

Syllabus for FS2006: Food Process Design and Optimisation

Semester 2, 2022

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In-person discussions: *Tues 9-10am (CONN-S3)*

Virtual lectures: *Thurs 2-3pm(ONLINE: FSB-322 available if needed)*

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1 Overview

Food science involves the generation of knowledge about food. Food scientists, however, do not only generate knowledge, they also create products, and to design products they must design processes. A food process may have to satisfy multiple criteria to be successful, with respect to Societal, Economic and Environmental domains. The successful process might therefore be that which contributes to the dietary needs of society, in a manner that creates profits and employment, while minimising environmental degradation. To achieve such a goal food scientists need a strong grasp of engineering principles, in addition to science.

This module will focus on a largely **physics- and engineering-based approach** to problems in food processing. The modern food factory at first seems bewilderingly complex, so we will need to break it down into manageable units. We will start by revisiting **fundamental concepts** such as units, dimensions, hydrostatics and fluid dynamics. We will spend some time on **instrumentation** and sensors that often get ignored in university courses, such as pumps, valves, gauges, etc. Then we will discuss some of the **major unit operations** involved in producing a variety of food products, from instant coffee to Irish whiskey and sports supplements.

Towards the end of the module we will discuss **bulk solids** like powders, which are of major importance to the export-based Irish food industry. If we have time towards the end of the module we will discuss some *hot topics*, including issues like sustainable processing, the role of processing in diet and the study of digestion as a process.

Throughout this module we will use a combination of qualitative (e.g., diagramming, critical thinking) and quantitative (e.g., measuring, calculating) approaches to analysis, design and optimisation. It might be possible to "survive" the module by ignoring the calculations, or by ignoring the theoretical aspects, but to do well you will need to study both. Throughout, we will pay close attention to factors that are challenging food processors today and how this may shape food processing in the future.

2 Module Design

2.1 Lectures

The module will use a hybrid approach, including both virtual and in-person elements. On Thursday each week lecture recordings will be made available that cover the main topic that week. On the following Tuesday the class will meet in person to discuss the material and clarify any points of confusion.

Video recordings will be made available on Youtube. You are encouraged to attend all in-person sessions; however, if you are unavailable for justifiable reasons then recordings will be made available of the in-person sessions also. Those of you who did FS1005 in first year Food Science will remember my approach, which many of you encouraged me to keep doing! The videos are designed to be short, dense and interesting. I encourage you to pause, take notes and re-watch as needed.

The slides will be made available to you in an interactive format on a

webpage I put together (link below). I will occasionally add clickable links and content to these slides that can be useful, so try to interact with the slides as much as possible (it should work well on phone, tablet or computer).

Notes that I have prepared for *specific* sections will be uploaded to Canvas when we are covering the relevant material in lectures. **These notes are not a replacement for viewing lectures.**

Please Note

My approach to lectures today is different to what I have done for many years. I now prepare my slides as **mini webpages**, which allows me to prepare more dynamic content that is easier to view on a phone. I also upload my lectures to **youtube**, which is easy to access, adjusts video quality based on internet strength and has excellent auto-captions ^a.

^aI can also upload to Panopto if students have region-specific issues with access, although Panopto uploads tend to have slightly lower quality

2.2 Assessment

Students will be awarded 15% for **practical reports** (see practical schedule below), 15% for an **"in-class" exam** (date below) and 70% for a **formal examination** in Summer 2021. A decent effort in the continuous assessment elements would mean you are very well placed to pass (at a minimum) in Summer.

3 Lecture Schedule¹

1. Class Meeting (18-Jan)
2. Intro to Food Processing (20-Jan)
3. Class Meeting (25-Jan)
4. Food Physics I & II (27-Jan)

¹The sequence is subject to change based on the needs of the class and our progress through the material. For example, if the class has great difficulty with a certain concept we may need to take more time on it. Similarly, if there is general interest in a topic it may demand more time than was originally planned. If we don't cover a topic it might be a disappointment (or a relief!) but rest assured *you will not be examined on it*. You will be notified of any major changes to the structure of this module and it is your responsibility to keep up-to-date on any of these changes.

5. Class Meeting (1-Feb)
6. Engineering Principles I & II (3-Feb)
7. Class Meeting (8-Feb)
8. Hydrostatics I & II (10-Feb)
9. Class Meeting (15-Feb)
10. Fluid Dynamics I & II (17-Feb)
11. Class Meeting (22-Feb)
12. Pre-exam review (24-Feb)
13. **CA exam** (1-Mar)
14. Food Processing at UCC (3-Mar)
15. Class Meeting (8-Mar)
16. Separation Science I & II (10-Mar)
17. Class Meeting (15-Mar)
18. Evaporation and Drying I & II (17-Mar)
19. Class Meeting (22-Mar)
20. Bulk Solids Science I & II (24-Mar)
21. Class Meeting (29-Mar)
22. Sustainable Processing I & II (31-Mar)
23. Class Meeting (5-Apr)
24. **Conclusion** (7-Apr)

4 Practical Schedule (dates TBC)

Several weeks after the start of the module there will be an in-person practical session every week for six weeks. The class will be divided in two, with one group doing their practical on Wednesday afternoon and the other on Thursday afternoon. Students will be provided with notes, report templates and pre-practical talks before each practical. The lectures and practicals are intended to work together - to understand the practicals you have to watch the lectures, to understand the lectures you need to do the practicals and do your reports. ²

1. Physical Characterisation of Foods
2. Principles of Fluid Statics
3. Measurement of Viscosity
4. Operation of Pumps and Mixers
5. Evaporation and Distillation
6. Integrated Process: Coffee
7. Food Processing at UCC (virtual)

5 Useful Links

Links to the Github website containing lecture slides should be visible on the Canvas page but is included also below. The slides are not designed to be downloaded as pdfs, but pdfs can be provided on request.

- Link to website where lecture slides will be hosted:
<https://edibotopic.github.io/lecture-slides/>
- Link to github repo showing code used to make the slides:
<https://github.com/edibotopic/lecture-slides>

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²**Note:** plagiarism will not be accepted. If a student is found to have extensively copied material from online sources (e.g., Wikipedia, my notes) in writing their report they may be awarded a mark of 0%.