Fundamentals of Precision Livestock Farming

Module: Facilities and Precision Livestock Farming

Prof. Maurizio Moschini

COURSE AIMS AND INTENDED LEARNING OUTCOMES

The course aims to provide students with knowledge of the possible automation solutions available for the management of animals (cattle, pigs, poultry) in feeding and resting areas, for climate control in animal housing, for the flow management of farmed animals, and for the preparation/distribution of rations, depending on the species bred and with a view to environmental sustainability. Aspects of handling and valorising livestock effluent produced on the farm will also be addressed.

At the end of the course, students will know and understand the main critical points related to the management of animals, food, and the main technological approaches available to improve production efficiency. They will know how to handle livestock effluents as well as the bases of various aerobic and anaerobic processes for exploiting the effluents themselves. For each of the topics covered, students will be able to identify and critically examine the reality of a farm, and evaluate possible sustainable alternative scenarios for improving the production process.

COURSE CONTENT

|  |  |
| --- | --- |
|  | ECTS |
| Management of animals in the feeding and rest area | 1.5 |
| Technologies for the identification of animals, for free and controlled access to food, and for controlling growth rates; heat stress and technologies for cooling animals/animal shelters; lighting control and animal performance. |  |
| Food and nutrition management | 1.25 |
| Technologies applied to the preparation and distribution of food and water aimed at production automation, efficiency and performance. |  |
| Management and valorisation of zootechnical effluent | 0.25 |
| Handling of effluent; biogas; composting. |  |

READING LIST

Large Dairy Herd Management, 3rd ed. (David K. Beede).

Feed efficiency in swine (edited by Patience JF), 2012.

Commercial poultry nutrition, 3rd ed. (Leeson S. and Summers JD)

Supplementary reading references for the individual topics covered will be provided during the course.

TEACHING METHOD

Theoretical frontal lectures (3 ECTS, 21 hours) in which the key concepts of the subject will be presented. Where necessary, the theoretical part is supported by application examples in order to facilitate students' reasoning and learning skills regarding the concepts covered.

ASSESSMENT METHOD AND CRITERIA

A final oral exam comprising general questions from which further specific questions may arise. Ten marks are allotted to each general question and the final mark, out of thirty, will be communicated immediately at the end of the exam. The assessment aims to provide a measure of the student's overall level of preparation on the entire course programme and to help the lecturer understand the student's reasoning skills and analytical rigour. Altogether, students must demonstrate their knowledge of the course contents, know how to express themselves with the appropriate terminology, and be able to orient themselves in different scenarios, demonstrating an ability to propose feasible processes of improvement.

NOTES AND PREREQUISITES

Students must possess basic knowledge of the concepts of biological processes and animal physiology.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.

Module: Rural Buildings

Prof. Ferdinando Calegari

*COURSE AIMS* *AND INTENDED LEARNING OUTCOMES*

The course aims to provide students with the necessary knowledge for analysing and dealing with problems related to the design of buildings and installations for a livestock farm, addressing the main technologies available and their methods of use, and applying the criteria for evaluating technical efficiency, environmental impact and economic advantage. At the end of the course, students will have the knowledge to identify and understand the main critical issues related to the design and sizing of buildings and installations for livestock farms. For each of the topics covered, students will be able to identify and critically examine in detail the situation of a farm, and evaluate possible alternative scenarios in terms of sustainability and improvement of production processes.

COURSE CONTENT

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| --- | --- |
|  | ECTS |
| Shelters for cattle, pigs and chickens  | 1.0 |
| Facilities for the storage of fodder and foodstuffs | 0.5 |
| Isolation and heat balancing in livestock housing | 0.5 |
| Milking plants (traditional and robotic) and control systems | 1.0 |

READING LIST

Chiumenti, *Costruzioni rurali*, Edagricole, Bologna, 2004;

Cavalchini, *La mungitura – tecnologie, scelta e gestione degli impianti,* Edagricole, Bologna, 2007;

Further reading references on the topics covered will be indicated during the course.

TEACHING METHOD

The course includes frontal/telematic lectures (3 ECTS, 21 hours) of a theoretical nature, in which the key concepts of the subject will be presented with application examples in order to facilitate students' reasoning and learning skills around the concepts presented.

ASSESSMENT METHOD AND CRITERIA

A final oral exam. The assessment aims to provide a measure of the student's overall level of preparation on the entire course programme and to help the lecturer understand the student's reasoning skills and analytical rigour. Altogether, students must demonstrate their knowledge of the course contents, know how to express themselves with the appropriate terminology, and be able to orient themselves in different scenarios, demonstrating an ability to propose feasible processes of improvement.

NOTES AND PREREQUISITES

Students must have basic knowledge of the concepts of animal welfare and physiology.

Time and place of students' reception

Prof. Ferdinando Calegari receives students after class or by appointment at the Geo-spatial Analysis and Remote Sensing Research Center - CRAST (tel. 0523 599243 - ferdinando.calegari@unicatt.it).

# Module: Applications of Sensors in Precision Livestock Farming

## Prof. Riccardo Negrini

COURSE AIMS AND INTENDED LEARNING OUTCOMES

Agro-zootechnical activities must meet, in addition to criteria of product quality and healthiness, also criteria of efficiency, environmental sustainability and animal welfare. Precision livestock farming is a tool that can potentially facilitate the transition to livestock farming 4.0 that responds to new production and environmental needs but at the same time is capable of producing food for a constantly growing world population.

This, however, requires knowledge of the available instruments and their applications and, above all, the necessary expertise to interpret the information generated by the new generation of sensors.

The course aims to provide students with a basic knowledge of the principles of precision livestock farming, the latest technological developments in the sector and their applications. Aspects related to the use of sensors for environmental monitoring and for the optimisation of company management will be explored.

Particular attention will also be paid to the interpretation of information derived from precision technologies at the animal level.

Each topic will be treated by combining the theoretical/technical notions with practical and application examples.

Knowledge and application of knowledge

At the end of the course, students will have acquired:

- a wealth of theoretical and practical information on the main systems of precision livestock farming;

- the competence necessary to interpret the information derived from precision sensors with a view to improving the efficiency and quality of production, reducing environmental impact and improving animal welfare;

- the ability to link different topics by fully exploiting the know-how acquired in their academic career.

Autonomous judging skills

The course aims to stimulate a critical and multidisciplinary approach in students, and to encourage a "problem-solving" attitude through real case studies discussed collectively in class.

Communication skills

At the end of the course, students will have acquired an appropriate and specific scientific lexicon related to precision technologies, and the ability to interpret and apply the information generated by sensors.

Learning ability

Thanks to the knowledge acquired and the critical skills developed during the course, students will be able to deepen their knowledge independently by consulting texts and scientific articles, and exploring resources on the web, appropriately weighing the reliability of the sources.

COURSE CONTENT

|  |  |
| --- | --- |
|  | ECTS |
| Introduction to Precision Livestock Farming  | 0.2 |
| Precision instruments and sensors applied to environmental monitoring | 0.3 |
| Precision livestock farming tools and information applied to the optimisation of business management | 1.0 |
| Precision instruments and sensors applied to animals | 1.5 |

READING LIST

Various Authors *Precision livestock farming applications. Making sense of sensors to support farm management* Edited by Ilan Halachmi, Wageningen Academic Publishers.

Materials for distribution and scientific articles handed out during the course.

The PowerPoint slides projected during lectures will be made progressively available on the Blackboard platform, in conjunction with the discussion in class.

TEACHING METHOD

Frontal lectures, aided by teaching materials in PowerPoint, during which the topics are dealt with in a logical and sequential fashion, framing them in a more general context of precision livestock farming before going into more detail on the unique features of the type of instrumentation or sensors described.

Seminars on specific topics held by industry experts complete the course teaching.

ASSESSMENT METHOD AND CRITERIA

The summative assessment is in the form of an oral interview which, through questions related to the topics covered, aims to assess the student's acquisition and understanding of the theoretical concepts taught, their breadth of reasoning, their command of the subject's specific technical and scientific language, and their ability to draw links between the topics covered.

The oral interview generally consists of a series of 3 open-ended questions on three different topics covered. The completeness of each answer, based on the student's achievement of the course aims, and their reasoning and linking skills, is assessed out of 10 marks. The final result is calculated as the algebraic sum of the individual marks obtained.

NOTES AND PREREQUISITES

Concepts of animal physiology and anatomy for livestock use, general zootechnics and produce of animal origin facilitate the understanding of some topics covered in the course.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.