Physics 813 – Group theory and Quantum Physics

Lecture: 9:30am to 10:20 a.m. MWF Jorgensen Hall 245
Instructor: Prof. Peter Dowben

This is a calculus, and matrix algebra-based course intended for engineering students or science majors (physics, chemistry, biology). The course is intended to cover basic group theory, finite groups and irreducible representation, quantum mechanics, wave mechanics and solid state physics.

Students with disabilities are encouraged to contact Services for Students with Disabilities (SSD), 132 Canfield Adm. Bldg., for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office <http://www.unl.edu/ssd/>, 132 Canfield Administration, 472-3787 voice or TTY.

Instructor:
Prof. Dowben's office is on the third floor of Jorgensen Hall, room 310L. Office hours can be arranged by appointment (the phone number is 472-9838; e-mail: PDOWBEN@unl.edu) or you can just try to drop "in".

Textbook:
The text for this course is **Symmetry and Spectroscopy by Harris and Bertolucci**

Lectures:
The lecture periods will include discussion of the assigned readings in the text, a variety of examples applied to physics, which illustrate some of the principles you will be learning, in class participation and examples of problem solutions. In addition, the lecture period will be used to give weekly homework updates, and special instructions.

Expected Courtesies
No audio or visual recordings (including camera cell phone recordings) may be made in or of the class without permission: the lecture material is the sole property of the University of Nebraska. It is expected that if you come to a class or lecture, you will stay the entire period. Arriving late or leaving early is RUDE. **Cell phones will be turned off** or, better yet, not brought at all to class. Questions should be addressed to the lecturer. We do want to help you, so be persistent if you cannot find help immediately.

Questions about homework are difficult to answer over the phone, so please schedule a meetl (see Homework). Grades cannot be given out over the phone under any circumstances. Persistent requests for grade information during grading (at the end of semester, in particular) will only serve to slow the grading process.

Homework:
To do well in this course you should plan on spending **at least** 8 hours, including class time, per week on this course. Homework must be written legibly, and there can be writing on one side of

the page only (do not write from and back) if on multiple pages. DO NOT crowd your writing or write in tiny lettering: in other words, make your homework easy to read. Make sure your name is placed on each and every page of the homework and that the name can be read (i.e. print you name in block letters). Calculator notation (10^8 or 10exp8) is forbidden. Homework can be placed in Dowben's mailbox or sent as an e mail file to pdowben@unl.edu.

Exams:
There is a plan for two exams, but this is subject to change given the fluid situation.

Tentatively the First Exam is March 24; 9:30 – 11 am
Second Exam: April 30th; 9:30 – 11 am

But these may be replaced by a single oral exam scheduled during exam week, with times chosen by mutual agreement. Each test will be worth 70 of the 200 total points possible for the course grade but will be graded on 100 points (to get your score contributing to your final grade, divide by 7/10). Each test will consist of 4 to 5 questions involving worked problems for which partial credit will be given. Graded exams will be returned. Again, if you handwriting is suspect (this is actually surprising true of most people) then print in block letters. If the oral exam us adopted, say in the case of a resurgence of the pandemic, then the oral exam will be 1/2 the course grade.

Make-ups:
There are **no** make-ups for homework or missed lectures. If you miss three or more homework assignments or an exam with a documented absence conforming to excused absence by the current standards of the College of Arts and Sciences at UNL, you may request an incomplete and will be able to repeat the entire course for a grade. Incompletes must be requested earlier than exam week.

Grading:
The grade you receive in the course will be based on combining exam and quiz grades as follows:

Examinations (including the final) 140 points: 70% Homework: 60 points: 30%

There is no curve for this course. Your letter grade will be assigned based upon the following numerical scale:

		percentage points (your score/200 in %))
A+	(4.0)	95-100
A	(4.0)	85-94
A-	(3.67)	82-84
B+	(3.33)	79-81
B	(3.0)	75-78
B-	(2.67)	72-74
C+	(2.33)	69-71

C	(2.0)	65-68
C-	(1.67)	62-64
D+	(1.33)	59-61
D	(1.0)	54-58
D-	(0.67)	50-53
F	(0)	0-49

Final grades will NOT be posted. Your can access your grades thorough the web, visit Prof. Dowben after exam week, or leave an addressed envelope with Prof. Dowben with your name and identification number (the envelope does NOT have to be stamped, only addressed clearly).

Schedule for Physics 813

Week 1: *Basics: Mathematical Background: Matrix methods applied to the Hamiltonian.*
Mathematical Background: Matrix methods applied to Fourier transforms and diffraction.

Week 2: *Matrix methods applied to Fourier transforms and diffraction.*

Week 3: The Hamitonian and *Basic Perturbation theory*

Week 4: *Basic Perturbation theory: Selections rules for a spherically symmetry atom (hydrogen)*

Week 5: Basics of Groups and Rings

Week 6: *Symmetry operations and basis functions*

Week 7: *Key finite groups. Schur's Lemma, the Orthogonality Theorem*

Week 8: *Irreducible representation theory*
What is an irreducible representation ?

Week 9: *Schoenflies notation; Galois notation*

Week 10: *Basic quantum mechanics with a perturbation, using the irreducible representation*

Week 11: *symmetry selection rules in photoemission from crystals*

Week 12: *secular equations & Energy Band models based on symmetry*

Week 13: *Introduction to continuous groups*

Week 14: *SU(2) and isospin –*

Week 15: *Fundamental representations SU(3); the 8-fold way and meson*

END OF SEMESTER