# MSE 1053: Structures of Crystals and Diffraction

**FALL, 2025**

**INSTRUCTOR:** Dr. Shijing Luo

**OFFICE:** Room 522 (New Building)

**EMAIL:** shijing.luo@scupi.cn

**OFFICE HOURS:** Wednesday: 16:30-18:30, Thursday & Friday: 13:30-17:30, or by appointment

**LECTURES:** Friday 8:15-11:00
Room N212, New Building

**TEACHING ASSISTANT:** Zheng Hanzhuo **2022141520061@stu.scu.edu.cn**

**QQ GROUP:**

**COURSE NUMBER:** 312059030

**CREDITS:** 3-credits

**TEXTBOOK:**

- M. De Graef and M.E. McHenry, "Structure of Materials", Cambridge University Press, 2nd edition (2012)

**Reference Books**

- C. Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2nd edition (2000) and reprinted 2003. (Key Reference)
- S.M. Allen and E.L. Thomas, "Structure of Materials", Wiley, 1999.
- Kelly, G.W. Groves and P. Kidd, Crystallography and Crystal Defects, John Wiley & Sons (2000).
- B.D. Cullity and S.R. Stock, Elements of X-Ray Diffraction, 3rd Edition Prentice Hall (2001).
- V. Randle, Microstructure Determination and its Applications, Inst. Of Materials, London (1992).
- V. Randle, The Role of Coincidence Site Lattice in Grain Boundary Engineering, Inst. Of Materials, London (1996).
- C.S. Barrett and T.B. Massalski, Structure of Metals, McGraw-Hill, 3rd ed. (1966).
- R. Tiley, Crystals and Crystal Structures, Wiley (2006).

**PREREQUISITE:**

ENGR 0022 Materials Structures and Properties

**DESCRIPTION:**

Basic crystallography of materials, including atomic packing and structures; crystal categorization; lattice and lattice systems; lattice plane and Miller indices; symmetry and symmetry operations; tensor properties of crystals; reciprocal space; point groups and space groups; quantitative stereology and microstructural characterization; and diffraction methods in materials science.

**COURSE OBJECTIVES:**

This course aims to provide students with a comprehensive understanding of the principles of crystal structure, the techniques used to determine these structures, and the techniques used to determine these structures. This course will provide a foundation for further studies in materials science, chemistry, physics, or engineering, where knowledge of crystal structures is essential.

**LEARNING OUTCOMES FOR THIS COURSE:**

After the successful completion of this course, students should develop:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

3. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**GRADE DETERMINATION:**

5%: participation (bonus)

10%: in-class assignments

20%: homework

30%: midterm exam

35%: final exam

**EXAMS:**

There will be one midterm exam and one final exam.

**PARTICIPATION:**

On-time attendance at all class activities is expected. Meanwhile, students are encouraged to join all kinds of class activities, including attending each class, asking/answering questions in classes, etc. If you must miss a class due to illness or other reasons, you should take a leave from the instructor at least one day before the class.

**IN-CLASS ASSIGNMENTS:**

In-class assignments will be assigned to students during class hours; the topics are usually related to the latest class or new theories/techniques introduced in the same class to check students' understanding of the basic knowledge. Generally, **NO** make-up quizzes will be allowed for absences from the class, unless prior approval has been granted by the instructor or a valid emergency, supported by appropriate documentation, is provided.

**HOMEWORK:**

To be assigned after the lectures. Submission requirements (including due dates) for all assessments will be announced to students in class or on Blackboard. Late assignments will be

**deducted 30% per day** and will not be accepted after **4 days** (including the 4th day) or after the solutions are distributed, whichever is earlier.

All homework and assignments must be **handwritten**, the submissions that fails the requirements will not be accepted otherwise.

**GRADE Policy:**

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|---|---|---|---|---|
| A: 90 – 100 | B+: 80 – 84 | B−: 73 – 75 | C: 66 – 69 | D: 60 – 62 |
| A−: 85 – 89 | B: 76 – 79 | C+: 70 – 72 | C−: 63 – 65 | F: < 60 |

If students have any concerns regarding their grades, they may submit a rebuttal within **5 days** of the grade announcement. No rebuttals will be accepted after this period.

**MATERIAL COVERED:**

The intended sequent content covered in this class is shown in the following table and might be adjusted according to the class schedule.

| Week | Contents | Descriptions |
|---|---|---|
| 1 (09/12) | Chp.1 | Course syllabus & general introduction |
| 2 (09/19) | Chp. 2 | Periodic table and interatomic bonds |
| 3 (09/26) | Chp. 3 & 5 | Crystal structure, crystal system, and lattice plane |
| 4 (10/03) | No class | Public Holiday |
| 5 (10/10) | Chp. 3 & 8 | Crystal symmetry |
| 6 (10/17) | Chp. 4 | Crystallographic computations |
| 7 (10/24) | Chp. 8 | Symmetry operation |
| 8 (10/31) | Chp. 6 | Reciprocal space |
| 9 (11/07) | Review | Midterm Exam Week |
| 10 (11/14) | Chp. 6 & 7 | Zone and stereographic projection |
| 11 (11/21) | Chp. 9 | Point Group |
| 12 (11/28) | Chp. 10 | Plane groups and space groups |
| 13 (12/05) | Chp. 11 | Stereographic projection and X-ray diffraction: geometry |
| 14 (12/12) | Chp. 11 | X-ray diffraction: geometry part II |
| 15 (12/19) | Chp. 12 | X-ray diffraction: Intensity |
| 16 (12/26) | Chp. 14 | XRD Patterns |
| 17 (01/02) | | Final Exam Week |

The instructor reserves the right to extend credit for alternative assignments, projects, or presentations, and to make changes to this syllabus as needed. All changes will be announced via Blackboard and/or in class.

**Copyrights:**

The handouts used in this course are copyrighted. By "handouts" we mean all materials generated for this class, which include but are not limited to syllabi, in-class materials, videos, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy or distribute the handouts, unless the author expressly grants permission.

**Academic Integrity:**

All students are expected to adhere to the standards of academic honesty. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty would be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to the confiscation of the examination of any individual suspected of violating the University Policy.