# Food Processing

**2022/2023 a.y.**

## Food rheology

## Prof. Roberta Dordoni

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The purpose of this course is to lead the student to a proper knowledge of rheology importance within the food industry. This knowledge, combined with case studies and seminars, will allow the student to critically identify the relationship occurring between rheological parameters of food products and their industrial processability (e.g., pumping, mixing, shearing, homogenizing), as well as with the felt perception during their consumption. In addition, the course will provide students with the basis for evaluating the behavior of liquid/creamy food products also from the thermal and colorimetric point of view.

In summary, at the end of the course, the student should be able to:

1. Recognize the main operative parameters effect on rheological, characteristics of foods;
2. Interpret experimental data and discriminate rheological behaviors of foods;
3. Acknowledge the instrumentation needed to measure specific rheological, thermal, and colorimetric properties of food products.

***COURSE CONTENT***

|  |  |
| --- | --- |
| - | ECTS |
| **Introduction** | 0.2 |
| **Rheological properties of food products:**  Monodimensional Newton’s equation. Viscosity and its dependence on temperature/pressure. Study cases: flow between plates and flow within pipes under laminar conditions. Evaluation of flow rate and stress profiles. Constitutive rheological equations. Shear stress vs. shear rate & viscosity vs shear rate graphs depending on the food nature. | 1.0 |
| **Instrumentation for viscosity measurement:**  Capillary and rotational viscometers. Mathematical basics and functioning principles. | 0.5 |
| **Mechanical properties of food products**  General information: importance, applications. Body/texture interactions, mastication. Physics behind texture: Young modulus & characteristics stress/strain curves. Critical points. Instrumentation: texturometer (functioning principles). | 1.1 |
| **Viscoelasticity**:  General information: importance, applications. Deborah number. Linear viscoelastic region. Oscillatory testing & mathematical models | 0.6 |
| **Thermal and colorimetric properties of food products:**  General information: importance, applications. Instrumentation and study cases. | 0.6 |
| **Tutorials:** Group work, numerical exercises, and viscosity determination from constitutive equations.  Seminars by experts on specific topics and/or participation in an educational visit. | 1.0 |

***READING LIST***

* M. BOURNE, *Food Texture and Viscosity: Concept and Measurement*, Academic Press, London, 2002.
* J.F. STEFFE, *Rheological Methods in Food Process Engineering*, Freeman Press, East Lansing, 1996.
* M. A. ANDY RAO - G.V. BARBOSA-CÁNOVAS, *Rheology of Fluids and Semisolid Foods: Principles & Applications*, Aspen Publisher, Gaithersburg, 1999.
* Lecturer's notes

***TEACHING METHOD***

* Lectures in which concepts and work methodologies are presented. These lectures are coupled with case studies.
* Numerical tutorials during which problems are solved with the methods seen during the lectures
* Different in-depth seminars held by experts from both industry and academia and/or participation in an educational visit (depending on the availability of experts and/or companies).
* The teaching materials used during the lessons will be available on the common platform for students (i.e., Blackboard). The course slides are to be considered an integral part of the reference bibliography.

***ASSESSMENT METHOD AND CRITERIA***

The student will be required to take a final oral exam consisting of 2-3 theoretical questions and in the discussion of the working group. The latter will be carried out during the semester, with an illustration of the topics and aims of the work, and the requirements of the final report (PowerPoint presentation). The work groups may consist indicatively of a maximum of 4-5 students, and the contribution and role of each member must be explicitly indicated in the final report. The final report will be assessed with a mark out of 30. The final mark will be taken as a weighted arithmetic mean of the mark obtained in the oral test (with a 2/3 weight) and that obtained in the group work assessment (with a 1/3 weight). In the case of working students or students unable to participate in the group work, this must be communicated to the lecturer at the beginning of the course, who will then be able to provide appropriate alternative ways to cover this part of the program.

***NOTES AND PREREQUISITES***

The course requires some basic knowledge of the chemical-physical characteristics of food products. Moreover, it is suggested that students review the basics of mathematics and physics with particular reference to equations, powers, exponential and logarithmic functions with related properties.

***OFFICE HOURS FOR STUDENTS***

Prof. Roberta Dordoni is available for the students after the lectures held in Cremona. In addition, he is available to receive students following specific appointments or through remote meetings. In any case, it is suggested to write an e-mail ([roberta.dordoni@unicatt.it](mailto:roberta.dordoni@unicatt.it)) in order to agree on the day and time of reception.

## Industrial research and development

## Prof. Marco Trezzi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The purpose of this course is to lead the student to a proper knowledge on the research and development activities performed in food companies. This knowledge, combined with case studies, will allow the student to know the steps in the new product development process, with specific reference to the dairy and bakery products.

At the end of the course, the student should be able to:

1. Understand the role, organization and main activities of an R&D department of a food company
2. Acknowledge the phases and the technical aspects of the new product development process
3. Have the necessary basic knowledge to set up and accomplish the development of new dairy and bakery products.

***COURSE CONTENT***

|  |  |
| --- | --- |
| - | ECTS |
| **Introduction** | 0.2 |
| **The R&D in the food industry**  Innovation models in the food industry. New products categories and their characteristics. Reasons why of the failure and the success of new products. R&D and product development metrics. R&D organizations. | 1.0 |
| **The innovation process in the food industry**  The innovation phase and gate process: idea generation, concept development and testing, business case development, product development, product testing and validation.  New product feasibility study: competitor’s product analysis and benchmarking, legislation requirements, patent analysis, sustainability analysis.  New product technical activities: project brief, ingredient and packaging material selection, technology identification, recipe development, product costing and cost optimization, lab bench and pilot plant prototyping, industrial tests, product testing | 1.4 |
| **Innovation in dairy products**  New products in the dairy category: food for specific consumer groups, lactose-free products, dairy drinks, plant-based alternatives | 0.7 |
| **Innovation in bakery products**:  New products in the bakery category: high fibre and wholemeal products, clean label approach, enzymes in bakery products, bakery fillings | 0.7 |

***READING LIST***

* G.W. Fuller*. New Food Product Development. From Concept to Marketplace.* CRC Press, Inc., 2011.
* H.R. Moskowitz, I.S. Saguy, T. Straus. *An Integrated Approach to New Food Product Development.* CRC Press, Inc., 2009
* Weibiao Zhou, Y.H. Hui.. *Bakery Products Science and Technology.* John Wiley & Sons, 2014
* D. Manley. *Manley’s technology of biscuits, crackers and cookies.* Woodhead Publishing Limited, 2011
* P. Walstra, J.T.M. Wouters, T.J. Geurts. *Dairy Science and Technology.* CRC Press, Inc., 2006.
* Lecturer's notes

***TEACHING METHOD***

* Classroom lectures will be held with the support of Power Point presentations.
* Case studies carried out in working groups during the semester, with an illustration of the topics and aims of the work, and the requirements of the final report (PowerPoint presentation).
* In-depth seminars held by experts from industry (depending on the availability of the experts).
* The teaching materials will be made available to students in pdf format and uploaded on common platform for students (i.e., Blackboard). Their knowledge will form the basis for the assessment of learning in the subject.

***ASSESSMENT METHOD AND CRITERIA***

The student will be required to take a final oral examination consisting of 2-3 theoretical questions and in the discussion of the working group. The latter will be carried out during the semester, with an illustration of the topics and aims of the work, and the requirements of the final report (PowerPoint presentation). The work groups may consist indicatively of a maximum of 4-5 students, and the contribution and role of each member must be explicitly indicated in the final report. The final report will be assessed with a mark out of 30. The final mark will be taken as a weighted arithmetic mean of the mark obtained in the oral test (with a 2/3 weight) and that obtained in the group work assessment (with a 1/3 weight). In the case of working students or students unable to participate in the group work, this must be communicated to the lecturer at the beginning of the course, who will then be able to provide appropriate alternative ways to cover this part of the program.

***NOTES AND PREREQUISITES***

The student should have a basic knowledge of chemistry, biochemistry, microbiology and food technology systems and processes, with particular reference to dairy and bakery products.

***OFFICE HOURS FOR STUDENTS***

Prof. Marco Trezzi is available for the students after the lectures held in Cremona.