

Items of Course Outlines

1. Instructor (s) – Name and Contact Details

Prof. Wang Ning, phwang@ust.hk

2. Teaching Assistant (s) - Name and Contact Details

Lou Chenxuan, clouaa@connect.ust.hk

3. Meeting Time and Venue – Lectures, Tutorials/ Laboratory

Wednesday and Friday (15:00 – 16:20), Room 2126D

4. Course Description - Credit Points, Pre-requisite, Exclusion, Brief Information/synopsis

Credit Points: 3

Pre-requisite: PHYS 2022

Exclusion: NIL

Brief Information/synopsis:

This course covers material structures and physical properties. Topics include the periodic structure of crystals with basic crystallography, symmetry operations and crystalline structures, diffraction and microscopy techniques to determine Bravais lattices and crystal structures, the imperfections in solid materials and their roles in physical properties, physical and mechanical behavior of solid materials based on different bonding types and common defects, the fundamental concepts of mechanical, electrical, optical and magnetic properties and nanomaterials including nanotubes, nanowires, graphene, and 2D semiconductors.

5. Intended Learning Outcomes

The goal of this course is to give students the opportunity to obtain the fundamental knowledge of structure and properties of materials. The lecture will present the introduction to the structure, properties, physical properties and selection of materials and engineering applications. In particular, students should be able to:

- 1) Use crystallography to describe the periodic structure of crystals and the mathematical relationship between symmetry operations and crystalline structures.
- 2) Explain how to use diffraction and microscopy techniques to determine Bravais lattices and crystal structures.
- 3) Describe the most important imperfections in solid materials and their roles in physical properties.
- 4) Explain the physical and mechanical behavior of solid materials based on different bonding types and their common defects.
- 5) Solve basic problems illustrating the fundamental concepts of mechanical, electrical, optical and magnetic properties of crystalline solids.

6. Assessment Scheme

<u>Assessment</u>	<u>Assessing Course ILOs</u>
15% Homework	1,2,3
20% Quiz	1,2,3
40% Mid-term Exam	4,5
25% Final Project Report	1,2,3,4,5

7. Student Learning Resources - Lecture Notes, Readings

- "Introduction to Materials Science for Engineers", Global Edition, by James Shackelford
- "Materials Engineering -Bonding, Structure, and Structure-Property Relationships", by Susan Trolier-McKinstry, Robert E. Newnham Cambridge University Press, 2018.

8. Teaching and Learning Activities

Scheduled activities: 4 hrs (lecture + tutorial)

9. Course Schedule

Teaching pattern:

- 1) Lattice and crystal structures
- 2) Crystallography of crystalline solids
- 3) Defects (point defect, dislocation, stacking fault, twins, grain boundary)
- 4) Methods to determine crystal structures (X-ray, electron diffraction, scanning electron microscopy, transmission electron microscopy)
- 5) Mechanical property
- 6) Phase diagram
- 7) Electrical property
- 8) Optical property
- 9) Magnetic property
- 10) Materials selection
- 11) Nanomaterials (nanotube, nanowires, graphene, semiconductors)
- 12) Lab tour/demonstration