CHEM 468
APPLICATIONS OF SYMMETRY TO CHEMISTRY
(a.k.a. “Group Theory”, “Group Therapy”, etc.)

MWF 9:00 am – 9:50 am (Neckers 328… for now…)

Professor Boyd M. Goodson
Department of Chemistry and Biochemistry
Office: Neckers 113
Phone: x3-6427
Email: bgoodson@chem.siu.edu

I. Office Hours:
By appointment (or just drop by…)

II. Grading:
25% Homework (~4-5 assignments)
10% Classroom Participation (see below)
25% 1st (and only) Midterm
40% Final Exam

III. Textbooks, etc.
Cotton, F.A., Chemical Applications of Group Theory, 3rd Ed.

Cheap, optional book:
Wilson, Decius, & Cross, Molecular Vibrations (a Dover book, mainly for reference)

Various other sources can also be helpful, including chapters in Atkin’s Physical Chemistry; the Dover book Symmetry and Spectroscopy by Harris and Bertolucci; and numerous other texts on the chemical applications of group theory (please feel free to ask me if additional texts are needed).

IV. Class Philosophy and Content
We will mostly follow a “traditional” course in how we cover the relevant aspects of group theory. However, as an experimental physical chemist by training, this course will be tilted in the direction of practical applications of group theory, particularly in regard to spectroscopy and other methods for characterizing molecules. Much of what we cover—particularly in the early going—will be right out of our primary text; problem sets will contain questions I write, along with some from various textbooks. Despite whatever you have taken (or remember), I will do my best to start the class assuming as little knowledge as possible.
The following concepts will (likely) be covered, not necessarily in order (and sometimes simultaneously):

1. Groups, symmetry, symmetry elements
2. (Some basic concepts / methods in Matrix Algebra, when necessary)
3. Representations of groups, and the “Grand Orthogonality Theorem”
4. Point groups and character tables
5. Using wave functions / orbitals as bases for representations
6. Projection operators
7. Symmetry and molecular structure
8. Selection rules, their origin, and application
9. Molecular orbital theory
10. Ligand field theory
11. The relationships between symmetry and normal modes
12. Applications of group theory to IR and Raman spectroscopy
13. Applications of group theory to electronic spectroscopy and electronic structure calculations
14. Applications of group theory to magnetic resonance
15. Space groups, crystallography, and other applications of group theory to “bulk properties”, condensed matter physics, surface science, etc.

V. Helpful Hints

1. Classroom participation—by you—is critical. For one thing, I have made it 10% of the grade. It is important that you not only show up, but that you contribute by asking questions, giving answers, working out board-problems, stumping the Prof., helping your classmates, etc. Because of the nature of the material (particularly how it involves the application of very abstract ideas for very practical applications on real molecules), you will all learn much faster if the class is highly interactive. This will also help me discern how well the material is being integrated into your brains. **COME TO CLASS EXPECTING TO BE ASKED QUESTIONS AND TO WORK PROBLEMS.**

2. Keep Up. A great deal of the course’s material is cumulative, so don’t fall behind. If you find yourself falling behind, get help—nip it in the bud.

3. Ask Questions. If something isn’t clear, let me know. Chances are, someone else (perhaps the Prof.) is having trouble with it too. If people don’t speak up, I will assume that a concept is understood by all.

4. Do the Problem Sets. Success in this class will take Practice, Practice, Practice. You have my permission to work on Problem Sets in groups, but don’t mindlessly “Team Xerox” anything. I advise you to work on them separately as best you can, and then work together to solve the harder problems.
VI. Basic Class Schedule

Week of (Monday):

- Jan. 18   MEET W, F
- Jan. 25    MEET M, W, F
- Feb. 1     MEET M, W, F
- Feb. 8     MEET M, W, F
- Feb. 15    MEET M, W, F
- Feb. 22    MEET M, W, F
- Feb. 29    MEET M, W, F
- Mar. 7     MEET M, W, F; **On Friday, Midterm Exam (In Class)**
- Mar. 14   *No Meeting all week; SPRING BREAK*
- Mar. 21    MEET M, W, F
- Mar. 28    MEET M, W, F
- Apr. 4     MEET M, W, F
- Apr. 11    MEET(?) M, W, F (ENC Conference – we may meet)
- Apr. 18    MEET M, W, F
- Apr. 25    MEET M, W, F
- May 2      MEET M, W, F
- May 9     **FINALS WEEK; Our Final: TBD**

---

**Emergency Procedures**

Emergency Procedures: SIUC is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.