## ***CEREAL GRAINS, PROCESSING AND TECHNOLOGY***

## Prof. stefano amaducci

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

Cereals are the dominant crops in world agriculture and they are the major source of calories and protein to the diets of humans and livestock. The course provides students with an understanding of the basic principles of cereal crop production. The course covers the critical management practices required for the sustainable production of cereals and particular emphasis will be placed on the understanding of the effect of “genotype x environment x management” on cereal yield and quality.

**Knowledge and analysis ability**.

At the end of the course, the student is expected to own fundamental knowledge about cereal crop eco-physiology, cultivation techniques and factors affecting yield and quality. Students should be able to:

- Recognise the plants and the fruits of the main cereal crops;

- Demonstrate a basic understanding of crop requirements during the main phenological phases.

**Know-how and its application**

Upon completion of the course the student should be able to:

- Describe the critical management practices for production of the major cereal crops;

- Identify and utilize the appropriate resources required to make critical decisions in cereal crop production;

- Understand the relations among cereal yield, cereal quality and the main agronomic factors.

**Autonomy in self-assessment**

Based on the knowledge acquired during the course, the student is expected to:

* provide autonomous and critical assessments of crop production systems and to elaborate effective strategies to solve practical problems related to cereal crop management.

**Communications skills.**

At the end of the course, the student is expected to discuss and debate on issue related to cereal crop cultivation, using suitable and proper technical language.

**Learning capacities**

At the end of the course, the student will be able to extend his/her knowledge beyond the notions learnt during the course, and to keep continuously updated on innovations affecting the production of cereals.

***COURSE CONTENT***

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|  | **CFU** |
| **Introduction to the course**Cereals: General characteristics, importance and diffusionOrigin and history of cereal cultivation, present and future trends. | 0,25 |
| **Wheat**Phenology, Crop biology and eco-physiology, Crop requirements, Nitrogen fertilisation and Nitrogen Use efficiency, Irrigation and Water use efficiency, How to control wheat quality through agronomic management, conventional vs organic management, remote sensing and precision management.  | 2,0 |
| **Barley**Principles of cultivation and plant biology. How to grow barley for food, feed or malt.**Rye, oat and minor cereals** Principles of cultivation and plant biology**Minor and ancient cereal** Principles of cultivation and plant biology | 1.0 |
| **Maize**Principles of cultivation and plant biology. How to grow maize for food destinations.**Rice** Principles of cultivation and plant biology.**Sorghum** Principles of cultivation and plant biology. | 1.75 |
| **Practical and field visit:** Calculation of nitrogen and water requirements for the main herbaceous crops. Introduction to precision fertilization and irrigation techniques. | 1.0 |

***READING LIST***

 FAO, 2016. Save and Grow in practice. A guide to sustainable cereal production. ISBN 978-92-5-108519-6 120 pp Availabe online at: www.fao.org/publications

 Colin Wrigley Ian Batey Diane Miskelly EDS. 2017. Cereal Grains 2nd Edition Assessing and Managing Quality. 830 pp

 Further readings, Notes and study materials will be supplied during the lectures.

***TEACHING METHOD***

Teaching will include indoor theoretical lessons and indoor and outdoor practicle activities:

Theoretical lessons will be taught in classroom with the support of power point presentations. Students will be encouraged to interact with the class and the teacher.

Practical activities and exercises will be carried out both indoor and outdoor. The students will be introduced to the calculation of nutrient and water balances and to the use of instruments and sensors relevant for the application of precision agriculture techniques.

Field visits will be organised to visit farms and companies involved in cereal production chhains.

***ASSESSMENT METHOD AND CRITERIA***

 Final written exam with 20 multiple-choice questions (1 points each), 2 open questions (3 points each) and 1 exercise (4 points). Students will be given 2 h time to answer all questions and to solve the exercise.

***NOTES AND PREREQUISITES***

Required pre-requisites for attending the course are basic knowledge of plant biology and physiology and applied agronomy.

Prof. Stefano Amaducci receives students at DIPROVES – Students are kindly requested to send an e-mail to set up an appointment.

## Prof. Gianluca Giuberti

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

 Students will deepen their knowledge concerning the principles and main concepts related to cereal grains, their use as ingredients, and processes related to cereal-based product manufacture in the gluten and gluten-free food systems. General characteristics of raw materials, main technological aspects related to cereal-based food production, and principles of food processing will be given. Expected learning skills are better defined as follows:

**Knowledge and analysis ability**

 On completion of the course, students are expected to: 1) own fundamental knowledge of chemical and technological properties of the various cereal grains generally used in the food industry; 2) have an understanding of the milling and thermal processes; 3) understand the role of gluten and starch in a range of cereal-based products; 4) understand the industrial process used in pasta and bakery product formulation both in the gluten and in the gluten-free food systems; 5) have an overview of the nutritional significance of different cereal-based foods.

**Know-how and its application**

 The students must be able to plan a process flowchart and identify the main factors affecting the functional, technological, and nutritional properties of a given cereal-based food product. In addition, students are expected to provide the most suitable solutions in food processing to improve the functional, technological, and nutritional properties by applying the consolidation of new technologies.

**Autonomy and self-assessment**

 In front of a given functional and nutritional issue, students are expected to provide autonomous analysis based on acquired knowledge. In addition, students are expected to manage research and technical development activities.

**Communications skills**

 The students are expected to be able to successfully supply, in both oral and written forms, a comprehensive technological and nutritional explanation of the different bakery-food products by using appropriate technical language.

**Learning capacities**

 At the end of the course, students will have scientific and technical tools suitable to either lead them to higher study courses or to operate in the industry successfully connected with producing cereal-based foods with autonomy and responsibility.

***COURSE CONTENT***

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|  | **CFU** |
| **Part 1:** cereal grains, type, milling and grade of flour.  | 0.5 |
| **Part 2:** starch, protein, and lipid: structural changes during mixing, thermal processing, and interactions.  | 1.0 |
| **Part 3:** modified starches, resistant starch, functional compounds, and other peculiar ingredients.  | 0.5 |
| **Part 4:** pasta and bread: process flowchart and technological aspects. | 1 |
| **Part 5:** products other than bread and pasta: process flowchart and technological aspects. | 0.5 |
| **Part 6:** functional foods, and future trends of research.  | 0.5 |
| **Practical classes:** Lab activities concerning novel bakery product production. Group works and seminars with industry representatives. | 1 |

***READING LIST***

 Bond, N., 2004. Rice milling. In: Champagne, E.T. (Ed.), Rice: Chemistry and Technology. AACC International, Inc., St. Paul, MN, USA.

 Dexter, J.E., Sarkar, A.K., 2004. Wheat: dry milling. In: Wrigley, C., Corke, H., Walker, C. (Eds.), Encyclopedia of Grain Science. Elsevier, Oxford, pp. 363-375.

 Maningat, C.C., Seib, P.A., Bassi, S.D., Woo, K.S., Lasater, G.D., 2009. Wheat starch: production, properties, modiﬁcation and uses. In: Bemiller, J.N., Whistler, R.L. (Eds.), Starch: Chemistry and Technology. Academic Press, New York, USA.

 Papageorgiou, M., Skendi, A., 2013. Flour quality and technological abilities. In: de Pinho Ferreira Guiné, R., dos Reis Correia, P.M. (Eds.), Engineering Aspects of Cereal and Cereal-based Products. CRC Press, Boca Raton, FL, USA.

 Serna Saldivar, S.O., 2010. Cereal Grains: Properties, Processing and Nutritional Attributes. CRC Press (Taylor & Francis Group), Boca Raton, FL, USA

***TEACHING METHOD***

 Learning activities will include lectures, seminars, class discussions, and practical activities. High interactivity between teacher and students will be stimulated.

***ASSESSMENT METHOD AND EVALUATION CRITERIA***

 Final written exam with 30 multiple-choice questions (1 point each). Students will be given 1 h time. In case of no answer or wrong answers, no points will be awarded. Should group work be carried out during the year with a final presentation of the work by the students, the final grade will consider both the written test and the group work assessment (max 2 points).

 ***NOTES, PREREQUISITES AND OFFICE HOURS***

 To properly follow the course, students should have basic knowledge of food technology processes, food preservation and rheology. Prof. Gianluca Giuberti receives students on the days when lectures are held at the DiSTAS – Section of Food Technologies, Enology and Environment.