Department of Chemical & Materials Engineering

CHME 495 Syllabus – Spring 2019

Brewing Science and Engineering

Class Schedule

Lecture: MWF 11:30 am - 12:20 pm, Jett Hall 259

Lab: Saturday 9:00 am - 4:00 pm, Jett Hall 184 (see course schedule for dates)

This course of study runs from Wednesday, January 16, through Friday, May 03.

There will be no class during the week March 25-29 due to Spring Break.

Instructors

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Catalog Description – 4 credit hours: 3 credits lecture + 1 credit (3 hours) lab

Details of beer production, fermentation science, brewery operation, and process design & economics. Engineering considerations including process safety, fermentation kinetics, unit operations, and economies of scale. Beer styles, recipe formulation, product quantification for tax purposes, and brew analytical methods will also be discussed.

Taught with FSTE 430 (3 credits) in Spring 2019 with differentiated assignments.

Prerequisites

- CHME 441, CHME 452, or permission of instructor; CHME 395V recommended

Textbook (required)

- *Brewing Science: A Multidisciplinary Approach*, by Michael Mosher and Kenneth Trantham, Springer, 2016 (ISBN 978-3319463933).
- Additional "readings" available on Canvas.

Textbooks (recommended for those with long-term brewing interests)

- *Brewing Elements* four-book series:
  - *Yeast: The Practical Guide to Beer Fermentation* by Chris White and Jamil Zainasheff, Brewers Publications, 2010 (978-0937381960).
  - *For the Love of Hops* by Stan Hieronymus, Brewers Publications, 2012 (ISBN 978-19384690105).
  - *Water: A Comprehensive Guide for Brewers* by John Palmer and Colin Kaminski, 2013 (ISBN 978-0937381991).
  - *Malt: A Practical Guide from Field to Brewhouse* by John Mallett, Brewers Publications, 2014 (ISBN 978-1938469121).
- *Handbook of Brewing: Processes, Technology, Markets* by Hans Michael Eßling, Wiley-VCH, 2009 (ISBN 978-3527316748).
- *Technology: Brewing and Malting, 5th Revised English Edition* by Wolfgang Kunze, VLB Berlin, 2014 (ISBN 978-3921690772)

Course Objectives

By the end of the lecture components of the course, students will be able to:

- Describe the brewing and beer context for the brewery locations.
- Create a brewery business plan, incorporating regulatory considerations.
- Create and modify a recipe based on style, cost, and complexity.
- Manage an ingredient inventory appropriate for size and style of brewery.
- Describe the characteristics of brewing ingredients.
- Manage safety considerations and engineering controls for brewery operations.
- Practice safe alcohol service and consumption.
- Obtain information and advice from workers within the brewing industry.
- Select brewing equipment and processing conditions for milling, mashing, sparging, boiling, fermenting, conditioning/aging, and packaging/storing.
- Evaluate and/or troubleshoot beer using sensory evaluation terms and tools.
- Size and cost brewery unit operations, processes, ingredients, and utilities.

Organization of the Course

This course is built around five learning modules that focus on the knowledge and skills needed by an engineer within a brewery. (We will not follow the text in sequence.)

- Context of brewing
  - Where, when, how, and why beer developed
  - Brewing's relationship to chemistry and chemical engineering
- Brewing ingredients: grains, water, hops, adjuncts
  - Malting
  - Biochemistry
  - Water chemistry
  - Recipe development

- Brewing process – What *we* do
  - Milling, treating water, mashing, sparging
  - Boiling, cooling, and fining
- Fermentation and maturation – What *yeast* does
  - Biology and biochemistry
  - Competing microorganisms: cleaning and sanitation
  - Flavors and off-flavors
- Finished beer logistics
  - Packaging: kegging, bottling, and canning
  - Storage, aging, and stability
  - Distribution
- Brewing context revisited
  - Marketing
  - Brewery vision – styles and R&D

Team-Based Learning
This course uses the team-based learning method. Most of the content is introduced outside of class as readings (with reading objectives) and pre-application exercise problems (Pre-Apps), and most of the application activities, conventionally done as homework and outside-of-class group projects, are done in teams during class. Teams will be determined the first day of class and will remain together the whole semester. To ensure that students are prepared with basic knowledge to do the in-class application exercises, quizzes are taken by individuals and then by teams at the beginning of some classes. (For more info, please see www.teambasedlearning.org)

New Mexico Servers License
All students will obtain a New Mexico (or Texas if the student has residency there) alcohol server permit as part of completing the course learning objectives. To receive credit, student must present a copy of their license by March 1.

Brewers Association Online Safety Trainings
All students will complete the online safety training modules (currently 14) offered by the Brewers Association. To receive credit for completing the training, students need to submit pdf files/screenshots of their certificates through Canvas by March 1. Modules can be accessed through: https://www.brewersassociation.org/best-practices/safety/free-online-brewery-safety-training/

End-of-Module Assessments
We will not have a final written exam. Instead, we will have written and/or practical assessments of the learning objectives at the end of each module, with the first "module" being assessed at the end of the course through the business plans.

Brewery Business Plans
As teams, we will design business plans for two breweries based on the initial ideas of the potential owner(s). Business plans will include descriptions of the location and space, beer recipes, overall brewery theme, specifications (with part numbers and manufacturers) of equipment, estimated capital and operating costs, and feasibility evaluation. These will be due before class during the final exam week.

Assessment

Individual (60-70%):		
Class preparation quizzes	10%	
End-of-module assessments	25%	
Required external trainings	10%	
Laboratory performance	15%	**not included in FTSE 430
Team (30-40%):		
Class preparation quizzes	10%	
Brewery business plan (by rubric)	20%	
Team contribution	10%	

The percentage of the final grade for each performance area will be determined by representatives during the first class. The team contribution will be determined by peer evaluation. Individuals will evaluate the contributions their team members by assigning an average of 10 points to the other team members. For example, members of a 5-person team, split 40 points between the other 4 members, and must give at least one score >10 and at least one score <10. Team contribution scores will be the average of the grades (out of 10) received. A "practice" team contribution evaluation will be done at mid-term so that students can receive feedback. We will give all students a midterm grade estimation before the last day to withdraw.

Safety Valves
The lowest individual quiz and end-of-module assessment grade will be dropped.

Common Syllabus Addendum
Additional policies can be found in the Chemical & Materials Engineering Department's common syllabus addendum: http://chme.nmsu.edu/academics/syllabi/chme-common-syllabus-addendum/.

Syllabus Preparation Date
- 4/26/19