

Syllabus for FS2006: Food Process Design and Optimisation

Semester 2, 2021

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Virtual lectures: *Tues 9-10am*

Thurs 2-3pm

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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 design 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 design and optimisation. We will also 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

Each week two video recordings of lectures will be published on Youtube (if you can't access Youtube for region-specific reasons then I can also upload videos to Panopto). The videos will vary in length depending on the topic. I will generally try to avoid putting two large lectures side-by-side where possible. In my view the "sweet spot" for a lecture is under 30 minutes and preferably 10-20 minutes.

I would advise you to keep on top of these releases. *Binge-watching* is a huge cultural phenomenon at the moment. However, while it might be nice to binge a TV show it might be unpleasant to binge hours of academic content! You can watch the videos on your phone in bed if you'd prefer but do try to keep on top of them.

You should also watch the videos actively if possible. By this I mean take notes during the video and look up anything that you don't understand. I will definitely use words that you haven't heard of before, because my weird job

has involved years of technical writing. If I don't explain something to your satisfaction then look it up - have you heard that the internet is amazing? Failing that - ask me to explain further.

The slides will be made available to you in an interactive format on a webpage I put together (link below). These slides are less "content dense" than the videos but might be useful for you to play around with and make notes on. I will also occasionally add clickable links to these slides that you find useful or interesting.h

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 this year is different to anything I have done before. I now prepare my slides as **mini webpages**, which allows me to prepare more animated slides that are easier to view on a phone. I also upload my lectures to **youtube**, which is easy to access and adjusts video quality based on internet strength ^a. I have trialled the approach with first year students this year and it has been very successful so far. I have viewed the pandemic as a time to try new things, and I hope you find some value in the approach I have taken.

^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. Introduction (26-Jan)
2. Food Physics I (28-Jan)
3. Food Physics II (2-Feb)
4. Engineering Principles I (4-Feb)
5. Engineering Principles II (9-Feb)
6. Hydrostatics I (11-Feb)
7. Hydrostatics II (16-Feb)
8. Hydrostatics III (18-Feb)
9. Fluid Dynamics I (23-Feb)
10. Fluid Dynamics II (25-Feb)
11. Fluid Dynamics III (2-Mar)
12. **In-class test** (4-Mar)
13. Food Processing at UCC (9-Mar)
14. Separation Science I (11-Mar)
15. Separation Science II (16 Mar)
16. Evaporation and Drying I (18-Mar)
17. Evaporation and Drying II (23-Mar)
18. Bulk Solids Science I (25-Mar)
19. Bulk Solids Science II (30-Mar)

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.

20. Automation and Industry 4.0 (1 Apr)
21. Sustainable Processing (13 Apr)
22. Processing and Diet (15 Apr)
23. Digestion as a Process (20 Apr)
24. **Conclusion** (22 Apr)

4 Practical Schedule

Beginning on the **17th of February** there will be a practical session each Wednesday for six weeks. The exception is the lab on the 16th March, which is on a Tuesday to avoid clashing with St. Patrick's Day. In normal circumstances the practicals involve both laboratory and process hall activities. Due to the pandemic they will be pre-recorded videos. Students will be provided with notes, report templates and data to accompany the videos. 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 watch the practicals and do your reports. ²

1. Physical Characterisation of Foods (17-Feb)
2. Principles of Fluid Statics (24-Feb)
3. Measurement of Viscosity (3-Mar)
4. Operation of Pumps and Mixers (10-Mar)
5. Evaporation and Distillation (16-Mar)
6. Integrated Process: Coffee (24-Mar)

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.

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

- 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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