SCUOLA DI SCIENZE AGRARIE, FORESTALI, ALIMENTARI ED AMBIENTALI

COURSE: Food engineering / Principles of machines and plants for the agro-food industry			
ACADEMIC YEAR: 2017/2018			
TYPE OF EDUCATIONAL ACTIVITY: Basic			
TEACHER: Giuseppe Altieri			
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Language: Italian			
ECTS: 6 (5 lessons and 1 tutorials/practice)	**n. of hours**: 56 (40h lesson and 16h tutorials/practice)	**Campus**: Potenza **School**: SAFE **Program**: First Cycle in Food Technology	**Semester**: I

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The course provides the basic principles needed to understand and analyse the physical systems and transformations related to machines, plants, unit operations and supplemental processes of food industry. It dispenses all the basic elements related to thermodynamics, heat transfer mechanisms, fluid flow, mass transport and to mechanics of the fluids. It supplies the basic knowledge to understand, critically analyse and to interpret various simple problems of practical interest in order to solve real problems allowing to gain the capability to analyse the production processes of food industry.

- ***Knowledge and understanding***: knowledge and understanding of basic principles related to thermodynamics, heat transfer mechanisms, fluid flow, mass transport and to mechanics of the fluids needed to understand and analyse the physical systems and transformations related to machines, plants, unit operations and supplemental processes of food industry.

- ***Applying knowledge and understanding***: ability to understand, critically analyse and to comprehend various simple problems of practical interest in order to solve real problems gaining the capability to analyse the production processes of food industry.

- ***Making judgements*****:** ability to know how to choose and apply, giving reasons, the most appropriated fundamental physical laws related to thermodynamics, heat transfer mechanisms, fluid flow, mass transport and to mechanics of the fluids; ability to analyse the production process with regard to machines, plants, unit operations and supplemental processes in order to solve real problems related to food industry processes.

- ***Communication skills***: ability to communicate and to outline, in a clear and detailed manner and with proper language, the physical phenomena involved, making their analysis and presenting a possible solution; ability to communicate the analysis of the production process appropriateness, including the process energy saving possible solutions.

- ***Learning skills*****:** ability on how to use the main reference textbooks about technical and scientific literature to take advantage of the innovation developed at the scientific level in order to constantly advance scientific and cultural personal skills.

PRE-REQUIREMENTS

The following skills are needed:

- basic concepts of mathematics;
- basic concepts of physics.

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SYLLABUS

The course is composed of 3 teaching blocks (TB) related to the physics and thermodynamics of physical systems, fluid flow, mass transfer and heat transfer, with guided classroom tutorials based on numerical and detailed cases study related to food industry applications.

TB1 – Physics and thermodynamics of systems (*20h theoretical lessons + 8h classroom tutorials*)

- physical quantities, unit systems, measurement error
- system definition, state of a system
- density, concentration, moisture content
- heat, temperature, pressure, enthalpy
- equation of state, perfect gas law
- phase diagram of water
- conservation of mass, mass balances
- thermodynamics, laws of thermodynamics
- energy, energy balance for closed and open systems
- total energy balance, power
- thermodynamic cycles, Carnot cycle, heat engine
- use of pressure-enthalpy diagram for real gases, refrigeration cycle
- energy in food processes
- property of dry air, water vapour and air-vapour mixtures
- psychrometric chart

TB2 – Fluid flow and mass transfer (*10h theoretical lessons + 4h classroom tutorials*)

- dimensional analysis
- properties of liquids, density, viscosity, the continuity equation
- Reynolds number, forces due to friction
- Bernoulli equation
- energy equation for steady flow of fluids
- flow and viscosity measurement
- flow characteristics of non-newtonian fluids
- transport of solid foods
- diffusion processes

TB3 – Heat transfer (*10h theoretical lessons + 4h classroom tutorials*)

- thermal properties of foods
- modes of heat transfer
- steady-state heat transfer
- estimation of overall heat-transfer coefficient
- the “fouling” problem
- unsteady-state heat transfer
- the Biot number and its use in heat transfer
- ohmic heating and microwave heating

TEACHING METHODS

The course is based on 3 teaching blocks and it provides 40 hours of theoretical lessons and 16 hours of guided classroom tutorials. The guided classroom tutorials are based on numerical and detailed cases study related to food industry applications using real data.

EVALUATION METHODS

The aim of examination is to verify the student achieved skills as previously listed.
The examination consists in an oral presentation of a work of deepening study about a topic related to the course, from this starting point the oral examination will continue on other topics treated during the course aiming to evaluate student skills.

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TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

The course material is constituted of selected material from reference textbooks and handouts in electronic format stored on a document cloud which will made accessible to the students.

The recommended textbooks, to further deepen the topics covered in the course, are the following:

- Bimbenet J.J., Dumoulin E., Trystram G., 1994, Automatic control of food and biological processes, Elsevier Science B.V., Amsterdam, The Netherlands;
- Friso D., 2013, Ingegneria dell'industria alimentare. Operazioni unitarie del food engineering. Macchine e impianti., CLEUP, Padova;
- Singh R.P., Heldman D.R., 2001, Introduction to food engineering, Academic Press, San Diego, California, USA;
- Singh R.P., Heldman D.R., 2015, Principi di Tecnologia Alimentare, Zanichelli, Casa Editrice Ambrosiana;
- Sharma S.K., Mulvaney S.J., Rizvi S.S.H., 2000, Food process engineering: theory and laboratory experiments, Wiley-Interscience, John Wiley & Sons, Inc., New York, USA;
- Valentas K.J., Rotstein E., Singh R.P., 1997, Handbook of Food Engineering Practice, CRC Press LLC, 2000 Corporate Blvd., N.W., Boca Raton, FL, USA.

INTERACTION WITH STUDENTS

At beginning of the course the lecturer will explain to students the pre-requirements needed, the educational goals, the expected learning outcomes, the course syllabus (structure/organization), the evaluation methods and the reference textbooks. Subsequently the students who will attend assiduously the course are asked for their name, surname and E-mail. After each lecture, related documents in electronic format will be available on a document cloud accessible to the students.
The lecturer will be available to receive students Tuesday (15.00-17.00) and Wednesday (15.00-17.00) and/or even in other days preferably after an E-mail contact.

EXAMINATION SESSIONS (FORECAST)[1]
13/09/2017, 18/10/2017, 15/11/2017, 13/12/2017, 17/01/2018, 14/02/2018, 14/03/2018, 11/04/2018, 16/05/2018, 13/06/2018, 11/07/2018.

EVALUATION BOARD
Giuseppe Altieri (President), Francesco Genovese (Member), Giovanni Carlo Di Renzo (Replacement Member)

SEMINARS BY EXTERNAL EXPERTS YES □ NO ●

FURTHER INFORMATIONS
Nothing

[1] Subject to possible changes: check the web site of the Teacher or the School for updates.