# MSE 102: Bonding, Crystallography and Defects
# Syllabus – Fall Semester, 2016
# Instructor: Professor Daryl C. Chrzan

| Date | Topic | Problem Sets |
|---|---|---|
| 08/25 | Organization, context and perspective. | |
| ***Part I:*** | ***Symmetry, Crystallography and Crystal Structures*** | |
| 08/30 | Introduction to lattices. Coordinates, directions, planes.<br>B.-O. Ch. 2, KGK Ch. 1, R, Ch. 2, S Ch.1 | |
| 09/01 | Lattices continued, introduction to symmetry operations.<br>B.-O. Ch. 5, R Ch. 3, S Ch. 2 | PS #1 Due |
| 09/06 | Symmetry operations, symmetry operations compatible with lattice translations. | |
| 09/08 | Improper rotations, glide planes, screw axes. 2D plane lattices. | PS #2 Due |
| 09/13 | 3D Bravais lattices; Introduction to crystal structures.<br>B.-O. Ch. 3&6 | |
| 09/15 | Crystal structures: Lattice+basis. Stereographic projections.<br>KGK Ch. 2 | PS #3 Due |
| 09/20 | 32 crystallographic point groups. 230 space groups. | |
| 09/27 | Introduction to the International Tables for Crystallography. | PS #4 Due |
| 09/29 | Relationship between symmetry and physical properties: Reciprocal lattices and diffraction.<br>AM reciprocal lattice, R Ch. 5 | |
| 10/04 | Diffraction continued. Introduction to tensors: Conductivity.<br>N Ch. 1&2, KGK Ch. 4 | PS #5 Due |
| 10/06 | Tensors continued: Piezoelectricity and elastic constants.<br>N Ch. 7&8, KGK Ch. 5 | |
| 10/13 | Tensors continued. | |
| 10/18 | **Exam on material covered in Part I.** | |
| ***Part II:*** | ***Bonding and Crystal Binding*** | |
| 10/20 | Intro to bonding. Van der Waal's bonding. | |
| 10/25 | Van der Waal's bonding continued, introduction to ionic bonding. | PS #6 Due |
| 10/27 | Ionic bonding: ionicity and electronegativity.<br>R Ch. 7 | |

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| 11/01 | The need to think quantum mechanically. Introduction to Schrödinger's equation. Particle in a box. | PS #7 Due |
| 11/03 | Quantum mechanical picture of bonding. Covalent and ionic limits. | |
| 11/08 | Solution to H atom; relationship to periodic table. | PS #8 Due |
| 11/10 | Covalent bonding. Introduction to the band theory of solids. AM Bloch, R Ch. 8, KP-Lec.pdf (under lecture notes) | |
| 11/15 | **Exam on material in Part II.** | |

## ***Part III: Point and Line Defects***

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| 11/17 | Point defects and equilibrium. Point defects in ionic materials. | |
| 11/22 | Point defects in covalent and metallic materials. | PS #9 Due |
| 11/24 | Thanksgiving Holiday. No class. | |
| 11/29 | Point defects continued. Intro to dislocations. | |
| 12/01 | Dislocations. Dislocations continued. | PS #10 Due |
| 12/16 | Final Exam 8-11AM | |

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