PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Higher School of Saharan Agriculture

El Oued

HIGHER SCHOOL OF SAHARAN AGRICULTURE - ELOUED

المدرسة العليا للفلاحة الصحراوية - الوادي

Academic Program

2nd Cycle

Agri-Food Technology

2nd Year

3rd Semester

Teaching Unit (TU): FTU3.1

Course Unit: Microbiological Engineering

VHS: 67 h30 m (C/T)

Credits: 4

Coefficient: 2

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

Learning Objectives

The student will understand the different stages from design to pilot-scale transposition of microbiological and enzymatic processes. Kinetically and thermodynamically characterized (micro)biological processes: Cellular growth, its measurement or estimation, substrate utilization, product formation. Yields. Productivities.

Course Content

Chapter 1 – Introduction to Microbiological Engineering

- Definition and history
- Fields of application in the food industry
- Role in industrial biotechnology
- Examples of industrial microbial products

Chapter 2 – Microbial Growth and Metabolism

- Growth kinetics (phases, Monod model)
- Factors influencing growth: temperature, pH, oxygen, nutrients
- Growth measurements: optical density, dry weight, CFU
- Regulation and primary/secondary metabolism

Chapter 3 – Culture Media and Fermentation Conditions

- Composition of nutrient media
- Preparation and sterilization of media
- Supplements and growth factors
- Types of fermentation (aerobic/anaerobic)

Chapter 4 – Bioreactor Design and Control

- Types of bioreactors (batch, fed-batch, continuous)
- Control parameters (temperature, pH, agitation, aeration, DO)
- Sterilization, inoculation, instrumentation
- Automation and process monitoring

Chapter 5 – Industrial Fermentations

- Alcoholic, lactic, acetic, and butyric fermentation
- Production of enzymes, organic acids, and vitamins
- Probiotics and starter cultures
- Example: industrial production of yogurt or beer

Chapter 6 – Separation and Purification Techniques

- Centrifugation, filtration, precipitation
- Chromatography, lyophilization (freeze-drying)
- Purification of metabolites (enzymes, antibiotics)

Chapter 7 – Asepsis, Sterilization, and Hygiene

- Sterilization techniques: heat, UV, filtration
- Aseptic practices in laboratory and industry
- Good Manufacturing Practices (GMP)
- Cross-contamination and microbiological control

Tutorials (TD)

TD1: Media preparation and sterilization

TD2: Bacterial growth curve

TD3: Batch culture and fermentation

TD4: Operation of a pilot fermenter (if available)

TD5: Separation techniques

TD6: Case studies – Industrial production analysis: yogurt, beer, citric acid

Teaching Unit (TU): FTU3.1

Course Unit: Food Microbiology

VHS: 45 h (C/PW)

Credits: 6

Coefficient: 3

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

Learning Objectives

Based on a detailed microbiological analysis of a food product, the student must be capable of evaluating and discriminating the type and level of hazard associated or potentially associated with it. The student must be capable of determining the necessary conditions for the prevention or control of microbial contaminants.

Course Content

Chapter 1 – Introduction to Food Microbiology

- History, definitions, and key issues
- Classification of microorganisms involved in food
- Role of microorganisms: beneficial vs. pathogenic

Chapter 2 – Food Microflora

- Origin of microorganisms in food (air, water, equipment, operators)
- Natural microbiota and contaminants
- Animal vs. plant products: microbial typology
- Biofilms and their importance in the food industry

Chapter 3 – Factors Influencing Microbial Growth in Food

- pH, water activity (Aw), temperature, oxygen
- Preservative effect of salt, sugar, smoking, acidification
- Microbial antagonism, natural inhibitors

Chapter 4 – Microbiological Spoilage of Food

- Types of spoilage: organoleptic, physicochemical
- Products concerned: meat, dairy products, fruits/vegetables, cereals
- Responsible microorganisms: yeasts, molds, psychrophilic/thermophilic bacteria

Chapter 5 – Pathogenic Microorganisms and Foodborne Illnesses

- Major pathogenic bacteria: Salmonella, Listeria monocytogenes, Escherichia coli O157:H7, Clostridium botulinum, Staphylococcus aureus, Campylobacter

- Microbial toxins (exotoxins/endotoxins)
- Foodborne parasites and viruses
- Prevention measures and sanitary control

Chapter 6 – Fermentation and Beneficial Microorganisms

- Traditional fermentations (milk, bread, cheese, wine, beer)
- Lactic acid bacteria, yeasts, technological molds
- Starter cultures and fermentation control

Chapter 7 – Methods of Microbiological Analysis of Food

- Sampling and dilution
- Enumeration methods: plating, filtration, selective media
- Rapid methods: PCR, ELISA, ATPmetry
- Reading and interpreting results

Practical Work (TP)

TP1: Food sampling and sample preparation

TP2: Microbial enumeration

TP3: Identification of microorganisms

TP4: Study of lactic acid fermentation

TP5: Analysis of a contaminated food product

TP6: Interpretation of analytical results (AFNOR/ISO standards)

Teaching Unit (TU): FTU3.2

Course Unit: Food Safety and Quality Management

VHS: 45 h (C/T)

Credits: 4

Coefficient: 2

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

Learning Objectives

The student must be capable of: mastering legislation on food hygiene; identifying potential sources of contamination during hazard analysis; implementing good practices to prevent these contaminations; establishing a cleaning and disinfection plan; and initiating an HACCP approach within an enterprise.

Course Content

Chapter 1 – Foundations of Food Safety

- Definitions and key challenges
- Global and national statistics on collective foodborne outbreaks
- Stakeholders in the food chain (producers, authorities, consumers)
- Introduction to risk analysis

Chapter 2 – Food-Related Health Hazards

- Biological hazards: bacteria, viruses, parasites
- Chemical hazards: pesticides, veterinary residues, additives
- Physical hazards: foreign bodies
- Food allergens and traceability

Chapter 3 – Food Quality and Safety

- Definition of food quality
- Hygienic, nutritional, and organoleptic quality
- Concepts of compliance, validation, certification

Chapter 4 – Quality Management Systems

- Quality assurance vs. quality control
- Introduction to ISO 9001, ISO 22000 standards
- IFS, BRC, FSSC 22000 benchmarks
- Internal audit and certification audit

Chapter 5 – HACCP Methodology (Hazard Analysis and Critical Control Points)

- Origin and principles
- The 7 principles of HACCP
- Implementation steps: manufacturing flow diagram, CCP identification
- Documentation and record-keeping

Chapter 6 – Good Practices and Hygiene in Industry

- Good Manufacturing Practices (GMP)
- Good Hygiene Practices (GHP)
- Cleaning and disinfection plan
- Management of non-conformities

Chapter 7 – Traceability, Labeling, and Regulations

- Coding, lot identification
- European regulations: 178/2002, FIC (INCO), 852/2004
- Product recalls, food crises
- Allergen labeling and sustainability

Tutorials & Practical Work (TD / TP)

TD1: Case study of a collective foodborne illness outbreak

TD2: Development of a simplified HACCP plan

TD3: Critical analysis of food labeling

TD4: Quality audit simulation

TP5: Hygienic control of a cleaning plan

TD6: Comparison of quality standards (ISO, IFS, BRC)

Teaching Unit (TU): FTU3.2

Course Unit: Process Control in Food Processing Industries

VHS: 45 h (C/T)

Credits: 4

Coefficient: 2

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

Learning Objectives

The student must be capable of understanding the fundamental principles of processing operations in the food industry; identifying and controlling parameters influencing the quality and safety of processed products; applying common unit operations in compliance with hygiene and quality standards; optimizing processes to improve yield, sustainability, and energy efficiency; and contributing to continuous process improvement by integrating technological innovations.

Course Content

Chapter 1 – Introduction to Food Processes

- Definition and classification of processes
- Processing chain: from raw material to finished product
- Factors influencing technological choices
- Economic, sanitary, and environmental issues

Chapter 2 – Physical Unit Operations

- Size reduction (grinding/milling), sieving, mixing
- Mechanical separation: sedimentation, centrifugation, filtration
- Heat transfer: conduction, convection, radiation
- Evaporation, concentration, dehydration

Chapter 3 – Thermal Treatments and Preservation

- Pasteurization, sterilization, UHT
- Cooling and deep-freezing
- Canning (appertization) and aseptic packaging
- Impact on nutritional and sensory qualities

Chapter 4 – Non-Thermal Technologies

- High pressure processing (HPP), pulsed electric fields (PEF)
- Ultrasound and UV light treatments
- Advantages and limitations

- Recent industrial applications

Chapter 5 – Process Automation and Control

- Introduction to supervisory control systems (SCADA)
- Sensors and measurement instrumentation
- PID regulation and alarm systems
- Traceability of production parameters

Chapter 6 – Specific Processes by Sector

- Dairy products: pasteurization, fermentation
- Cereals and baking: milling, baking, fermentation
- Fruits and vegetables: blanching, freezing
- Meat and fish: salting, smoking, sous-vide cooking

Chapter 7 – Process Optimization and Sustainability

- Eco-design of processes
- Valorization of by-products
- Reduction of waste and energy consumption
- Performance analysis tools (yield, cost, carbon footprint)

Tutorials & Practical Work (TD / TP)

TD1: Study of a food production line (e.g., yogurt, juice, biscuit)

TD2: Material and energy balance calculations

TD3: Process simulation under industrial constraints

TD4: Critical analysis of a processing flowchart

TP5: Real-time monitoring of thermal treatment parameters

TD6: Diagnosis and improvement of an existing process

Teaching Unit (TU): MTU3

Course Unit: Physiological and Nutritional Biochemistry

VHS: 45 h (C/T)

Credits: 5

Coefficient: 3

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

Learning Objectives

The student must be capable of: understanding major physiological functions and their biochemical regulation; identifying the role of major nutrients in cellular metabolism; analyzing nutritional imbalances and their pathophysiological consequences; relating nutritional intake to the metabolic needs of the organism; and interpreting biological and nutritional indicators to evaluate health status.

Course Content

Chapter 1 – Introduction to Nutritional Biochemistry

- Definition and objectives of nutritional biochemistry
- Energy and metabolic requirements
- Energy balance concepts
- Recommended Daily Allowances (RDA / ANC)

Chapter 2 – Carbohydrate Metabolism

- Digestion and absorption of carbohydrates
- Glycolysis, gluconeogenesis, glycogenolysis, glycogenesis
- Hormonal regulation (insulin, glucagon)
- Glycemic index and glycemic load

Chapter 3 – Lipid Metabolism

- Digestion, absorption, and transport of lipids
- Beta-oxidation, lipogenesis, ketogenesis
- Role of lipoproteins (HDL, LDL, VLDL)
- Essential fatty acids and cardiovascular health

Chapter 4 – Protein and Amino Acid Metabolism

- Digestion and absorption of proteins
- Deamination, transamination, urea cycle
- Essential amino acid requirements
- Proteins of high and low biological value

Chapter 5 – Micronutrients: Vitamins and Minerals

- Classification and functional roles
- Deficiencies and excesses: clinical signs
- Bioavailability and interactions
- Recommended Dietary Allowance (RDA)

Chapter 6 – Metabolic Integration and Nutritional Status

- Metabolism during fasting and postprandial states
- Adaptations to stress, exercise, and malnutrition
- Biochemical markers of nutritional status
- Introduction to biological assessments

Chapter 7 – Applied Nutrition and Pathologies

- Obesity, diabetes, metabolic syndrome
- Nutritional deficiencies (iron, calcium, vitamins)
- Preventive and therapeutic nutrition
- Fundamentals of sports and infant nutrition

Tutorials & Practical Work (TD / TP)

TD1: Daily energy requirement calculation and dietary assessment

TD2: Case study: Type 2 diabetes and dietary regimen

TD3: Interpretation of biological nutritional panels

TD4: Critical reading of nutrition labels

TP5: Plasma assay of glucose, proteins, and lipids

TD6: Design of a balanced meal plan for a given profile

Teaching Unit (TU): MTU3

Course Unit: Food Chemistry

VHS: 60 h (C/T/PW)

Credits: 4

Coefficient: 2

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

Learning Objectives

The student must be capable of: identifying and characterizing the main chemical constituents of food; understanding chemical transformations of food during processing, storage, or cooking; relating chemical composition to nutritional value, sensory quality, and food safety; and applying chemical analysis methods to evaluate food composition and quality.

Course Content

Chapter 1 – Introduction to Food Chemistry

- Definition, objectives, and importance in the food industry
- Classification of food constituents
- Concept of the food matrix
- Introduction to analytical techniques

Chapter 2 – Water and Physicochemical Properties

- Structure and role of water in food
- Water activity (Aw) and microbiological stability
- States of water (free vs. bound)
- Impact on preservation and texture

Chapter 3 – Food Carbohydrates

- Monosaccharides, disaccharides, and polysaccharides
- Functional roles (sweetening power, gelling, thickening)
- Chemical reactions: enzymatic and non-enzymatic browning (Maillard reaction, caramelization)
- Effects of processing and storage

Chapter 4 – Food Lipids

- Saturated and unsaturated fatty acids, triglycerides, phospholipids
- Chemical properties (iodine value, oxidative rancidity)
- Nutritional and technological role
- Peroxidation reactions, hydrogenation, relevance in formulation

Chapter 5 – Food Proteins

- Structure and classification
- Biological and technological functions (solubility, foaming capacity, gelling)
- Denaturation, coagulation, Maillard reactions
- Biological value and digestibility

Chapter 6 – Vitamins, Minerals, and Additives

- Roles and stability of water-soluble and fat-soluble vitamins
- Major minerals: Ca, Fe, Zn, Na, K
- Food additives: preservatives, colorants, flavorings, antioxidants
- Regulations and maximum limits

Chapter 7 – Post-Harvest and Processing Chemical Reactions

- Oxidation, hydrolysis, polymerization
- Impact of pH, temperature, and oxygen
- Chemical alterations during storage (rancidity, browning, vitamin loss)
- Concrete cases: cooking, fermentation, preservation

Tutorials & Practical Work (TD / TP)

TD1: Calculation of chemical composition of food from nutrition labels

TD2: Comparative study of chemical indices of edible oils

TD3: Case study: formulation of a high-protein food product

TP1: Spectrophotometric assay of vitamin C in fruit juices

TP2: Assay of reducing sugars (Fehling or DNS method)

TP3: Lipid oxidative stability test

Teaching Unit (TU): DTU3

Course Unit: Ethics and Professional Deontology

VHS: 22 h 30min (C)

Credits: 1

Coefficient: 1

Evaluation method: Exam: 100 %.

Learning Objectives

The student must be capable of: understanding the fundamental principles of ethics and deontology in scientific and professional contexts; identifying moral and legal responsibilities related to practice in the food, biological, or research sectors; recognizing ethical dilemmas and adopting a responsible stance in decision-making; and knowing the regulatory frameworks and codes of conduct applicable to their profession.

Course Content

Chapter 1 – Introduction to Ethics and Deontology

- Definitions: morality, ethics, deontology
- Differences and complementarities
- Philosophical and historical origins of ethics
- Importance in scientific and technical professions

Chapter 2 – Fundamental Principles of Professional Ethics

- Respect for human dignity
- Responsibility, integrity, transparency
- Justice, loyalty, and impartiality
- Confidentiality and privacy protection

Chapter 3 – Ethics in Scientific Research

- Scientific integrity: plagiarism, falsification, data manipulation
- Informed consent and human participant protection
- Animal welfare in experimentation
- Publications, conflicts of interest, and intellectual property

Chapter 4 – Deontology in Agro-Food Professions

- Responsibility regarding public health and the environment
- Transparency in consumer information
- Management of conflicts of interest and industry relations
- Cases of non-compliance, alerts, and whistleblowing

Chapter 5 – Legal Frameworks and Reference Texts

- Professional codes of ethics (engineers, researchers, technicians...)
- Declarations and conventions: Helsinki, Nuremberg, UNESCO
- European regulations and national laws
- Role of ethics committees

Chapter 6 – Ethical Reflections Applied to Contemporary Challenges

- Sustainable food and ethics
- GMOs, biotechnologies, and the precautionary principle
- Artificial intelligence and data in food science
- Ethics facing inequalities in access to nutrition and healthcare

Teaching Unit (TU): DTU3

Course Unit: Technological and Statistical Quality Control

VHS: 22 h 30min (C)

Credits: 1

Coefficient: 1

Evaluation method: Exam: 100 %.

Learning Objectives

The student must be capable of: understanding the principles of quality control applied to food processes; mastering statistical tools for analyzing product and process quality; interpreting control results to ensure production compliance and consistency; and implementing a monitoring and continuous improvement approach based on reliable data.

Course Content

Chapter 1 – Introduction to Quality Control

- Definitions: quality, control, assurance, quality management
- Objectives of quality control in the food industry
- Types of control: incoming raw materials, in-process, finished product
- Relationship with customer satisfaction and regulatory compliance

Chapter 2 – Technological Control Methods

- Physicochemical parameters: pH, dry matter content, salt content, etc.
- Control of organoleptic characteristics
- Metrology: instruments, calibration, measurement uncertainties
- On-line vs. laboratory control

Chapter 3 – Introduction to Statistics Applied to Quality

- Concepts of population, sample, mean, standard deviation
- Data representation: histograms, distribution curves
- Use of analysis software (e.g., Excel, R, Minitab)

Chapter 4 – Statistical Process Control (SPC)

- Control charts (mean, range, c, p, etc.)
- Process capability (Cp, Cpk indices)
- Detection of drifts and special causes
- Sampling frequency and sample size

Chapter 5 – Sampling Plans and Acceptance

- Single, double, and multiple sampling plans
- ISO 2859 standards (e.g., single acceptance sampling plan)
- Alpha and beta risks, Acceptable Quality Level (AQL)

Chapter 6 – Quality Analysis and Improvement Methods

- Quality tools: 5M (Fishbone/Ishikawa diagram), Pareto chart, 5Ws (QQOQCP)
- PDCA methodology (Plan-Do-Check-Act)
- Introduction to Six Sigma and Lean Management
- Practical case studies in the food industry

Teaching Unit (TU): TTU3

Course Unit: Applied Statistics

VHS: 22 h 30min (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment: 100 %.

Learning Objectives

The student must be capable of: understanding basic concepts of descriptive and inferential statistics; correctly interpreting experimental data from scientific or industrial work; selecting appropriate statistical methods based on analysis objectives; and using statistics to support decision-making or experimental validations.

Course Content

Chapter 1 – Introduction to Statistics

- Definition and objectives of applied statistics
- Types of variables (quantitative, qualitative)
- Population vs. sample
- Applications in scientific and industrial domains

Chapter 2 – Descriptive Statistics

- Mean, median, mode
- Range, variance, standard deviation, coefficient of variation
- Graphical representations: histograms, box plots, frequency curves
- Interpretation of descriptive results

Chapter 3 – Probability Concepts

- Classical probabilities: probability distribution, independent events
- Binomial distribution, Poisson distribution, Normal distribution
- Application to random biological or industrial phenomena
- Tables and distribution curves

Chapter 4 – Statistical Estimation

- Point and interval estimation
- Sampling error
- Confidence intervals for a mean or proportion
- Precision and reliability of estimates

Chapter 5 – Hypothesis Testing

- Null hypothesis (H0) and alternative hypothesis
- Student's t-test (mean), Chi-square test (independence), proportion test
- Error risks (alpha, beta), statistical power
- Significance threshold (p-value) and interpretation

Chapter 6 – Analysis of Variance (ANOVA)

- Principle of one-way ANOVA
- Conditions of application
- Comparison of means among multiple groups
- Interpretation of results

Chapter 7 – Correlation and Regression

- Linear correlation (Pearson coefficient)
- Simple linear regression: regression line, interpretation
- Application to experimental data (e.g., dose-response, temperature vs. growth)
- Limitations and pitfalls to avoid

4th Semester

Teaching Unit (TU): FTU4.1

Course Unit: Health and Nutrition

VHS: 67 h30 m (C/PW)

Credits: 6

Coefficient: 3

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

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Analyze the complex relationships between dietary patterns and human health.
- Assess nutritional requirements across various age groups and physiological conditions.
- Identify dietary imbalances and evaluate their systemic clinical consequences.
- Formulate evidence-based dietary recommendations tailored to specific practical scenarios.

Course Content:

Chapter 1 – Introduction to Nutrition and Health

- Basic definitions and foundational concepts
- Nutrition as a primary disease prevention strategy
- Public health challenges and global priorities

Chapter 2 – Nutritional Requirements of the Body

- Macronutrients and micronutrients classification
- Recommended Dietary Allowances (RDA), Population Reference Intakes (PRI), and nutritional standards
- Endogenous and exogenous factors modifying physiological needs

Chapter 3 – Dietary Balance and Guidelines

- Balanced daily ration and dietary diversity principles
- National Nutrition and Health Program (PNNS) recommendations and food pyramids
- Nutritional labeling analysis and consumer literacy

Chapter 4 – Nutrition and Pathologies

- Obesity, type 2 diabetes, and cardiovascular diseases
- Deficiency-induced nutritional pathologies
- Food allergies and metabolic intolerances

Chapter 5 – Life-Stage Nutrition

- Infant nutrition, pediatric requirements, and adolescent growth
- Pregnancy, lactation, and geriatric nutrition
- Specialized physiological conditions: Sports nutrition

Chapter 6 – Food Additives, Contaminants, and Food Safety

- Food additives: Technological functions and regulatory framework
- Chemical and biological food contaminants
- Acceptable Daily Intake (ADI), Maximum Residue Limits (MRL), and food-drug interactions

Chapter 7 – Eating Behaviors

- Psychological, social, and cultural determinants of food choice
- Eating disorders (anorexia nervosa, bulimia nervosa, orthorexia)
- Food environments, marketing, and consumer decision-making

Practical Work Sessions (TP):

TP1: Calculation of daily energy and nutritional requirements

TP2: Nutritional evaluation and audit of a standard menu / dietary ration

TP3: Clinical case study – Nutritional management in diabetes and obesity

TP4: Critical analysis and verification of commercial nutrition labels

TP5: Simulation of personalized nutritional counseling and dietary plan formulation

Teaching Unit (TU): FTU4.1

Course Unit: Biotechnology, Research and Development

VHS: 67 h30 m (C/PW)

Credits: 6

Coefficient: 3

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

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Master the scientific principles and technical methodologies of modern biotechnology.
- Handle microorganisms and molecular biology tools proficiently within an experimental setting.
- Comprehend the complete life cycle of biotechnological product and process development.
- Apply experimental research methodologies to R&D projects in biotechnology.

Course Content:

Chapter 1 – Introduction to Biotechnology

- Definitions, history, and classification (red, white, green, and blue biotechnology)

- Economic, industrial, and societal challenges
- Overview of current global innovations

Chapter 2 – Technical Foundations of Biotechnology

- Microbial culturing techniques and fermentation kinetics
- Molecular biology toolkits: PCR amplification, gene cloning, and gel electrophoresis
- Production, separation, and purification methodologies for biomolecules

Chapter 3 – Research and Development (R&D) in Biotechnology

- Product development pipeline: From proof-of-concept to commercial market
- Experimental validation, scale-up, and pilot plant trials
- Technology transfer, intellectual property management, and scientific intelligence

Chapter 4 – Industrial and Agri-Food Biotechnology

- Probiotics, industrial enzymes, and biocontrol agents
- Industrial applications: Dairy fermentation, bio-aromas, and food additives
- Agri-food innovations (alternative protein sources, bio-based sustainable packaging)

Chapter 5 – Regulatory and Ethical Aspects

- Regulatory frameworks (Genetically Modified Organisms [GMOs], biosafety protocols)
- Intellectual property: Patenting strategies and technology licensing
- Ethical considerations, risk perception, and public acceptability

Practical Work Sessions (TP):

TP1: Cultivation, isolation, and enumeration of biotechnological microorganisms

TP2: Laboratory-scale batch fermentation (yeast or lactic acid bacteria)

TP3: Extraction, recovery, and quantitative assay of a biotechnological product (e.g., organic acid or enzyme)

TP4: Introduction to Polymerase Chain Reaction (PCR) and agarose gel electrophoresis

Teaching Unit (TU): FTU4.2

Course Unit: Food Hygiene, Behavior, and Nutritional Diseases

VHS: 67 h30 m (C/T)

Credits: 6

Coefficient: 3

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

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Understand the fundamental principles of food hygiene, sanitation, and regulatory standards.
- Identify high-risk dietary behaviors and assess their systemic public health impact.
- Comprehend the pathophysiological mechanisms underlying nutrition-related diseases.
- Formulate preventive interventions in food hygiene, sanitation, and public health nutrition education.

Course Content:

Chapter 1 – Principles of Food Hygiene

- Definition, scope, and objectives of food hygiene
- Sources and vectors of contamination: Biological, chemical, and physical hazards
- Physiological growth factors and environmental limits of foodborne pathogens
- Fundamental sanitation rules for food matrices, contact surfaces, and processing environments

Chapter 2 – Dietary Behaviors and Influencing Factors

- Dietary habits, lifestyle models, and dietary patterns
- Psychological, cultural, socioeconomic, and environmental determinants
- Media advertising, food environments, and nutritional education initiatives
- Emotional eating, compulsive food intake, and psychological triggers

Chapter 3 – Nutritional Deficiency Pathology

- Micronutrient deficiencies (iron deficiency anemia, iodine deficiency, vitamin A and D deficiencies)
- Physiological, metabolic, and clinical consequences
- High-risk vulnerable populations (pediatric, maternal, and geriatric demographics)

Chapter 4 – Pathologies of Nutritional Excess

- Overweight, clinical obesity, and insulin resistance / type 2 diabetes mellitus
- Dyslipidemias, hypertension, and atherosclerotic cardiovascular disease
- Metabolic syndrome and chronic systemic low-grade inflammation

Chapter 5 – Prevention and Nutritional Education

- Public health strategies: National nutrition guidelines (PNNS) and WHO recommendations
- Health education frameworks and effective nutritional communication techniques
- Promotion of healthy lifestyles (dietary optimization and physical activity)

Tutorial Sessions (TD):

TD1: Analysis and corrective action planning for a non-compliant food hygiene scenario

TD2: Evaluation of consumer dietary behaviors and associated health risk factors

TD3: Clinical case study on the pathophysiological management of a nutritional disease

TD4: Design and formulation of an evidence-based nutritional prevention communication campaign

Teaching Unit (TU): MTU4

Course Unit: Analytical Techniques in Food Technology (TIAA)

VHS: 40 h30 m (C/T/PW)

Credits: 5

Coefficient: 3

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

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Master the primary analytical instrumentation and techniques applied in agri-food industries.
- Select appropriate physicochemical and microbiological testing methods for food quality control.
- Interpret complex analytical results in accordance with current international regulatory standards.
- Operate laboratory instrumentation safely and execute standard analytical protocols with precision.

Course Content:

Chapter 1 – Introduction to Food Analytical Techniques

- Strategic role of analytical testing in industrial quality control and assurance
- Classification of analytical techniques: Physical, chemical, and biological methods

- Analytical standards and regulatory reference frameworks (ISO, AFNOR, Codex Alimentarius)

Chapter 2 – Physicochemical Analysis of Food Products

- Determination of pH, titratable acidity, density, moisture content, crude fat, and total protein
- Assay of carbohydrates (reducing and total sugars), ash content, and dietary fibers
- Classical analytical methods: Titrimetry, gravimetry, UV-Vis spectrophotometry, Soxhlet extraction, and Kjeldahl digestion

Chapter 3 – Microbiological Analysis of Foods

- Detection and enumeration of indicator and pathogenic microorganisms (Total Viable Count [TVC/FMAT], total/fecal coliforms, yeasts/molds, Salmonella, Listeria)
- Conventional culture methods vs. rapid automated diagnostics (Petrifilm, PCR, ELISA immunoassays)
- Interpretation of results against regulatory microbiological criteria

Chapter 4 – Advanced Instrumental Analysis

- UV-Visible spectrophotometry and molecular absorption principles
- Chromatographic techniques: Thin-Layer Chromatography (TLC), High-Performance Liquid Chromatography (HPLC), Gas Chromatography (GC)
- Physical measurements: Colorimetry, conductimetry, and rotational viscosimetry

Chapter 5 – Sampling Methodologies and Sample Preparation

- Representative sampling strategies: Simple random and stratified sampling
- Sample preservation, homogenisation, and serial dilution protocols
- Concepts of sample representativeness, analytical precision, and measurement uncertainty

Tutorial Sessions (TD):

TD1: Reading, statistical processing, and regulatory interpretation of analytical laboratory reports

TD2: Selection and optimization of analytical methods tailored to specific food matrices

TD3: Drafting an industrial Standard Operating Procedure (SOP) for laboratory analysis

Practical Work Sessions (TP):

TP1: Physicochemical evaluation: Determination of pH, titratable acidity, and moisture content

TP2: Quantitative determination of total protein content via the Kjeldahl method

TP3: Quantitative extraction and determination of crude fat content via the Soxhlet method

TP4: Basic microbiological enumeration: Total Viable Count (TVC) and coliform testing

TP5: Introduction to analytical separation via Thin-Layer Chromatography (TLC)

Teaching Unit (TU): MTU4

Course Unit: Nutritional Requirements

VHS: 20 h30 m (C)

Credits: 2

Coefficient: 1

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

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Comprehend human nutritional requirements based on age, biological sex, physiological status, and physical activity levels.
- Know Recommended Dietary Allowances (RDA) and Population Reference Intakes (PRI) for all essential nutrients.
- Identify endogenous and environmental factors influencing basal and active energy expenditure.
- Apply nutritional requirement principles within preventive public health frameworks.

Course Content:

Chapter 1 – Introduction to Nutritional Requirements

- Fundamental terms: Physiological need, dietary intake, deficiency, and overconsumption
- Objectives and principles of meeting nutritional requirements
- Overall dietary balance and nutritional adequacy guidelines

Chapter 2 – Human Energy Requirements

- Basal Metabolic Rate (BMR) and Total Energy Expenditure (TEE)
- Determinants of energy expenditure: Age, biological sex, physical activity level (PAL), and physiological state
- Predictive equations, indirect calorimetry principles, and factorial calculation methods

Chapter 3 – Macronutrient Requirements

- Proteins: Biological value, amino acid scoring, metabolic roles, and population requirements
- Carbohydrates: Digestible sugars vs. dietary fiber, glycemic index, and glycemic load
- Lipids: Essential fatty acids (Omega-3 and Omega-6), lipid fractions, and dietary ratios

Chapter 4 – Micronutrient Requirements

- Vitamins (fat-soluble: A, D, E, K; water-soluble: B-complex, C): Functions, recommended intakes, and clinical deficiency states
- Macro-minerals and trace elements: Calcium, iron, iodine, zinc, sodium, and magnesium
- Bioavailability, intestinal absorption enhancers, and dietary inhibitors

Chapter 5 – Variability in Human Nutritional Requirements

- Specific population requirements: Infants, children, adolescents, pregnant/lactating women, and elderly demographics
- Specialized dietary requirements: High-performance athletes, vegetarians/vegans, and clinical metabolic conditions
- Recent updates and revisions to nutritional standards (e.g., EFSA, WHO, FAO guidelines)

Teaching Unit (TU): MTU4

Course Unit: Quality Approach, Good Practices, and Hygiene in Agri-Food Technology

VHS: 20 h30 m (C)

Credits: 2

Coefficient: 1

Evaluation method: Exam: 100 %.

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Understand the theoretical foundations and implementation of quality management systems in agri-food industries.
- Master and apply Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP).
- Integrate international regulatory requirements regarding food safety, sanitation, and consumer protection.
- Contribute effectively to the design, operation, and auditing of Quality Management Systems (QMS).

Course Content:

Chapter 1 – Fundamentals of Quality Management in Agri-Food

- Multidimensional nature of food quality: Hygienic, nutritional, organoleptic, and legal dimensions
- Strategic objectives and economic imperatives of industrial quality management
- Core concepts: Quality Control (QC), Quality Assurance (QA), and Total Quality Management (TQM)
- Interdepartmental roles and responsibilities (production, quality assurance, maintenance, logistics)

Chapter 2 – Good Manufacturing Practices (GMP)

- Core principles and regulatory foundations of GMP
- Facility design, sanitary zoning, processing equipment maintenance, and personnel ergonomics
- Operational hygiene protocols and sanitary process control
- Strategies for the prevention of physical, chemical, and biological cross-contamination

Chapter 3 – Good Hygiene Practices (GHP)

- Essential sanitation principles in food processing plants
- Master Cleaning and Disinfection Plans (SSOP / PND): Chemistry, execution, and validation
- Industrial waste management, effluent treatment, and integrated pest management (IPM)

- Sanitary monitoring, operational record-keeping, and procedure validation

Chapter 4 – International Quality Standards and Certifications

- ISO standards framework: ISO 9001 (QMS), ISO 22000 (FSMS), and FSSC 22000
- Global Food Safety Initiative (GFSI) recognized standards: IFS Food and BRCGS
- Internal and external auditing procedures, certification mechanics, and continuous improvement (PDCA cycle)

Chapter 5 – Food Safety Legislation, HACCP, and Traceability

- European and international regulatory frameworks: Hygiene Package, EC Regulation No. 852/2004
- Hazard Analysis Critical Control Point (HACCP) system: 7 principles and 12 logic steps
- Upstream, internal, and downstream product traceability mechanisms
- Product recall/withdrawal protocols, crisis communication, and emergency response management

Teaching Unit (TU): DTU4

Course Unit: Food Packaging and Films

VHS: 22 h30 m (C)

Credits: 1

Coefficient: 1

Evaluation method: Exam: 100 %.

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Understand the multifunctional roles of packaging systems in modern agri-food processing and distribution.
- Identify the physical, chemical, and mechanical properties of diverse food packaging materials.
- Comprehend mass transfer phenomena and interactions between food matrices and contact packaging materials.
- Evaluate regulatory compliance, environmental sustainability, and technological innovations in food packaging.

Course Content:

Chapter 1 – Introduction to Food Packaging Systems

- Primary functions: Containment, preservation/protection, logistics/transport, communication, and marketing
- Historical evolution and technological milestones in food packaging
- Hierarchical classification: Primary, secondary, and tertiary packaging systems

Chapter 2 – Packaging Materials and Their Properties

- Polymeric materials (PE, PP, PET, PVC, PS, EVOH): Processing, barrier performance, and applications
- Glass and metallic containers (steel, tinplate, aluminum): Structural integrity, inertness, and infinite recyclability
- Paper, paperboard, and corrugated fiberboard: Structural properties, barrier coatings, and conversion techniques

Chapter 3 – Flexible Packaging Films and Conversion Technologies

- Single-layer vs. multilayer laminated flexible structures
- Film manufacturing processes: Extrusion blown film, cast film extrusion, co-extrusion, and lamination techniques
- Gas and vapor barrier properties: Permeability mechanisms for oxygen, carbon dioxide, water vapor, and light

Chapter 4 – Packaging-Food Matrix Interactions

- Mass transfer phenomena: Overall and specific chemical migration of additives, monomers, and plasticizers
- Flavor scalping, organoleptic degradation, and oxidative chemical deterioration
- Material-product compatibility testing and shelf-life modeling

Chapter 5 – Regulatory Framework and Labeling Mandates

- EC Regulation No. 1935/2004 on materials and articles intended to come into contact with food
- Good Manufacturing Practice for food contact materials: EC Regulation No. 2023/2006
- Mandatory labeling declarations, consumer safety information, and traceability requirements

Chapter 6 – Sustainable Packaging Innovations

- Bio-based, biodegradable, compostable, and recyclable polymer formulations
- Active packaging (oxygen scavengers, moisture absorbers, antimicrobial release systems) and intelligent packaging (freshness indicators, time-temperature indicators [TTIs])
- Environmental impact reduction strategies: Eco-design, lightweighting, circular economy, and waste recovery

Teaching Unit (TU): DTU4

Course Unit: Entrepreneurship and Project Management

VHS: 20 h30 m (C)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment: 100%

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Acquire theoretical models and practical competencies in entrepreneurship and industrial project management.
- Structure and execute an entrepreneurial venture from opportunity identification to commercial launch.
- Analyze financial, economic, organizational, and human dimensions in project leadership.
- Apply standardized project management toolkits for planning, scheduling, risk mitigation, and performance monitoring.

Course Content:

Chapter 1 – Introduction to Entrepreneurship

- Definitions, economic significance, and core attributes of entrepreneurship
- Typology of entrepreneurs and business creation models
- The entrepreneurial process lifecycle: From opportunity discovery to enterprise launch
- Critical success factors and common failure modes in new ventures

Chapter 2 – Business Opportunity Identification and Validation

- Methods for generating, screening, and validating innovative project concepts
- Market research methodologies, industry structure analysis, and competitor mapping
- Technical, operational, and commercial feasibility assessments
- SWOT analysis framework (Strengths, Weaknesses, Opportunities, Threats)

Chapter 3 – Venture Creation and Financial Planning

- Selecting appropriate legal structures and corporate forms
- Administrative creation steps, statutory compliance, and seed capital mobilization
- Business Plan engineering: Executive summary, market strategy, operational roadmap, and financial projections
- Entrepreneurial financing mechanisms: Founder equity, bank debt, venture capital, angel investors, and public innovation grants

Chapter 4 – Project Management Frameworks

- Project definition, constraints (scope, time, cost, quality), and success criteria

- Project lifecycle phases: Initiation, planning, execution, monitoring/control, and closure
- Quantitative planning tools: Work Breakdown Structure (WBS), Gantt charts, PERT/CPM network analysis, and PM software
- Project control: Earned Value Management (EVM), risk management, schedule control, and budget optimization

Chapter 5 – Human Resource and Team Leadership

- Project team assembly, role definition, and matrix organizational structures
- Leadership styles, stakeholder communication, and team motivation strategies
- Conflict resolution techniques and high-performance team dynamics
- Recruitment strategies and human capital management in growing ventures

Chapter 6 – Venture Performance Evaluation and Strategic Expansion

- Evaluating project outcomes: Profitability metrics, Return on Investment (ROI), and Net Present Value (NPV)
- Post-launch operational stabilization and business sustainability strategies
- Growth strategies: Market penetration, product diversification, strategic alliances, and internationalization
- Exit strategies: Trade sale, management buyout (MBO), merger, or initial public offering (IPO)

Teaching Unit (TU): TTU4

Course Unit: Lean Startup

VHS: 20 h30 m (C/T)

Credits: 1

Coefficient: 1

Evaluation method: Continuous assessment: 100%

Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Understand the evolution of higher education institutions toward University 4.0 and innovation ecosystems.
- Master the Lean Startup methodology for rapid hypothesis testing and iterative product development under extreme uncertainty.
- Utilize Customer Discovery, Business Model Canvas, and Minimum Viable Product (MVP) frameworks.
- Apply data-driven analytics, artificial intelligence tools, and strategic pivot/persevere logic to steer venture growth.

Course Content:

Unit 01 – Historical Evolution of Higher Education: From Pioneer Academies to University 4.0

- Stage 1: Platonic Academies (c. 387 BC) — Foundational philosophical discourse
- Stage 2: Medieval Universities (13th–14th Centuries) — Institutional scholarly guild model
- Stage 3: First-Generation University (University 1.0) — The Teaching University model
- Stage 4: Second-Generation University (University 2.0) — Research-driven Humboldtian model
- Stage 5: Third-Generation University (University 3.0) — Commercialization and technology transfer focus
- Stage 6: Fourth-Generation University (University 4.0) — Innovation ecosystem hub, AI-driven, and entrepreneurial engine

Unit 02 – The Pioneer University in the Era of Artificial Intelligence and Knowledge Economy

- Role of higher education in driving knowledge-based economic growth
- Integration of AI tools, deep technology transfer, and interdisciplinary innovation hubs

Unit 03 – Entrepreneurship and Innovation Ecosystem in Algeria

Part I: Evolution of the National Ecosystem

- Axis 1: Strategic drivers behind Algeria's transition toward a knowledge economy

- Axis 2: Key characteristics and structural components of the national entrepreneurship ecosystem post-2020

Part II: Integrated Operational Architecture

- Axis 1: The university as an institutional pillar of national technological innovation
- Axis 2: Executive Decree No. 12-75 (Graduate Thesis to Startup/Patent) and the historic transformation of Algerian universities

Unit 04 – Introduction to Startups and the Lean Startup Paradigm

- Defining startups: Temporary organizations designed to search for a repeatable and scalable business model
- Contrast between traditional corporate planning vs. entrepreneurial discovery under uncertainty

Unit 05 – Agile Venture Methodology (Lean Startup Core Mechanics)

- Foundational thesis of the Lean Startup methodology (Eric Ries framework)
- Root cause analysis: Why traditional product launches fail
- The radical paradigm shift: From execution of an unproven plan to hypothesis discovery
- The startup structured as a scientific experimental laboratory
- Validated learning as the primary strategic unit of progress
- Cycle time reduction and rapid feedback loops (Build-Measure-Learn)
- Managing continuous innovation through empirical experimentation
- Eliminating waste (time, capital, effort) in product design
- Decision-making protocols under conditions of extreme market uncertainty
- The entrepreneur operating as a scientific researcher hypothesis tester

Unit 06 – Market Validation and Customer Discovery

- Customer Discovery methodology (Steve Blank framework)
- Uncovering latent customer problems, pain points, and behavioral patterns

Unit 07 – Business Model Architecture (Business Model Canvas)

- Deconstructing the 9 building blocks of the Business Model Canvas (BMC)
- Mapping value propositions, customer segments, revenue streams, and cost structures

Unit 08 – Minimum Viable Product (MVP) Engineering

- Defining the Minimum Viable Product: Concierge, Wizard of Oz, smoke test, and functional prototypes
- Maximizing validated learning per unit of development effort

Unit 09 – Artificial Intelligence and TRIZ Methodology in Innovation

- Application of Generative AI in ideation, competitive intelligence, MVP code generation, and automated marketing
- TRIZ Methodology (Theory of Inventive Problem Solving): Identifying technical contradictions and formulating the Ideal Final Result (IFR)

- Synergistic integration of AI models with TRIZ problem-solving algorithms
- Deep Tech Startups: Commercializing breakthrough scientific research
- Practical Workshop: Accelerated ideation-to-innovation workflow using AI and TRIZ

Unit 10 – Strategic Pivot or Perseverance Decision Framework

Axis 01: The Pivot or Persevere Decision

- Core theoretical concept of strategic course adjustment
- Defining Perseverance: Doubling down on validated hypotheses
- Defining the Pivot: Structured course correction designed to test a new fundamental hypothesis
- Psychological and organizational hurdles making pivot decisions challenging
- Typology of pivots: Zoom-in, zoom-out, customer segment, customer need, platform, architecture, value capture, engine of growth, and channel pivots
- Quantitative and qualitative decision criteria: When to pivot vs. when to persevere
- Practical case study analysis of successful tech venture pivots
- Interdependence between the pivot decision and the Build-Measure-Learn feedback loop
- Common pitfalls: Sunk cost fallacy, vanity metric obsession, and delayed pivoting

Axis 02: Data-Driven Startup Steering and Growth Scaling

- Actionable Key Performance Indicators (KPIs) vs. Vanity Metrics
- Operational governance and innovation leadership within agile teams
- Growth measurement paradigms in early-stage ventures
- The AARRR Pirate Metrics framework: Acquisition, Activation, Retention, Revenue, Referral
- Product-Market Fit (PMF): Quantitative indicators of real market demand solving verified pain points
- Problem-Solution Fit (PSF): Validating that proposed value propositions directly resolve validated customer pain
- Retention, Churn, and Burn metrics analysis: Calculating user retention curves, churn velocity, and net cash burn rate
- Validated Learning Metrics: Quantifying knowledge gained per experiment
- Early failure management: Fast-failing protocols to preserve capital and pivot efficiently
- Kill Criteria: Pre-established quantitative thresholds governing project termination

Unit 11 – Performance Measurement, Analytics, and Failure Management

- Rationale for rigorous performance measurement in non-linear startup environments
- Actionable KPI dashboards and cohort analysis
- AARRR growth funnel optimization

- Institutional failure management: Psychological safety, post-mortems, and organizational learning

Unit 12 – Venture Growth, Financing, and Strategic Scaling

- Foundational concepts of startup capitalization and investment stages
- Sources of capital: Bootstrapping, grant funding, seed funds, venture capital, and corporate VC
- Financing rounds: Pre-seed, Seed, Series A, B, C, and growth equity
- The Lean Startup definition of sustainable growth
- Interplay between capital efficiency, milestone achievement, and valuation
- Growth Hacking: Rapid cross-channel experimentation for user acquisition
- Growth Funnel optimization and virality loops (viral, sticky, and paid growth engines)
- Integrating capital raises into the Build-Measure-Learn feedback loop
- International scaling strategies: Localization, regulatory compliance, and global market expansion

Tutorial Sessions (TD):

TD 01: Comparative analysis: From University 1.0 to University 4.0 and the modern innovation ecosystem

TD 02: Deep-dive workshop: Navigating Algeria's national entrepreneurship and innovation ecosystem (Decree 12-75)

TD 03: Ideation studio: Generating, screening, and selecting innovative startup concepts

TD 04: Lean Startup workshop: Formulating falsifiable hypotheses and designing validation experiments

TD 05: Customer Discovery fieldwork: Conducting problem-interview scripts and analyzing customer pain points

TD 06: Business Model Canvas engineering and Minimum Viable Product (MVP) specification design

TD 07: AI & TRIZ simulation lab: Solving technical contradictions and evaluating Pivot vs. Persevere scenarios

TD 08: Venture analytics workshop: AARRR metrics dashboard building, burn rate calculation, and growth strategy presentation