

(DRAFT SYLLABUS)

## ECM 1, Winter Quarter 2014

# The Design of Coffee

GE Credit: Science and Engineering; Visual Literacy and Scientific Literacy (3 units)

Instructors: Prof. William Ristenpart & Prof. Tonya Kuhl  
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Lecture: Mondays 2:10 pm – 3:00 pm

Laboratory: 2 hours weekly, in Everson Hall room 126

Instructor Office Hours: Wednesdays & Fridays 2-3pm, 3012 or 3106 Bainer Hall

TA Office Hours: see detailed schedule

### Course Objective:

This class is intended to serve as a non-mathematical introduction to how engineers approach and solve problems, as elucidated by the process of roasting and brewing coffee. The instructors will provide qualitative overviews of the basic principles of engineering analysis and design, and then guide the students in corresponding laboratory experiments testing the effect of design choices on the sensory qualities of coffee. In this manner, students will learn that even a process with only two “chemicals” – coffee beans and water – can have tremendous variability depending on the design choices.

### Grading:

Mid-quarter quiz	(Individual)	10%
Final Exam	(Individual)	25%
Lab conduct, safety, cleanup	(Individual)	5%
Weekly lab write-ups	(Group)	30%
Design project video	(Group)	30%

### Course Format:

Each week will begin with a 50 minute instructor-led discussion about a different chemical engineering principle, with a focus on how that principle is manifested in the production of coffee. We will then go into the laboratory to perform complementary experiments to elucidate or test those engineering principles – and then of course to taste the resulting coffee!

On most weeks a short “pre-lab” reading assignment will be due prior to the lab exercises (typically focusing on a key safety or experimental procedure matter.) The lab exercises will typically be performed in groups of three students. After the lab, each group will submit a short lab “report” summarizing their qualitative and/or quantitative findings, typically due before the next lab. In the final week of the course, each group will prepare their “ideal cup of coffee” that will be judged in a blind taste testing. Finally, each group will prepare a maximum 5-minute long video that describes their design decisions and results. Both exams in the course (quiz and final) will be multiple choice.

### Safety:

All labs will be conducted in the Everson Hall 126, which is a *food-grade facility*. Unlike most labs on campus, you are allowed to eat or drink food within this lab. This means, however, that absolutely no chemicals are allowed inside, only food grade products. Furthermore, hygiene is important. Everyone must wash their hands upon entering the lab, and help clean-up their station at the end of lab. Only drink from your own cup.

Safety (continued):

The main safety hazard in this course is the risk of burns: the coffee pots and roasters can get hot enough to cause *severe burns* if contacted with bare skin. Exercise great caution around them; note that “horseplay” or other misconduct will result in expulsion from the laboratory and almost definitely a failing grade in the course. The other safety hazard involves fires: just like bread can catch fire in a toaster, *coffee beans can catch fire in a roaster*. Never leave the roaster unattended, and pay special attention to the instructor and TA guidelines on safe use of all equipment. If you have any safety questions at any time, do not hesitate to ask!

Coffee Design Project:

The main goal of the coffee design project is to make the best cup of coffee, using the least amount of electrical energy. Each group will receive a score defined by the ratio

$$\text{Final Score} = \frac{\text{Blind Taste Test Score}}{\text{Total Electrical Energy}}$$

The group in each section that receives the highest final score ‘wins’ the design project and will receive a prize. The two inputs into the final score are defined as follows.

- The coffee will be judged in a blind taste test by a panel of ‘experts’ on a scale of 0 to 100 (where 0 is the worst cup of coffee in the history of mankind, and 100 is nirvana in a cup.) The scores from each of the panelists will be averaged together.
- Your group must keep track of how many Joules of electrical energy you used during the entire process of roasting and brewing your coffee. Any piece of equipment you plug into an outlet must be monitored using the energy meter and included in your final tally.

In the final weeks of the course, your group will use Powerpoint and other software video editing tools to create a video presenting your final design, including the process flow diagram, mass balances, energy usage and sensory impressions. The video will be five minutes max; all members of the group must help present in the video. The grade for your design project video is broken down as follows: Quality of the video (oral & slides), 25 %; technical description of the design, 25%; creativity and originality of the design, 25 %; and overall coffee quality (taste & energy usage), 25 %. The following guidelines must be followed:

- 1) The only ingredients you are allowed to use are green coffee beans and water. No syrups, sweeteners, spices, or other artificial flavors may be added.
- 2) For the blind taste test you must prepare enough for everyone in the section, plus the taste panel, to each get 1 fluid ounce of coffee. This means you must make at least 1oz x 36 people = 36 oz = 4.5 cups = approximately 1 liter of coffee.
- 3) You are free to use any combination of the equipment available in the lab for roasting and brewing your coffee. If your group would like to use a different piece of equipment, you may do so with the instructor’s permission. Note: absolutely no open flames are allowed in the lab, so no portable stoves or burners.
- 4) Most importantly, remember that good engineers think of new ways of doing things... we encourage creative designs!