



UNIVERSIDAD  
DE BURGOS

## COURSE DESCRIPTIONS

### Bachelor's Degree in Food Science and Technology

➤ **1<sup>st</sup> year**

#### **5145 GENERAL BIOLOGY**

##### **THEMATIC UNIT I: INTRODUCTION**

###### **1. OBJECTIVES AND COMPETENCIES**

1. Objectives. 2. Contents of the subject. 3. Evaluation methods. 4. Activities Training and teaching methodology. 5. Sources of bibliographic information and Internet resources.

###### **2. INTRODUCTION TO BIOLOGY**

1. Concept of biology. 2. The organization of living things. General Features. 3. Bioelements. 4. Biomolecules. 4.1. Types of biomolecules. 4.2. Water: Biological structure and functions.

##### **THEMATIC UNIT II: COMPOSITION OF LIVING ORGANISMS.**

###### **BIOMOLECULES**

###### **3. CARBOHYDRATES**

1. Definition and nomenclature. 2. Monosaccharides. 3. Disaccharides. 4. Polysaccharides. 5. Glycoconjugates: Proteoglycans, glycoproteins and glycolipids. 6. Biological importance of carbohydrates.

###### **4. LIPIDS**

1. Concept, classification and biological interest. 2. Fatty acids. 3. Triacylglycerols. 4. Waxes. 5. Phospholipids. 6. Glycolipids. 7. Sterols. 8. Terpenes. 9. Eicosanoids. 10. Carotenoids and other compounds.

###### **5. PROTEINS**

1. Classification and biological function of proteins. 2. Amino acids. 2.1. Structure of amino acids. 2.2.  $\alpha$ -amino acid side-chain properties: Types of  $\alpha$ -amino acids. 3. Peptides and proteins. 3.1. Peptides of biological importance. 4. Levels of organization of proteins.

###### **6. NUCLEIC ACIDS**



1. Classification and biological function of nucleic acids. 2. Nucleotides. 3. Structure and organization of deoxyribonucleic acid. 4. Ribonucleic acid. 4.1. Structure and organization. 4.2. Types of ribonucleic acid.

## **7. VITAMINS**

1. General considerations. 2. Classification. 3. Nicotinic acid. 4. Riboflavin. 5. Pantothenic acid. 6. Folic acid. 7. Biotin. 8. Thiamine. 9. Pyridoxine. 10. Vitamin B12. 11. Ascorbic acid. 12. Vitamin A. 13. Vitamin D. 14. Vitamin E. 15. Vitamin K.

## **THEMATIC UNIT III: CELLULAR ORGANIZATION OF LIVING ORGANISMS**

### **8. INTRODUCTION TO THE CELL**

1. Cell theory. 2. Prokaryotes and eukaryotic cells. 3. Organization of eukaryote cells. 3.1. Animal and plant cells.

### **9. BIOLOGICAL MEMBRANES AND CELL SURFACE**

1. Composition and architecture of membranes. 1.1. The lipid bilayer. 1.2. Membrane proteins. 1.3. Asymmetry of the membranes. 2. Dynamics and fluidity of the membrane. 3. Membrane permeability. 4. Cell surface. 4.1. The extracellular matrix. 4.2. The cell wall. 5. Cellular unions.

### **10. CYTOPLASM**

1. Structure and function of the cytoplasm. 2. The cytoskeleton. 2.1. Filaments and microtubules. 2.2. Cilia and flagella. 2.3. Cellular movements.

### **11. CYTOPLASMIC ORGANELLES**

1. Ribosomes. Structure, composition and physiological function. 2. The reticle Reticulum. Structure and physiological function. 3. Structure and function of the Golgi complex. 4. Structure and function of lysosomes. 5. Structure and function of the peroxisomes. 6. Structure and function of the glyoxysomes. 6. Vacuoles: structure and function. 7. Vesicular transit, secretion and endocytosis. 8. Mitochondria. 8.1. Structure and chemical composition. 8.2. Physiological functions of the mitochondria. 9. The chloroplasts. 9.1. Structure. 9.2. Sheath and thylakoid membranes. 9.3. Intermembrane and stroma spaces. 9.4. Chemical composition. 9.5. Physiological functions of the chloroplasts.

### **12. THE NUCLEUS**

1. Nuclear structure and function. 2. The nuclear envelope. 3. The nucleolus. 4. Chromosomes and chromatin. 4.1. Structure of prokaryotic chromosome. 4.2. Structure of the eukaryotes chromosomes.

## **THEMATIC UNIT IV: REPRODUCTION OF LIVING ORGANISMS**

### **13. CELL REPRODUCTION**

1. Cell cycle. 1.1. Phases of the cell cycle. 1.2. Cell cycle control. 1.3. Cell proliferation and death (apoptosis). 2. Cell division. 2.1. Mitosis and cytokinesis. 2.2. Cell division and the reproduction of organisms

### **14. MEIOSIS AND SEXUAL REPRODUCTION**



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1. Generalities of meiosis. 2. Phases of meiosis. 3. Consequences of meiosis: Genetic variation. 4. Meiosis and biological cycles.

## **15. Fundamentals of Inheritance**

1. Genes and Genome. 1.1. Concept of gene. 2. Fundamentals of Mendelian Genetics. 3. Genotype and phenotype. 4. Chromosomal inheritance theory.

## **THEMATIC UNIT V: EVOLUTION AND BIODIVERSITY**

### **16. THE EVOLUTIONARY PROCESS**

1. The origin of life. 2. Evolution theory. 3. The evolutionary process. 3.1. Natural selection and adaptation.

### **17. THE DIVERSITY OF LIFE**

1. Taxonomy. 2. Phylogeny. 2.1. Phylogenetic trees. 3. Classification systems of Living things. 3.1. The five kingdoms.

## **THEMATIC UNIT VI: BIOLOGY AND SOCIETY**

### **18. BIOLOGY AND SOCIETY**

1. Social impact of biology. 1.1. Health. 1.2. Biotechnology. 1.3. Environment. 1.4. Agriculture and livestock. 1.5. Ecology.

## **5146 MATHEMATICS**

### **1. Functional models**

Functional models of a variable: functions, equations, graphs.

-Definitions and basic properties. Derivatives. Representation. Optimization.

Approach.

-Basic models in Nature Sciences: exponential/logarithmic growth.

Models in ecology, biology and chemical reactions.

Functional models of various variables.

-Analysis and optimization. Representation of functions of 2 variables, level curves.

-Derivation and interpretation.

-Change models.

### **2. Stochastic models**

Descriptive statistics.

Introduction to descriptive and inferential statistics:

-Experimental variability.

-Random Variable.

-Descriptive measures.

Introduction to inferential statistics.

-Point Estimate.

-Estimation by confidence intervals.

Introduction of regression and calibration lines.

- Construction and interpretation of regression lines.
- Construction and interpretation of calibrated lines.

## 5147 GENERAL CHEMISTRY

### FIRST BLOCK

#### Topic 1: INTRODUCTION TO CHEMISTRY

Atoms, isotopes, and molecules. Concept of the Mol. Formulation and nomenclature of the principal types of inorganic compounds. Percentage composition. Chemical equations. Performance of a reaction. Units of concentration. Solutions and dilution. Pressure of a gas. The general gas law.

#### Topic 2: ATOMIC STRUCTURE AND CHEMICAL PERIODICITY

Wave mechanics. The hydrogen atom. Radial function and angular function. Quantum numbers. Polyelectronic atoms. Electronic configuration. Shielding and effective nuclear charge. Periodic table of the elements. Periodic properties.

#### Topic 3: CHEMICAL BOND

Covalent bond: Valence link theory, hybridization of atomic orbitals, Link and overlap strength, resonance. Molecular topology. Theory of molecular orbital. The ionic bond. The bond in the metals. Interactions intermolecular. Introduction to coordination chemistry.

### SECOND BLOCK

#### Topic 4: CHEMICAL THERMODYNAMICS

Basic terms in thermochemistry. Energy changes in chemical reactions. Enthalpy. Calorimetry. The standard state. Entropy (S), Gibbs free Energy (G) and Spontaneity criteria.

#### Topic 5: INTRODUCTION TO CHEMICAL EQUILIBRIUM

The equilibrium constant. Factors that alter the chemical equilibrium. Equilibrium of Phases. Binding properties.

#### Topic 6: BALANCES IN DISSOLUTION

Theory of acids and bases of Arrhenius and Bronsted-Lowry. Acid-base properties of Water. Concept of PH. Strength of acids and bases. Weak acids and bases. Acid-base properties of salts. Common ion effect. Shock absorbing solutions. Solubility equilibrium. The common ion effect and the solubility. Redox reactions. Adjustment of redox equations.

#### Topic 7: CHEMICAL KINETICS

Introduction. Relationship between concentration and reaction time. Models Theorists of chemical kinetics. Effect of temperature and catalysts.

## 5148 ORGANIC CHEMISTRY

### Introduction

#### Teaching Plan

Training objectives of the subject. Contents. Evaluation. Training Activities. Sources of bibliographic information and Internet resources.

#### Topic I. Introduction to Organic Chemistry

Organic Chemistry: concept and historical development. Composition of organic compounds. General characteristics and properties of organic compounds. Organic Chemistry in the context of food science.

#### The bond in organic compounds.

#### Topic II. The bond in organic compounds.

The covalent bond in organic compounds: the octet rule. Structures of Lewis. Isomerism and constitution isomers. The form of the organic molecules: hybridization theory. Localized bond formation. Bonds with oxygen and nitrogen. Bond parameters. Covalent polar bond and its consequences: inductive effect. Conjugation and electronic delocalization. Resonance, resonant forms and resonance stabilization. Bonds. Weaker than covalent: relationship with the physical properties of organic compounds.

#### Constitution, classification and representation of organic compounds.

#### Topic III. Constitution, classification and representation of organic compounds.

Constituent units of organic compounds. Classification of organic compounds: major families of organic compounds. Representation of the organic compounds. Molecular and structural formulas. Types of structural formulas. Constitutional isomerism and stereoisomerism.

#### Organic compounds such as acids and bases

#### Topic IV. Organic compounds such as acids and bases

Revision of the concept of acid and base. Use of pKa tables. Relationship between structure and acid-base behavior. Effect of PH on the structure of the organic compound.

#### Stereochemistry

#### Topic V. Stereoisomerism in organic compounds

Stereoisomerism concept. Conformation and configuration. Chirality. Enantiomers. Optical activity. Racemic mixtures. Absolute and relative configuration. Fischer projection formulas. Molecules with two or more asymmetric carbons. Diastereomers and meso forms. Stereoisomerism in cyclic compounds. Importance of chirality in nature.



## Structure and reactivity of organic compounds

### **Topic VI. General considerations of organic reactions.**

Chemical reaction. Types of organic reactions. Representation of the organic reactions. Mechanism of organic reactions. Energy Aspects of a reaction: reaction profiles, transition states and intermediates. Features of organic reactions. Comparison between organic reactions in the laboratory and in the biological environment.

### **Topic VII. Saturated hydrocarbons: alkanes and cycloalkane.**

Saturated hydrocarbon chains: nomenclature and properties. Conformational study in saturated hydrocarbon chains. Alicyclic Systems: Nomenclature, properties and stereoisomerism. Reactivity of alkanes and cycloalkane: combustion and halogenated reactions. Alkane halogenation mechanism. Free radical reactions in foods.

### **Topic VIII. Unsaturated hydrocarbons: alkenes, alkynes and aromatic compounds.**

Description of the double bond. The double bond as a structural element. Z/E Isomerism. Nomenclature and properties of alkenes. Dien systems. The Double bond as a function. Alkene Reactivity: addition reactions. Polymerization by addition. Alkene oxidation. The Diels-Alder reaction. The triple bond: aspects to take into account. Nomenclature and properties of the Alkynes. Main reactions of the Alkynes. Aromatic hydrocarbons: Structure and properties of the benzene ring. Aromaticity, anti-aromaticity and the Hückel rule. Nomenclature of Arenes. Most relevant heterocyclic systems. Reactions of aromatic compounds: Electrophilic aromatic substitution and oxidations.

### **Topic IX. Alcohols, phenols, ethers and Thiols.**

Structural relationship and constitutional isomerism of alcohols, phenols and ethers. Classification, nomenclature and physical properties of alcohols, phenols and ethers. Acidity and basicity of alcohols and phenols. Reactivity of alcohols: reactions of Dehydration, substitution and oxidation. Reactivity of phenols: substitution Aromatic and oxidation. Phenols as food antioxidants. Ethers. Thiols

### **Topic X. aldehydes and ketones.**

Structure, nomenclature and physical properties of aldehydes and ketones. Aldehydes and ketones in nature and in everyday life. Reactivity of the carbonyl group. Nucleophilic addition reactions of the carbonyl group. Oxidation and reduction of aldehydes and ketones. Aldol condensation.

### **Topic XI. Carboxylic acids and their derivatives.**

Structural comparison, nomenclature and physical properties of the carboxylic acids and their derivatives. Acidity and acidity constant. Conversion of acids into salts. Soaps. Preparation of carboxylic acids and their principal derivatives. Principal reactions of the carboxylic acid derivatives. Importance of phosphoric esters in biological systems.

### **Topic XII. Amines and related nitrogenated compounds.**

Structure and classification of the amines. Nomenclature and physical properties of the



amines. Amine basicity. Amine salts. Amine acylation. Aromatic compounds of diazonium. Azo dyes.

## **5149 APPLIED PHYSICS**

### **UNIT 1**

#### **Foodstuff as physical systems**

Importance of prediction and measurement of physical properties of foodstuff. Classification of physical properties. Physical magnitudes and measurements. Unit systems, international system. Dimensional analysis.

### **UNIT 2**

#### **Foodstuff morphogeometric properties**

Importance of morphogeometric properties in processing operations and in process and food products control. Size and form of foodstuff. Granulometry. Density of solids, liquids and vapor. Apparent density and porosity. Application of measurements of density in the quality control of various foodstuffs.

### **UNIT 3**

#### **Surface properties of foodstuffs**

Importance of surface properties in food formulation and stability. Surface tension. Laplace equation. Capillary phenomena. Measurement of surface tension. Tensoactivity. Different operations of the food processing which are affected by surface properties.

### **UNIT 4**

#### **Rheological properties and food textures.**

Importance of rheological and textural properties in processing operations and in process and food products control. Newton's law of viscosity. Rheological classification of fluids. Rheological models. Concept of texture and methods of evaluation.

### **UNIT 5**

#### **Thermal properties of foodstuff**

Importance of thermal properties in food processing. Thermal and temperature equilibrium. Heat interchange without phase change: sensitive heat. Heat interchange with phase change: latent heat. Properties related with heat transfer and its mechanisms: conduction, convection, radiation. Thermodynamic systems and processes. Applications in thermal property measurement and quality control.

### **UNIT 6**

#### **Optic properties and color of foods**



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Importance of optic and color properties in foods as parameters in the control of processes and food products. Absorbance, reflectance and transmittance. Light reflexion and refraction. Polarized light and optic activity.  
Colorimetry. Color specification systems. Color spaces and coordinates.  
Applications of color and of optic properties during processing and quality control of food products.

## **UNIT 7**

### **Electrical properties of foodstuff**

Importance of electrical properties in food processing control.  
Electric current. Ohm's Law. Circuits. Resistivity and specific conductivity of foods.  
Dielectric properties.

## **UNIT 8**

### **Radioactivity and ionizing radiations in foods.**

Importance of radioactivity and ionizing radiations in the food quality and control processes. Radioactive disintegration. Isotopes and activity. Radiological units. Food irradiation.

## **UNIT 9**

### **Measurements of physical properties of foods**

Experimental techniques of mechanical, heat, electrical, optical and colorimetric properties. Measurement of radiation.

## **5150 MICROBIOLOGY**

### **I. THE MICROBIAL WORLD: BASES AND APPLICATIONS**

#### **Unit 1. Concept of Microbiology. Historic evolution of microbiology.**

Concepts of microbiology and microorganism. Discovery of microorganisms. Invention of the microscope. Controversy about spontaneous generation. The role of microorganisms in foods. Importance of current microbiology and its relationship with other sciences.

#### **Unit 2. The microbial world.**

Biological situation of microorganisms: various attempts of biological classification. Archaea. Groups of microorganisms and its distribution in nature.

### **II. BACTERIAL STRUCTURE**

#### **Unit 3. Bacterial cell components.**

Cell wall. Cytoplasmic membrane. Cytoplasm.

#### **Unit 4. Optional elements and spore.**

Capsule. Glycocalyx. Flagella. Fimbriae. Endospore. Forms of bacterial resistance. Sporulation and germination.



### **III. MICROBIAL PHYSIOLOGY**

#### **Unit 5. Microbial nutrition.**

Essential elements in the nutrition of microorganisms. Trophic types according to energy source: carbon and hydrogen or electrons. Growth factors.

The role of oxygen and its relationship with microorganisms. Incorporation of nutrients.

#### **Unit 6. Microbial growth.**

Definition and phases of growth. Mathematical analysis and growth estimate of microorganisms. Synchronous growth. Continuous culture of microorganisms: chemostat. Physico-chemical factors that influence microbial growth.

#### **Unit 7. Microbial metabolism.**

Metabolism of heterotrophic microorganisms. Metabolism of autotrophic microorganisms. Biosynthesis. Regulation of microbial metabolism.

### **IV. GENETICS OF MICROORGANISMS**

#### **Unit 8. Molecular basis of genetics.**

The role of genes. Phenotypical variations or adaptations. Genotypical variations or mutations. Molecular bases and mechanisms of production.

#### **Unit 9. Genetic transfer.**

Mechanisms. Transformation. Transfection. Conversion. Transduction. Conjugation. Transposition. Practical applications.

### **V. MICROBIOLOGICAL CONTROL**

#### **Unit 10. Introduction.**

Importance of microbial control. Definition of terms. Sterilization and disinfection.

#### **Unit 11. Action of physical and chemical agents on microorganisms.**

Physical agents: temperature, humidity, desiccation, radiations and mechanical agents. Organic and inorganic chemical agents. Action mechanisms. Evaluation of disinfectants. Resistance to disinfectants.

#### **Unit 12. Antimicrobials.**

Concept. Classification. Main families of antimicrobials (antibiotics). Action mechanisms. Types and resistance mechanisms. Antibiogram.

### **VI. MICROBIOLOGICAL ANALYSIS: CULTURE TECHNIQUES, ISOLATION AND IDENTIFICATION**

#### **Unit 13. Techniques of observation of microorganisms.**

Optical microscope. Types of microscopes. Scanning and transmission electron microscopy. Tinction methods: simple, differential and structural tinctures.

#### **Unit 14. Culture, isolation, identification and conservation of microorganisms.**

Culture media: composition and preparation. Types. Pure culture: concept and methods of obtention. Identification. Maintenance and conservation of pure cultures. Collections of microorganisms.

#### **Unit 15. Methods for immunological and genetic detection of microorganisms.**



Fundamentals of Microbial Immunology: concept and types of antigens and antibodies. Bases of antigen-antibody reaction. Applications: enzyme immunoanalysis, immunofluorescence, serotyping and other immunological techniques. Serology tests. Genetic techniques: hybridization and PCR. Rapid techniques.

## **VII. MICROBIAL SYSTEMS**

### **Unit 16. Microbial taxonomy: generalities.**

Concept of species. Problems in the classification of microorganisms. Historical evolution of the taxonomic study of microorganisms. Nomenclature. Numeric taxonomy. New approaches in microbial taxonomy: molecular and genetic taxonomy. Microbial evolution and taxonomy. Bergey's manual.

## **VIII.- MYCOLOGY**

### **Unit 17. Introduction to mycology.**

Structural and physiological characteristics of fungi. Types of cellular organization. Ecology. Taxonomic characteristics and classification. Unicellular forms: yeasts. Mycelial forms: molds.

## **IX. FOOD PARASITOLOGY**

### **Unit 18. Introduction to food parasitology**

General characteristics of protozoa and helminths. Taxonomic classification. Most important genii/species.

## **X. VIRUSES AND OTHER SUBCELLULAR REPLICATIVE AGENTS**

### **Unit 19. Overview of viruses.**

The discovery of viruses. Concept of virus. General characteristics: morphology and structure. Chemical composition and properties. Types of viruses and general classification. Methods for the study of viruses: isolation, quantification, identification and multiplication kinetics. Subviral particles: viroids and prions.

### **Unit 20. Bacteriophage.**

Morphology and structure. Types. Lithic cycle and lysogenic cycle. Practical applications.

Phagotype. Bacteriocins.

### **Unit 21. Animal viruses.**

General characteristics. Infection and multiplication mechanisms. Effects of viral infection on cells. Animal virus classification.

### **Unit 22. Vegetable viruses.**

Morphology, chemical structure and composition. Differential and taxonomic characteristics. Types of inclusion. Transmission. Damages and diseases in host. Representative examples.



## 5151 HUMAN PHYSIOLOGY

### TOPIC 1. BLOOD

#### Unit 1. Internal pool

1. Concept of internal pool. Homeostasis. 2. Functions of blood. 3. Plasma, sera, haematocrit, sedimentation rate, blood volume. 4. Red blood cells. 5. Erythropoiesis. 6. Iron Metabolism. 7. Haemolysis. 8. Anaemia. 9. Leukocytes and platelets/thrombocytes. Haematopoiesis.

#### Unit 2. Blood Groups

1. Concept of antigen-antibody. 2. Blood groups, ABO system. 3. Genetic determination of blood type. Technique. 4. Rh system. 5. Fetal erythroblastosis.

#### Unit 3. Coagulation

1. Coagulation and haemostasis. 2. Parts of haemostasis. 3. Prevention of coagulation. 4. Alterations of coagulation

### TOPIC. CIRCULATORY SYSTEM

#### Unit 4. Introduction to the circulatory system

1. Introduction. 2. Definition and functions. 3. Anatomic and functional concepts.

#### Unit 5. Heart and electrocardiogram

1. Anatomic-functional considerations of the heart. 2. Properties of the cardiac muscle. 3. Introduction to electrocardiography. Basic electrophysiology. 4. Vector analysis 5. Electrocardiogram/waves. 6. Leads. 7. General alterations of ECG 8. Utility of ECG.

#### Unit 6. Haemodynamics

1. Concept, measurement and interrelations between pressure, flow and resistance. 2. Cardiac output. 3. Cardiac cycle. 4. Arterial blood pressure, measurement, regulation, physiological variations. 5. HBP: associated factors, evolution; socio-sanitary importance.

#### Unit 7. Nerve control

1. Blood flow regulation. 2. Local mechanisms. 3. General mechanisms. 4. Nerve control. Introduction to the nervous system. Sympathetic NS, parasympathetic and vasomotor center. 5. Humoral control.

### TOPIC 3. RESPIRATORY SYSTEM

#### Unit 8. Breathing. Anatomy

1. Concept. 2. Anatomic bases. 3. General functions of the respiratory system. 4. Defensive mechanisms. 5. Lung and thoracic cage. 6. Ventilatory mechanics,



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respiratory muscles. 7. Distensibility. 8. Respiratory cycle, changes in pressure and rate. 9. Lung volumes and capacity.

## **Unit 9. Gas transportation**

1. Alveolar air, partial pressures. 2. Respiratory membrane. 3. Alveolar diffusion. 4. O<sub>2</sub> transport in blood. 5. O<sub>2</sub> and Hb dissociation curve. 6. Hb utilization coefficient. 7. CO<sub>2</sub> transport. 8. Alterations in breathing

## **Unit 10. Breathing control**

1. Anatomic functional bases. 2. Respiratory center. 3. Breathing control, chemoreceptors. 4. Comparative stimulant effects of H<sup>+</sup>, CO<sub>2</sub>, O<sub>2</sub>, on breathing. 5. Other factors that affect pulmonary ventilation. 6. Aerospace physiology. Breathing at high altitudes. 7. Breathing acclimatization. 8. Physiology of breathing at great pressures.

## **TOPIC 4. DIGESTIVE SYSTEM**

### **Unit 11. General functions. Anatomy.**

1. Anatomic introduction. 2. Functions. 3. Ingestion. 4. Chewing, control. 5. Swallowing/Deglutition. 6. Gastric motility, motor functions, contractions. 7. Control of gastric voiding. 8. Innervation. 9. Vomiting. 10. Small intestine motility. 11. Large intestine motility. 12. Defecation. 13. Constipation. 14. Diarrhea.

### **Unit 12. Secretion**

1. Daily digestive secretion. 2. Secretion of saliva. 3. Regulation of saliva secretion and phases. 4. Functions of saliva secretion. 5. Gastric secretion. 6. Regulation of gastric secretion, phases. 7. Pancreatic secretion, enzymes and bicarbonate. 8. Regulation of pancreatic secretion. 9. Bile secretion, anatomy, bile storage, and regulation of secretion. 10. Bile salts. 11. Cholesterol secretion, gallstones. 12. Small and large intestine secretions.

### **Unit 13. Absorption. Cholesterol and arteriosclerosis**

1. Introduction, anatomic bases. 2. Mechanisms. 3. Water and electrolyte absorption. 4. Absorption and metabolism of calcium and vitamin D. 5. Iron absorption. 6. Absorption and digestion of carbohydrates, hydrolysis. 7. Regulation of blood glucose level. 8. Digestion and absorption of proteins. 9. Fats in diet. 10. Digestion of fats. 11. Absorption. 12. Lipoproteins. 13. Cholesterol cycle. 14. Endogenous synthesis. LDL receptors. 15. Cholesterol and arteriosclerosis Epidemiology.

## **TOPIC 5. ENDOCRINOLOGY**

### **Unit 14. Endocrine system: hormonal functions and classification**

1. Introduction. 2. General functions. 3. Concept of hormone. Classification. 4. Mechanisms of action of hormones.

### **Unit 15. Hypophysis and hypothalamus**

1. Introduction. 2. Regulation in the production of pituitary hormones. 3. Adenohypophysis. Growth hormone. Effects. 4. Factors that intervene in growth. 5. Neurohypophysis. Oxytocin and vasopressin.

### **Unit 16. Thyroid gland**



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1. Structure and hormones. 2. Effects of thyroid hormones. 3. Control of thyroid secretion. 4. Endocrine control of Ca and P metabolism.

## **Unit 17. Pancreas and adrenal glands**

1. Structure and hormones of the pancreas. 2. Insulin. 3. Glucagon. 4. Adrenal cortex. Structure and hormones. 5. Glucocorticoids. 6. Mineralocorticoids.

## **Unit 18. Reproductive system**

1. Testicles. Androgens. Testicular function control. 2. Ovaries. Functions. 3. Ovarian hormones. 4. Menstrual cycle.

## **TOPIC 6. NERVOUS SYSTEM**

### **Unit 19. General organization**

1. Neurons. 2. Afferents, efferents and nerve centres. 3. Nerve trunks and tracts. 4. Types of nerve transmission. 5. Neurotransmitters. 6. Post-synaptic potentials. 7. Interneurons. Central neurotransmitters. 8. Synaptic plasticity.

### **Unit 20. Motor systems**

1. General organization. 2. Types of muscles. 3. Muscle control. Peripheral mechanisms. 4. Spinal motor reflexes. Spinal cord. 5. Brainstem motor functions. 6. Motor functions of the basal ganglia. 7. Motor functions of the cerebral cortex. Pyramidal and extrapyramidal systems. 8. General organization of the sympathetic and parasympathetic. 9. Central control of visceral functions: physiology of the hypothalamus.

### **Unit 21. Superior functions of the CNS**

1. Electrophysiology of the cerebral cortex. 2. Overall activity of the brain: electroencephalogram. 3. Neurophysiological bases of human behavior. 4. Superior functions of the CNS. Learning, memory, language, associative areas

## **TOPIC 7. EXCRETORY SYSTEM**

### **Unit 22. Kidney and body fluids**

1. General structure: nephrons. 2. Body fluids. Compartments. 3. Osmotic pressure. Intra-extra-cellular water movements.

### **Unit 23. Filtration and excretion**

1. Glomerular filtration. 2. Tubular secretion. 3. Na and water transport. 4. Urine concentration and dilution. 5. Renal excretion of H<sup>+</sup> and conservation of CO<sub>3</sub>H<sup>-</sup>. 6. Acid-base equilibrium control. 7. Body fluid volume and osmolarity control. 8. Urine and urinary tracts.

## **5152 BIOCHEMISTRY**

### **UNIT I: INTRODUCTION TO BIOCHEMISTRY**

#### **1. OBJECTIVES AND COMPETENCIES**



1. Objectives. 2. Content: thematic units of the course. 3. Competencies that the student must acquire. 4. Training activities and teaching methodology. 5. Methods of evaluation. 6. Source of bibliographical information and internet resources.

## **2. INTRODUCTION TO BIOCHEMISTRY**

1. Concept and objectives of biochemistry. 2. Biomolecules: function-structure relationship. 3. Weak interactions in aqueous medium and their importance in biological systems. 3.1. Nature of non-covalent interactions. 3.2. Mission of water in biological processes.

## **UNIT II: COMPOSITION AND FUNCTION OF PROTEINS**

### **3. INTRODUCTION TO PROTEINS.**

1. Biological function and importance of proteins. 2. Amino acids. 3. Peptide bonds. 3.1. Peptides. 3.2. Polypeptides as polyampholytes. 3.3. Structure of peptide bonds. 3.4. Stability and formation of peptide bonds.

### **4. STRUCTURE AND COMPOSITION OF PROTEINS.**

1. Structure and composition of proteins. 2. Primary structure. 3. Secondary structure. 4. Supersecondary structures. 5. Tertiary structure. 6. Quaternary structure. 7. Denaturation and folding. 8.- Bioinformatics: protein databases.

### **5. STRUCTURE AND FUNCTION OF FIBROUS PROTEINS.**

1. Concept and function of fibrous proteins. 2. Structure of keratins. 3. Structure of silk fibroin. 4. Structure of collagen and elastin.

### **6. STRUCTURE AND FUNCTION OF GLOBULAR PROTEINS.**

1. Characteristics of globular proteins. 2. Myoglobin. 2.1 Tertiary function and structure. Hemo group. 2.2. Affinity for CO. 3. Haemoglobin as allosteric protein. 3.1. Quaternary function and structure. 3.2. Molecular evolution of myoglobin and haemoglobin. Invariant positions. 3.3. Differences between myoglobin and haemoglobin 3.3.1. Union of oxygen to myoglobin and haemoglobin. 3.3.2. BPG Effect. 3.3.3. Bohr effect.

### **7. EXPERIMENTAL METHODS FOR STUDYING PROTEINS.**

1. Purification of proteins: essential steps for knowing their function. 2. Separation of proteins by electrophoresis. 2. Separation of proteins by size, solubility, charge and affinity. 3. Ultracentrifugation. 4. Determination of primary structure of proteins. 5. Determination of proteic structure by X-ray crystallography. 6. Localization and determination of proteins with antibodies.

### **8. ENZYMES. BASIC CONCEPTS.**

1. Function and general characteristics of enzymes. 1.1. Concept and function. Nomenclature and classification. 1.2. Catalytic power and specificity. 2. Enzyme mechanism of action. 2.1. Diminishment of activation energy. 2.2. Formation of the enzyme-substrate complex. 2.3. Characteristics of active center. 2.4. Cofactors and coenzymes. 4. Experimental determination of enzyme activity.

### **9. ENZYME KINETICS.**

1. Effect of substrate concentration on the reaction speed. 2. Michaelis-Menten equation. 2.1. Determination of  $K_m$  and  $V_{max}$ . 2.2. Meaning of  $K_y$  and  $V_{max}$ . Refill



number. 3. pH and temperature effects. 4. Enzymatic inhibition. 4.1. Reversible inhibition (competitive and non-competitive). 4.2. Irreversible inhibition. 5. Allosteric enzymes.

## **UNIT III: BIOLOGICAL MEMBRANES AND TRANSPORT**

### **10. TRANSPORT PHENOMENA THROUGH BIOLOGICAL MEMBRANES.**

1. Composition, structure and characteristics of biological membranes. 2. Thermodynamics of transport: Conduits and pumps. 2.1. Passive transport: diffusion. 2.2. Facilitated transport: accelerated diffusion. 2.3. Active transport: transport against concentration gradient.

### **11. CELL SIGNALLING AND SIGNAL TRANSDUCTION.**

1. Intercellular metabolic regulation. 2. Signal transduction through membranes. 2.1. Membrane receptors, G proteins and second messengers. 2.2. Cyclical AMP. 2.3. Second messengers derived from phosphatidylinositol biphosphate. 2.4. Calmodulin

## **UNIT IV: GENERATION, TRANSFORMATION AND USE OF METABOLIC ENERGY**

### **12. INTRODUCTION TO METABOLISM. PRINCIPLES OF BIOENERGETICS.**

1. Introduction to metabolism. General concepts. 2. Types of metabolic pathways. 3. Standard and real variation of free energy. Energy coupling. 4. Role of ATP as energy intermediary. Cell energy charge. 5. Oxidation-reduction reactions. Reduction potential. Differences between NADH and NADPH. 6. Catabolism and anabolism. Stages in the extraction of energy from foods.

### **13. REGULATION OF METABOLIC PATHWAYS.**

1. Types of metabolic regulation. 1. Control of catalytic activity of enzymes. 1.1. Reversible allosteric control. 1.2. Reversible covalent modification. 1.3. Isoenzymes. 2. Enzyme concentration control. 3. Regulation by substrate accessibility. Compartmentalization. 4. Hormonal regulation of energy metabolism in mammals.

### **14. GLYCOLYSIS AND GLUCONEOGENESIS**

1. Overview of glycolysis. Localization and energy yield. Anaerobic and aerobic glycolysis. Relationship with other pathways. 2. Phases and reactions of glycolysis. 3. Synthesis of 2,3-diphosphoglycerate. 4. Anaerobic glycolysis. 4.1. Alcoholic fermentation. 4.2. Lactic fermentation. 5. Regulation of glycolysis. 6. Overview of gluconeogenesis. 7. Pathway precursors. Gluconeogenesis reactions 8. Coordinated regulation of glycolysis and gluconeogenesis. Futile cycles.

### **15. CITRIC ACID CYCLE.**

1. Oxidative decarboxylation of pyruvate. Pyruvate dehydrogenase complex. 2. Overview of citric acid. Cellular localization. Action coupled with the respiratory chain. 3. Cycle reactions: conversion of citrate into oxaloacetate. 4. The cycle as source of biosynthetic precursors. Anaplerotic pathways. Glyoxylate cycle. 5. Regulation of pyruvate dehydrogenase complex and citric acid cycle.

### **16. OXIDATIVE PHOSPHORYLATION.**





1. Overview. Cellular localization. 2. Redox potentials and changes in free energy. 3. Enzymatic complex carriers of electrons. 4. Proton-motive force and ATP synthesis. Chemiosmotic theory. 5. Decoupling agents. 7. Glycerol-3-phosphate and malate-aspartate shuttles. 8. Regulation of oxidative phosphorylation. 9. Energy yield of oxidative phosphorylation. 10. Cellular processes driven by proton gradients.

## **17. PENTOSE-PHOSPHATE PATHWAY.**

1. Overview. Function and localization of pathway. 2. Reactions and relation to other metabolic pathways. 3. Control of pentose-phosphate pathway.

## **18. GLUCOGEN METABOLISM.**

1. The glucogen as storage polysaccharides and source of glucose. 2. Degradation of glucogen. Entry into glycolysis. 3. Synthesis of glucogens. 4. Coordinated regulation of glucogen phosphorylase and glucogen synthetase.

## **19. METABOLISM OF LIPIDS AND FATTY ACIDS**

1. Overview. 1.1. Triacylglycerols (triglycerides) as deposits of energy. 1.2. Digestion, absorption and mobilization of fats. 1.3. Mobilization of fats and transport of lipids through the blood (lipoproteins). 2. Fatty acid oxidation. 2.1. Activation of fatty acids and transport to the interior of the mitochondria. 2.2. Beta-oxidative degradation of fatty acids. 2.3. Ketone bodies formation. 3. Fatty acid biosynthesis.

## **20. METABOLISM OF AMINOACIDS AND CYCLE OF UREA.**

1. Introduction. 2. Deamination of amino acids. 2.1. Transamination of amino acids. 2.2. Oxidative deamination of glutamate. 2.3. Deamination of serine and threonine. 2.4. Transport of ammonia. Glucose-alanine cycle. 3. Nitrogen excretion. 3.1. Ammoniotelic, ureotelic and uricotelic animals. 3.2. Urea cycle. Localization. 3.3. Connection between urea cycle and citric acid cycle. 4. Degradation of carbonated skeletons of amino acids.

## **21. PHOTOSYNTHESIS.**

1. Overview of the process of photosynthesis. 2. Reactions to light. 2.1. Light energy uptake systems. Photosynthetic pigments. Reaction centres. 2.2. Transfer of electrons through photosystems I and II. 2.3. Cyclic electronic flow through photosystem I. 2.4. Proton pumping through the thylakoid membrane. ATP photosynthesis with and without water photolysis. 2.5. Localization of photosystem I and ATP-synthase in unstacked thylakoid membranes. 3. Carbon assimilation reactions. Calvin cycle. 3.1. CO<sub>2</sub> binding and sugar production. 3.2. Regeneration of ribulose biphosphate acceptor.

## **5153 CHEMICAL ENGINEERING FUNDAMENTALS**

### **INTRODUCTION AND BASIC CONCEPTS**

#### **Introduction**

General concept of chemical engineering. Role of chemical engineering in the food industry. Examples of industrial processes.

#### **Basic concepts.**



Flow charts. Phenomena and transport mechanisms. Discontinuous, continuous and semi continuous operations. Stationary and non-stationary regime. Dimensional analysis.

## **MACROSCOPIC BALANCES OF MATTER**

### **Macroscopic balances of matter.**

Basic concepts. General expression of macroscopic balance. Simplified forms. Systems with recirculation, short-circuit and bleed.

### **Matter balancing without reaction**

Matter balance in stationary regime without reaction. Matter balance in non-stationary regime without reaction. Application to discontinuous processes.

### **Matter balance with reaction**

Matter balance in stationary regime with reaction. Application to continuous stirred-tank reactor and to transformation and separation processes. Application to discontinuous stirred-tank reactors (BR)

## **MACROSCOPIC ENERGY BALANCES**

### **Macroscopic energy balances**

Different types of energy intervening in food processing. General expression of macroscopic balance of energy. Simplified form.

### **Energy balance without reaction**

Energy balance in stationary regime without reaction. Application to systems without change of state. Application to systems with change of state. Energy balance in non-stationary regime without reaction. Application to discontinuous heating processes.

### **Energy balance with reaction**

Energy balance in stationary regime with reaction. Application to continuous stirred-tank reactors (BR). Application to discontinuous stirred-tank reactors (BR).

## **MACROSCOPIC BALANCES OF MECHANIC ENERGY**

### **Basic concepts of rheology**

Concepts and application of rheology. Rheological classification of fluids. Determination of rheologic properties.

### **Mechanic energy balance**

Mechanic energy conservation equation. Fluid flow in conduction pipes. Circulation regime. Kinetic energy correction factors. Loss of energy due to friction. Pumping work. Fluid flow in porous beds and fluidization.

## **5154 NOURISHMENT AND EDUCATION**

### **1. Food in human culture.**

Brief introduction to food and culture. Concepts.

### **2. Characteristics and conditioning factors of human feeding.**



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- Food as sociocultural adaptation system.
- Factors determining food choices.
- Peculiarities and types of food in the world.
- Self-regulation of food publicity: PAOS code. The media as a tool for consumer food education.
- Food psychology.

### **3. Food, gastronomy and tradition in Spain.**

- Food throughout history.
- Evolution of gastronomic and food habits around the table in Spain: new trends.
- Table protocol.
- Wine serving and pairing.

### **4. Communication techniques.**

- Introduction to publicity.
- Communication techniques. Mass media.
- Influence of publicity in food behavior.

### **5. Information management**

- Searching and recovering information
- Selection of information resources
- Bibliography

## ➤ **2<sup>nd</sup> year**

## **5156 MOLECULAR BIOLOGY**

### **UNIT I: INTRODUCTION**

#### **LESSON 1.- OBJECTIVES AND COMPETENCIES.**

1. Objectives. 2. Content: Thematic units of the subject curriculum. 3. Competencies that the student must acquire. 4. Methods of evaluation. 5. Training activities and teaching methodology. 6. Bibliography and Internet resources.

#### **LESSON 2.- INTRODUCTION. STRUCTURE OF NUCLEIC ACIDS.**

1. Concept and objectives of molecular biology. 2. DNA and RNA: life-directing molecules. 3. Structure and characteristics of DNA. 3.1. Chemical structure of DNA. 3.2. Tridimensional conformation of DNA: double helix. 3.3. Size and shape of DNA. Supercoiling. 4. RNA structure. 4.1. Chemical structure of RNA. 4.2. Types of RNA: characteristics.

## **UNIT II: EXPERIMENTAL TECHNIQUES USED IN MOLECULAR BIOLOGY**

### **LESSON 3.- CUTTING AND SEPARATING DNA.**

1.- Controlled cutting of DNA: Restriction enzymes. 2.- Separation of DNA fragments: electrophoresis. Visualization of separated fragments.

### **LESSON 4.- HYBRIDIZATION TECHNIQUES.**

1.- DNA denaturation and annealing. 2.- DNA hybridization. 3.- Hybridization rigor. 4.- Types of hybridization.

### **LESSON 5.- DNA SEQUENCING. BIOINFORMATICS.**

1.- DNA sequencing. 1.1. Sequencing methods. 1.2. Human genome project and other sequenced genomes.

### **LESSON 6.- POLYMERASE CHAIN REACTION.**

1.- Basis for PCR. 2. Types of PCR. 3. Molecular markers: types and applications.

## **UNIT III: TRANSMISSION OF GENETIC INFORMATION**

### **LESSON 7.- DNA REPLICATION.-**

1. Introduction. 2. Characteristics of DNA replication. 3. Mechanism of replication process. Enzymes and proteins involved in the replication process. 4. Replication in prokaryotes. Replication in eukaryotes. Regulation 5. DNA repair.

### **LESSON 8.- BIOSYNTHESIS AND RNA MATURATION.-**

1. DNA transcription in prokaryotes. RNA polymerases. 1.2. Stages: Start. Promoting sequences. Elongation. Termination. 2. Transcription in eukaryotes. 2.1 RNA polymerases. 2.2. Promoters. Transcription factors. 2.3. Stages: Start. Elongation. Termination 3. RNA maturation.

### **LESSON 9.- TRANSLATION: GENETIC CODE AND PROTEIN BIOSYNTHESIS.-**

1. Overview of the process of translation. 2. Genetic code. 3. Structure, characteristics and function of ribosomes. 4. Transfer of RNA as adapting molecule. 5. Aminoacid activation. Aminoacyl-tRNA synthetases. 6. Stages. Start. Elongation. Termination. 7. Post-translation maturation.

## **UNIT IV: GENETIC EXPRESSION CONTROL**

### **LESSON 10.- INTRODUCTION.-**

1.- Regulation of genetic expression in prokaryotes and eukaryotes. Overview. 2.- Genetic regulation proteins. Activators and repressors. DNA binding domains. DNA-Protein interactions.

## 5157 ANALYSIS TECHNIQUES

### Theoretical classes

#### **Unit 1. Concept of analytic chemistry.**

General process of analysis.

Classification of analysis methods.

Sample preparation.

#### **Unit 2. Gravimetric methods.**

Gravimetric analysis.

Notions of thermogravimetry and electrogravimetry.

#### **Unit 3. Volumetric methods.**

Preparation of solutions.

Basics of volumetric analysis.

Acid-base volumetries.

Complex formation volumetries.

Redox volumetries.

Precipitation titrations.

#### **Unit 4. Methods for optic analysis.**

Nature of electromagnetic radiation.

Interaction of electromagnetic radiation with material systems.

Molecular absorption techniques: visible UV absorption, infrared absorption.

Atomic absorption techniques.

Atomic emission techniques: flame photometry, coupled plasma techniques.

Spectroscopy instruments.

#### **Unit 5. Introduction to electroanalytic techniques.**

Concept of electrochemistry.

Electrochemical cells.

Electroanalytical methods.

Potentiometry.

#### **Unit 6. Separation methods in analytical chemistry.**

Overview of separation methods. Classification.

Extraction methods.

Ion separation by means of ion exchange.

Gas chromatography.

High-performance liquid chromatography (HPLC).



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## **Practicals**

### **Session 1**

Applications of acid-base titration and titration of precipitation in food analysis.

### **Session 2**

Applications of redox titrations in food analysis.

### **Session 3**

Applications of molecular absorption spectroscopy, atomic absorption and emission spectroscopy in food analysis.

### **Session 4**

Applications of potentiometry:  
potentiometric determination of acetic acid in vinegar.

### **Session 5**

Application of gravimetry in food analysis.

### **Session 6**

Liquid-liquid extraction. Partition and recovery coefficient.

### **Session 7**

Chromatographic applications in food analysis.

### **Session 8**

Application of ion exchange in food analysis.

## **5158 METHODS FOR QUALITY AND MEASUREMENTS CONTROL**

**Quality and control of experimental determinations.**

### **1. Random characteristics of determinations, effect and modelling**

Descriptive statistics, analysis and distributions, graphic representations, adherence to theoretical distributions.

### **2. Quantifying uncertainty**

Confidence intervals. Sample sizes

Practicals: "Test that regulating solution has specific pH" and "Build confidence interval for average global value" to 5% level of significance with data of all lab groups.

Classic descriptive and robust analysis of all results.

### **3. Decisions from measurements with uncertainty**



Hypothesis contrast, significance level, power, sample size. Importance of the effect of a factor and determination of sources of experimental variability: analysis of variance with fixed and random factors, reproducibility, repeatability.

Practicals: "Calculation of sample size so that stipulated conditions are met in pH measurement".

"ANOVA analysis of sampling factor effect in determining erythrosine" and "Evaluating repeatability and reproducibility through interlaboratory assay (intergroup), in determining the pH of a predetermined solution".

"Test the homogeneity in solid sampling (mixture of common salt with erythrosine) by means of variance analysis"

#### **4. Models to relate instrumental variables with properties**

Regression by minimum squares, calibration, standard addition, comparison of procedures, detection capacity.

Practicals: "Detection of food coloring, assessing, through calibration, the probabilities of a false positive and a false negative result in accordance with ISO 11843",

"Quantitative determination of a problem by means of standard addition" and "Determination of tartrazine and yellow-orange in industrial food coloring".

#### **5. Control of precision and accuracy**

Shewhart control charts for the mean and the standard deviation, construction and analysis.

#### **6. International standards applicable to the quality of analytical determination**

Lab accreditation. ISO standards, IUPAC, FDA and EU regulations, with special emphasis on the control of toxic residues and/or pollutants in food products.

Practicals: "Analysis of a qualification assay for laboratories (results in all groups) in the determination of tartrazine"

#### **7. Introduction to the design of experiments for the selection of factors and optimization.**

Screening designs. Factorial designs. Methodology for experimental optimization by means of response surfaces.

Case studies: "Optimization, by means of a surface response, of a liquid-liquid extraction with variation of two experimental parameters", "Optimization of the performance of a reaction", "Optimization of ingredients to make a sponge cake", "Optimization of food gels".

#### **8. Introduction to food chemometrics.**

Analysis in main components.

Practicals in main components. "Analysis of a mixture of food colorings (tartrazine and yellow orange) by means of visible ultraviolet spectrophotometry".

## **5159 UNIT OPERATIONS IN THE FOOD INDUSTRY (I)**

### **Introduction to basic operations**

#### **Unit 1. Introduction**

Food processes. Classification of basic operations. Keys for learning the program: Methodology and competencies.

### **MECHANICAL OPERATIONS. Stirring and mixing operations**

#### **Unit 2. Stirring and mixing food**

Basic concepts. Flow models in stirred tanks and stirring equipment. Power consumption and mixing time. Criteria for the change in scale. Emulsification and homogenization of liquids.

#### **Unit 3. Mixture of solids and fine pastes**

Characteristics of solid mixtures. Grade, speed and time of mixture. Equipment and efficacy criteria for mixing powder and granular solids. Equipment and efficacy criteria for mixing pastes and plastic masses.

### **MECHANICAL OPERATIONS. Mechanical separation operations**

#### **Unit 4. Sedimentation and floating.**

Principles of operation and design basics. Equipment for continuous gravitational sedimentation. Sedimentation under the influence of a centrifugal force. Particle classification through elutriation. Other particle classification systems. Flotation.

#### **Unit 5. Decanting, filtration and pressing.**

Basics of decanting operation and applications. Gravitational and centrifuge decanters. Basics of filtration and main applications in the food industry. Filtration modes. Filtration equipment: pressure filters, vacuum filters and centrifugal filters. Principles, applications and equipment used in the pressing operation.

## **5160 FOOD MICROBIOLOGY AND PARASITOLOGY (I)**

### **I. MICROORGANISMS OF INTEREST IN FOOD**

#### **1. Food microbiology and parasitology: Overview.**

Introduction History. Microbiological criteria. Microbial indicators. Microbial association.

#### **2. Food mycology (I): molds.**

Overview of food molds: morphological, physiological and culture characters. Mold classification. Most important molds.

#### **3. Food mycology (II): yeast and yeasty molds.**

Overview of food yeast: morphological, physiological and culture characters. Classification of yeasts. Most important yeasts.

#### **4. Food bacteriology (I).**

Overview of food bacteria: morphological, physiological and culture characters. Most important genera of bacteria. Most important groups of bacteria.

#### **5. Food bacteriology (II): agroalimentary applications**

Probiotic bacteria. Plant Growth Promoting Rhizobacteria (PGPR). General characteristics. Classification. Bacteriocins. Practical applications.

## **6. Food virology.**

Overview of viruses, viroids and prions in food. Most important viruses.

## **II. MICROBIAL ECOLOGY OF FOOD**

### **7. Intrinsic factors.**

Water activity. pH and acidity. Redox potential. Nutrients, antimicrobial natural constituents and biological structures.

### **8. Extrinsic factors.**

Conservation temperature. Water vapor pressure and nature of atmosphere.

### **9. Factors depending on technological treatments. Implicit factors.**

High temperatures. Ultraviolet radiation. Ionizing radiation. Antimicrobial chemical preserving agents: organic acids and salts; curing salts, smoking and related substances. Antimicrobial preserving agents: antibiotics, gases.

## **III. FOOD PARASITOLOGY**

### **10. Protozoa.**

Entamoeba histolytica. Giardia lamblia. Toxoplasma gondii. Cryptosporidium parvum. Other protozoa responsible for food-transmitted diseases.

### **11. Trematode helminths.**

Clonorchis sinensis. Heterophes. Metagonimus yokogawai. Opisthorchis. Paragonimus westermani. Fasciola hepatica.

### **12. Cestode helminths.**

Taenia saginata and Taenia solium. Diphyllbothrium latum and Diphyllbothrium pacificum. Echinococcus granulosus.

### **13. Nematode helminths.**

Trichinella spiralis. Anisakis. Angiostrongylus cantonensis and Angiostrongylus costaricensis. Ascaris lumbricoides.

## **IV. PATHOGENIC MICROORGANISMS TRANSMITTED BY FOOD**

### **14. Agents responsible for food poisoning.**

Bacillus cereus. Clostridium botulinum and its toxins. Staphylococci and staphylococcal enterotoxins. Clostridium perfringens. Micotoxin-producing molds.

### **15. Pathogenic enterobacteria.**

Campylobacter. Salmonella. Shigella. Escherichia coli.

### **16. Other pathogenic microorganisms.**

Yersinia enterocolitica. Vibrio parahaemolyticus and Vibrio cholerae. Listeria Monocytogenes

## **V. BASICS OF MICROBIOLOGICAL ANALYSIS OF FOOD**

### **17. Introduction.**

Sampling and analysis of final products: ecological principles, analytic bases and necessity of reference values. Sampling: single sample, repeated sample, sampling plans and representative sampling.





## **18. Microorganism markers.**

Introduction. Aerobic mesophilic bacteria recount. Anaerobic recount.

Advantages and limitations of mesophilic recount. Enteric bacteria markers: E. coli, coliforms and Enterobacteriaceae. Enterococci. Molds and yeasts. Other microorganism markers. Rapid techniques.

## **19. Microorganism pathogens.**

Determination of Gram-negative bacteria: Salmonella, Shigella, E. coli, Yersinia enterocolitica, Vibrio cholerae and V. parahaemolyticus. Determination of Gram-positive bacteria: Staphylococcus aureus and Staphylococcal enterotoxins, Bacillus cereus, Clostridium perfringens and Clostridium and their toxins. Determination of molds and mycotoxins, viruses and protozoas.

## **20. Quality criteria.**

Indirect tests. Direct stability tests. Principles and application of predictive microbiology in foods. Detection of antimicrobial substances.

## **5161 ECONOMY AND MANAGEMENT OF FOOD COMPANIES**

### **Economics and Management**

#### **Unit 1.- Introduction to business**

- 1.1.- Business and businessperson.
- 1.2.- Types of business.
- 1.3.- Business objectives.
- 1.4.- Business as a system.

#### **Unit 2.- Accounting statements.**

- 2.1.- Accounting and the production cycle.
- 2.2.- The asset.
- 2.3.- Annual statements.

#### **Unit 3.- Company financing.**

- 3.1.- The company's financial decisions.
- 3.2.- Investment decision.
- 3.3.- Decision to finance.

#### **Unit 4.- The company's productive function.**

- 4.1.- The production subsystem: concept, elements and relations.
- 4.2.- Classes of productive processes.
- 4.3.- The objectives of productive subsystem.
- 4.4.- Concept of productivity and its measurement.
- 4.5.- Productivity improvement in the company.
- 4.6.- Costs in the business.

**Unit 5.- Marketing function.**

- 5.1.- Introduction.
- 5.2.- Strategic marketing.
- 5.3.- Operational marketing.

**Unit 6.- Management process. The administration subsystem.**

- 6.1.- Introduction.
- 6.2.- Decisions.
- 6.3.- The planning function.
- 6.4.- The organization function.
- 6.5.- The staff integration function.
- 6.6.- The executive function.
- 6.7.- The control function.

## **5162 UNIT OPERATIONS IN THE FOOD INDUSTRY (II)**

**Unit 1. Introduction to separation processes**

Separation processes: characteristics and separation agents. Classification of separation processes. Fundamentals of material transfer. Material transfer coefficients. Equilibrium between phases. Distribution coefficients. Separation factor

**Unit 2. Distillation**

Liquid-vapor equilibrium. Distillation and rectification of binary mixtures. Parameters of influence in the rectification process. Equipment. New distillation processes in the food industry. Applications in the food industry.

**Unit 3. Extraction**

Solid solubility in fluids. Solid-liquid extraction. Cleansing. Liquid-liquid equilibrium. Liquid-liquid extraction. Extraction with supercritical fluids. Parameters of influence in extraction processes. Equipment. New extraction processes in the food industry. Applications in the food industry.

**Unit 4. Ion absorption and exchange**

Adsorption equilibrium. Adsorption kinetics. Operation by stages. Adsorption columns. Parameters of influence. Ion exchange. Ion exchange resins Equipment. Applications in the food industry.

**Unit 5. Dehydration and drying operations**

Psychometrics. Water activity. Hot air drying. Lyophilization. Parameters of influence in these processes. Equipment. Applications in the food industry.

**Unit 6. Particle formation processes**



Crystallization. Nucleation. Crystal growth. Parameters of influence in these processes. Equipment. Applications in the food industry.

## **Unit 7. Processes of membrane separation**

Fundamentals. Classification. Parameters of influence in the operations of separation with the most common membranes in the food industry. Characteristics of these operations. Equipment. Applications in the food industry

## **5163 FOOD MICROBIOLOGY AND PARASITOLOGY (II)**

### **INTRODUCTION (5 HOURS)**

#### **1. OVERVIEW**

Microbial growth. Microbial associations responsible for the alterations. Factors that modulate microbial growth. Types of microorganisms based on factors that modulate growth

### **MICROBIOLOGY AND PARASITOLOGY OF THE DIFFERENT FOODS (57.5 HOURS)**

#### **2. MEAT AND MEAT PRODUCTS**

Introduction. Microbiological alteration of meat. Analysis and control of alteration. Main pathogens: types, analysis and control

#### **3. POULTRY MEAT AND ITS DERIVATIVES**

Introduction. Production of poultry meat. Characteristics of poultry meat. Processing of poultry meat. Alteration of poultry meat. Main pathogens: types, analysis and control

#### **4. EGGS AND EGG PRODUCTS**

EGGS: Introduction. Microbial contamination and alteration. Main pathogens: types, analysis and control

EGG PRODUCTS: Introduction: definition and types. Main pathogens: types, analysis and control

#### **5. MILK AND DAIRY PRODUCTS**

Introduction. Raw milk. Heat-treated milk. Cream, condensed milk and powdered milk. Ice cream. Fermented milk. Cheese

#### **6. FISH AND FISH PRODUCTS**

Introduction. Sources of contamination. Modifications due to microorganisms. Main pathogens. Primary processing. Aquiculture. Frozen fish products. Cooked crustaceans. Slightly conserved fish products. Semi-conserved fish. Fermented fish products. Dehydrated fish products. Pasteurized fish products. Conserved fish.

#### **7. VEGETABLE PRODUCTS**

VEGETABLE PRODUCTS Introduction. Initial microbiota. Pathogens: types, analysis and control. Different types of vegetable products.



NUTS: Introduction. Initial microbiota. Pathogens. Processing. Alteration. Pathogens. Control.

FRUIT AND DERIVATIVES: Introduction. Initial microbiota. Processing. Pathogen alterations. Control. Minimally processed fruits. Frozen fruits. Canned fruits. Dehydrated fruits. Fermented and acidified fruits. Plant shoots. Mushrooms.

## **5164 CHEMISTRY AND FOOD BIOCHEMISTRY**

### **UNIT I – INTRODUCTION**

#### **1.- INTRODUCTION TO FOOD BIOCHEMISTRY**

1.- Nature and purpose of Food chemistry and biochemistry. 2.- Concept of the discipline.

#### **2.- WATER**

1.- Importance of water in foods. 2.- Structure and physicochemical properties. 2.1.- Water-solute interactions. 3.- Concept of water activity (wa) and relative vapor pressure (RVP). 4.- Isotherms of sorption. 4.1.- Hysteresis of sorption isotherms. 4.2.- Theoretical interpretation. 4.3.- State of water in foods. 4.4.- Interest of sorption isotherms for food technology. 5.- Influence of the composition and physical state of food on water fixation. 6.- Water activity and food deterioration reactions. 7.- Molecular mobility (Mm) and food stability.

#### **3.- VITAMINS AND MINERALS IN FOODS: CHEMICAL PROPERTIES AND BIOCHEMICAL FUNCTION.**

1.- Introduction. 2.- Liposoluble vitamins as food components. 2.1.- Carotenoids as aromatic precursors. 2.2.- Cooxidation phenomenon. 3.- Hydrosoluble vitamins. 3.1.- Functions of ascorbic acid in foods. 4.- Macroelements. 5.- Trace elements. 6.- Alterations of foods by mineral substances. 7.- General causes of the loss of minerals and vitamins in foods during handling and storage.

#### **4.- ENZYMES.**

1.- Introduction. 2.- Modification of foods by endogenous enzymes. 2.1. Reaction to enzymatic browning. 3.- Main applications of enzymes in the food industry.

#### **5.- FUNCTIONAL PROPERTIES OF FOOD CONSTITUENTS.**

1.- Definition and classification. 1.1.- Hydration properties. 1.2.- Association and structuration properties. 1.3.- Surface properties. 2.- Functional properties of proteins in foods. 3.- Functions of monosaccharides and polysaccharides in foods. 4.- Properties of lipids.



## UNIT II - FOOD BIOCHEMISTRY SYSTEMS

### 6.- CHARACTERISTICS OF MUSCULAR TISSUE.

1.- Structure of muscular tissue. 2. Components and function. 2.1.- Proteins of the contractile system and its function. 2.2.- Sarcoplasmic proteins. 2.3.- Chemistry and biochemistry of meat coloration. 2.4.- Connective tissue proteins. Collagen. 2.5.- Other components. 3.- Biochemistry of muscular contraction. 4.- Biochemical changes in postmortem muscle. 4.1.- Rigor mortis. 4.2.- The maturation process. Enzymatic systems. 5.- Influence of technological treatments on muscular proteins.

### 7.- CHARACTERISTICS OF NUTRITIVE FLUIDS OF ANIMAL ORIGIN: MILK.

1.- Milk biosynthesis. 2.- Protein fraction. 2.1.- Casein fraction. 2.1.1.- Micellar milk phase. 2.2.- Whey proteins. 2.3. Isolation and identification 3.- Carbohydrates. Lactose. 4.- Lipids. 4.1.- Structure and composition of fatty globules. 5.- Milk enzymes. Peroxidase system. 6.- Processing effects on milk components.

### 8.- CEREALS AND DERIVATIVE PRODUCTS.

1.- OVERVIEW. 2.- Proteins. 3.- Lipids. 4.- Carbohydrates. 5.- Starch. 5.1.- Structure and behavior of chemical constituents. 5.2.- Retrogradation and gelatinization phenomena. 5.3.- Functional properties of natural starch and modified starch. 6.- Bread biochemistry. 6.1.- Bread ageing phenomenon.

### 9.- LEGUMINOSAE.

1.- Introduction. 2.- Reserve proteins. 2.1.- Functional properties and chemical modifications of proteins in soy. 3.- Cyanogenic glycosides. Biosynthesis and degradation. 4.- Proteinase inhibitors. 5.- Other components.

### 10.- CHARACTERISTICS OF EDIBLE PLANT TISSUES

1.- Introduction. 2.- Carbohydrates. 2.1.- Monosaccharides and oligosaccharides. 2.2.- Components of vegetal wall. Pectins, technological interest. 3.- Nitrogen compounds. 4.- Lipids and lipid substances. 4.1.- Limonoid formation. 5.- Aromatic substances. 5.1.- Principal mechanisms of formation of smells and tastes in foods. 5.2.- Glucosinolates. 5.3.- Sulphur compounds in Allium and Brassica species. 6.- Organic acids. 7.- Phenolic compounds. Flavonoids. 8.- Coloring substances. 8.1.- Anthocyanins. Structure and degradation processes. 8.2.- Chlorophylls. Alterations during treatment. 8.3.- Betalains. Biosynthesis. 9.- Toxic compounds. 10.- Post-harvest maturation biochemistry. 10.1.- Respiration and climacteric. 10.2.- Post-harvest biochemical changes. 10.3.- Maturation process control. Ethylene biosynthesis.

### 11.- FATS AND OILS.

1.- Introduction to lipids in foods. Chemical and physical properties. 2.- Characteristics of the main food fats and oils. 3.- Fat modification treatments.

**UNIT III - MECHANISMS OF ALTERATION AND MODIFICATIONS OF THE MAIN COMPONENTS OF FOODS DURING TREATMENT AND STORAGE**

**12.- DETERIORATION OF LIPIDS**

1.- Overview. 2.- Lipolysis. 3.- Autooxidation reactions. 3.1.- Reaction mechanism. 3.2.- Other factors that intervene in the oxidation of food lipids. 4.- Oxidating reactions through lipoxygenases. 5.- Reversion phenomenon. 6.- Heat decomposition of lipids. 6.1.- Fried food chemistry.

**13.- PROTEIN MODIFICATIONS**

1.- Introduction. 2.- Denaturation of proteins. 3.- Destruction of amino acids. 4.- Protein-protein interaction. 5- Interaction between proteins and oxidizing agents. 6- Interaction of proteins with other food constituents, contaminants and additives. 7.- Alterations or improvement of functional properties.

**14.- CARBOHYDRATE REACTIONS**

1.- Hydrolysis. 2.- Heat dehydration and degradation. 3.- Browning reactions. 3.1.- Caramelization phenomenon. 3.2.- Maillard reactions.

**UNIT IV - FOOD ADDITIVES**

**15.- INTRODUCTION TO FOOD ADDITIVES.**

1.- Definition and classification. 2.- Regulation of the use of additives. 3.- Interest of the use of additives in food technology. 4.- Additives and toxic risks.

**16.- CONSERVING ADDITIVES.**

1.- Conserving additives (antibacterial and antifungi). 2.- Antioxidant additives. 3.- Water activity depressant additives and agents. 4.- Anti-hardening additives.

**17.- SENSORY PROPERTIES ENHANCER ADDITIVES.**

1.- Aromatics and modifiers of aroma and taste. 2.- Sweeteners. 3.- Coloring agent. 4.- Thickening and gelling agents. 5.- Emulsifying agents.

**5165 FEEDSTOCK PRODUCTION**

**INTRODUCTION**

**1**

Concept of raw material. Framework of production of vegetable raw materials. Purpose of industrial plant production. Importance of the adjustment of production to industry needs. Raw material production in Castile and Leon. Statistics. Surfaces. Productions. Main species of cattle raising, agriculture, forestry or medicinal interest in the food industry.



## **PRODUCTION OF RAW MATERIAL OF PLANT ORIGIN.**

### **2**

Climate factors:

Light and development. Phytochrome and photomorphogenesis. Heat radiation: Thermoperiodism. Effect of the cold: Vernalization. Action of high temperatures. Protection against high temperatures. Methods of protection against frost. The wind. Interest of the defense against wind.

### **3**

The ground as substrate for plants growth. Soil constituents: mineral matter, organic matter, water, air. Physical and chemical properties and their influence in the development of vegetation. Influence of pH in the availability of nutrients. Accommodation of crops to soil reaction. Water management in crop soil. Irrigation water and salinity. Problems.

### **4**

Chemical water potential and water potential. Components of water potential. Water absorption and transport. Loss of water by plant. External transpiration factors that affect the speed of transpiration. Stomata movements. Nutrients absorption through roots. Transport through the phloem. Effect of environmental factors on transport. Transport mechanisms.

### **5**

Mineral composition of plants. Plant fertilization and yield. Mineral deficiencies. Nitrogen capture. Symbiotic fixation of N. Metabolic pathways for N assimilation. Biologic denitrification. Bio-availability of N and productivity. Nitrogenated fertilization.

### **6**

Phosphorous dynamics in soil. Assimilable forms of phosphate. Mineral phosphated fertilizers. Potassium dynamics in soil. Mineral potassium fertilizers. Fertilizing with trace elements. Form and distribution of fertilizers.

### **7**

Growth and development. Auxins. Gibberellins. Cytokinins. Ethylene. Abscisic acid and other inhibitors. Agronomic application of phytohormones.

### **8**

Fruit formation and maturation. Fruit formation and growth. Hormone content during development. Parthenocarpic fruits. Chemical composition of fruits. Greenhouse optimization. Productive significance of photorespiration. Fixation and biological assimilation of CO<sub>2</sub> in C<sub>4</sub> and CAM plants. Strategies of their use as factors of ecological adaptation and agricultural reform.

### **9**

Techniques for reproducing plant material. Sexual propagation. Asexual propagation, staking, layering, grafting. Micropropagation techniques. Seeds, technical characteristics. Nurseries.

### **10**

Production, harvesting and conservation of production. Species cultivated for their grains. Harvesting winter, summer cereals, grain-legumes, sunflower seeds. Grain



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conditioning. Storage. Subterranean organs (beetroot and potato). Harvesting and conservation. Green forage.

Harvesting. Withering. Silaging. Dehydration.

## **11**

Agents damaging to crops. Arthropods; mites; fungi; viruses; bacteria; nematodes. Systematic position. Characteristics and main groups. Diagnostics and methods of detection. Post-harvest diseases. Main plagues and diseases.

Non-parasitic diseases. Physiology of plants in unfavorable conditions.

## **12**

Methods of phytopathogenic agent control. Cultural methods. Physical control. Chemical control. Biological control and integrated management. Phytosanitary regulations.

Phytosanitary products. Toxicology, persistence, waste, dissipation curves, phytotoxicity, resistance. Ecotoxicology Risks.

## **13**

Cultivation systems. Extensive and intensive cultivation. Farming techniques. Rotation and alternatives. Greenhouses, farming under plastic cover, hydroponic and aeroponic farming.

New techniques in agriculture. Conservation agriculture and biologic agriculture.

## **PRODUCTION OF RAW MATERIALS OF ANIMAL ORIGIN**

### **14**

Production of bovine milk. Production systems and variation factors. Physiological basis of lactic secretion. Composition of milk and variation factors.

### **15**

Beef production. Lactation for calves. Fodder-based beef production. Forage-based beef production. Meat quality.

## **5166 FOOD SCIENCE I**

### **I.-GENERAL PRINCIPLES**

#### **1.0-Bromatology: general principles**

Concept and content. Food. Nutrients. Food products. Historical development. Relationship with other sciences. Objectives. Bibliography.

#### **2.0-Food classification**

According to their origin. According to their properties. According to their nutrient content. According to their reaction in the organism. According to the Spanish Food Code.

#### **3.0-Food Quality**

Concept. Nutritional value of food. Factors that condition quality, characterization, and nutritional value of food. Implications in the food industry. Food fraud.





## **4.0-Generalities of Food Analysis**

Types of analysis. Official analytical control protocols.

## **5.0-General Food analysis**

Natural components. Microstructural analysis. Analysis of additives, impurities, and pollutants.

## **II.- DESCRIPTIVE AND ANALYTICAL BROMATOLOGY**

### **6.-Meat**

Definition. Types and classification. The channel as a structural unit. The quality of the channel. Factors that determine the chemical composition of the channel. Composition of meat and its possible variations. Importance of composition in the definition of the quality and nutritional value of meat.

### **7.-Other Meats**

Poultry and game. Classification and composition. Quality markers. Nutritional value.

### **8.-Meat products and derivatives**

Classification: Meat emulsions. Meat gels. Fresh Meat products and marinated meats. Raw-cured meat products. Salted meats. Heat-treatment of meat products. Smoked meat products. Low-fat and salt-based meat products. Extracts and meat broths. Guts. Offal and tripe. Composition. Quality markers. Nutritional value.

### **9.-Analysis of meats and meat products**

Methods of analysis of substances of interest. Quality specifications. Fitness for sale and consumption in accordance with the physical-chemical results.

### **10.-Fish, molluscs, crustaceans, fish roe, krill, and other foods from fishing and aquaculture. Snails.**

Description and identification of species of food interest. Characteristics. Classification. Structure. Properties. Composition of this food group and its possible variations. Biological factors influencing chemical composition. Importance of chemical composition in the definition of freshness, quality and nutritional value of food from fisheries and aquaculture. Alterations and food fraud.

### **11.-Derivatives of fishery and aquaculture products**

Surimi. Kamaboko. Fish and shellfish analogues. Semi-preserves. Preserves. Salted products. Dried products. Smoked products. Fermented products. Characteristics. Properties. Composition. Nutritional value and importance in food. Alterations and frauds.

### **12.-Analysis of food from fisheries and aquaculture**

Methods of analysis of substances of interest. Determination of freshness. Quality specifications. Aptitude for sale and consumption according to the physical-chemical results.

### **13.-Eggs and egg products**

Denomination. Classification. Structure. Physical characteristics. Chemical composition of the white and the yolk of the egg and its possible variations. Importance of composition in the definition of freshness, quality and the nutritional value of eggs and egg products. Dietary importance of eggs and egg products. Industrial use of egg. Alterations and food frauds.



## **14.-Analysis of eggs and egg products**

Methods of analysis of substances of interest. Determination of freshness. Quality specifications. Aptitude for sale and consumption according to the physical-chemical results.

## **15.-Milk**

Definition. Classification according to the different technological treatments. Characteristics and properties of the different types of milk. Chemical composition and its possible variations. Factors that modify the chemical composition of milk. Importance of the composition in the definition of the quality and the nutritional value of the different types of milk. Importance of milk in food. Alterations and food frauds.

## **16.-Special Milks**

Fermented milks. Acidified milks. Formula milks. Features. Properties. Composition and its influence on quality. Nutritional value and importance in food. Alterations and food frauds.

## **17.-Dairy products and derivatives other than cream and butter**

Lactose. Casein. Whey. Curd. Cheese. Cottage cheese. Features. Properties. Composition and its influence on quality. Nutritional value and importance in food. Alterations and frauds.

## **18.-Analytical determinations of milk, products, and dairy derivatives**

Methods of analysis of substances of interest. Quality specifications. Fitness for sale and human consumption depending on the physical-chemical results.

## **19.-Other protein foods**

Unicellular proteins

### **III.-PREPARED DISHES, ORGANIC FOOD AND MODIFIED FOODS**

## **20.-Pre-packed meals, organic food, functional foods and genetically modified foods.**

Types. Composition. Interest in human food. Analytical determinations.

## **5167 FOOD SENSORY ANALYSIS**

### **Methodology of sensory analysis**

#### **Introduction and Generalities**

General aspects of sensory analysis: historical future of sensory analysis, academic and scientific recognition, regulatory definitions. Presentation of the Sensory Analysis Methodology: approach, planning, implementation, analysis, interpretation and preparation of reports.

#### **Methodology I**

Methodology I: International standards and standardized methodology: Premises. Utensils. Types of tests and judges. Selection and training of judges. Certification and

accreditation of panels, protocols and procedures. Untrained judges: selection and ways to work with them.

### **Methodology II**

Methodology II: Sampling. Sample preparation and coding. Tasting cards and data collection.

Peculiarities of statistical analysis and interpretation of the sensory test results. Standardized tests and free tests. Tests with scales. Multivariate tests.

## **Sensory perception**

### **Stimuli and sensory receptors**

Mechanisms of the sensory response: receptors and stimuli, and the interpretation of the signal. Conditions of the sensory response, with special emphasis on the intrinsic factors of the sample and the individual, considering the incidence of a range of genetic and cultural factors linked to the individual and even the chemical structure and the physical properties of the stimuli, among others, and without forgetting the extrinsic factors linked to the surrounding environment and the setting.

## **Instrumental analysis of sensory properties**

### **Color measurement**

Equipment used. Color systems. Applications. Correlation and complementarity with sensory measurement.

### **Texture measurement**

Methods of measurement. Imitative methods. Equipment used. Texturometers. Applications. Correlation and complementarity with sensory measurement.

### **Measurement of aroma and taste**

Equipment used. Types of sensors. Applications. Correlation and complementarity with sensory measurement.

## **Usefulness of sensory food analysis**

### **Generalities**

The sensory quality of food, its bonds with acceptance and preference, and the conditioning factors.

### **Applications of sensory analysis in the Food Industry**

Applications of sensory analysis in: process and product control; In the characterization and definition of food types; in sensory marketing: market studies and studies with consumers in general; in the development of new products, processes, applications and presentations (packaging, labels, etc.; and new possibilities.)

➤ 3<sup>rd</sup> year

## 5168 FOOD SCIENCE II

### FATTY FOODS

#### **Animal fats.**

Nutritional role. Classification. Composition and transformation. Alterations. Adulteration and falsification.

#### **Vegetable fats.**

Nutritional role. Classification. Composition and transformation. Commercial types of vegetable fats and their by-products. Alterations. Adulteration and falsification.

#### **Artificial fats.**

Hydrogenated, fractionated, inter-esterified and trans-esterified fats. Margarines. Anhydrous fats. Synthetic fats.

#### **Analytical determination of fats and oils.**

Physical determination. Chemical determination. Specific reactions. Determination of commercial quality.

### CEREALS AND DERIVATIVES.

#### **An overview of cereals.**

Nutritional importance. Structure. Nutritional value.

#### **Main cereals used as food.**

Characteristics and classification. Composition. Quality. Alterations and impurities. Preservation. Uses.

#### **Food stemming from the milling of cereals.**

Milling products and by-products. Flours. Yield and degree of extraction. Types of flours. Treatment. Alterations and storage.

Improvement and whitening agents. Adulteration and falsification.

#### **Bread.**

Types of bread. Characteristics of bread. Baker's yeast and chemical raising agents. The storage and aging of bread. Defects and alterations.

#### **Pasta.**

Characteristics. Types. Composition.

#### **Cakes and pastries.**

Types. Characteristics. Composition. Bread complements. Powders used in sweets and pastries.

#### **Other foodstuffs made from cereals and derivatives.**

Breakfast cereals. *Gofio*. Hulled cereal grains. Pearled cereal grains. Crushed and pressed cereal grains.



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## **Analytical determination of cereals and derivatives.**

Physical determination. Chemical determination. Micrography.

## **DRIED LEGUMES**

### **An overview of legumes.**

Nutritional importance. Structure. General composition. Nutritional value.

Toxic and anti-nutritive elements.

### **Main legumes used as food.**

Characteristics and classification. Composition. Quality. Alterations and impurities. Preservation. Uses. Legume derivatives

### **Analytical determination of dried legumes and derivatives.**

Physical determination. Chemical determination. Micrography.

## **TUBERS, STARCHY ROOTS AND VEGETABLES**

### **Potatoes and derivatives.**

Types. Characteristics. Composition. Production and yield. Nutritional value and importance as a foodstuff. Alterations and storage.

### **Other tubers, starchy roots and derivatives.**

Types. Characteristics. Composition. Production and yield. Nutritional value and importance as a foodstuff. Alterations and storage.

### **Vegetables, seaweeds and derivatives.**

Types. Characteristics. Composition. Production and yield. Nutritional value and importance as a foodstuff. Alterations and storage. Vegetable derivatives.

### **Fruit and nuts.**

Types. Characteristics. Composition. Production and yield. Nutritional value and importance as a foodstuff. Alterations and storage. Fruit and nut derivatives.

### **Analytical determination of vegetables, fruit and nuts.**

Physical determination. Chemical determination. Micrography. Quality indicators.

## **5169 FOOD TECHNOLOGY I**

### **The conservation and processing of foodstuffs.**

Conservation of food from exposure to heat.

Conservation of food using cooling and freezing techniques.

Conservation of food through a reduction in water activity.

Other conservation techniques: fermentation, smoking, use of additives.

### **Raw material conditioning and initial conversion operations.**

Cleaning the raw materials.

Reducing the size and formation of emulsions.

Physical separation: centrifugation, extraction, filtration and separation with membranes.

## 5170 NUTRITION

### Unit 1.

#### **The basics of nutrition.**

Historical perspective and general aspects. Concept of food and nutrition. Nutrition in relation to other disciplines. A general overview of nutrition. Food as a source of nutrients and energy. Digestion. The role of nutrients. Energy value. Nutrients and their relationship to body composition.

#### **A balanced, nutritional diet.**

Needs and recommendations. Energy balance. Energy expenditure study techniques. Food composition tables and databases. Food guides.

#### **Assessment of nutritional status.**

Nutritional status study techniques. Assessment of dietary intake: national, family and individual surveys. Anthropometry and bioimpedance in the assessment of nutritional status.

#### **Nutrients and other food components.**

Carbohydrates, fats, proteins, fiber, water, electrolytes, minerals and vitamins. Structure, classification and biological functions. Digestion, absorption and metabolism. Differences depending on origin: natural and synthetic sources. Deficiencies and toxicity. Alcohol, nucleic acids, organic acids, antioxidants etc. The potential and real nutritional value of food.

#### **The physiology of nutrition.**

Regulating intake, oxidative stress and immunity and genes. The role of nutrients and other food components. Nutrient/xenobiotic interaction.

## 5171 FOOD TOXI-INFECTIONS

### **The theory of food toxi-infection.**

I- **Introduction.**

II- **Bacteria and the toxins responsible for food-borne diseases.**

#### **A. The enterobacteriaceae family.**

The most common genera. Morphological, biological and biochemical characteristics. Antigens. Habitat. Pathogenic characteristics. Resistance and sensitivity.

### 1. Salmonella

Taxonomy. Antigens. Biological and biochemical characteristics. Multiplication and destruction conditions. Habitat. Epidemiology. Salmonellosis in humans. Salmonellosis in animals. Prevention. Isolation and identification.

### 2. Shigella

Taxonomy. The biological and biochemical characteristics of Shigella sp. Factors that influence the multiplication of Shigella. Epidemiology. Pathogenic action. Prevention, isolation and identification.

### 3. Escherichia coli

Taxonomy. Morphological and biochemical characteristics. Growth factors. Antigens. E. Coli pathogens: Enterotoxigenic E. coli, enteroinvasive E. Coli, enteropathogenic E. coli, E. coli enterohemorrhagic E. coli. Epidemiology. Transmission. Isolation and identification.

### 4. Yersinia enterocolitica

Taxonomy. Morphological, biological and biochemical characteristics. Growth, resistance and sensitivity. Biovarieties and serovarieties. Factor influencing virulence and physiopathology. Clinical forms. Diagnosis and treatment. Epidemiology. Reservoir. Association with food. Prevention. Isolation and identification.

## **B. The Clostridium genera (Clostridiaceae family).**

Classification. Habitat. Morphological and biochemical characteristics. Pathogenic action.

### 5. Clostridium botulinum

Factors that favor growth. Morphological and biochemical characteristics. The four Cl groups. Botulinum. The three forms of botulism in humans: food-borne botulism, wound botulism and infant botulism. Habitat. Epidemiology. Growth in foodstuffs. Resistance and sensitivity. Prevention. Detection, identification and counts.

### 6. Clostridium perfringens

Factors that favor growth. Morphological and biochemical characteristics. Resistance and sensitivity. Toxins. Habitat. The three diseases it produces: Gas gangrene – food toxi-infection through Cl type A. Perfringens-Enteritis necroticans. Isolation and identification.

## **C. The Bacillus genera (Bacillaceae family).**

Characteristics of the genera. Species. Classification.

### 7. Bacillus cereus

Morphological and biochemical characteristics. Factors that favor growth. Diarrheic syndrome. Emetic syndrome. Prevention. Detection, count and identification.

### **D. The Listeria genera (Listeriaceae family).**

Species in the Listeria genera. Habitat. Morphological and biochemical characteristics.

### 8. Listeria monocytogenes

Morphological and biological characteristics. Habitat. Factors that favor growth. Sensitivity and resistance. Transmission. Pathogenic action. Listeriosis in humans. Clinical pictures. Diagnosis and treatment. Listeriosis in animals. Epidemiology. Food contamination. Prevention. Isolation and identification.

### **E. The Campylobacter genera (Campylobacteriaceae family).**

Morphological and biochemical characteristics of the genera. Conditions for growth. Species responsible for food toxi-infection.

### 9. Campylobacter jejuni

Factors that favor growth. Resistance and sensitivity. Disease characteristics. Pathogenic characteristics. Infectious dose. Pathogenic mechanisms and factors that favor virulence. Diagnosis and treatment. Reservoir. Transmission. Food.

## **5172 FOOD STANDARDIZATION AND LEGISLATION**

### **Food standards and legislation.**

The basis for standards and legislation.

Introduction to relevant law. The Spanish Constitution and food-related matters. European Union law. The Spanish Agency for Food Safety and Nutrition.

### **Food legislation.**

Antecedents, concept, objectives and terminology. The Spanish Food Code.

Codex. Denominations of origin and quality marks.

Specific food and drink law.

Vertical and transversal domestic and European provisions.

### **Consumer and user protection.**

National and regional regulations Consumer and user associations: The OMIC (the Municipal Consumer Information Centre).

### **Professional ethics.**



## 5173 PUBLIC HEALTH

### • **MODULE I. Health and illness.**

**Subject Area 1.** Approaches to a concept of health. Background and development. Implications.

**Subject Area 2.** Determining factors in health.

**Subject Area 3.** The health-illness process. Prevention levels. The concept and role of Public Health. Community Public Health. Demographics.

### **PRACTICAL WORK: Determining factors in health.**

Lecture and group discussion of articles and real statistics regarding the circumstances that determine the appearance of illness in societies.

### • **MODULE II. Health systems.**

**Subject Area 4.** Organizational models. Health policy. Different health systems.

**Subject Area 5.** The Spanish health system. The General Health Act.

**PRACTICAL WORK:** Health system models. A comparison of health models.

### • **MODULE III. Epidemiology.**

**Subject Area 6.** The epidemiological method. The causality principle. Descriptive epidemiology. Epidemiological data and variables. Health information. Epidemiological measurement. Rates, incidence and prevalence.

**Subject Area 7.** Epidemiological analysis. Case-control and cohort studies. The concept of risk. Experimental research into public health.

**PRACTICAL WORK:** Epidemiology. Epidemiological measurement. Diagnostic accuracy. Lecture and interpretation of epidemiological research and social health statistics.

### • **MODULE IV. Health administration. Health programming.**

**Subject Area 8.** Health administration. The administrative process and its various phases. Diagnosis of the health of a community. Concept and approaches.

**Subject Area 9.** Health programming. The programming process.

**PRACTICAL WORK:** Health programmes.

Health programmes.

### • **MODULE V. Food and illness.**

**Subject Area 10.** The epidemiology of transmittable diseases.

**Subject Area 11.** Diseases transmitted by foodstuffs.

**Subject Area 12.** Food and cancer from an epidemiological perspective.

**Subject Area 13.** Epidemiological relationship between food and cardiovascular illness. Cardiovascular risk.



**PRACTICAL WORK:** Epidemiology and food. Lecture and interpretation of articles and reports on epidemiological research into cancer, cardiovascular illness and transmittable diseases.

## **5174 QUALITY MANAGEMENT SYSTEMS**

### **General concepts.**

Definitions and concepts of quality. Quality related factors.

Quality in the food industry.

Quality in the food industry.

The specific characteristics of food quality. Food quality throughout the chain.

### **Quality management.**

Organization and decision making.

Planning, control and improving quality.

Three basic aspects of quality management:

design, control and improving quality.

Quality assurance.

The fourth basic aspect of quality management:

Key quality assurance process basics.

Quality assurance.

Quality assurance systems.

The principles of ISO standard 9001:2015. Elements ensuring domestic and European food quality guarantees: PDO, GI, TSG. Guarantee marks etc.

## **5175 FOOD SCIENCE III**

### **Mushrooms.**

Most common edible species. Nutritional value. Toxic components. Analytical determinations. Chemical quality markers.

### **Stimulant condiments, spices, infusions and foodstuffs and derivatives. Non-stimulant condiments, spices and infusions.**

Main groups. Characteristics. Classification. Composition. Interest as a human food. Quality markers. Analytical determinations.

### **Stimulant food and drink.**

Coffee. Tea. Cocoa. Characteristics. Composition. Interest as a human food.

Quality markers. Other stimulant foodstuffs. Substitutes. Derivatives.

Analytical determinations.

### **Natural sweeteners, confectionery products and honey-related foods.**

**Sugars and derivative products.**

Classification. Composition. Interest as a human food. Storage and conservation. Quality parameters.

**Confectionery products.**

Classification. Composition. Interest as a human food. Storage and conservation. Quality parameters.

**Analytical determinations of natural sweeteners and confectionery products.**

Physical parameters. Chemical parameters. Deterioration parameters.

**Honey.**

Types. Composition. Interest as a human food. Granulation. Quality parameters. Storage and conservation. Sediment components. Adulteration and falsification. Analytical determinations.

**Other honey-related foods.**

Bee pollen. Royal jelly. Propolis. Mead. Oxymel.  
Composition. Interest as a human food. Quality parameters.  
Analytical determinations.

## **5176 FOOD TECHNOLOGY II**

**New strategies in food conservation.**

**Combined conservation and minimal processing methods.**

Definition. Comparison of both strategies with regard to their objectives, applications used in the processing of food and types of food obtained.

**New conservation technologies.**

Ionising radiation. High hydrostatic pressure. Electrical pulses. Ultrasound.  
Other emerging technologies.

**Food transformation.**

**Extrusion and texturing methods.**

The extrusion process. Types of extruders. Main types of extruded food.  
Texturing methods.

**Packaging and storing food.**

**General concepts.**

Packaging definitions. Functions. The design and selection of the packaging.

**Packaging types and materials.**

Metal packaging. Glass packaging. Plastic packaging. Other materials. The environmental impact of food packaging. Packaging waste management.

**Packaging systems.**

The packaging of food for sterilization within the container. Aseptic packaging. Flexible and semi-rigid plastic food packaging. Vacuum and modified atmosphere packaging. Active and smart packaging.

**Food design strategies in the food and drink industry.**

**Tools used in the design of new products.**

Review of the various strategies employed through a focus on various foods: modification of ingredients, modification of processing, foods for consumer sectors with special needs etc.

## **5177 DIETETICS**

**Unit 1.**

**Introduction to dietetics.**

The background and development of dietetics: changes in recommendations and the reasons behind them. The application of nutrition knowledge to dietetics.

**An individual's diet at the various stages of their life.**

The diet of a healthy adult. Diet and fertility. Diet throughout the life cycle: gestation, breastfeeding, childhood, adolescence and old age. Diet and physical activity.

**Group diet.**

Community nutrition. Alternative diets. Nutritional education as a tool in community nutrition.

**Diet as a preventive factor in multiple pathologies.**

Therapeutic diets. The role of diet in the prevention and treatment of an illness: malnutrition, eating disorders, excess weight and obesity, cardiovascular illness, cancer, osteoporosis, diabetes, allergies and food intolerance etc.

## **5178 ABIOTIC TOXICOLOGY OF FOODS**

**General overview of the abiotic toxicology of foods**

- A brief history of and background to abiotic toxicology.
- Acute and chronic toxicity.
- The concept of a toxic and lethal dose. The liberation, absorption, distribution, metabolism and excretion



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- of toxic compounds found in food. The possibility of their neutralization.
- General approaches to the analysis of toxins in food.
- Allergies and food intolerance.

## **Descriptive abiotic toxicology**

- Anti-nutritional substances found in food.
- Toxic compounds produced during food processing.
- Natural toxins found in plant-based food.
- Toxins in mushrooms and mycotoxins.
- Natural toxins found in fish and seafood.
- Toxins produced by pathogens.
- The potential toxicity of food additives.
- The migration of potential toxic substances through contact with food packaging.
- The toxicity of metals found in food.
- Radionuclides in food.
- The toxicity of pesticides found in food.
- Toxicity due to the presence of organic products found in food, other than pesticides.
- Toxicity due to the presence of pharmaceutical products.
- Toxicity due to food-food and food-drug interaction.

## **5179 FOOD BIO-TECHNOLOGY**

### **UNIT I. INTRODUCTION. THE MAIN APPLICATIONS OF FOOD BIO-TECHNOLOGY**

#### **SUBJECT AREA 1. OBJECTIVES AND SCOPE**

1. Objectives. 2. Content: Units from the study program. 3. Skills to be acquired by the student. 4. Assessment methods. 5. Study activities and teaching methodology. 6. Sources of bibliographical information and internet resources.

#### **SUBJECT AREA 2. THE CONCEPT OF FOOD BIO-TECHNOLOGY. MAIN APPLICATIONS.**

1. The concept of food bio-technology. 2. Food production applications, additives and auxiliary technologies. 3. Molecular markers and their applications. 3.1. Traceability applications. 3.2. Applications used in the authentication of components. 3.3. Applications used in the detection of pathogens and the control of disease.

### **UNIT II. THE GENETIC MODIFICATION OF FOOD**

#### **SUBJECT AREA 3. INTRODUCTION. THE CONCEPT OF GENETIC ENGINEERING.**

1. The concept of genetic engineering. 2. The objectives of genetic engineering.

#### **SUBJECT AREA 4. GENETIC MANIPULATION TECHNIQUES**



1. Introduction. 2. Stages in the obtaining of genetically-modified organisms. 3. The genetic manipulation of prokaryotes. 4. The genetic modification of yeasts. 5. Genetically-modified plants. 5.1. In vitro plant cultivation. 5.2. Vectors used in the manipulation of plants. 5.3. The transformation of plant cells.

## **SUBJECT AREA 5. THE APPLICATION OF GENETIC ENGINEERING TO FOODS**

1. Types of transgenic foods. 2. Use in food. 3. Plants and other transgenic organisms.

### **UNIT III. FERMENTATION IN FOOD PRODUCTION**

#### **SUBJECT AREA 6. INTRODUCTION TO FERMENTATION**

1. The concept of fermentation. 2. The background to and development of industrial fermentation. 3. Modifications to food (aroma and flavor, texture, color etc.) 4. Agents involved: Substrates, micro-organisms, products.

#### **SUBJECT AREA 7. FERMENTER MICRO-ORGANISMS**

1. Introduction. 2. Industrial micro-organisms. 3. Microbial metabolism. 4. Nutritional needs. 5. Environmental conditions. 6. Control and inhibition of microbial growth. 7. Regulation of the metabolism.

#### **SUBJECT AREA 8. MAIN TYPES OF FERMENTATION**

1. The Embden-Meyerhof pathway (alcoholic - lactic acid - mixed acid - butanedioic acid - butyric acid - propionic acid). 2. The Hexose-monophosphate pathway. 3. The C2-C3 pathway

#### **SUBJECT AREA 9. FERMENTATION TECHNOLOGY**

1. Selection of micro-organisms. 2. Substrate in the fermentation process. 3. Stress conditions. 4. Monitoring fermentation. 5. Products of interest.

### **UNIT IV. ENZYME TECHNOLOGY APPLIED TO FOOD PRODUCTION**

#### **SUBJECT AREA 10. INTRODUCTION TO ENZYME TECHNOLOGY**

1. Enzyme technology as a biotechnological tool. 2. Introduction to the use of enzyme technology.

#### **SUBJECT AREA 11. THE INDUSTRIAL PRODUCTION OF ENZYMES**

1. Sources of enzymes. 1.1. Micro-organisms as sources of industrial enzymes. Technical and economic advantages. 2. The production of enzymes through fermentation. 3. Enzyme extraction and purification. 4. Legal considerations in the production of enzymes.

#### **SUBJECT AREA 12. THE IMMOBILISATION OF ENZYMES.**



1. Introduction. 2. Immobilization techniques. 3. The properties of immobilized enzymes. 3.1. The effect on stability. 3.2. Kinetic properties. 3.3. pH effects. 4. The main applications of immobilized enzymes.

## **SUBJECT AREA 13. THE MAIN APPLICATIONS OF ENZYMES IN THE FOOD INDUSTRY**

1. Enzymes in protein processing. 2. Starch and its derivatives. 3. Enzymes in baked food. 4. Enzymes in dairy products. 5. Enzymes in malt-derived products and alcoholic drinks. 6. Enzymes in other products of commercial interest. 7. Analytical uses.

## **UNIT V. BIOREACTORS AND THEIR USE IN THE FOOD INDUSTRY**

### **SUBJECT AREA 14. TYPES OF BIOREACTORS AND THEIR OPERATION**

1. Introduction. 2. Surface and submerged fermentation. 3. Agitation and aeration systems. Gas-liquid transfer.

### **SUBJECT AREA 15. THE CHARACTERISTICS OF BIOLOGICAL PROCESSES**

1. Selection criteria in the setting up of a bioreactor. 2. Formulation of the medium. 3. Design and operation of a typical fermentation process. 4. Process control operating variables.

### **SUBJECT AREA 16. METABOLIC STOICHIOMETRY AND GROWTH KINETICS**

1. Cellular growth: prior considerations. 2. Overall growth stoichiometry: formulation of the medium and yield factors. 3. Growth kinetics and the forming of products. 4. Environmental effects.

### **SUBJECT AREA 17. CALCULATION OF IDEAL BIOREACTORS**

1. Mass balances. 2. Discontinuous bioreactor. 3. Continuous tank-agitated bioreactor with Monod chemostat.

## **5180 CATERING**

**Subject Area 1.** Food habits and consumption in Spain.

**Subject Area 2.** Mass catering and responsible consumption. Menu planning based on consumer needs.

**Subject Area 3.** Elaboration and distribution systems: cold and hot chains.

**Subject Area 4.** The processing of food in mass catering. The application of new culinary methods in catering.

**Subject Area 5.** Prepared meals.

**Subject Area 6.** The planning of premises, facilities and equipment.

**Subject Area 7.** The effect of processing on the nutritional value of foods.

**Subject Area 8.** Mass catering and health and safety at work.

**Subject Area 9.** Mass catering in educational establishments.

**Subject Area 10.** Mass catering in hospitals and nursing homes. Food and people with special needs.

## **5181 SAFETY AND TRACEABILITY IN THE FOOD INDUSTRY**

**Introduction to food safety.**

**General concepts.**

The concept of food safety. The food chain.

**Hazards and risks.**

**Hazards and risks.**

Physical, chemical and biological hazards including the parasites most commonly found in foods. Other dangers. Conservation methods. Sources of contamination.

**Food safety management.**

**Management tools.**

Program pre-requisites. The HACCP system. Risk analysis.

**Traceability systems.**

**Regulations and certification.**

Integrated certification systems (BRC, IFS, GlobalGap, ISO 22000: etc.)

Basic EU food safety regulations. Consumer protection organizations.

➤ **4<sup>th</sup> year**

## **5182 ANIMAL ORIGIN FOOD TECHNOLOGY**

**Section 1. The meat industry.**

The meat industry.

Industrial meat production and meat products: Slaughter and dressing.

Meat by-products. Transforming muscle into meat. Post-slaughter operations.

Meat quality. The conservation of meat through refrigeration. Meat products: diagrams of meat production processes.

**Section 2. The dairy industry.**

The dairy industry.



Industrial milk production for human consumption and other dairy products: processing, effect on product characteristics, process control, possible defects.

**Section 3. Other products.**

Other animal-based products.

Fish and the processing of fish products.

Egg-based products.

## **5183 FRUITS AND VEGETABLES FOOD TECHNOLOGY**

### **THE TECHNOLOGY OF FRUITS, VEGETABLES AND OTHER DERIVED PRODUCTS**

#### **FRUIT AND VEGETABLE CONSERVATION METHODS**

**Subject Area 1.** The application of refrigeration systems to fruit and vegetables.

**Subject Area 2.** The application of controlled and modified atmospheres to fruit and vegetables.

#### **THE TECHNOLOGY OF PRODUCTS DERIVED FROM FRUIT AND VEGETABLES**

**Subject Area 3.** The technology of vegetable preserve production.

**Subject Area 4.** Jam and jelly production.

**Subject Area 5.** Juice production.

**Subject Area 6.** Pickles.

#### **THE TECHNOLOGY OF CEREALS AND OTHER DERIVED PRODUCTS**

##### **Subject Area 7. THE STORAGE OF CEREALS**

Harvest and transport. Basic storage systems. Alterations and signs of deterioration in the grain and their effect on product quality.

##### **THE MILLING OF CEREALS**

**Subject Area 8.** The dry milling of cereals.

**Subject Area 9.** The wet milling of cereals.

**Subject Area 10.** Baking technology.

The baking process. Types of bread. The ageing and conservation of bread.

#### **THE TECHNOLOGY OF ALCOHOLIC BEVERAGE PRODUCTION**

##### **Subject Area 11. WINE PRODUCTION**

Grape harvesting. Obtaining the must. Wine-making techniques: red, white and rosé.

#### **THE TECHNOLOGY OF OILS AND FATS**

##### **Subject Area 12. VEGETABLE OILS**

Types of vegetable oils. Olive oil extraction methods. Oil extraction from seeds.



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## **THE TECHNOLOGY OF SWEETENERS AND CONFECTIONERY PRODUCTS**

### **Subject Area 13. SUGAR AND DERIVED PRODUCTS**

The process of obtaining sugar. Candy and sweets. *Turrón* and marzipan. Caramelized sugar. Sugar syrups.

## **THE TECHNOLOGY OF STIMULANT FOOD AND DRINK**

### **Subject Area 14. COFFEE**

The green coffee production process. Initial treatment. Toasting and grinding. Decaffeinated coffee. Instant coffee. Substitutes.

### **Subject Area 15. TEA**

The main varieties of tea. The production process. Instant tea.

### **Subject Area 16. COCOA AND CHOCOLATE**

Cocoa. The cocoa production process. The chocolate production process. Shaping and topping. Substitutes.

## **5184 ENVIRONMENTAL MANAGEMENT IN THE FOOD INDUSTRY**

### **Environmental management.**

#### **The key areas of environmental management.**

Environmental management systems. ISO 14000 environmental management standards. Other UNE environmental regulations.

#### **Environmental law.**

European regulations. Spanish legislation. Regional and local legislation. Integrated Pollution Prevention and Control (IPPC)

### **Waste management.**

#### **Types of industrial waste.**

Waste classification. The European Waste List. Packaging waste. Integrated packaging management systems. The physical-chemical characterization and toxicology of waste.

#### **Waste treatment.**

Prevention. Preparation for reuse. Recycling. Energy recovery and related areas. Disposal.

### **Waste water.**

#### **The characterization of waste water.**

Consumption and emission levels. Approaches to minimize water use. Physical-chemical characterization.

#### **Waste water treatment systems.**

Treatment aims and discharge conditions. Treatment process classification. Physical operations. Chemical processes. Biological processes.

**Slurry treatment.**

Agricultural use. Slurry thickening. Chemical stabilization. Biological stabilization.  
Washing and drying.

## **6739 FOODS AND HEALTHY PROPERTIES**

### **I. INTRODUCTION.**

Brief description of nutritional statements and the properties of healthy foods and the legal situation affecting them.

### **II. FOOD CONSTITUENTS AND THEIR POSSIBLE USES AS "FUNCTIONAL" INGREDIENTS.**

Description of the main metabolic and biochemical routes that play a role in the functionality of food constituents. The main groups of food constituents of "functional" interest and their biochemical role.

### **III. THE EFFECT OF "FUNCTIONAL" INGREDIENTS ON HEALTH.**

Description of the health effects of certain food categories and their ingredients. Scientific evidence and statements currently permitted by law.

### **IV. PREPARING FOODS WITH HEALTHY PROPERTIES WHICH MEET THE REQUIREMENTS FOR NUTRITIONAL CLAIMS.**

Technologies and strategies applicable to the obtaining and preparation of food ingredients with healthy properties.

## **7563 SUSTAINABILITY IN THE FOOD INDUSTRY**

### **UNIT 1. GENERAL CONCEPTS**

#### **Subject Area 1.** Introduction to sustainability.

The definition of a sustainable company.

Unsustainable vs. sustainable.

Sustainability from a corporate point of view.

#### **Subject Area 2.** Sustainability and the environment.

The Earth as a system.

Biogeochemical cycles.

10.2. The importance of ecosystems to the Earth.

The conflict between society and the economy and the environment.

Circular, functional and collaborative economies.

#### **Subject Area 3.** The environmental impact of the food chain.

The food supply chain.

The environmental impact of food supply.

## **UNIT 2. MANAGEMENT ASPECTS**

**Subject Area 4.** Assessment of the impact and intensity measurement.

Life cycle analysis.

Intensity indicators.

**Subject Area 5.** Improvements to food production and transformation efficiency.

Efficiency and sustainability.

Improvements to efficiency.

Clean and sustainable production.

The integration of sustainability into management systems.

**Subject Area 6.** New technologies in the food industry.

Technological cycles.

Innovation and sustainability.

**Subject Area 7.** Environmental statements and information.

Environmental claims and statements.

Regulations and directives.

Sustainability reports.

Carbon offsets and emissions trading.

## **UNIT 3. WORK ON IMPACT**

**Subject Area 8.** Atmospheric emissions.

Emissions with local, regional and global impact.

Emissions inventories.

Reducing emissions.

**Subject Area 9.** Water and waste water.

Water as a resource.

Water and food production.

Efficient use of water in food processing.

The treatment of waste water.

Rain water management.

**Subject Area 10.** Solid waste.

Minimizing the impact of solid waste.

Eco-industrial development.

**Subject Area 11.** Energy.

Energy within a context of sustainability.

Improved energy efficiency in food processing plants.

Technological innovation.

Carbon-free energy.



**Subject Area 12.** Food packaging.  
Materials used in food packaging.  
The environmental impact of food packaging.  
Reducing the impact of packaging.

**Subject Area 13.** Food transport.  
Methods of food transport.  
Transport distance indicators.  
Transport efficiency.  
Transport emissions  
Reducing the impact of food transport.

## **UNIT 4. A SUSTAINABLE FUTURE**

**Subject Area 14.** A biological-based economy.  
The concept of biorefining.  
Obtaining chemical substances from sugars.  
Obtaining chemical substances from synthesis gas.  
Biofuels.  
Raw materials used as fuels and chemical products.  
The drawbacks of a biological-based economy.

**Subject Area 15.** Conclusions  
Paradoxes in the production of industrial foods.  
The foundations of sustainability.  
Highlights on the path toward sustainability.  
Sustainability within the context of dwindling resources.

## **6741 TECHNOLOGY OF PRODUCTS DERIVED FROM CEREALS AND ALCOHOLIC DRINKS**

### **Section I. Foods derived from cereals.**

#### **1. Non-conventional baking techniques.**

Baking systems: Chorleywood, Do-Maker, others. Sourdoughs. The application of cold in baking: Controlled fermentation. Pre-baked bread. Sliced bread.

#### **2. Cakes and pastries.**

Raw materials used in cake and pastry products. Puff pastries. Soft doughs (cakes and sponges).

#### **3. Biscuit products.**

Ingredients. Biscuit production formulas and processes. Secondary operations. Common defects. Production processes for wafers and crackers.

#### **4. Pasta.**

Types of pasta. Ingredients and production process. Characteristics. Quality and defect



criteria

5. Aperitifs, breakfast cereals and others.

Production processes for extruded foods. Characteristics. Production processes for non-extruded foods. Puffed cereal grains. Cereal flakes. Characteristics.

### **Section II. Alcoholic drinks.**

6. Wine production technology.

Wine making: pre-fermentation operations, post-fermentation operations and ageing. Traditional production methods: red wine and white wine. Ageing processes.

7. Special wines.

Wines produced using the carbonic maceration method. Thermovinification. Flash expansion. *Doble pasta* and bleeding techniques. Pectinolytic enzymes. Naturally sparkling wines. Sherry wines.

8. News trends and modern wine-making practices.

Raw materials: Alternatives to sulfur, pre-fermentation maceration.

Fermentation: Oxygen control and dealcoholizing.

Stabilization: Exchange resins.

Ageing. Wood substitutes.

9. Beer production technology.

The production process. Types of beers. News trends in beer-making. Dealcoholizing techniques. Reducing the calorie content. Gluten-free beers.

10. The production of spirits.

Definition and types of spirits. The production of aged distilled spirits. The production of other distilled drinks. The production of liqueurs, aperitifs and bitters.

## **6742 DESIGN AND DEVELOPMENT OF MEAT PRODUCTS**

### **Unit 1.**

The principles of product design.

Basics.

### **Unit 2.**

The foundations of formulation.

Food additives – their use and application.

### **Unit 3.**

Industrial processing and cost calculation.

How to design an industrial process and calculate production costs for a product.

### **Unit 4.**

Fermented meat products.

The basic principles and preparation of such products. Defects.

### **Unit 5.**

Minced cooked meat products (smooth meat pastes and emulsions).



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The basic principles and preparation of such products.

## **Unit 6.**

Whole cooked meat products.

The basic principles and preparation of such products.

## **Unit 7.**

Whole cured meat products. Salted meat products.

The basic principles and preparation of such products. Defects and parasites.

## **Unit 8.**

Other products.

The basic principles and preparation of such products.

## **6743 NEW TENDENCIES IN HUMAN NOURISHMENT**

### **Introduction.**

The influence of evolution on eating habits on the establishment of nutritional recommendations.

### **Dietary patterns.**

The Mediterranean diet: Intangible cultural heritage.

The Atlantic diet and the Cantabrian diet.

Other dietary patterns.

The role of gastronomy in healthy eating.

### **New understanding of the relationship between food and health.**

Nutrigenetics and nutrigenomics: toward a personalized diet.

From a universal food pyramid to an individualized food pyramid.

### **New understanding of the role of food in different physiopathological situations.**

Food during the first stages of life and the risk of illness in adulthood.

### **Advances in nutritional policy.**

Nutritional policy stemming from our new understanding of the human diet.

Nutritional supplements.

The application of advances in physiopathological situations.

## **6744 EDUCATION FOR HEALTH IN NOURISHMENT AND NUTRITION**

### **Health education:**

a. Introduction. Health as a basic right. The independence of a person. Taking responsibility for one's health.

b. Determining factors in health. The concept of health education.

c. Education as a process aimed at improving one's quality of life and that of the community.

**Changes to behavior in order to improve society's health.**

- a. Levels of intervention in education – mass, group and individual.
- b. Health education methods and resources.
- c. Motivational interview.
- d. Analyzing the role of the media in the formation of one's self-image and lifestyle.

**The drawing up of a nutritional health education program.**

- a. Identification of dietary and nutritional needs for health.
- b. General and specific goals.
- c. The society in question.
- d. Activity content and approach strategies.
- e. Material and human resources.
- f. Assessment.

**Health and nutritional education with specific groups.**

- a. Nutritional education with children and adolescents. The school and the school canteen as a nutritional education resource.
- b. Nutritional education and the elderly.
- c. Nutritional education and women.
- d. Nutritional education for people with special needs.

**The assessment of different dietary and nutritional education programs.**

Nutritional education programs: the WHO, the FAO, the UN, the EU, Spain. An overview of the "NAOS Strategy" (Nutrition, Physical Exercise and Prevention of Obesity). Nutritional educational games. Approaches to social communication in diet and nutrition.

**The role played by food science and technology in health and nutrition education.**

## **6745 INSTRUMENTATION FOR PROCESS CONTROL IN THE FOOD INDUSTRY**

**Subject Area 1.** The importance of sensorization and control. The intended aims. Definition of monitoring variables. Control variables. Aims of its implementation in the food industry.

**Subject Area 2.** Introduction to food industry process control. Definitions and basic concepts regarding process control systems. Indicators and instruments in a process control system. Levels of process control. Control types. The design of a control system.

**Subject Area 3.** Introduction to food industry process instrumentation.





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The measurement process. The classification of measuring instruments. Basic definitions and concepts. Transferring measurements. Smart instrumentation. Calibration. P&I diagrams.

**Subject Area 4.** The measurement of temperature, pressure, level and flow. Real application in the food industry.

Physical properties used. The principles and classification of measurement.

Measurement selection. Control systems used in the food industry

(coffee extract, the drying of flour etc.): sensorization and control proposals.

**Subject Area 5.** Process analysis. Implementation in the sensorization and control of a food process. Other variables of special importance in the food industry.

Line analysis. Physical properties used in real time analysis.

Sampling and conditioning systems. Industrial implementation of process analyzers.

used in food production control. The measurement of weight, density, viscosity,

texture: principles and matters of interest.

**Subject Area 6.** Final control elements.

Control valves: General characteristics. Energy regulation: valves vs. electrical systems.

## **Practical laboratory sessions**

### **Practical session 1.**

The study of a temperature feedback control system.

### **Practical session 2.**

Use and calibration of different temperature sensors used in control loops.

### **Practical session 3.**

Pressure and level measurement. The calibration of manometers.

### **Practical session 4.**

The use of different flow meters.

## **6746 ADVANCES IN THE ANALYSIS AND CONTROL OF FOOD QUALITY**

### **Unit 1.**

#### **Area 1.**

Techniques aimed at ensuring food quality and safety throughout the food chain. Automated sampling procedures. Online quality control systems. Non-destructive techniques. Techniques for the swift detection of components of interest.

**Area 2.**

Simultaneous analysis of main food components. Applications in the food industry and in quality control.

**Area 3.**

Methods used to identify animal and vegetable species for human consumption.

**Area 4.**

Advanced methods used to mineral and vitamin elements in foods.

**Area 5.**

Advanced analysis of organic acids, colorings and sweeteners in foods.

**Area 6.**

Identification of volatile and semi-volatile substances responsible for food aroma. Extraction and analysis processes.

**Area 7.**

Assessment of antioxidant and anti-bacterial activity in foods.

**Area 8.**

Analysis and control of bioactive compounds and anti-nutritional components in foods.

**Area 9.**

Advances in the analysis and control of residues found in food: pesticides, PCBs, PAHs, dioxins, antibiotics and elements that have been passed on from food packaging.

## **6747 NEW TECHNOLOGIES IN FOOD CONSERVATION AND TRANSFORMATION**

**Innovations in food production and design.**

New approaches to food processing.

**The modification of sensorial properties through ingredients of technological processes.**

Texture modification.

Micro- and Nano-encapsulation of ingredients and food additives.



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**Ethnic demands and sectors with special needs.**

**Packaging as an innovation tool.**

New packaging materials.

Recycling and sustainability in food packaging.

New packaging. Functionality and design.

New active and intelligent packaging strategies.

## **6748 THE COMMERCIAL LIFE OF PROCESSED FOODSTUFFS**

**Introduction.** Factors that affect useful life.

**Measuring useful life.** Sensorial, instrumental, physical, chemical and microbiological determinations.

**Predicting useful life.** Predictive models. Accelerated testing. Predictive experiment design.

**Prolonging the life of foods:** the selection and quality of raw materials. The formulation of products. Conservation techniques and production. Packaging. Storage and distribution. Domestic handling.