Genomics and Animal Genetic Improvement

Prof. Riccardo Negrini; Prof. Paolo Ajmone Marsan

***Text under revision. Not yet approved by academic staff.***

COURSE AIMS AND INTENDED LEARNING OUTCOMES

The course will deal with the principles underlying traditional methods and modern genomic applications in the genetic improvement of animals in livestock production.

Knowledge and ability to understand

At the end of the course, students will be able to know and understand the basic principles of animal selection and genomic applications for the identification of useful genes, the measurement of biodiversity, and the improvement of monogastric and ruminant production of zootechnical interest.

Understanding and applying knowledge

At the end of the course, students will be able to define the selection objectives and design a genetic improvement program for a zootechnical species, and to make selective choices according to the type of breeding and objectives chosen. They will also be able to evaluate the use of genomics in genetic improvement programmes.

Autonomous judging skills

At the end of the course, students will be able to evaluate an animal genetic improvement programme and make corrective choices that increase efficiency, including with the help of genomic tools.

Communication skills

At the end of the course, students will be able to appropriately use the scientific language and specific vocabulary of genetics, genomics and genetic improvement.

Learning ability

At the end of the course, students will be able to learn more about animal anatomy and physiology independently through the consultation of texts, scientific articles and web resources.

COURSE CONTENT

|  |  |
| --- | --- |
|  | ECTS |
| Review of basic genetics. New technologies for *genotyping* and the complete sequencing of genomes. The organisation of the animal genome. Genetic markers. | 1.0 |
| The genetics of zootechnical populations; allele and genotype frequencies; Hardy-Weinberg equilibrium; kinship and inbreeding; genetic variability within and between populations. | 1.0 |
| Molecular markers, the measurement of biodiversity, and reconstruction of the evolutionary history of livestock species. | 1.0 |
| Quantitative genetics; genotype and environment; repeatability and heritability; phenotypic and genetic correlations between traits.  | 1.0 |
| Genealogical books and population registers; functional checks; pedigree-based methods for the genetic evaluation of breeders. | 1.0 |
| Selection criteria and objectives; indices and selection schemes. | 1.0 |
| The application of genomic knowledge to selection: *genome-wide* analysis and genomic selection.  | 1.0 |
| Use of genomics to identify genes responsible for useful and harmful traits. | 1.0 |

READING LIST

Preferred text

G. Pagnacco, *Genetica animale applicata,* Editore CEA, 2004.

Recommended texts

B. Kinghorn-J. Van de Werf-M. Ryan, *Animal Breeding. Uso delle nuove tecnologie Edizioni Plus,* Pisa, 2004.

L.D. Van Vleck-E.J. Pollak-E.A.B. Oltenacu, *Genetica per le Scienze Animali,* SEU, Servizio editoriale Universitario (University Publishing Service) of Pisa, 1988.

Van Vleck-Pollack-Oltenacu, *Genetics for the Animal Sciences,* Publisher WH Freeman & Co., ASIN: 0716718006, 1995.

F.W. Nicholas, *Veterinary Genetics,* Oxford University Press, New York, USA, 1987.

D.S. Falconer-T.S.C. MacKay, *Introduction to Quantitative Genetics,* 4th edition, Longman Scientific & Technical, Essex, UK, 1996.

A.J. Clark, *Animal breeding. Technology for the 21st Century,* Overseas Publishers Association, Amsterdam, NL, 1998.

F.W. Nicholas, *Veterinary Genetics,* Oxford University Press, New York, USA, 1987.

TEACHING METHOD

- Dialogue-based and theoretical frontal lectures supported by PowerPoint slides, during which the theory and practice of genetic improvement and the conservation of biodiversity in zootechnical species are presented and discussed in the light of modern DNA analysis technologies.

- The course will be supplemented with seminars involving external experts on specific topics relevant to genetics and the selection of animals in livestock production.

- Work groups will be organised for small projects or the in-depth analysis of topics of interest to students, related to genetic improvement or the conservation of zootechnical biodiversity.

ASSESSMENT METHOD AND CRITERIA

An interim test is scheduled on the content covered in the first part of the course. The test will consist of 4 questions and 2 exercises. Each correct answer to the questions carries a maximum mark of 5. Each exercise performed correctly carries a maximum mark of 6, for a total of 32 marks. This test will be in a written format.

At the end of the course a final oral exam will be held: this will cover the second part of the course for those students that obtained a mark of at least 18/32 and accepted the interim test assessment; for all other students, this exam will cover the entire course programme.

The final mark will be calculated as the average between the marks received for the interim test and the oral exam.

NOTES AND PREREQUISITES

Pre-requisites: Basic genetics, Basic statistics.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

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