Course Code:	CHEM 380
Course Title (credits):	Special Topics in Chemistry: Brewing Chemistry (3)
Term and Year:	Spring 2014
Course Ref. No. (CRN):	10284

Instructor:	Sean Ryland
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Office hours:	2:00-4:00 PM Th and by appointment

Lecture Meeting Time:	MW 7:00-8:15 PM
Lecture Location:	TCES 205

Course Description:

This course applies chemical and biological principles to the science and engineering of brewing beer. Students will study spend classroom time learning and discussing the history, components and processes of brewing at the home and commercial scales. If older than 21, students may participate in field trips to local microbreweries and homebrewing projects.

Student Outcomes:

Students successfully completing these courses will demonstrate the following:

- Understanding of chemical, biological and engineering concepts central to brewing.
- Ability to articulate the challenges and advantages of brewing at the home and industrial scales.
- Demonstration of brewing techniques in written and/or practical applications.

Methods for Assessing Student Outcomes:

Students will be evaluated based on papers, projects and participation in classroom discussions. Classroom discussion will be centered on brewing ingredients, processes and products. A variety of projects will presented in class and students will have the opportunity to choose several of these projects.

Learning Strategies:

This class will use a variety of instructional and learning techniques including lectures and in-class activities such as labs and tastings. Outside of class, various class activities and projects will be arranged with the instructor and/or other students.

Instructional Texts and Materials:

Required:

- **At least one** of the following texts:
  - Handbook of Brewing, 2nd Edition ed. by Fergus G. Priest (ISBN: 082472657X)
  - How to Brew, by John Palmer (ISBN: 0937381888)

Recommended:

- One brewing starter kit including:
  - 2x6.5 gallon buckets
  - 1 bottle capper
  - 1 hydrometer
  - 1 racking cane
  - Method of sanitization
- Access to a computer with Microsoft Excel or Beersmith 2 (available online)

Attendance:

Attendance will be taken at each lecture, as it is difficult to participate in classroom discussions without being present. The attendance will factor into then student's overall participation grade. Missing a class will result in a zero for all discussions and classwork for that lecture. In the event of an excused absence, a student can meet with the instructor during office hours to conduct an informal one-on-one discussion about what he or she missed. Acceptable excuses include, but are not limited to, illness (of the student or a dependent) with a physician's note, military duty or family bereavement. Oversleeping or conflicting employment schedules are NOT acceptable excuses.

Sanctions for Cheating and/or Plagiarism

The Honor Code

The faculty of SNC believes students must be held to high standards of integrity in all aspects of college life in order to promote the educational mission of the College and to encourage respect for the rights of others. Each student brings to the SNC community unique skills, talents, values and experiences which, when expressed within the community, contribute to the quality of the educational environment and the growth and development of the individual. Students share with members of the faculty, administration and staff the responsibility for creating and maintaining an environment conducive to learning and personal development, where actions are guided by mutual respect, integrity, responsibility and trust. The faculty and students alike must make diligent efforts to ensure high standards are upheld by their colleagues and peers as well as themselves. Therefore faculty and students accept responsibility for maintaining these standards at Sierra Nevada College and are obligated to comply with its

regulations and procedures, which they are expected to read and understand. If writing is turned in by you, without citation or shared credit, it means you wrote it. Any shared work should be credited, paragraph by paragraph.

Consequences of Violating the Student Honor Code

SNC students and faculty share the responsibility for maintaining an environment of academic honesty. Thus, all are responsible for knowing and abiding by the SNC Faculty/Student Honor Code published in the current SNC Catalog. Faculty are responsible for presenting the Honor Code and the consequences of violating it to students at the start of their classes AND for reporting all incidences of academic dishonesty to the Provost. Students are responsible for knowing what constitutes CHEATING, PLAGIARISM and FABRICATION and for refraining from these and other forms of academic dishonesty. Violations of the Honor Code become part of a student's academic record.

1st Offense: Student receives a zero for assignment/exam and counseling with faculty on the honor code, consequences for violating the honor code, and the value of academic honesty in learning.

2nd Offense: Student fails course and receives counseling with faculty on the honor code, consequences for violating the honor code, and the value of academic honesty in learning.

3rd Offense: Student is expelled.

Special Accommodations (ADA) Statement:

"In accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, students with a documented disability are eligible for support services and accommodations. If a student wishes to request an accommodation, contact the Director of Student Services (Prim Library room 323) at (775) 831-7799 x7534 within the first week of the semester."

Grading Policy:

Letter grades will be awarded in CHEM 380 according to standard grading conventions as follows. A: >90%, B: 80-90%, C: 70-80%, D: 60-70%, F: <60%. Plus and minus grades will awarded accordingly. Grades will be determined as follows:

Process Paper:	30%
Brewery Business Plan:	20%
2 Approved Projects:	30%
Participation:	20%

Process Paper (Due March 14): Each student will write a 5-6 page paper explaining the process of brewing beer, including a discussion of each step in the process, each class of ingredient (i.e. malted barley, hops, water, etc) and that ingredient's effect on the final product. More information will be provided at a later date.

Brewery Business Plan (Due May 14): In the spirit of entrepreneurship, the final project for CHEM 380 will be a business plan for a new microbrewery or brewpub (the distinction of which will be discussed in class) or novel business concept approved by the instructor. The business plan should be "a formal statement of a set of business goals, the reasons they are believed to be attainable, and the plan for reaching those goals" (Pinson, Anatomy of a Business Plan). More information for this project will provided at a later date.

Two (2) Physical Projects (Due May 5): Over the course of the semester, at least two of the following projects consisting of both physical and written components must be completed.

- Brew a 5 gallon batch of beer and submit the following:
  - A 1-2 page write-up with the following information:
    - What recipe did you use and where did it come from?
    - What choices were made regarding ingredients and process and what effects are you hoping to achieve?
    - What happened during the brewing process? Did everything go according to plan?
  - A sample of yeast collected from the krausen (procedure will be provided)
  - A bottle of the final product.
- Visit a brewery and submit the following:
  - An analysis of the marketing of the brewery (who is the target consumer and why?)
  - An evaluation of the beers served (what styles of beer were served, how well does the beer conform to the style guidelines and what makes the brewery's offerings unique). If you are under 21, information regarding taste can be obtained by interviewing a friend or a server/bartender/brewer at the brewery.
  - Estimate the maximum amount of beer produced in a year and support this estimate by considering the number and size of the brewing vessels. How does this compare to the amount of beer actually produced (i.e. ask a tour guide)
  - A photograph of you at the brewery

- Grow hops from a cutting available online and submit the following:
    - A write-up with the following information:
        - What variety(ies) did you choose and why?
        - What flavors do you expect to obtain from the final product?
        - How many ounces or pounds of hops do you expect to produce?
        - How will the product be stored to avoid spoilage?
        - An explanation of the growing and harvesting process. What aspects are different from traditional gardening?
        - Why are hops not grown from seeds?
    - Photographs of the process showing noticeable growth.
- Analyze a water quality report from a local utility district and submit a write up with the following information:
    - Concentrations of all ions and minerals relevant to the brewing process
    - Effects of the relevant ions on the brewing process and final product (i.e. total alkalinity, residual alkalinity, chlorine and chloride concentrations)
    - Discussion of the beer styles that can be brewed without any adjustment to the water profile, including the effect of total alkalinity and grain choice on mash pH.
    - The steps to take in order to change the water profile and produce a different style of beer and still reach the target mash pH.
    - Any additional information provided in the water report that is relevant to the brewing process and the final product

  The location of the utility district chosen for this project must be approved by the instructor to prevent overlap. However, as many as three students can work together to analyze the same district.
- Produce malted barley from raw barley and submit the following:
    - A write-up containing the following information:
        - A description of the malting process
        - What is the objective of each step in the malting process?
        - What did you do to malt the barley on a small scale?
        - What qualities are you looking for in the finished product?
        - What decisions did you make to achieve that product?
    - A sample of the raw barley and the malted barley
    - Photographs of the process

  These projects are well-suited to working in groups, but the size of each group can be **NO MORE THAN** three people. In addition, all members of the group must submit their own write-up and proof of project participation. Group members can work together to complete the physical project, but each write-up must be written individually.

Participation: the participation portion of the final grade will consist of attendance at the class lectures. This will be assessed by a short writing assignment at the beginning of every class, which will then be used to foster discussion in the following lecture. These writings will begin

AT 7:00 PM, so punctuality is encouraged. If the student misses the in class writing, it cannot be made up, and the student will receive at most 33% credit for the attendance of that lecture.

Due Dates and Late Work: Assignments are due at the beginning of class the day they are due. Once class has started, assignments are docked 10% of the total points possible. Every day following, the assignments lose an additional 10%. Assignments more than 5 days late will receive feedback from the instructor, but no credit will be awarded.

Acknowledgements:
Thanks to the SNC science department for the use of syllabi in crafting this syllabus. In addition, my wife provided lots of valuable feedback on the structure of this course, so if you are unhappy with anything, blame her.

Week	Day	Date	Topic	Chapter(s)	Special
1	M	1/20	No Class		
	W	1/22	Introduction	N/A	
2	M	1/27	Simple Overview	Palmer: 1-3, Priest: 3	
	W	1/29	All Grain Process	Palmer: 14, Priest: 3	
3	M	2/3	History of Alcohol	Priest: 1	
	W	2/5	History of Beer	Priest: 1	
4	M	2/10	Class on Friday	N/A	Class Brew Day
	W	2/12	Microbiology	Palmer: 6, Priest: 8	
5	M	2/17	Fermentation	Palmer: 8-9, Priest: 12	
	W	2/19	Hop Chemistry	Palmer: 5, Priest: 7	
6	M	2/24	Hop Flavors/Use	Palmer:5, Priest: 7	
	W	2/26	Malting Barley	Palmer: 12, Priest: 5	
7	M	3/3	Using Malt	Palmer: 12, Priest: 5	
	W	3/5	Water Chemistry	Palmer: 4, Priest: 4	
8	M	3/10	Brewing Water	Palmer: 4, Priest: 4	In-Class Activity
	W	3/12	Adjuncts	Palmer: 12, Priest: 6	Process Paper Due
9	M	3/17	Spring Break		
	W	3/19			
10	M	3/24	Beer Styles	Palmer: 20, Priest: 2	Sampling (over 21)
	W	3/26	Recipe Design	Palmer: 20, Priest: 2	
11	M	3/31	Hop Analysis	Handout	In-Class Activity
	W	4/2	Improving Process	Palmer: Appendices C-F	Last Week to Brew
12	M	4/7	Industrial Brewing	Priest: 10	
	W	4/9	Industrial Brewing	Priest: 10	
13	M	4/14	Packaging	Palmer: 11, Priest: 14	
	W	4/16	Kegging	Priest: 14	In-Class Activity
14	M	4/21	Common Problems	Palmer: 22, Priest: 19	
	W	4/23	Historical Styles	N/A	
15	M	4/28	Distillation	N/A	
	W	4/30	TBA		
16	M	5/5	Competition	N/A	Physical Projects Due
	W	5/7	No Class		
Finals	W	5/14	6:30-9:30 PM		Business Plan Due