CHEMISTRY 360- Physical Chemistry II
Theme of Course: Optical Spectroscopy and Materials Science

Spring 2016

Location: BSC 308, Time: T/R: 8:30 am – 9:45 am, Credits: 4 hours

Instructor: Professor Sarah A. Winget **Office:** BSC 301E; 404.471.5379
Email: *swinget@agnesscott.edu* **Office Hrs:** Mon 10.30-11.30am, Thu 1-2pm

Course Description: An advanced course that builds on concepts learned in CHE260. The theme of this course will be optical spectroscopy and materials science, and three major topics will be discussed: (i) quantum mechanics, which will include discussion of selection rules and electronic, rotational and vibrational spectroscopy, (ii) an introduction to classical and modern optics and lasers, which will include quantum mechanics of lasers and laser optics, and (iii) an introduction to physical chemistry and molecular spectroscopy concepts crucial to the interdisciplinary field of materials science.

Prerequisites: CHE 260

Course Expectations: Students will be expected to…

1. Complete reading and homework assignments before class.
2. Participate in class - take notes, answer questions, ask questions, engage in group work, etc.
3. Be respectful to instructor and peers.
4. Read all course e-mail – they will contain important tips and reminders.
5. Utilize course/school resources to aid in learning and understanding.

Course Goals: By the end of the course…

1. Students will be able to explain fundamental principles of quantum mechanics and communicate the implications of the theories to chemistry and real-life phenomenon.
2. Students will be able to describe elementary atomic and molecular electronic structure and evaluate how these structures influence the various types of spectroscopy (ie. rotational, vibrational, and electronic).
3. Students will be able to explain how spectroscopy is used to determine microscopic properties of molecules
4. Students will be familiar with terminology and applications of classical and modern optics (ie. geometrical optics, diffraction, interference, and polarization).
5. Students will be able to explain the quantum mechanics behind lasers and laser optics, and will be able to construct/set-up a simple laser and an optical set-up.
6. Students will be able to explain a variety of physical chemistry and molecular spectroscopy concepts that are particularly relevant to the field of materials science.

Relevance to the departmental and college curriculum: This course can count as one of the two in-depth courses that are required for the Chemistry major, or one of the four in-depth courses that required for the American Chemical Society (A.C.S.) approved Chemistry major, or one of the four chemistry courses beyond CHE150 that are required for the Chemistry minor, or for the additional biology/chemistry course required for the biochemistry major.

Text: No textbook is required for this course, however readings will be assigned from various handouts and current research articles. These will be distributed via *moodle.*

Workload Statement: This is a 4-credit course that meets 3 hours per week. To succeed in a 4-credit course the college expects you to spend 10-12 hours per week on the course (including scheduled classroom time). That means you should be spending an average of 7-9 hours per week outside of class on this course, on reading, weekly homework problems, and on a literature project.

Appointments: Appointments may be made with Dr Winget via e-mail (swinget@agnesscott.edu)

Attendance: Attendance is not required, but students will notice a strong correlation between their grade and the number of classes they attend.

Moodle (courses2.agnesscott.com): is a web-based course management system that will be used in this course. The syllabus, grades, in-class materials, assignments, study guides, etc. will be posted for your access.
Note: Email correspondence using Moodle is directed to Agnes Scott accounts.

Homework Assignments: Homework assignments will generally be assigned on Thursday and will be due by 5pm the following Thursday. Students must show ALL work to receive full credit. Late homeworks will be reduced by 5% points per day up to a maximum of 7 days. Homework may be scanned and submitted electronically by email or may be dropped off at Dr Winget's office on Thursday afternoons.

Exams:
There will be two exams. Each exam will be given out during the semester and you will have one week to complete and return it. The exams will be take home exams but will be of the closed-note, closed-book variety. Only the contents of the exam envelope, your calculator and your pencil may be used during an exam. There will not be a final exam in this course.

Course Grades/Grading Scale:

Assignments	**%**
Homework (6 plus polyenes computation)	25%
Exams (2)	50%
Literature Review Presentation (1)	25%

Absolute Grading Scale:

A	93-100	B-	80-82	D+	67-69
A-	90-92	C+	77-79	D	63-66
B+	87-89	C	73-76	D-	60-62
B	83-86	C-	70-72	F	0-59

Honor Code/Academic Integrity:
Students are strongly encouraged to work with other students on homework assignments, but please remember that it is an Honor Code violation to simply copy solutions to problems (from any source: whether it be other students, solutions manuals, etc.) and claim the work as one's own.

Course Evaluation: Near the end of the semester you will be notified by email, and provided with a link to follow, to complete course evaluations online outside of class. You are expected to complete the them as your feedback is extremely valuable to Dr. Winget, the department, and the administration. Of particular importance are constructive comments that help Dr. Winget improve the course.

Accommodations: Agnes Scott College seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in this class, please contact Kelly Deasy in the Office of Academic Advising (X6150) to make or complete the registration process. Once registered, please contact Dr. Winget by email in order to make an appointment to discuss the specific accommodations needed for this course.

This course adheres to the principles of diversity and inclusion integral to the Agnes Scott community. We respect people from all backgrounds and affirm people's decisions about gender expression and identity. Please feel free to correct D. Winget if your preferred name or gender pronoun are different from that listed on the class roster.

For the safety of the entire community, any incidence of or information about sexual misconduct must be reported immediately to Title IX Coordinator Karen Gilbert (kgilbert@agnesscott.edu)

Course Schedule:

#	DATE	Topic for the Class	Due (by 5pm)
		Quantum Mechanics of Molecular Spectroscopy	
1	**T-Jan 12**	Welcome and Introduction. Historical context of QM, Heisenberg Uncertainty Principle (recap)	
2	**Th-Jan 14**	Particle-in-a-box and operators (recap)	Nothing due
3	**T-Jan 19**	Spin and Molecular Orbitals (recap)	
4	**Th-Jan 21**	Rigid Rotor	Nothing due
5	**T-Jan26**	Harmonic Oscillator	
6	**Th-Jan 28**	Term Symbols	Assign 1 (class 1-4)
7	**T-Feb 2**	Selection Rules	
8	**Th-Feb 4**	Rotational Spectroscopy	Assign 2 (class 5-6)
9	**T-Feb 9**	Vibrational Spectroscopy	
10	**Th-Feb 11**	Rovibrational Spectroscopy and Raman Spectroscopy	Assign 3 (class 7-8)
11	**T-Feb 16**	Introduction to individual literature projects	
12	**Th-Feb 18**	**Dr Winget out of town** – class works on their literature projects. Exam 1 available from Amy Whitworth today	Assign 4 (class 9-10)
13	**T-Feb 23**	Electronic Spectroscopy and Molecular Spectroscopy review	
		Optics and Lasers for Molecular Spectroscopy	
14	**Th-Feb 25**	Introduction to Optics (Reflection, Refraction, Scattering, Stokes etc).	Exam 1 (class 1-10)
15	**T-Mar 1**	Geometrical Optics	
16	**Th-Mar 3**	In the optics lab for hands-on optics	Assign 5 (class 13-14)
--	**T-Mar 8**	**SPRING BREAK**	
--	**Th-Mar 10**	**SPRING BREAK**	
--	**T-Mar 15**	**PEAK WEEK**	
--	**Th-Mar 17**	**PEAK WEEK**	
17	**T-Mar 22**	In the optics lab for hands-on optics	
18	**Th-Mar 24**	Lasers	Assign 6 (class 15-16)
		Materials Science and Molecular Spectroscopy	
19	**T-Mar 29**	Introduction to polyenes computation	
20	**Th-Mar 31**	Class works on polyenes computation	**Turn In Literature Presentation articles with a detailed summary to Moodle**
21	**T-April 5**	Spectroscopic Techniques for characterizing nanoparticles	
22	**Th-April 7**	Probing catalytic activity of nanoparticles	**Turn In Literature Presentation PowerPoint slides to Moodle**
23	**T-April 12**	Nanoparticles and spectroscopy in biology	
24	**Th-April 14**	Probing the toxicity of nanoparticles	Polyenes Computation
25	**T-April 19**	Individual presentations	
26	**Th-April 21**	Individual presentations – Exam 2 available from Amy Whitworth today	Nothing due
--	**T-April 26**	**SpARC – NO CLASSES**	
27	**Th-April 28**	Presentation on Dr Winget's Materials Science Research	Exam 2 (class 13-18, 21-24)
28	**T-May 3**	Presentation by a member of the Qin Group at Ga-Tech	