

Materials Science and Engineering (MTSE) 3010
(Bonding and Structure)

Fall 2026

Credits: 3

During this course we will discuss how elements can be combined to produce non-crystalline and crystalline solids with specified properties in order to understand the links between chemical bonding, crystal structures and physical properties. We will also specify the microstructure, and the mesoscale structure of materials, such as metals, ceramics, electronic materials, and polymers.

Professor:	Thomas Scharf
Pronouns:	He/Him
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Office Hours:	Wednesday 12 PM – 2 PM (email for appointment)
Class Hours:	T/R 3:25-4:45 PM
Class Location:	Discovery Park B190

Main Textbook

Structure of Materials - An Introduction to Crystallography, Diffraction & Symmetry
by Marc De Graef and Michael McHenry (2nd edition, 2012)
ISBN# 978-1-107-00587-7 Cambridge University Press

Supplementary Textbook

Structure and Bonding in Crystalline Materials
By Gregory S. Rohrer
ISBN# 0-521-66379-2 Cambridge University Press

Course Notes

Course notes for each class will be posted on Canvas in “Modules” link before each lecture. I will also supply additional handouts and references posted to Canvas.

Homework

Four homework sets will be assigned and graded. I will post last year’s homework and solutions on Canvas. The purpose of the homework is to aid in learning the material. To this end, some collaboration among students in preparing the homework is acceptable. However, in the main, the work should be primarily yours and blatant copying will result in failing grade. Late homework will not be accepted.

Exams

There will be two exams: midterm and a comprehensive final. I will post last year’s midterm, final exam, and their solutions on Canvas.

Grading

Homework is 35%, Midterm is 30%, Final is 35%

Attendance

I consider attendance mandatory. If you are going to miss class email me. Also, no cell phones

TA

Mr. Anil Mandal (AnilMandal@my.unt.edu); email Anil to set up an appointment (Zoom or MS Teams is preferable, he will email you back his meeting link).

Academic Integrity

As is understood by the vast majority of students, our basic relationship is based on trust.

Course Syllabus (*Subject to Change*)

Date	Topic	Homework
Aug 18	Introduction and Review of Simple Bonding Models	
Aug 20	Periodic Trends & Bonding Force/Energy	
Aug 25	Lennard-Jones Model	
Aug 27	Lennard-Jones Model (cond.)	
Sept 1	Born-Mayer-Huggins Model	
Sept 3	Crystal Lattice & Unit Cells	Hwk 1 out
Sept 8	Metallic Crystal Structures	
Sept 10	Ceramic Bonding & Crystal Structures	
Sept 15	Ceramic Bonding & Crystal Structures (cond.)	Hwk 1 in
Sept 17	Interstitial Compounds	
Sept 22	Introduction to Crystallography	Hwk 2 out
Sept 24	2-D & 3-D Bravais Lattices	
Sept 29	Primitive and Basis Vectors in Crystal Structures	
Oct 1	Basic Symmetry Operations	Hwk 2 in
Oct 6	2-D Point & Plane Groups	
Oct 8	Midterm	
Oct 13	3-D Point Groups	
Oct 15	3-D Point Groups (cond.)	
Oct 20	Neumann's Law and Tensor Properties	Hwk 3 out
Oct 22	3-D Space Groups	
Oct 27	3-D Symmetry Elements in Crystalline Materials	
Oct 29	3-D Symmetry Elements in Crystalline Materials (cond.)	Hwk 3 in
Nov 3	Relationships between planes and directions	
Nov 5	Introduction to XRD & Indexing Crystal Systems	
Nov 10	Structure Factors	Hwk 4 out
Nov 12	XRD Intensity Calculations	
Nov 17	XRD Intensity Calculations (cond.)	
Nov 19	Texture Determination and Pole Figures	
Dec 1	Stereographic Projection and Texture/Anisotropy	Hwk 4 in
Dec 3	Diffraction Applications Review	
Dec 7	Final Exam 3:30 p.m. - 5:30 p.m.	