## Syllabus

### Course description

<table>
<thead>
<tr>
<th><strong>Course title</strong></th>
<th>Agricultural Engineering</th>
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<tbody>
<tr>
<td><strong>Course code</strong></td>
<td>40139</td>
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<tr>
<td><strong>Scientific sector</strong></td>
<td>AGR/08 - AGR/09</td>
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<tr>
<td><strong>Degree</strong></td>
<td>Agricultural and Agro-Environmental Sciences</td>
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<tr>
<td><strong>Semester</strong></td>
<td>II</td>
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<tr>
<td><strong>Year</strong></td>
<td>II</td>
</tr>
<tr>
<td><strong>Academic year</strong></td>
<td>2016-2017</td>
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<tr>
<td><strong>Credits</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Modular</strong></td>
<td>Yes</td>
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<table>
<thead>
<tr>
<th><strong>Total lecturing hours</strong></th>
<th>36+36</th>
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<tbody>
<tr>
<td><strong>Total lab hours</strong></td>
<td></td>
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<tr>
<td><strong>Total exercise hours</strong></td>
<td>24+24</td>
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<tr>
<td><strong>Attendance</strong></td>
<td>Optional</td>
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<tr>
<td><strong>Prerequisites</strong></td>
<td>Mathematics and Statistics, Physics</td>
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### Specific educational objectives

This course belongs to those characterizing the Bachelor program, in the area of forest and agricultural engineering. By the end of the course, students are expected to be able to:
- recognize the relevance of a sustainable water management in rural areas;
- realize the relevant engineering and economic principles for a mechanisation system;
- determine water budgets at the basin and plot scale;
- predict flood discharge in small rural catchments;
- design stable channels for irrigation and/or drainage;
- design simple irrigation systems.
- select and size the most important components of a mechanisation system in a given farm context;
- predict the technical performances of an existing farm machinery set;
- evaluate the operating costs of an existing farm machinery set;
- perform an investment analysis for alternative machinery sets;
- identify both weak- and strength-points of any mechanisation solution, with emphasis to safety issues.

### Module 1

<table>
<thead>
<tr>
<th><strong>Agricultural Machinery</strong></th>
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<tbody>
<tr>
<td><strong>Lecturer</strong></td>
</tr>
<tr>
<td><strong>Scientific sector of the lecturer</strong></td>
</tr>
<tr>
<td><strong>Teaching language</strong></td>
</tr>
<tr>
<td><strong>Office hours</strong></td>
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<tr>
<td><strong>Teaching assistant (if any)</strong></td>
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<tr>
<td><strong>Office hours</strong></td>
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</table>
### List of topics covered

1. Introduction to applied physics for farm machines
2. Thermodynamic cycles, energy and efficiency in mechanised processes
3. Power generation systems and energy resources; energy needed and energy consumption
4. Endothermic engines and related performance standard curves
5. Machinery classification and farm context: a system analysis approach
6. Overview on Farm and Forestry Tractors (FTR)
7. FTR: technical general features and construction aspects
8. FTR: fundamentals of dynamic power balance; power supply forms
9. FTR: adherence and traction performance;
10. FTR: methodologies for tractor sizing and selection
11. Overview on Farm Implements and Plants (IMP)
12. IMP: general features and classification of machines
13. IMP: methodology for determining power demand
14. IMP: work time analysis and work-rate calculations
15. Tractor-implement combination analysis
16. Analysis of technical performances: workability, worktimes assessment and organization of works
17. Analysis of economic performances: fixed and variable costs, operating costs, principles of investment analysis
18. General methodology for selecting and sizing a farm machinery set
19. Ergonomic and safety of farm machines
20. General methodology for analysing an existing farm machinery set according to multicriteria approach

The course will even cover the following special topics:

21. Soil tillage and drilling equipments
22. Fertilizing and chemical spreading equipments
23. Forage harvesting and conservation techniques
24. Special problems for cultivation and harvesting equipments in hilly and mountain areas
25. An introduction to forestry machinery: solutions for light and heavy mechanisation

### Teaching format

This is a lecture-lab course in which topics are presented by the Professor. Practical activities (lab classes and field excursions) are led by the Professor eventually assisted by a teaching assistant. Slides pdf-presentations will be available in the course reserve collection database of the Faculty. Additional materials related to both proposed and solved exercises and articles on specific topics will be provided by the Professor, directly.

### Module 2

**Rural Hydrology and Hydraulics**

**Lecturer**
Francesco Comiti, building K, office K203, email francesco.comiti@unibz.it, tel: 0471017126, webpage: http://pro.unibz.it/staff2/fcomiti/web_comiti/index.htm

**Scientific sector of the lecturer**
AGR/08 - IDRAULICA AGRARIA E SISTEMAZIONI IDRAULICO FORESTALI

**Teaching language**
English

**Office hours**
From Tuesday to Friday, upon arrangement by email

**Teaching assistant (if any)**
Dr. Andrea Andreoli, andrea.andreoli@unibz.it

**Office hours**
upon arrangement by email
### List of topics covered

The course will cover the following topics:

1. The hydrological cycle
2. Stream basins and their channel network
3. Precipitation: measurement, spatial analysis and extreme value statistics
4. Dynamics of water in the soil (saturated and unsaturated conditions)
5. Runoff processes: types and characteristics
6. Rainfall-Runoff models (Rationale and SCS methods)
7. Flood hydrographs and flow duration curves
8. Basics of hydrostatics (Pascal’s and Stevin’s laws) and their application
9. Fundamental equations of hydrodynamics (continuity, conservation of energy, conservation of momentum) and their applications to orifices, weirs, and local losses
10. Uniform flow in open-channels (Manning's equation, shear stress, channel stability)
11. Uniform flow in closed-conduits (Darcy-Weissbach equation, Moody's diagram, localized head losses)
12. Principles of land reclamation and channel design
13. Design of pressurized irrigation systems

### Teaching format

In this course the theoretical concepts are presented in the class by the Professor whereas practical activities (lab classes and field excursions) are led by the Professor in conjunction with the teaching assistant (TA).

Students are required to work independently in the lab – under the supervision of the professor and of the TA – and at home to solve exercises and prepare a report based on them and on the field trip. Power Point presentations of the lectures will be made available on the Moodle website of the University (http://kronos.education.unibz.it/FUBmoodle), along with links to external resources and exercises.

### Learning outcomes

**Knowledge and understanding** on farm machinery use in mountain areas, with related aspects on safety, work organization and energy impacts; on water dynamics in rural environments related to flood protection as well as agricultural production

**Applying knowledge and understanding** in the planning, selection and use of farm machinery in mountain areas; in the analysis of water budget and flood discharge in small catchments, design of stable channels (for drainage or irrigation) and irrigation systems

**Making judgments** through the choice of the most appropriate parameters for hydrological and mechanical analysis presented in a written report and in the written exercises

**Communication skills** to present topics and issues relative to agricultural hydrology and machinery with pertinent and adequate technical terminology

**Learning skills** to deepen and update the knowledge acquired during the course seeking relevant information on scientific and technical literature

### Assessment

The assessment of students’ outcomes will be carried out through i) written exams featuring applied exercises; ii) oral
exams on theoretical aspects of the topics; iii) individual reports on field and lab activities.

<table>
<thead>
<tr>
<th>Assessment language</th>
<th>Italian (Module 1) and English (Module 2)</th>
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<tbody>
<tr>
<td>Evaluation criteria and criteria for awarding marks</td>
<td>The final grade for the entire course will be calculated as the average of the final grades obtained in the two modules. The mark for Module 1 will be assigned as follows: report on exercise and lab activities (30%), written exam (30%), oral exam (40%). It will not be possible to pass the exam if one of the three assessment is insufficient. The mark for Module 2 will be assigned as: individual report on lab activities and field visit (20%), written exam (40%), oral exam (40%). It will not be possible to pass the exam if one of the three assessment is insufficient. Grades are assigned based on correctness and clarity of answers, mastery of the technical language, capability to establish relationships between different topics.</td>
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<table>
<thead>
<tr>
<th>Required readings</th>
<th>• Dingman S.L., Physical hydrology. Waveland press, 2008 (selected chapters will be indicated in class) • Lazzari M., Mazzetto F. Prontuario di meccanica agraria e meccanizzazione. Reda Ed., 2004</th>
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