Course: MTLS 2B03
Title: Introduction to the Thermodynamics of Materials

Instructor:
Hatem S. Zurob
Office: JHE-357D, Ext. 23515
Email: zurobh@mcmaster.ca

Office Hours:
• Tuesday: 12:30-1:30 in JHE 357D
• Friday: 2:30-3:30 in JHE 352

Teaching Assistants:
– Saba Gol
– Daniella Pallisco
– Jonas Wagner

Calendar Description:

Two lectures, Two Tutorials, one lab (three 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 7: Third law of thermodynamics.
Week 8: Equilibrium in one component systems.
Week 9: Behavior of gases.
Week 10: Non-ideal gases.
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:**


**Other useful Resources:**

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

**Lectures:**

Monday 2:30 and Friday 1:30 in BSB 120.

**Tutorials:**

Monday 4:30 and Wednesday 11:30, BSB 120.

**Laboratories:**

Laboratories are scheduled every other week. Each student will perform four experiments. The experiments are listed below and described in detail in the laboratory manual:

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

**Evaluation:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight (%)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Participation</td>
<td>12%</td>
<td>(4 labs in total)</td>
</tr>
<tr>
<td>Assignments</td>
<td>12%</td>
<td>(4 assignments in total)</td>
</tr>
<tr>
<td>Quizzes</td>
<td>26%</td>
<td>(2 quizzes, 1 hour each, Oct. 2\textsuperscript{nd}, Nov. 6\textsuperscript{th})</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
<td>(2.5 hr exam)</td>
</tr>
</tbody>
</table>

* You will receive 3% 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 a hardbound lab book in which all lab observations and discussions are recorded. The TA will initial these at the end of each lab.
* Assignments are to be submitted into the appropriate drop-off box on Avenue. Late submissions will be penalized 25% per day.

**Policy Reminders:**

**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. 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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

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.**

**Academic Accommodation:**

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail [sas@mcmaster.ca](mailto:sas@mcmaster.ca). For further information, consult McMaster University’s Academic Accommodation of Students with Disabilities policy.
Missed Work:

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:

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation 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.

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: Hatem S. Zurob, August 2019