MS1016 – Thermodynamics of Materials

Course Code	MS1016					
Course Title	Thermodynamics of Materials					
Co-requisites	MS1015	Materials Science (pre ICC Curriculum Student)				
	MS1017	Introduction to Materials Science (Students on ICC Curriculum)				
Pre-requisites	NIL					
Pre-requisite for	NIL					
No of AUs	3					
Contact Hours	LECTURES	26 hrs	TUTORIALS	13 hrs		

Course Aims

This course aims to acquaint you with the basic concepts and laws of thermodynamics and expose you to how thermodynamics is applied to various classes of materials and related phenomena. Emphasis has also been placed on the connections between thermodynamic concepts and materials phenomena. It is essential for successful materials scientists and engineers to acquire basic knowledge on thermodynamics which is devoted to the study of energy and its transformations.

Intended Learning Outcomes (LO)

By the end of this course, you would be able to:

1. Explain the 1st law of thermodynamics and its applications to close and open systems.
2. Explain the 2nd law of thermodynamics, and describe the difference between a reversible process and an irreversible process.
3. Explain Maxwell's relations and describe their applications to deriving thermodynamic properties.
4. Calculate partial molar volumes, volume of mixing and entropy of mixing for a binary solution.
5. Describe the condition of equilibrium between two states, and apply it to derive the Clausius-Clapeyron equation and explain vapor equilibria.
6. Describe the difference between 1st-order and 2nd-order phase transitions.
7. Describe chemical equilibrium and calculate the equilibrium constant.
8. Describe the thermodynamics of solutions.
9. Explain the Gibbs phase rule, and use it to describe phase diagrams.
10. Explain the lever rule and its application.
11. Describe the phase rule for condensed systems and eutectic phase diagrams.
12. Describe three-component phase diagrams.
13. Explain electrochemical equilibrium, and apply Nernst equation to calculate electrochemical equilibrium.

Course Content

Imperfections in solids, diffusion in solid systems, interface movement and solidification (includes nucleation, grain growth and further solidification), phase transformations and kinetics in solids (emphasis on steels).

Reading and References

Suggested reading:

1. Thermodynamics of Materials Vol I, David V Ragone, John Wiley & Sons Inc, 1995.

2. Introduction to the Thermodynamics of Materials, 6th edition, David R Gaskell, David E Laughlin, CRC Press, 2018.

Course Policies and Student Responsibilities

(1) CA

Absentees must be supported by a medical certificate or other valid official documents.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.