

- Peter Atkins, Four Laws that Drive the Universe
- David Ragone, Thermodynamics of Materials
- Robert DeHoff, Thermodynamics in Materials Science

### Lectures:

Lectures will be livestreamed using MS Teams on Thursday 8:30. Recordings of the lectures will be posted on Avenue.

### Tutorials:

Tutorials will be livestreamed using MS Teams on Thursday 12:30. Recordings of the tutorials will be posted on Avenue.

### Laboratories:

Laboratories are scheduled every other week. Students are asked to attend the labs on MS Teams. During these lab meetings on Teams, the TAs will guide you through a series of activities related to the lab. The labs have an interactive component which you can access on the following webpage: [http://matls.mcmaster.ca/2B03/Lab\\_Main\\_Page.html](http://matls.mcmaster.ca/2B03/Lab_Main_Page.html)

The labs will cover four themes:

- (1) Engines.
- (2) Heat-Capacity.
- (3) Calorimetry.
- (4) Formation and Concentration Cells.

## Evaluation:

Lab Participation	8% (4 labs in total)*
Lecture & Tutorial Participation	8% (TopHat)**
Assignments	16% (4 assignments in total)***
Quizzes	34% (2 quizzes)
Final Exam	34% (2.5 hr exam)

\* You will receive 2% for “attending” each of the labs, performing the required tasks and participating in the lab discussion with the TA. All students are expected to keep take notes and perform some calculations during the lab. An image of the calculations should be uploaded on Avenue to receive full credit.

- Students who are in a different time zone and cannot attend lectures, tutorials or labs at the assigned times should contact the course instructor as soon as possible in order to make alternative arrangements for awarding participation marks.

\*\* We will use TopHat to encourage participation in lectures and tutorials. To earn the participation mark, one must answer the true/false and multiple-choice participation questions during class. Attending <25% of the lectures and tutorials will result in a participation mark of 0%, attending 25-49% of the lectures and tutorials will lead to a participation mark of 2%. Attendance in the range of 50 to 74% will lead to 4% and attendance of >75% will lead to a participation mark of 8%.

- Access to TopHat is provided to all MATLS 2B03 students at no cost. Details on how to access your account will be provided during our first class.

\*\*\*Assignments are to be submitted into the appropriate drop-off box on Avenue. Late submissions will be penalized 25% per day.

- Stuff happens! You can submit one of your assignments up to 3 days late without any penalty.

## Important Notices to Students from the University Administration

### **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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), 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 software must inform the Instructor 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](http://www.mcmaster.ca/academicintegrity).

### **COURSES WITH AN ON-LINE ELEMENT**

**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.

### **CONDUCT EXPECTATIONS**

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

### **ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES**

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or [sas.mcmaster.ca](http://sas.mcmaster.ca) to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

## **REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK**

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”.

## **ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)**

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.

## **COPYRIGHT AND RECORDING**

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

## **EXTREME CIRCUMSTANCES**

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Completed by: Leili Tafaghodi, August 2021