UNSW Course Outline

MATS6101 Thermodynamics and Phase Equilibria - 2024

Published on the 22 May 2024

General Course Information

Course Code : MATS6101
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Materials Science & Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This is a course for postgraduate students in the School of Materials Science and Engineering. It provides fundamentals of thermodynamics of materials using lectures. The main subjects covered are thermodynamics basics; heat, work, and internal energy; heat capacity; enthalpy,

entropy, and free energy; three laws of thermodynamics; redox processes; Equilibrium and gas-solid phase transitions (chemical equilibrium, first- and second-order phase transitions, fugacity and activity, gas-solid equilibria, Ellingham diagrams); Solution thermodynamics and phase diagram construction (Gibbs-Duhem equation, Raoult and Henry's laws, Solutions and activity) and phase diagram construction); and interpretation and applications of binary and ternary phase diagrams (unary systems, binary systems, ternary effects on microstructures, phase calculations, drawing isothermal and vertical sections of real ternary systems).

Course Aims

The aim of this course is to introduce the basic thermodynamic principles and to develop the capability of applying these principles to phase transformations and the chemical and electrochemical processes of pure substances, solutions, and multiphase systems. This course also aims to introduce the features and principles of unary systems, binary and ternary phase diagrams, as well as the develop the capability for identification and graphical representation of phase equilibria in real materials systems and the thermodynamic stabilities of phases.

Relationship to Other Courses

First 6 weeks of this course will be jointly conducted with MATS2008

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply the laws of thermodynamics to different systems.
CLO2 : Construct phase diagrams using the principles of thermodynamics.
CLO3 : Predict materials' phases and microstructure from phase diagrams.
CLO4 : Relate the properties of materials to their microstructure.

Course Learning Outcomes	Assessment Item
CLO1 : Apply the laws of thermodynamics to different systems.	• Test • Assignment 1 • Final Exam
CLO2 : Construct phase diagrams using the principles of thermodynamics.	• Assignment 2 • Final Exam
CLO3 : Predict materials' phases and microstructure from phase diagrams.	• Test • Assignment 2 • Final Exam
CLO4 : Relate the properties of materials to their microstructure.	• Test • Assignment 2 • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Test Assessment Format: Individual	25%	Start Date: Week 3 & Week 7
Assignment 1 Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Week 5: 24 June - 30 June
Assignment 2 Assessment Format: Individual	20%	Due Date: Week 9: 22 July - 28 July
Final Exam Assessment Format: Individual	40%	Start Date: Exam Period

Assessment Details

Test

Assessment Overview

The test occurs in Week 3 and will be 2 hours in duration in the area of fundamentals of thermodynamics.

Feedback: you will receive your marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class. Feedback for the test will be provided before the Census date.

Hurdle requirement: you must achieve at least 35% in the test, as well as an average of at least 45% across the test and final exam, to receive a passing grade in the course.

Course Learning Outcomes

- CLO1 : Apply the laws of thermodynamics to different systems.
- CLO3 : Predict materials' phases and microstructure from phase diagrams.
- CLO4 : Relate the properties of materials to their microstructure.

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve ≥35% in the Quizes and ≥35% in the final exam, and ≥45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless of if they receive over 50% in total for the course.

Assignment 1

Assessment Overview

You will be required to complete a problem-based assignment in the areas of equilibrium and gas-solid phase transitions.

Assignment 1 will be posted in Week 5. You will have approximately 2 weeks to complete and submit this assignment.

Feedback will be given two weeks after submission, including your marked assignment and overall comments on how the class performed. Additionally, you might receive personal feedback and comment on how you have performed.

Course Learning Outcomes

- CLO1 : Apply the laws of thermodynamics to different systems.

Assignment 2

Assessment Overview

You will be required to complete two problem-based assignments in the areas of phase diagrams.
You will be given the first problem set in Week 6 and the second problem in Week 8. The assignment will test your understanding of the phase diagrams. Each assignment will take about 4 hrs to resolve and each contribute 10% to your overall course grade.

Feedback will be given two weeks after submission of the assignment including the mark for the assignment, and overall comments on how the class performed, and common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Course Learning Outcomes

- CLO2 : Construct phase diagrams using the principles of thermodynamics.
- CLO3 : Predict materials' phases and microstructure from phase diagrams.
- CLO4 : Relate the properties of materials to their microstructure.

Final Exam

Assessment Overview

The final exam will focus on the interpretation and applications of unary, binary and ternary phase diagrams.

The examination will take place in formal examination period and be 2 hrs in duration.

Feedback may be available through inquiry with the course convenor.

Hurdle requirement: you must achieve at least 35% in the final exam, as well as an average of at least 45% across the test and final exam, to receive a passing grade in the course.

Course Learning Outcomes

- CLO1 : Apply the laws of thermodynamics to different systems.
- CLO2 : Construct phase diagrams using the principles of thermodynamics.
- CLO3 : Predict materials' phases and microstructure from phase diagrams.
- CLO4 : Relate the properties of materials to their microstructure.

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve ≥35% in the Quizes and ≥35% in the final exam, and ≥45% weighted average over the two exams. Students who fail

to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless of if they receive over 50% in total for the course.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Language of thermodynamics. State functions. Heat and work. Internal energy, enthalpy, and entropy changes in chemical and physical processes.
Week 2 : 3 June - 9 June	Lecture	Gibbs and Helmholtz energies. Chemical Equilibrium. Redox processes. Thermodynamics of redox processes. Pourbaix diagrams
Week 3 : 10 June - 16 June	Assessment	Quiz 1 (25%)
	Lecture	Joshi's lecture starts: Equilibrium, Reaction Quotient and Rate Laws
Week 4 : 17 June - 23 June	Lecture	Thermodynamic Properties of Pure Fluids, Enthalpy, Heat Capacity, Entropy & Properties Classification
Week 5 : 24 June - 30 June	Assessment	Assignment (15%) Questions will be uploaded on Moodle
	Lecture	Understanding and Application of the Clausius-Clapeyron Equation, and Fugacity
Week 7 : 8 July - 14 July	Lecture	Gibbs phase rule. Principles and features of Unary systems and binary systems. Lever rule. Phase diagram calculations. Microstructure development and applications
Week 8 : 15 July - 21 July	Lecture	Thermodynamics of binary phase diagrams
Week 9 : 22 July - 28 July	Lecture	Principles and features of ternary phase diagram. Introduction of software for thermodynamic calculations
	Assessment	Assignment 2 (20%)
Week 10 : 29 July - 4 August	Lecture	Summary of the third part

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

https://timetable.unsw.edu.au/2024/MATS6101.html

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Rakesh Joshi		Room 448 School of Materials Science and Engineering (Building E10)	0449534314	Microsoft Teams or by appointment	No	Yes
Lecturer	Sarasadat Taherymoosavi				by appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others'

ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or

submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines