MSE 102: Bonding, Crystallography and Defects
Syllabus – Fall Semester, 2020
Instructor: Professor Daryl C. Chrzan

Date	Topic	Problem Sets
08/27	**First day of class: logistics, mathematical background**	
Part I:	***Symmetry, Crystallography and Crystal Structures***	
09/01	**Introduction to lattices. Coordinates, directions, planes.** **B.-O. Ch. 2, KGK Ch. 1, R, Ch. 2, S Ch.1**	
09/03	Lattices continued, introduction to symmetry operations. B.-O. Ch. 5, R Ch. 3, S Ch. 2	
09/8	Symmetry operations, symmetry operations compatible with lattice translations.	PS #1 Due
09/10	Improper rotations, glide planes, screw axes. 2D plane lattices.	
09/15	3D Bravais lattices; Introduction to crystal structures. B.-O. Ch. 3&6	PS #2 Due
09/17	Crystal structures: Lattice+basis. Stereographic projections. KGK Ch. 2	
09/21	**@HOME**: **Quiz #1 All things lattice based, crystal definitions.**	
09/22	32 crystallographic point groups. 230 space groups.	
09/24	Introduction to the International Tables for Crystallography.	PS #3 Due
09/29	Relationship between symmetry and physical properties: Reciprocal lattices and diffraction. AM reciprocal lattice, R Ch. 5	
10/01	Diffraction continued. N Ch. 1&2, KGK Ch. 4	PS #4 Due
10/05	**@HOME: Quiz #2 Symmetry, Diffraction and the International Tables**	
10/06	Introduction to tensors: Conductivity. General transformation properties	

10/08	Symmetry constraints on tensors.	
10/13	Linear elasticity theory, elastic constants. N Ch. 7&8, KGK Ch. 5	PS #5 Due
10/15	Tensors continued.	

Part II: Bonding and Crystal Binding

10/20	Intro to bonding. Van der Waal's bonding.	PS #6 Due
10/22	Van der Waal's bonding continued, introduction to ionic bonding.	
10/26	**@HOME: Quiz #3 Tensors**	
10/27	Ionic bonding continued.	
10/29	Ionic bonding: ionicity and electronegativity. R Ch. 7	
11/03	The need to think quantum mechanically. Introduction to Schrödinger's equation. Particle in a box.	PS #7 Due
11/05	Quantum mechanical picture of bonding. Covalent and ionic limits.	
11/09	**@HOME: Quiz #4 Classical Models of Bonding van der Waals and ionic bonding**	
11/10	Solution to H atom; relationship to periodic table.	
11/12	Covalent bonding. Introduction to the band theory of solids. AM Bloch, R Ch. 8, KP-Lec.pdf (under lecture notes)	
11/17	Continued Discussion of the band theory of solids.	PS #8 Due

Part III: Point and Line Defects

11/19	Point defects and equilibrium. Point defects in ionic materials.	
11/23	**@HOME: Quiz #5 Covalent Bonding, Band Theory of Crystals**	
11/24	Point defects in covalent and metallic materials.	
11/26	Thanksgiving Holiday. No class.	

12/01	Point defects continued. Intro to dislocations.	
12/03	Dislocations continued.	PS #9 Due
12/??	Final Exam	

B.O. = Borchardt-Ott; KGK = Kelly, Groves and Kidd; R = Rohrer; S = Sands; N = Nye; AM = Ashcroft and Mermin