

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Higher School of Saharan Agriculture El Oued



Academic Program 2nd Cycle

1st Year

1st Semester

Semester: 01

Teaching Unit: Fundamental

Subject: Animal production I

VHS: h (C/T)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives

This program aims to provide students with advanced knowledge in animal reproductive physiology and genetic improvement techniques used in livestock production. It enables students to understand the hormonal and physiological mechanisms regulating reproduction in different animal species. The program also develops practical skills in assisted reproductive technologies, pregnancy diagnosis, and the management of reproductive disorders. In addition, it introduces modern biotechnologies such as embryo transfer and genomic selection for genetic improvement. Finally, students will acquire the ability to analyze quantitative genetic parameters and apply appropriate selection methods in animal breeding programs.

Course Content :

CHAPTER 1: Reproductive physiology

1.1. Comparative Estrous Cycles

- Definition and hormonal regulation of cycles
- Interspecific comparison: cattle, sheep, pigs, goats
- Factors influencing cycles: photoperiod, nutrition, environment

1.2. Spermatogenesis and Semen Quality

- Stages of spermatogenesis (with explanatory diagram)
- Parameters for semen quality evaluation

- Influencing factors: temperature, stress, pathologies

2. REPRODUCTIVE CONTROL TECHNIQUES

2.1. Artificial Insemination (AI)

- Principles, history, and zootechnical importance
- Techniques for semen collection, processing, and preservation
- Insemination protocols adapted to different species

2.2. Estrus Synchronization

- Hormonal protocols: Ovsynch, CIDR, PGF2 α
- Advantages and limitations according to species

2.3. Pregnancy Diagnosis

- Classical methods: rectal palpation, ultrasonography
- Hormonal tests for early detection

3. REPRODUCTIVE PATHOLOGIES

3.1. Female Infertility

- Ovarian disorders: anestrus, follicular or luteal cysts
- Reproductive tract infections: metritis, endometritis

3.2. Male Infertility

- Genetic or acquired hypofertility
- Prevention, management, and treatments

4. REPRODUCTIVE BIOTECHNOLOGIES

4.1. Embryo Transfer

- Superovulation, collection, and transfer
- Cryopreservation and genetic banks

4.2. Genomic Selection

- Principles of SNP markers
- Modern applications and future perspectives

CHAPTER 2: GENETIC IMPROVEMENT

1. PRINCIPLES OF QUANTITATIVE GENETICS

1.1. Heritability

- Definition, interpretation, and calculation methods
- Applied examples: milk production, growth rate

1.2. Genetic Correlations

- Interpretation of correlations between traits
- Practical applications in breeding programs

2. SELECTION METHODS

2.1. Pedigree Selection

- Early genetic evaluation based on parental performance
- Limitations in the absence of direct data

2.2. Performance Selection

- Measurement of individual traits
- Consideration of environmental effects

2.3. Selection Index

- Construction of a synthetic index (e.g., dairy ISU index)
- Weighting of traits according to production objectives

Tutorials

TD1: Comparison of the reproductive systems and estrous cycles of female livestock animals.

TD2: Comparison of gestation and placental types in female livestock animals.

TD3: Calculation and interpretation of heritability for production traits.

TD4: Analysis of genetic correlations between production traits.

Educational visits

Visit to a livestock farm: observation of reproductive practices, zootechnical records, and breeder selection criteria.

Semester: 01

Teaching Unit: Fundamental

Subject: Plant Protection 1 (Zoophytiatry)

VHS: h (C /PW)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

The Plant Protection–Zoophytiatry module in the third year aims to provide students with fundamental knowledge for managing crop pests. This begins with identifying the pest organism, understanding its bioecology, and recognizing its natural enemies (entomopathogenic agents, parasitoids, and predators).

Only after this step are control methods implemented, with a preference for integrated pest management (IPM), using cultural, biological, physical, and other control strategies. Special attention is given to major outbreaks and quarantine pests.

Course content:

I. Basis of the classification of harmful phytophagous animals and potential pests.

II. Bioecology of major pest groups (mites, insects, birds, mammals).

- In agricultural environments:

A. Cereal crop pests (e.g., *Aelia germari*, cereal bug)

B. Orchard pests (e.g., *Ceratitidis capitata*, Mediterranean fruit fly)

C. Vegetable crop pests (e.g., *Tuta absoluta*, tomato leafminer; noctuid moths)

Stored product pests (e.g., weevils, bruchids, *Tribolium*, moths)

- In forest environments:

D. Pine processionary moth (*Thaumetopoea pityocampa*), gypsy moth (*Lymantria dispar*) on oak, and bark beetles in forest ecosystems

- Major pest outbreaks: desert locust (*Schistocerca gregaria*), sparrows, and gerbils
- Quarantine pests

III. Types of damage caused by pests

IV. Pest control techniques

Practical works:

PW1: Morphological Observation and Classification of Orthopteroids

PW2: Study the morphological diversity of Homoptera (aphids, scale insects, whiteflies) and Hemiptera (true bugs)

PW3: Study of the main orders of agricultural pests: Coleoptera, Lepidoptera, Diptera, and Hymenoptera.

PW4: Implementation of Integrated Pest Management strategies under simulated conditions, including the evaluation of different control methods such as trapping, physical barriers, and biological control.

Semester: 01

Teaching Unit: Fundamental

Subject: Agrifood industrial technology

VHS: h (C /PW)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

This module introduces students to the main thermal processes used in the food industry for food preservation, including pasteurization, sterilization, drying, and freeze-drying

Course Content:

1. General Introduction to Food Technology

- Definition, challenges, and objectives of food processing operations.
- Food preservation and safety: basic principles.

2. Thermal Processing of Food Products

- **Pasteurization:** principles, objectives, temperature curves, microbiological efficiency.
- **Sterilization:** principle, time-temperature equivalents, F_0 , Z , D values, heat-resistant bacteria.
- **Thermo-bacteriology:** inactivation of pathogens, effects on beneficial microflora and nutritional quality.

3. Drying of Food Products

- Thermodynamic bases: humid air, latent heat, energy balance.
- Concept of water activity (A_w) and food hygroscopicity.
- Types of drying: convection, conduction, infrared, microwave, and spray drying.
- Dryer calculations and design: airflow, duration, temperature, hygrometry.
- Special case: Freeze-drying
- Principle, stages, advantages, limitations, and fields of application.

4. Product/Process Interactions

- Effects of thermal treatments on sensory, nutritional, and microbiological properties.
- Selection of the appropriate process according to the nature of the product (liquid, semi-solid, solid, coated products, etc.).

Practical Work:

PW1: Evaluation of the effectiveness of a pasteurization treatment

PW2: Simulation of a sterilization process and F0 calculation

PW3: Convective drying of a solid food product

PW4: Experimental freeze-drying study

Educational Visits:

Visit to a food production unit (dairy, cheese factory, etc.) to observe industrial use of fermentation, enzymes, production processes, quality control, and hygiene.

Semester: 01

Teaching Unit: Fundamental

Subject: Pedology

VHS: h (C/T/PW)

Credits: 6

Coefficient: 3

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

The aim of this course is to show that soil is an integral part of the landscape. It shows that the soil is a part of the whole terrestrial ecosystem where it plays a major role as a reservoir for water and nutrients. It also shows that the soil is a living medium that regulates the flow of matter. These functions vary in time and space and are affected by human activities. Finally, this teaching should provide an understanding of the processes involved in soil formation, its classification and its importance as a non-renewable natural resource for human activities.

Course Content:

Chapter I. General Concepts of Soil

1. Definitions
2. Formation

Chapter II. Soil Components

1. Nature
2. Organization

Chapter III. Soil Properties

1. Physical properties
2. Chemical properties
3. Biological properties

Chapter IV. Soil Functions

1. Agronomic functions

2. Ecological functions
3. Environmental functions

Chapter V. Classification and Spatial Distribution

11. Soil classification
12. Spatial distribution
13. Soils of Algeria

Tutorials

TD1: General concepts of soil

TD2: Soil components

TD3: Soil properties

TD4: Soil functions

TD5: Soil classification and spatial distribution

Practical work

PW1: Soil description

PW2: Particle size analysis

PW3: Organic matter content

PW4: Determination of total limestone content

PW5: Measurement of pH and electrical conductivity (EC)

PW6: Soil density and porosity

PW7: Determination of a nutrient element

PW8: Reading and interpretation of a soil map

Semester: 01

Teaching Unit: Methodology

Subject: Cultural practices

VHS: h (C/PW)

Credits: 2

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

I. SOIL TILLAGE

Training Objectives:

The aim of this section is to understand all agricultural techniques that allow the control of a set of parameters essential for successful crop production, by using mechanical actions carried out by various types of equipment to bring the soil to the desired physical condition.

Course Content:

- Fundamental properties influencing soil tillage
- Plowing
- Reduced tillage and superficial operations
- Minimum tillage
- Cultivation techniques aimed at water conservation
- Soil profile (cultural profile)

II. SOIL AMENDMENTS AND FERTILIZATION

Training Objectives:

Mineral fertilization represents the most costly operational expense in field crops. This practice, which plays a decisive role in both the quantitative and qualitative yields of crops, can also have negative impacts on the environment. Therefore, rational fertilization aims to meet plant nutritional needs by supplementing the soil's supply of mineral elements under economically viable conditions and with respect for the environment.

Course Content:

- Definitions

I. Fertilizers

- Mineral fertilizers
- Straight (single-nutrient) fertilizers
- Compound fertilizers
- Organo-mineral fertilizers
- Organic fertilizers

II. Amendments

- Liming and humic amendments
- Basic mineral amendments
- Characteristics of basic mineral amendments
- Organic amendments

III. Laws and Practices of Mineral Fertilization

- Different laws of mineral fertilization
- Practical fertilization: general rules

Practical Work:

- **PW1:** Plowing and reduced tillage
- **PW2:** Superficial tillage and soil profile
- **PW3:** Comparison between conventional tillage and conservation tillage systems (TCS)

Personal Work:

- Fertilization strategy for wheat (durum or soft): split applications; calculation of the expected dose using the balance-sheet method
- Phosphorus and potassium fertilization of a given cereal (wheat or maize): quantification of inputs and outputs, calculation of the balance
- Fertilization of potato

Semester: 01

Teaching Unit: Methodology

Subject: Agricultural machinery

VHS: h (C/PW)

Credits: 3

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

This course aims to introduce students to the fundamentals of agricultural mechanization and the various agroequipment used in both plant and animal production.

Students will:

- Understand energy sources and the operating principles of agricultural machinery.
- Learn the role of mechanization in modernizing agriculture.
- Integrate concepts from rural engineering, automation, and robotics.
- Develop critical thinking regarding the technological and economic impacts of agroequipment in agricultural systems.

Course Content:

1. Introduction to Agroequipment and History of Agricultural Mechanization

- Concept of mechanical solutions and production means (human force, emergence of tools, development of mechanisms, machine creation, increasing energy needs, transition to non-human energy sources, functional limitations)
- Development of mechanized agricultural processes (tillage, sowing, planting, harvesting, etc.)
- Agricultural infrastructure and buildings (greenhouses, storage facilities, silos, etc.)
- Control, management, and regulation systems

2. Energy Sources and Their Use in Agriculture

- Engines used in agriculture and transmission of motion and power
- Agricultural tractors
- Tractor–implement connections and adjustment concepts:
 - Hitching systems (single-point, three-point; mounted, semi-mounted, trailed machines)
 - Hydraulic lift system
 - Power take-off (PTO)
- Renewable energy in agriculture

3. Agroequipment in Crop Production

3.1 Cropping Systems and Production Environments

- Cropping systems (intensive, extensive) and the role of agroequipment
- Greenhouses (nurseries, off-season production), growth chambers (controlled environments), agricultural soils

3.2 Soil Preparation Equipment

3.2.1 Deep Tillage Tools:

- Subsoilers
- Chisel plows
- Disc plows
- Moldboard plows

3.2.2 Secondary Tillage Tools:

- Harrows
- Tine implements (cultivators, weeders)
- Powered tools

3.2.3 Surface Tillage Tools:

- Harrows
- Rollers

3.3 Planting Equipment

- Seed drills (row seeders, precision seeders, direct seeding machines)
- Planting and transplanting equipment (potato planters, transplanters, etc.)

3.4 Crop Maintenance, Plant Protection, and Fertilization Equipment

- Sprayers (air-assisted and boom sprayers)
- Manure spreaders
- Fertilizer distributors

3.5 Irrigation and Drainage Equipment

- Sprinkler irrigation systems (center pivot, lateral move, gun and hose reel systems)
- Localized irrigation systems (e.g., drip irrigation)
- Drainage equipment and ditch construction tools

3.6 Harvesting Equipment

- Combine harvesters
- Tuber harvesters
- Beet lifters
- Forage harvesters

4. Agroequipment in Animal Production

- Forage harvesting machines (forage harvester, mower, tedder, windrower, baler, wrapper)
- Mechanical milking systems
- Aquaculture equipment
- Principles of rural construction (livestock buildings, storage silos, etc.)

5. Post-Harvest Agroequipment

- Oil extraction systems
- Feed processing and production chains

6. Automation and Robotics in Agriculture

- Precision agriculture
- Levels of automation in agricultural machinery
- Agricultural automation systems and robots
- Sensors and monitoring of agronomic parameters

Practical work

- **PW1:** Traction equipment and soil preparation tools
- **PW2:** Seeders and planters
- **PW3:** Spreaders and sprayers
- **PW4:** Harvesting machines
- **PW5:** Renewable energy in agriculture

Personal work

Students are required to explore additional topics not covered in lectures, such as:

- Conservation agriculture and direct seeding techniques
- Cost analysis of agricultural machinery use in Algeria
- Mechanization status of Algerian agriculture

Semester: 01

Teaching Unit: Methodology

Subject: Biometry

VHS: h (C/PW)

Credits: 2

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

The analysis of experimental data in agronomy requires the use of appropriate statistical tools.

After an introduction to classical statistics, we considered it useful to gain a deeper understanding in order to make the most of the collected data. These methods are mainly based on a “bio” statistical approach, which consists of verifying ANOVA assumptions and statistical tests, modeling and optimizing real phenomena, as well as performing multivariate data analysis.

Course Content:

Chapter I: Non-Parametric Statistical Tests

A. Fundamental Principles

1. Non-parametric test for comparing two samples:

- Independent samples
- Median test
- Rank test for independent samples (Mann–Whitney test)
- Paired samples
- Sign test
- Rank test for paired samples (Wilcoxon test)

2. Non-parametric test for comparing multiple samples:

- Independent samples
- Extension of the median test
- Kruskal–Wallis test
- Paired samples
- Friedman analysis of variance

3. Non-parametric measures of correlation:

- Point correlation coefficient
- Spearman rank correlation coefficient
- Kendall's coefficient of concordance

Chapter II: Analysis of Variance (ANOVA)

1. One-way ANOVA:

- Data and statistical model
- Conditions of application
- ANOVA: parameter estimation method
- Mean comparison test

2. Two-way ANOVA:

- Statistical model
- Conditions of application
- ANOVA: parameter estimation method
- Mean comparison test
- Two-way ANOVA without replication

Chapter III: Design of Experiments Methodology

1. Terminology:

- Types of factors
- Experimental domain
- Standardized variables (centered and reduced)
- Response function

2. Factorial Designs: □ Two-level factorial designs (2^k) □ Fractional factorial designs ($2^{(k-p)}$) □

Experimental design matrix

- Main effects and interaction effects
- First-order model presentation
- Statistical analysis

3. Response Surface Design:

- Second-order model presentation
- Optimization process
- Central composite designs
- Box-Behnken design

Chapter IV: Statistical Data Analysis

1. Principal Component Analysis (PCA): Data table and numerical summaries

- Construction and analysis of standardized data
- Weights and centroid
- Variance-covariance and correlation matrices
- Eigenvalues extraction

PCA Procedure:

- Representation of individuals
- Representation of variables
- Combined interpretation

Axis interpretation:

- Selection of number of axes
- Interpretation of axes
- Correlation circle

Study of individuals:

- Contribution of individuals
- Quality of representation
- Factorial plane analysis

2. Correspondence Analysis (CA): Problem formulation

- Data table
- Row and column profiles
- Reduction of point cloud and extraction of axes

Results interpretation:

- Contributions
- Inertia
- Independence test

3. Statistical analysis software:

- SPSS
- Statgraphics
- JMP8

Semester: 01

Teaching Unit: Methodology

Subject: Agroecosystems

VHS: h (C)

Credits: 2

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

The teaching provided in the 1st year of higher education institutions (equivalent to the 3rd year) is oriented toward the acquisition of sufficient knowledge and skills so that the student achieves a satisfactory understanding of ecosystems created, modified, and maintained by humans—namely, agroecosystems.

Since the basic concepts of ecology are acquired during the 2nd year of preparatory classes, the module “Agroecosystems” mainly aims to introduce knowledge about their functioning, geographical distribution, and the limits of territories influenced by human activity for the purpose of their exploitation.

The new concepts of agroecology support and integrate into the selected teachings. They help in understanding emerging approaches and increasingly adopted practices related to agroecology or sustainable, clean, organic, and environmentally friendly agriculture.

Course Content:

Introduction: Definitions

1. Origin of Agroecosystems

- Transition from *sylva* to *saltus* and to *ager*

2. Agroecosystems Worldwide and Development of Different Cropping Systems

3. Agroecosystems in Algeria

- Review of orography and the main geomorphological features of the Quaternary period
- Agro-climatic zones and anthropogenic factors
- Potential and suitability of agroecological territories
- Land consolidation and agricultural abandonment

- Limits of productivity and energy transfers

4. Agroecology

- Definitions
- Different approaches
- Agroecological methods and practices
- Traditional (peasant) vs. current and modern approaches

Personal Work:

Field trip to several conventional farms and to an agroecological farming system.

Semester: 01

Teaching Unit: Discovery

Subject: Forest, steppe, and Saharan ecosystems

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: 100 % Exam

Training Objectives:

This course aims to develop a comprehensive understanding of forest, steppe, and Saharan ecosystems, with a particular focus on Algerian environments. Students will learn to identify the main ecological formations, analyze the characteristics and functioning of forest ecosystems, and understand the services they provide to society and biodiversity. The course also seeks to build skills in ecological observation, evaluation, and interpretation of ecosystem dynamics. Finally, it promotes awareness of sustainable management and conservation strategies, enabling students to appreciate the importance of protecting natural resources and applying responsible environmental practices.

Course Content:

I. Concepts and Definitions

1. Forest
2. Forestry
3. Forest environments
4. Concept of ecosystem
5. Steppe environments

II. Different Forest Formations

1. Forest
2. Maquis
3. Garrigue
4. Matorral

5. Steppe formations

III. Presentation and Characteristics of Algerian Forests

1. Extent and surface area
2. Historical overview
3. Main forest massifs in Algeria
4. Main forest tree species
5. Analysis of forest stands (qualitative and quantitative study)
6. The Algerian steppe
7. Threats and protection

IV. Services Provided by Forest Environments

1. Supporting services
2. Provisioning services
3. Regulating services
4. Cultural services

V. Management and Conservation of Forest Environments

Personal work

Practical Aspects

Preparation of a report in small groups following a field trip.

Objectives of the field trip:

- Concepts of watershed and forest as a water reservoir (participatory and discussion-based presentation with students in the field)
- Observation of different forest formations (basic concepts on stand structure)
- Observation of some services provided by the forest environment

Semester: 01

Teaching Unit: Discovery

Subject: Systemic Approach in Agriculture

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: 100 % Exam

Training Objectives:

This course aims to provide students with the concepts and analytical tools necessary to understand the different components of a farming system and their interactions with the environment in a global, integrated, and coherent manner.

Students will develop a systemic vision of agriculture, allowing them to better analyze production systems and address complex agricultural challenges.

Course Content:

CHAPTER 1: Introduction to the systemic approach

- 1.1 Limitations of the Cartesian approach
- 1.2 The systemic approach: definitions and principles
- 1.3 System theory

CHAPTER 2: Agricultural production systems

- 2.1 Definitions and components
- 2.2 Methods for analyzing a production system
- 2.3 Main agricultural production systems in Algeria
- 2.4 Sustainable agriculture and the agroecosystem.

Personal work

Presentations on the production system oriented toward agriculture: the agrarian system.

Semester: 01

Teaching Unit: Transversal

Subject: General Economics and Entrepreneurship

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment 100 %

Training Objectives:

This program aims to provide students with fundamental knowledge in economics and entrepreneurship, enabling them to understand the functioning of economic systems and the mechanisms of market economies. It introduces students to major economic concepts such as production, consumption, money, inflation, and national accounting, while developing their analytical and critical thinking skills regarding economic issues. The program also familiarizes students with the principles of entrepreneurship, innovation, business creation, and marketing. In addition, it develops students' ability to design and evaluate business projects through the preparation of business plans and field-based entrepreneurial studies. Finally, the course encourages initiative, creativity, and strategic thinking for the development and management of entrepreneurial activities.

Course Content:

I. GENERAL ECONOMICS

CHAPTER 1: ECONOMICS AS A SOCIAL SCIENCE

1.1. Objects and methods of economics

1.2. Macroeconomic and microeconomic approaches

1.3. Schools of thought

- Classical
- Neoclassical
- Keynesian

- Institutionalism

CHAPTER 2: ECONOMIC ACTIVITY

2.1. Components of economic activity

- Production
- Distribution
- Exchange
- Consumption

2.4. The role of the State in economic regulation: economic policy

2.5. Market economy

CHAPTER 3: MONEY

3.1. Definition of money and its different functions

3.3. Monetary institutions

- Central bank
- Commercial banks
- Public treasury

3.4. Inflation

- Definition
- Causes
- Economic and social effects

CHAPTER 4: NATIONAL ACCOUNTING

4.1. Definition and purpose of national accounting

4.2. The economic circuit

(Relationships between the different economic agents)

4.3. Main aggregates of national accounting

- GDP
- GNP
- National income
- Trade balance

4.4. Main national accounting tables

- Overall Economic Table (TEE)
- Input-Output Table (TEI)

II. INTRODUCTION TO ENTREPRENEURSHIP

1. Entrepreneurship and the entrepreneur
2. Innovation and opportunity
3. Intrapreneurship: definition and process
4. Business creation
5. Marketing
6. The Business Plan
7. Development strategies for a start-up company

Personal work

Writing a monograph dedicated to an entrepreneur whom the student will observe in the field for at least one day, or writing a business plan for a business creation project.

2nd Semester

Semester: 02

Teaching Unit: Fundamental

Subject: Animal production 2

VHS: h (C/T)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment 40% Exam 60%

Training Objective:

To provide students with the fundamental and practical knowledge required for the rational management of modern livestock farming by covering the basics of animal nutrition, housing, animal welfare, techno-economic indicators, major production sectors, and strategies for disease prevention and health management. This module aims to train professionals capable of optimizing zootechnical performance while respecting sustainability and animal health standards.

Course Content:

CHAPTER 1: LIVESTOCK MANAGEMENT

1. TYPES OF FEED AND RATIONS

a) Basic feeds

- Green forages, silage, hay
- Concentrates and agro-industrial by-products

b) Nutritional requirements

- Energy bases: UFL, UFV
- Protein requirements: PDI
- Mineral and vitamin supplementation

c) Ration formulation

- Feeding methods (dry, wet, semi-wet rations)

- Ration formulation software (e.g., INRAtion, RuminAl)
- Adaptation of rations according to production type (milk, meat, reproduction)

d) Species-specific feeding

- Ruminants: cattle, sheep, goats
- Poultry
- Monogastrics: horses and small-population animals

e) Common feeding errors

- Digestive disorders (acidosis, bloat)
- Mineral imbalances and deficiencies

2. HOUSING AND ANIMAL WELFARE

- Principles of livestock building design
- Welfare criteria according to EFSA recommendations

3. TECHNO-ECONOMIC INDICATORS

- Growth: average daily gain (ADG)
- Feed efficiency: feed conversion ratio (FCR)
- Fertility: conception rate and calving rate

CHAPTER 2: OVERVIEW OF PRODUCTION SECTORS

1. DAIRY PRODUCTION

1.1. Holstein breed

- Zootechnical performance
- Herd organization and management

1.2. Pastoral systems

- Adaptations to climatic constraints

- Comparative profitability analysis

2. MEAT PRODUCTION

- Cattle: comparison between Charolais and local breeds
- Sheep: Ouled Djellal vs. Rembi breeds
- Poultry: Label Rouge systems vs. intensive farming
- Camels: local breeds
- Rabbits: local populations and imported breeds

CHAPTER 3: SANITARY MAINTENANCE AND HEALTH MANAGEMENT

1. Principles of prophylaxis

1.1. Hygiene of buildings and equipment

- Cleaning, disinfection, biosecurity
- Waste management and pest control

1.2. Vaccination and preventive treatments

- Vaccination schedules by species
- Control of internal and external parasites

2. Health monitoring

2.1. Recognition of clinical signs

- Temperature, behavior, appetite, performance
- Individual or group monitoring records

2.2. Basics of infectious and parasitic diseases

- Common diseases: clostridial diseases, parasitoses, mastitis
- Prevention methods and intervention protocols

Tutorials

TD 1: Formulation of feed rations for dairy cattle and meat sheep

TD 2: Design of livestock housing respecting animal welfare standards

TD 3: Comparative analysis of zootechnical performance in the meat production sector

TD 4: Development of a prophylaxis schedule for goat and sheep farming

Semester: 02

Teaching Unit: Fundamental

Subject: Plant protection 2 (Phytopathology)

VHS: h (C/PW)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment 40% Exam 60%

Training Objective:

This course aims to introduce students to the fundamental principles of plant pathology by providing them with the knowledge required to identify, understand, and analyze plant diseases. It covers plant pathogens (fungi, bacteria, and viruses), their mechanisms of action, epidemiological cycles, and associated symptoms. Special attention is given to the agronomic impacts of diseases as well as disease management strategies. The course combines theoretical lectures, practical work, and personal research activities.

Course Content:

Chapter I

1. Introduction to Plant Pathology

- Definition and objectives of plant pathology
- Brief history of plant pathology
- The concept of disease in plants
- Different types of biotic and abiotic plant diseases
- Economic impact of diseases on agricultural production

2. Principles of Plant Pathology

- Etiology of plant diseases
- Diagnosis of plant diseases

- Disease cycle and stages of development
- Basic concepts of plant disease epidemiology

3. Morphology and Classification of Phytopathogenic Fungi

- Definition of fungi
- General characteristics of organisms traditionally called fungi:
 - Vegetative structures of fungi
 - Reproduction of fungi
- Classification and systematics of the major groups of phytopathogenic fungi

4. Phytobacteriology

A. Phytopathogenic prokaryotes

- Eubacteria
- Archaea
- Mollicutes

B. The bacterial cell

- Constant and non-constant elements
- Different modes of action of phytopathogenic bacteria (toxins, enzymes, polysaccharides, hormones)
- Symptomatology of bacterial diseases
- Study of a bacterial disease

5. Phytovirology

Part I:

1. Definition and general concepts of plant viruses
2. Symptomatology

3. Principles of diagnosis in virology (methodology without mentioning identification techniques)

Part II: Natural transmission of viruses (aphids, nematodes, seeds, weeds, etc.)

Part III:

1. Methods for controlling viral diseases:
 - a. Principles of sanitary selection
 - b. Curative methods
 - c. Preventive methods

Chapter II: Methods for Controlling Plant Pests and Diseases

- Definition of plant disease control
- Strategies for controlling plant diseases
- Different methods for controlling plant diseases

Practical work

PW 01: Study of some vegetative and reproductive fungal structures and introduction to the phyla Chytridiomycota and Zygomycota

PW 02: Phylum Ascomycota: Taphrinales and Erysiphales (powdery mildews)

PW 03: Phylum Basidiomycota (smuts, bunts, and rusts)

PW 04: Imperfect fungi (= Deuteromycetes)

PW 05: Phylum Oomycota (downy mildews and white rusts) and phylum Plasmodiophoromycota (clubroot disease of cabbage)

Personal work

In addition to lectures and practical work, groups of students will be required to carry out personal projects, including:

- Preparation of a phytopathological herbarium or illustrated technical sheets containing about ten samples of plant diseases
- Bibliographic studies on fungal, bacterial, or viral diseases

Semester: 02

Teaching Unit: Fundamental

Subject: Human Nutrition and Food Quality

VHS: h (C/PW)

Credits: 4

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

- Acquire fundamental knowledge of human nutrition and nutritional physiology.
- Understand the link between agricultural production, food processing, and their impacts on health.
- Develop basic skills to assess nutritional needs and food quality.

Course Content:

I. Basic concepts of Nutrition

Introduction to the basic concepts of human nutrition.

II. Major Food Groups and Their Components

- Energy-giving foods
- Protein-rich foods
- Water, minerals, and vitamins

III. Digestion and Absorption

Mechanisms of digestion and nutrient absorption.

IV. Nutritional requirement

- Specific needs: nutritional balance
- Energy requirements
- Macronutrient requirements: fats and proteins
- Vitamin and mineral requirements

V. Quality Control Concepts

- Physicochemical qualities
- Hygienic qualities
- Nutritional qualities
- Organoleptic qualities

Semester: 02

Teaching Unit: Fundamental

Subject: General hydraulics, irrigation and drainage

VHS: h (C/T/PW)

Credits: 6

Coefficient: 3

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

This course provides a review of the fundamental laws governing the equilibrium and motion of fluids. It presents the application of these laws to solving practical problems such as pressure calculation, design of pressurized pipelines, and pump operation.

The program also covers the basic concepts related to irrigation and drainage techniques.

Course Content:

1. FUNDAMENTALS OF GENERAL HYDRAULICS

1.1. Hydrostatics

- Fundamental equation of fluid statics
- Hydrostatic pressure and forces acting on liquids
- Piezometric head, vacuum head, pressure measurement
- Pressure forces
 - On plane surfaces
 - On curved surfaces

1.2. Hydrodynamics

- Bernoulli equation for a perfect fluid
- Bernoulli equation for a real fluid
- Flow regimes

- Head losses
- Pipeline calculations
- Pumps

2. BASIC CONCEPTS OF IRRIGATION AND AGRICULTURAL DRAINAGE TECHNIQUES

2.1. Irrigation

- Irrigation issues and challenges
- Structure of an irrigation network from upstream to downstream
- Different types of irrigation:
 - Surface irrigation
 - Pressurized irrigation
 - Drip irrigation
- Concepts of characteristic flow rate, irrigation module, and irrigation unit
- Basic principles for calculating irrigation doses

2.2. Drainage

- Drainage issues (excess water and salinity)
- Terminology (reclamation, drainage, collector, inspection chamber, etc.)
- Functions of drainage
- Characteristics of a drainage network, installation, and maintenance
- Design criteria

Practical work

PW 1: Center of pressure and pressure forces in a static medium

PW 2: Flow regimes, orifices, and nozzles

PW 3: Measurement of flow rates and head losses

PW 4: Visit to an irrigation and drainage area (El Oued)

Tutorials

TD 1: Pressure and pressure forces in a static medium

TD 2: Perfect and real fluids, calculation of head losses

TD 3: Pipeline calculations and technical characteristics of an irrigation network

TD 4: Principles for calculating irrigation doses and irrigation frequency

Semester: 02

Teaching Unit: Methodology

Subject: Introduction to plant breeding

VHS: h (C)

Credits: 2

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

This course is composed of three essential components for understanding and applying plant breeding. It covers:

- The use of genetic resources, which constitute a gene bank essential for any improvement program.
- The learning of the genetic foundations of plant breeding.
- The use of plant biotechnology tools and approaches.

Course Content:

Chapter I: Genetic Resources

1. Definition, importance, and challenges
2. Relationships between genetic resources, plant breeding, and biotechnology
3. Inventory and collection
4. In situ and ex situ conservation
5. Patentability of living organisms, intellectual property rights, and trade-related issues
6. Legal aspects and regulations

Chapter II: Fundamentals of Plant Breeding

1. Definition of plant breeding
2. Genetic variability

- Existing genetic variability
- Induced genetic variability
- 3. Concepts of quantitative genetics
 - Traits with nearly continuous variation (quasi-quantitative traits)
 - Basic statistical concepts (normal distribution, mean, variability, variance)
 - Different modes of gene action
 - Heritability
- 4. Principles of plant breeding
 - Breeding of annual species
 - Breeding of fruit species
 - Breeding of forest species

Chapter III: Biotechnological Approach to Plant Breeding

1. Importance of genetic diversity in breeding
2. Conservative selection (cloning)
3. Creative selection
 - Somaclonal variation and mutagenesis
 - Somatic hybridization
 - Advanced HD methods
 - Transgenesis

Personal work

- Quantitative genetics
- Challenges in genetic resources management (documentary screenings and discussions)
- Gene silencing

Semester: 02

Teaching Unit: Methodology

Subject: Cropping Systems 1 (Cultivated Herbaceous Species)

VHS: h (C/PW)

Credits: 2

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

To make students aware of the agronomic and economic importance of these species in the Algerian cropping system, as well as aspects related to their biology and technical production practices.

Course Content:

PART 1: CEREAL CROP PRODUCTION

I. General Overview

- Definition and origin of cereals
- Uses and grain composition

II. Morphological Characteristics

- The grain
- Vegetative system
- Reproductive system

III. Biological Characteristics

- Description of the development cycle
- Vegetative period
- Reproductive period
- Maturation period

- Development physiology
 - Vegetative phase
 - Reproductive phase
 - Maturation phase

IV. Example: Wheat Cultivation

- Choice of cropping system
- Varieties cultivated in Algeria
- Cultivation zones
- Soil types
- Soil tillage
- Sowing
- Supplementary irrigation
- Fertilizer elements
- Protection against diseases, pests, and weed control in cereals
- Harvesting

PART 2: HEDGE CROPS

Chapter I. The role of hedge crops in Algeria's cropping system

1. General overview of the Algerian cropping system
2. Definition of row crops
3. Importance of row crops in a cropping system

Chapter II. The main hedge crops

1. Industrial crops

1.1. Sunflower (*Helianthus annuus* L.)

- Uses and outlets of sunflower
- Morphological description
- Development cycle
- Crop management

1.2. Sugar beet (*Beta vulgaris*)

- Uses of sugar beet
- Morphological description
- Development cycle
- Crop management

2. Food legumes

2.1. Chickpea (*Cicer arietinum*)

- Role of food legumes in the Algerian cropping system
- Morphological description
- Development cycle
- Crop management

PART 3: VEGETABLE CROPS

1. Importance of vegetables in human nutrition
2. Suitable zones for vegetable cultivation and types of production systems
3. Protected cultivation:
 - Mulching
 - Small tunnels
 - Greenhouse (greenhouse effect)
4. Suitable zones for protected crops

5. Propagation of vegetable species:
 - Nursery sowing:
 - Bare-root seedlings
 - Plug (root ball) seedlings
 - Direct seeding
 - Transplanting:
 - Manual
 - Mechanical
6. Soilless cultivation techniques:
 - Substrate systems
 - Nutrient solution systems
7. Vegetable harvesting
8. Conditioning and marketing of vegetable products

Practical Work:

PW 01: Study of cereal crops (barley and oats)

PW 02: Study of seeds, vegetative and reproductive stages of winter cereals

PW 03: In situ estimation of winter cereal yield

PW 04: Study of row crops: rapeseed (*Brassica napus L.*), lentil (*Lens culinaris*)

PW 05: Calculation of greenhouse crop costs and expenses

Educational Visits:

Two multidisciplinary field trips to vegetable farms in El Oued.

Semester: 02

Teaching Unit: Methodology

Subject: Cropping systems 2 (Arboriculture and Viticulture)

VHS: h (C/T)

Credits: 2

Coefficient: 1

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objective:

This module aims to provide students with the essential biological and physiological foundations needed to understand the functioning of fruit trees and grapevines. It enables the identification of fruit species, understanding of their vegetative and reproductive cycles, as well as propagation techniques. The course also strengthens the observation of vegetative and reproductive organs. It constitutes an essential basis for the rational management of orchards and vineyards.

Course Content:

Part 1: Fruit Trees

1-Introduction to Fruit Growing

- Definition, economic and ecological importance
- History and main fruit productions in the region

2-Botanical Classification of Fruit Trees

- Classification by families (Rosaceae, Rutaceae, etc.)
- Differences between pome fruits, stone fruits, nuts, and citrus

3-Anatomy and Physiology of Fruit Trees

- Vegetative organization: roots, stems, leaves
- Physiological functions: photosynthesis, respiration, transpiration, sap circulation

4- Fruit Production Organs

- Formation and types of buds

- Architectural differences in pome Rosaceae (apple, pear) and stone fruits (apricot, cherry)

5-Biological Cycle of Fruit Trees

- Phenology: flowering, fruit set, enlargement, maturation
- Alternation of vegetative and reproductive stages

6- Annual Evolutionary Cycle of the Fruit Tree

- Periods of dormancy, vegetative resumption, flowering, fruiting, and senescence
- Influence of climatic conditions

7-Propagation of Fruit Trees

- Sexual propagation (seeds) and asexual (cuttings, grafting)
- Agronomic interest of the rootstock

Part 2: Biology and Physiology of the Vine

1- Introduction to Ampelography

- Viticultural importance, history, cultivation regions

2- Botanical Classification of the Vine

- Genus *Vitis*, cultivated species (*Vitis vinifera*, *V. labrusca*, etc.)
- Main varieties (cultivars)

3- Anatomy and Physiology of the Vine

- Vegetative organs (shoots, canes, tendrils) and reproductive organs (inflorescences, clusters)
- Physiology of growth, flowering, and berry maturation

4- Biological Cycle of the Vine

- Budburst, flowering, veraison, maturation, leaf fall
- Vegetative rest and resumption of growth

Tutorials:

TD 01: Morphological identification of fruit species

TD 02: Analysis of fruiting organs in Rosaceae

TD 03: Principles and techniques of grafting in fruit growing

TD 04: Ampelographic identification of cultivars

TD 05: Study of the annual cycle of the vine

Semester: 02

Teaching Unit: Methodology

Subject: Bioclimatology, Water Resources and Agriculture

VHS: h (C/PW)

Credits: 3

Coefficient: 2

Evaluation method: Continuous assessment: 40% Exam: 60 %.

Training Objectives:

This course aims to enable students to understand the interactions between climatic factors and agricultural systems. It covers the fundamentals of climatology and applied bioclimatology in agriculture, as well as sustainable water resource management. Emphasis is placed on the analysis of meteorological phenomena, climate types, evapotranspiration, and crop water requirements. Students will be able to integrate climatic parameters into agronomic decision-making.

Course Content:

Climatology

1.1 Meteorological phenomena

- Composition and structure of the atmosphere
- Meteorological observations (measurement and evaluation)
- Atmospheric pressure and wind (Buis-Ballot's law)
- Clouds
- Atmospheric disturbances (fronts and evolution)

1.2 Climate classification

- Equatorial climate
- Tropical climates (humid and dry)
- Temperate climates (oceanic, continental, Mediterranean)
- Subarctic climates
- Polar climates

Bioclimatology

- Nature and properties of radiation and its interaction with plant cover
- Temperature and heat exchanges in the soil–plant–atmosphere system
- Evapotranspiration of vegetation cover
- Effects of thermal and water stress

Water and Agriculture

3.1 Water resources

3.1.1 Global scale (water cycle)

3.1.2 In Algeria

3.2 Water use in agriculture

- Water and food production
- Agricultural water requirements
- Role of irrigation in food production
- Water quality and environmental aspects
- Regulations and legal aspects of water use

Tutorial

TD 01: Estimation of potential evapotranspiration

TD 02: Estimation of dry season duration

TD 03: Calculation of crop water requirements

Semester: 02

Teaching Unit: Discovery

Subject: Food Biotechnology

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment 100 %

Training Objectives:

The aim of this course is to provide fundamental knowledge in food biotechnologies. It serves as an introduction to the use of living organisms, the underlying principles and regulations governing their use, as well as their advantages, limitations, and fields of application.

By the end of this course, students will be able to:

- Define biotechnology and food biotechnology concepts.
- Identify the main components of biotechnology systems.
- Compare different microbial production strategies used in industry.
- Recall the principles of biocatalysis and explain their role and importance in agri-food industries.
- Apply knowledge of enzyme implementation in practical industrial examples.
- Describe the structure and operation of bioreactors.
- Analyze examples of industrial bioreactor applications.
- Assess the importance of biotechnology in modern food industries.

Course Content:

Chapter 1: General Introduction

- Definitions
- Components of biotechnology

Chapter 2: Fundamentals of Microbial Engineering

- Microbial kinetics
- Fermentation process management

- Case studies on biomass and metabolite production

Chapter 3: Fundamentals of Enzyme Engineering

- Review of biocatalysis
- Importance of biocatalysts in agri-food industries (AFI)
- Enzyme implementation and applications

Chapter 4: Fundamentals of Bioreactors

- Bioreactors with immobilized enzymes (examples)
- Bioreactors with immobilized cells (examples)

Chapter 5: Conclusion

Semester: 02

Teaching Unit: Discovery

Subject: Weed science

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment 100 %

Training Objectives:

- Understand the fundamentals of weed science and the impact of weeds on crops.
- Identify the main weed species and their effects on agricultural systems.
- Discover crop protection and weed control methods adapted to the agronomic context.

Course Content:

1. Definitions

Introduction to key concepts of weed science and terminology related to weeds.

2. History of weeds

Evolution of the perception and management of weeds in agriculture.

3. Effects on crop physiology

- Interspecific competition
- Influence on growth and development
- Effects on yield and crop quality

4. Major weed groups and affected crops

Classification of weeds and identification of the most impacted crops.

5. Weed control and crop protection

Methods for managing and controlling weeds in agricultural systems.

Personal Work:

1. Identification of major invasive and harmful weed species

- Field-based recognition of common weeds.

2. Preparation of an annotated herbarium

- Collection and annotation of weed samples with their characteristics.

Semester: 02

Teaching Unit: Transversal

Subject: Agricultural Economics

VHS: h (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment 100 %

Training Objectives

- Understand the fundamentals of economics applied to agriculture.
- Identify the specific economic characteristics of agriculture and their impact on agricultural and rural development.
- Develop an understanding of economic challenges related to agriculture in both local and global contexts.

Course Content:

CHAPTER 1: ECONOMIC SPECIFICITIES OF AGRICULTURE

This chapter explores what makes agricultural economics unique compared to other sectors, using practical examples and real-world situations from agricultural systems.

1.1 Importance of Land in Agriculture

- **Key concept:** Land is an essential but limited resource in agriculture. Its quality (soil fertility, soil type) and availability directly influence production.
- **Practical example:** Comparison between a fertile plot suitable for wheat cultivation and an arid plot requiring irrigation investments.
- **Challenge:** How to manage pressure on agricultural land in the context of urbanization and climate change?
- **Suggested activity:** Analysis of a local soil map and discussion of its impact on crop selection.

1.2 Seasonality and Dependence on Natural Conditions

- **Key concept:** Agricultural production depends on natural cycles (seasons, climate) and is vulnerable to hazards (droughts, floods).
- **Practical example:** Impact of delayed rainfall on maize production in a specific region.
- **Challenge:** How can farmers plan production under climatic uncertainty?
- **Suggested activity:** Case study on farmer adaptation strategies to drought (e.g., drought-resistant crops, irrigation).

1.3 Complementarity Between Different Agricultural Productions

- **Key concept:** Farms often combine multiple activities (crop production, livestock, agroforestry) to optimize resources and reduce risks.
- **Practical example:** A mixed farm combining cereal production and cattle farming, where manure is used as fertilizer.
- **Challenge:** How to balance different production activities to maximize income while preserving the environment?
- **Suggested activity:** Simulation of a mixed farming system to understand economic interactions.

1.4 Rigidity of Demand

- **Key concept:** Demand for agricultural products (such as bread or rice) is relatively inelastic because they meet basic needs.
- **Practical example:** Even if wheat prices increase, consumers continue to buy bread, while farmers cannot quickly adjust production levels.
- **Challenge:** How can farmers cope with price fluctuations in agricultural markets?

Suggested activity: Analysis of a price trend graph (e.g., wheat or milk) and discussion of its economic impacts.