UNIVERSIDAD DE BURGOS

COURSE DESCRIPTIONS

Joint Degree in Agroalimentary Engineering and the Rural Environment and Industrial Management Engineering

➢ 1st year

7998 ANIMAL AND PLANT BIOLOGY

THEMATIC UNIT I: INTRODUCTION

1. OBJECTIVES AND COMPETENCES

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

2. INTRODUCTION TO BIOLOGY

1. Concept of Biology.
2. The organization of living beings.

2.1. General characteristics.

3. Chemical composition of living beings.

THEMATIC UNIT II: BIOLOGICAL DIVERSITY

3. THE DIVERSITY OF LIFE

1. The origin of life.
2. The first cells.
3. Evolutionary history of biological diversity.

4. CLASSIFICATION OF ORGANISMS

1. Classification systems for living beings.
2. Taxonomy.
3. Phylogeny and systematics.

THEMATIC UNIT III: CELLULAR COMPONENTS AND CELL PHYSIOLOGY

5. INTRODUCTION TO THE CELL

1. Cell theory.
2. Prokaryotic and eukaryotic cells.
3. Animal and plant cells.

6. CELL MEMBRANES AND CELL SURFACE

1. Composition and architecture of the membranes.
2. Dynamics and fluidity of the membrane.
3. Permeability of the membrane.
4. Transport through the membrane.

4.1. Signalling on the cell surface.

5. The cell wall.

7. CYTOPLASM AND CYTOPLASMIC ORGANELLES

1. Structure and function of the cytoplasm.

1.2. The cytoskeleton.

2. Cytoplasmic organs.
3. Vesicular transit, secretion and endocytosis.

8. NUCLEUS

1. Nuclear structure and function.
2. Nuclear sheath.
3. Nucleolus.
4. Chromosomes and chromatin.

4.1. Structure of the prokaryotic chromosome.

4.2. Structure of eukaryotic chromosomes.

9. FUNDAMENTALS OF INHERITANCE

1. Genes and genome.

1.1. Concept of gene.

2. Fundamentals of Mendelian genetics.
3. Genotype and phenotype.
4. Chromosomal theory of heredity.

THEMATIC UNIT IV: PLANT STRUCTURE AND FUNCTION

10. PLANT STRUCTURE AND GROWTH

1. The body of plants.
2. Plant tissues.
3. Plant organs.

3.1. Shape and structure of the leaf.

3.2. Stem structure and growth.

3.3. Root structure and growth.

11. VITAL PROCESSES IN PLANTS

1. Basic functions of plants.
2. Plant nutrition.

2.1. Transport in vascular plants.
3. Reproduction in angiosperms.
4. Plant development.
4.1. Tropisms.
4.2. Plant hormones.

THEMATIC UNIT V: ANIMAL STRUCTURE AND FUNCTION
12. STRUCTURE OF ANIMALS
1. The shape of the animals.
2. Animal tissues.
3. Organs and systems.
13. VITAL PROCESSES IN ANIMALS
1. Basic animal functions.
2. Animal nutrition.
3. Circulation and exchange of gases.
4. Osmoregulation and excretion.
5. Hormones and endocrine system.
6. Animal reproduction.

7999 BUSINESS ECONOMICS I

ECONOMICS
ECONOMICS AND ECONOMIC ANALYSIS
1.1.- Concept of economics. Scarcity and choice.
1.2.- Economic activity.
1.3.- The circular flow of income.
1.4.- The frontier of production possibilities.

2.- THE MARKET, DEMAND AND SUPPLY
2.1.- The market.
2.2.- Demand, supply and equilibrium.
2.3.- Displacements of the demand curve.
2.4.- Displacements of the supply curve.

3.- THE COMPANY IN THE MARKETS
3.1.- The company and production.
3.2.- Production and costs in the short term.
3.3.- Production and costs in the long term.
3.4.- Perfect competition. Market equilibrium.
3.5.- Other forms of market.

3.6.- Forms of market in agricultural products.
3.7.- The role of the State in the Economy.

COMPANY

4.- COMPANY AND ENTREPRENEUR

4.1.- Company and entrepreneur.
4.2.- Types of companies.
4.3.- Objectives of the company.
4.4.- The company as a system.

5.- THE MANAGEMENT PROCESS. THE ADMINISTRATION SUBSYSTEM

5.1.- Introduction.
5.2.- Decisions.
5.3.- The planning function.
5.4.- The organization function.
5.5.- The personnel integration function.
5.6.- The management function.
5.7.- The control function.

6.- THE FINANCIAL STATEMENTS.

6.1.- Accounting and the production cycle.
6.2.- Patrimony.
6.3.- The annual accounts.

7.- FINANCING IN THE COMPANY

7.1.- The financial decisions of the company.
7.2.- The investment decision.
7.3.- The financing decision.

8.- THE PRODUCTION FUNCTION

8.1.- Introduction to the operations subsystem.
8.2.- Productivity.
8.3.- Costs in the company.

9.- THE MARKETING FUNCTION

9.1.- Introduction to marketing.
9.2.- Strategic marketing.
9.3.- Operational marketing.

8000 PHYSICS I

I. MAGNITUDES AND UNITS

1. Scalar and Vectoral Magnitudes. Physical units.

1.1. Introduction.

1.2. Scalar and Vectoral Magnitudes.

1.3. Basic operations with vectors.

1.4. Magnitudes and dimensions.

1.5. Dimensional analysis.

1.6. Units and systems of units.

II. MECHANICS OF THE PARTICLE AND THE SOLID

2. Kinematics of the particle

2.1. Introduction.

2.2. Position Vector.

2.3. Velocity Vector.

2.4. Acceleration Vector. Intrinsic components.

2.5. Circular movement. Angular velocity. Angular acceleration.

2.6. Relative movement.

3. Particle dynamics.

3.1. Introduction.

3.2. Newton's Laws.

3.3. Linear momentum.

3.4. Habitual forces in Mechanics.

3.5. Diagram of the free body.

3.6. Inertial and non-inertial reference systems.

3.7. Inertial Forces.

8008 GEOLOGY AND CLIMATOLOGY

Unit I: Basic Geology

Topic 1: Geological Weather

1. Geological Weather. Geochronology.

2. Geological Time Divisions.

Topic 2: Earth Structure and Plate Tectonics

1. Earth Structure and Composition.

2. Cortical Plates and Plate Tectonics.

3. The Orogenies.

Topic 3: Structural Geology

1. Fragile Behaviour: Faults and Fissures.
2. Ductile Behaviour: Folds and Diapirs.

Topic 4: Stratigraphy

1. Concepts of Stratum, Stratification and Facies.
2. Polarity Criteria.
3. Stratigraphic Sections and Columns.

Topic 5: Mineralogy

1. Concept of Mineral.
2. Notions of Crystallography.
3. Classification of Minerals.

Unit II: APPLIED GEOLOGY

Topic 6: Igneous Rocks. Classes, uses and problems

1. Igneous Rock Concept and Mineralogical Composition.
2. Textures of the Igneous Rocks.
3. Classes of Igneous Rocks: Plutonic, Volcanic and Philonian.

Topic 7: Sedimentary Rocks. Classes, uses and problems

1. Sedimentary Rock Concept and Mineralogical Composition.
2. Textures of the Sedimentary rocks.
3. Classes of Sedimentary Rocks: Detritic and Chemical.

Topic 8: Metamorphic Rocks. Classes, uses and problems

1. Concept of Metamorphism and main minerals.
2. Metamorphism types and rock classes: Thermal contact, Regional and Dynamic pressure.

Topic 9: Methods of Geological Exploration

1. Indirect Methods.
1.1 Photogeology and Remote Sensing.
1.2 Geophysical Prospecting: Seismic, Electric, Geo-Radar, Gravimetry.
2. Direct Methods.
2.1 Geological surveys, surface cartography.
2.2 Surveys.
2.3 Wells.
2.4 Probing.

Topic 10: Geomorphology

1. Terrain Morphology. Landscape.
2. Analysis of drainage basins.
3. Erosion, Transport and Sedimentation. Rivers.

4. Geomorphological Maps.

Topic 11: Hydrogeology

1. Concept of Hydrogeology.
2. The presence of water in the subsoil. Hydrogeological Parameters.
3. Types of Aquifers.

Topic 12: Water in the Rocky Mountains

1. Influence of water on the Terrain and Works.
2. Treatment of the waters of the Rocky Mountains.

Unit III: Applied Geology Practices

APPLIED GEOLOGY PRACTICES

- Practice 1: Identification of minerals and rocks.
- Practice 2: Course and Dip Concepts. The problem of the three points.

Apparent Dips.

- Practice 3: Stratum Power and Cartographic Tracing.
- Practice 4: Geological cuts.

Unit IV: Climate Factors and Elements

Topic 1.- Atmosphere and solar radiation

Atmosphere Structure and Composition. Nature of solar radiation. Variation of solar radiation received by the earth. Thermal balance of the earth.

Topic 2.- Heat and Temperature

Distribution of the radiation in the earth. Daily and annual variation in air temperature.
Vertical variation of temperature: thermal inversion. Frost. Methods of protection against frost.

Topic 3.- Atmospheric pressure and wind

Atmospheric pressure. Relationship between wind and atmospheric pressure. General circulation of the atmosphere. Classification of winds. Windbreaks and crop protection.

Topic 4.- Atmospheric humidity and precipitation

Steam in the atmosphere. Precipitations. Formation and evolution of air masses. Fronts and storms. Other types of depressions. Droughts and methods of combating drought.

Unit V: Evapotranspiration and crop protection

Topic 5.- Evapotranspiration.

Potential and reference evapotranspiration. Soil water balance. Water needs of crops. Effects of vegetation on water balance. Estimation of components of water balance.

Unit VI: Climate and bioclimatic classifications

Topic 6.- Climate classifications

Climate indexes. Köppen classification. Bioclimatic classification of
Agricultural interest classifications: Turc and Papadakis.

Unit VII: CLIMATOLOGY internship program

Practice 1
Climate data management. Interpretation, study of correlations and estimation of data.
Study of series and analysis of their variability. Energy balance and thermal integrals.
Practice 2
Estimation of evapotranspiration.
Practice 3
Climate classifications. Examples of use of climographs, climatic indexes and climatic classifications.

8001 MATHEMATICS

MATHEMATICS 1

Topic 0. Previous knowledge

In order to be able to follow the subject properly it is necessary to have gained Baccalaureate level knowledge of mathematics.
If the student has not studied to Baccalaureate level or has not taken the subject of Mathematics in 2nd year, taking a mathematics course in preparation for the University is recommended.

Topic 1. Real functions of real variable

Real numbers. Complex numbers. Limit of a function in a point and properties. Limits and algebraic operations. Calculation of limits. Infinitesimals and infinites. Continuity and properties. Types of discontinuities. Theorems about continuity.

Topic 2. Derivation and applications.

Concept and geometric interpretation. Derivatives and algebraic operations. Chain rule. Derived from some functions. Growth of a function in a point, relative extremes and concavity. Theorems on derivable functions. Taylor's Formula.
Study and drawing of flat curves. Hyperbolic functions.
Numerical solving of equations. Polynomial interpolation.

Topic 3. Calculation of antiderivative.

Antiderivative of a function. Indefinite integral. General integration procedures.

Topic 4. Defined integral and applications.

Definition and properties. Theorem of the average value. Fundamental Theorem of Barrow's Rule. Variable change. Integration in parts. Basic notions about improper integrals. Applications of the defined integral to the calculation of areas, lengths and volumes.
Integration or numerical quadrature.

Topic 5. Multi-variable functions. Differential calculus

Basic definitions. Real function of several variables. Limits and continuity.
Partial derivatives. Differentiation. Tangent plane to a surface at a point.
Vector functions of several variables. Chain rule. Relative and absolute extremes.
Topic 6. Multiple Integrals. Applications.
Double integrals: geometric interpretation and variable change. Triple integrals: change of variable. Plane and spatial applications: centres of mass and moments of inertia.

8003 AGRICULTURAL BOTANY

Block I. Introduction and generalities.

Topic 1

Botany as Science and Cultivated Plants.
The concept of vegetable. Taxonomy, systematics and nomenclature. Scientific names, international code of botanical nomenclature and international code of nomenclature for cultivated plants. Agricultural Botany.

Topic 2

Vegetative structures. Morphological levels of organization: protophytes, talophytes, prochormophytes and chromophytes. Root, stem and leaves. Adaptations of the plants to the environment.

Topic 3

Reproduction. Reproductive structures (i). Asexual reproduction. Sexual reproduction. Biological cycles.

Topic 4

Reproduction. Reproductive structures (ii). Sexual reproduction in spermatophytes. Flowers and inflorescences. Pollination and fertilization. Seed. Fruits and infructescences. Diaspora dispersion and seed germination.

Block II. Algae, Fungi, Bryophytes and Pteridophytes

Topic 5

Algae. Introduction. Prokaryotic Algae. Eukaryotic Algae. General Characteristics.
Morphology. Systematic. Rhodophyta. Chromophyta. Chlorophyta. Algae and
Economic importance.

Topic 6

Mushrooms General Characteristics of Mushrooms. Morphology. Systematic. Mushrooms and the environment.
Economic importance.

Topic 7

The Bryophytes. Division Bryophyta. General characteristics. Morphology of the gametophyte and the sporophyte. Morphology. The Bryophytes and the environment. Economic importance.

Topic 8

The Pteridophytes. Pteridophyte Division (Facts and related topics). General characteristics; gametophyte and sporophyte. Biological cycle. Ecology and distribution. Interest and applications.

Block III. Spermatophytes: gymnosperms and angiosperms

Topic 9

Gymnosperms. Introduction. General characteristics. Classification. Cl.
Cicadopsida: the cicas. Cl. Ginkgopsida. Cl. Pinopsida: Conifers (Families of the Araucarias, the Pines and the Cypresses) and Taxidas (the Yew).
Ornamental Conifers.
Species and genera of forest and ecological interest.

Topic 10

Angiosperms I: General characteristics. Classification. Agronomic and/or economic interest groups.

Topic 11

Angiosperms II: Monocotyledons. Eudicotyledons. Agronomic and/or economic interest groups

Block IV. Agronomic importance groups

Topic 12

Cereals. General characteristics. Family Poaceae (Gramineas): Cereals and their Use (wheat, barley, rye, oats, rice, sorghum, millet and corn).

Topic 13

Legumes. Fabaceae family (=Papilionoidea): Grain legumes (broad bean, pea, lentil, soya, beans, chickpea, peanut, lupin).

Topic 14

Oilseeds and wax producers. Cannabaceae family: hemp. Family
Brassicaceae (Cruciferae): oilseed rape. Family Fabaceae (=Papilionoidea): soybean and peanut. Family Sterculiaceae: cocoa. Family Oleaceae: olive tree. Family Asteraceae
(Compounds): sunflower and safflower. Family Arecaceae (= Palmae): palm and coconut trees. Others (Family Papaveraceae: opium poppy; Family Juglandaceae: walnut. Family Malvaceae: cotton).

Topic 15

Plants producing sugars and beverages. Family Chenopodiaceae: Sugar beet. Family Poaceae (Gramineas): sugar cane. Other families (Aceraceae family: sugar maple; Arecaceae family: palm trees.

Topic 16.

Medicinal and drug-producing plants. Family Taxaceae: Yew. Family
Papaveraceae: opium poppy. Family Moraceae: hemp. Family Cistaceae: rockrose.
Family Salicaceae: Willows. Family Apiaceae (= Umbelliferae): hemlock. Solanaceae: alkaloid-producing species (belenos, estramonio, belladonna and mandrake), tobacco. Family Asteraceae (Compounds): chamomile.

Topic 17.

Forest resources and fibre producing plants. Gymnosperms. Gymnosperms. Fagaceae family: chestnut, beech, holm oak, cork oak, gall oaks and oaks. Betulaceae family: birch, alder and hazelnut. Ulmaceae family: elm and hackberry. Moraceae family: mulberry trees. Juglandaceae family: walnut. Salicaceae Family: poplars, aspens and willows. Rosaceae family.

8004 EDAPHOLOGY

TOPIC 1.- THE SOIL AND ITS EVOLUTION

Soil from different perspectives of study.
Relations of Soil Science with other sciences.
Soil Formation Factors: Jenny's Equation.
Man as a factor in soil formation.

TOPIC 2.- SOIL FORMING PROCESSES

Basic training processes.
Weathering processes: Physical. Chemical. Biological.
Soil-genetic processes.
Additions. Transformations. Translocations. Losses.

TOPIC 3.- SOLID PHASE OF THE SOIL I: INORGANIC FRACTION

Soil mineral components.
Silicates and aluminosilicates.
Clays, silts and sands.
Electropositive colloids.

TOPIC 4.- SOLID PHASE OF THE SOIL II: ORGANIC FRACTION

General concepts.
The living organisms of the soil.
Evolution of organic matter in the soil. Influencing factors.
Organomineral compounds.
Humus: composition and types.

TOPIC 5.-PHYSICAL PROPERTIES OF SOIL

Structure.
Density.
Porosity.
Colour.
Temperature.

TOPIC 6.-CHEMICAL PROPERTIES OF SOIL

Ion exchange.
Soil acidity and alkalinity.

Soil oxidation-reduction potential.

TOPIC 7.- LIQUID AND GASEOUS PHASE OF SOIL

Classification of water in soil.

Soil dissolution.

Chemical composition of the gaseous phase of soil.

Movement of gases in soil.

TOPIC 8.- PROFILE AND HORIZONS

Nomenclature of horizons.

Diagnostic horizons (FAO).

TOPIC 9.- GENERAL PRINCIPLES OF SOIL CLASSIFICATION

General classification criteria.

Diagnostic properties.

Taxonomic classes and nomenclature rules.

Methodology for classifying soils.

8005 PHYSICS II

THERMODYNAMICS

TOPIC 1. TEMPERATURE AND HEAT

1.1. Introduction.

1.2. Concept of temperature.

1.3. Thermometers and temperature scales.

1.4. Thermal expansion in solids.

1.5. Heat capacity and specific heat.

1.6. Phase changes. Latent heat.

1.7. Heat propagation mechanisms.

TOPIC 2. PRINCIPLES OF THE THERMODYNAMICS

2.1. Introduction.

2.2. Thermodynamic systems. Ideal gas.

2.3. Work in thermodynamics.

2.4. Internal energy. First principle of Thermodynamics.

2.5. Thermodynamic processes of an ideal gas.

2.6. Second principle of Thermodynamics. Thermal machines.

ELECTROMAGNETISM

TOPIC 3. ELECTRIC FIELD

3.1. Introduction.

3.2. Coulomb's Law.

3.3. Electrical field strength

3.4. Potential Energy and Electrical Potential.
3.5. Gauss's Law. Applications.
3.6. Conductors and dielectrics.
3.7. Electric field in conductors.
3.8. Capacitors.

TOPIC 4. DIRECT CURRENT

4.1. Introduction.
4.2. Electric current. Current Intensity.
4.3 Ohm's Law. Electrical resistance.
4.4. Joule's Law.
4.5. Generators. Electromotive force.
4.6. Kirchhoff's Laws.

TOPIC 5. MAGNETIC FIELD

5.1. Introduction.
5.2. Magnetic field. Lorentz Force.
5.3. Force of a magnetic field on a current.
5.4. Sources of magnetic field.
5.5. Ampère's Law.
5.6. Magnetic force between conductors.
5.7. Magnetic field in material media. Magnets.

TOPIC 6. ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

6.1. Introduction.
6.2. Flow of a magnetic field.
6.3. Faraday and Lenz Laws.
6.4. Generation of alternating currents.
6.5. Self-induction.
6.6. Mutual induction.
6.7. Energy associated with a coil.
6.8. Transformers.

OPTICS

TOPIC 7. FUNDAMENTALS OF OPTICS

7.1. Introduction.
7.2. Nature of light. Electromagnetic spectrum.
7.3. Propagation of light.
7.4. Reflection and refraction.
7.5. Interference and diffraction.

8006 COMPUTER SCIENCE

Introduction to Computer science.
History and Basic Concepts.
Office Automation.
Word processing.
Spreadsheet.
Presentation.
Operating Systems.
Memory and Processes.
Management of Files and Users.
Introduction to Programming.
Basic concepts.
Programming.
Computer Networks.
Networks.
Internet.
Other applications.
Common applications on the course.

8007 MATHEMATICS II

Part I

1. Basic notions

Resolution of systems. Matrices and determinants. Inverse matrix and range.

2. Vector spaces and Euclidean vector spaces

Real vector space. Subspaces. Linear dependence and independence. Generating set, bases and dimension. Base change. Inner product. Standard and distance.
Angles and orthogonality. Base change matrix between ortho-normal bases in R2.

3. Linear applications and diagonalization

Concept and properties. Image and core. Associated matrix. Similarity of matrices.
Eigenvalues and Eigenvectors. Characteristic polynomial. Diagonalization.

Part II

4. Basic notions of differential equations

First definitions. General and particular solution.

Part III

5. Descriptive statistics

Statistical variable. Position and dispersion parameters. Linear regression.

6. Probability and Random Variables

Probability. Discrete and continuous random variables. Position and dispersion measurements. Probability distribution models.

7. Uncertainty environments

Statistical models. Decision making in uncertain environments.

8002 GENERAL CHEMISTRY

UNIT I: FUNDAMENTAL CHEMISTRY

Topic 1: Stoichiometry and chemical reactions

Composition of Matter. Atomic and molecular concepts. Language of
ways of expressing the concentration of dissolutions. Types of chemical reactions.
Balances and calculations in chemical reactions. Theoretical and experimental
Limiting reagent.

Topic 2: Dispersed systems: solutions and colloids

Nature and type of solutions. Colligative properties. Nature and type of
Properties of colloidal systems. Colloidal stability and coagulation.

Topic 3: Thermodynamics and chemical kinetics

Chemical applications of the 1st and 2nd principles of Thermodynamics. Chemical balance.
Equilibrium Displacement. Reaction Speed. Fuels.

UNIT II: EQUILIBRIUM IN AQUEOUS SOLUTION

Topic 4: Acid/Base, Precipitation and Complexation Balances

Acid/base equilibrium: strength of acids and bases; pH concept; pH calculation in
Dissolution/precipitation and complexing equilibria: product of
solubility, solubility modifications, complex stability.

Topic 5: Oxidation-reduction equilibria

Oxidation/reduction equilibria: galvanic and electrolytic cells; potential corrosion of materials
and protection methods.

UNIT III: APPLIED AND ENVIRONMENTAL CHEMISTRY

Topic 6: Macromolecules. Synthetic polymers

Basic concepts of Organic Chemistry. Most important organic compounds.
Concept and classification of synthetic polymers. Molecular structure and properties
of polymers. Condensing polymers. Copolymers.
Plastics and applications.

Topic 7: Environmental Chemistry

Water. Importance and properties. Composition of natural waters.
Water pollution and indicator parameters. Water treatment and quality criteria.
The air. Composition of the atmosphere. Pollution of the atmosphere and control. Climate
Air quality criteria.
Waste. Pollution by waste. Types of waste: characterization and treatment.

UNIVERSIDAD DE BURGOS

➢ 2nd year

8010 BIOCHEMISTRY

UNIT I: INTRODUCTION

1. OBJECTIVES AND COMPETENCES

1. Goals. 2. Contents of the subject. 3. Competences to be acquired by the
4. Training activities and teaching methodology. 5. Evaluation
6. Source of bibliographic information and Internet resources.

2. INTRODUCTION TO BIOCHEMISTRY

1. Concept and objectives of Biochemistry. 2. Biomolecules: structure-function relationship.
3. Weak interactions in aquatic medium and their importance in biological systems.

UNIT II: BIOMOLECULES

3. GLUCIDES

1. Concept and classification. 2. Monosaccharides. 3. Disaccharides. 4. Polysaccharides. 5. Glyco-conjugates: proteoglycans, glycoproteins and glycolipids. 6. Carbohydrates as information-carrying molecules.

4. LIMPS

1. Concept and classification. 2. Fatty acids. 3. Tricylglycerols. 4. Waxes. 5. Glycerophospholipids. 6. Sphingolipids. 7. Eicosanoids. 8. Steroids. 9. Terpenes. 10. Liposoluble vitamins.

5. PROTEINS

1. Functions and biological importance of proteins. 2. Amino acids. 3. Link
4. Structure and conformation of proteins. Denaturation
5. Fibrous and globular proteins.

6. ENZYMES

1. Function and general characteristics of enzymes. 2. Mode of action of enzymes

3. Kinetics of enzymatic reactions. 4. Regulatory enzymes. 5. Enzymes of interest in the agroalimentary industry.

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
11. Ascorbic acid. 12. Vitamin A. 13. Vitamin D. 14. Vitamin E. 15. Vitamin K.

8. NUCLEIC ACIDS

1. Classification and biological function of nucleic acids. 2. Structure and organization of deoxyribonucleic acid. 3. Ribonucleic acid. 3.1. Structure, organization of types of ribonucleic acids. 4. Genetic manipulation and new biotechnological products.

UNIT III: BIOENERGETICS AND METABOLISM

9. INTRODUCTION TO METABOLISM

1. General concepts of metabolism. 2. Principles of bioenergetics. 3. Types of metabolic routes. 4. Role of ATP as metabolic intermediary. 5. Differences between NADH and NADPH. 6. Regulation of the metabolism.

10. GLYCOLYSIS AND GLUCONEOGENESIS

1. Overview of glycolysis. Location and energy yield. 2. Phases and reactions of glycolysis
3. Synthesis of 2.3-bisphosphoglycerate 4. Aerobic and anaerobic glycolysis
5. Regulation of glycolysis. 6. Overview of gluconeogenesis. 7.
Precursors of the route. Reactions of gluconeogenesis. 8. Coordinated regulation of glycolysis and gluconeogenesis. Futile cycles.

11. CITRIC ACID CYCLE

1. Oxidative decarboxylation of pyruvate. Pyruvate dehydrogenase complex
2. Overview of the citric acid cycle. Cell localization. Action coupled with the respiratory chain.
3. Cycle reactions. The cycle as a source of biosynthetic precursors. Anaplerotic routes
4. Regulation of the pyruvate dehydrogenase complex and the citric acid cycle.
5. The glyoxylate cycle.

12. OXIDATIVE PHOSPHORYLATION

1. Overview. 2. Electron transport enzymatic complexes. 3. Proton motor force and synthesis of ATP. 4. Shuttles of glycerol-3-phosphate and malateaspartate.
5. Regulation of oxidative phosphorylation.

13. PENTOSE PHOSPHATE PATHWAY

1. Overview, function and location of the route. 2. Reactions and relationship with other metabolic pathways. 3. Pathway regulation.

14. METABOLISM OF GLYCOGEN

1. Glycogen as a storage polysaccharide and source of glucose. 2.
Glycogen degradation. 3. Synthesis of glycogen. 4. Coordinated regulation of
glycogen phosphorylase and glycogen synthase.

15. METABOLISM OF FATTY ACIDS AND LIPIDS

1. Overview. Triacylglycerides as energy deposits. Digestion and absorption
1.3. Transport of lipids. Lipoproteins. 2. Activation of fatty acids and transport to the interior of the mitochondria. Degradation β-oxidative of fatty 4. Formation of ketone bodies. 5. Pathway regulation.

16. CATABOLISM OF AMINO ACIDS AND UREA CYCLE

1. Degradation of dietary proteins into amino acids. 2. Reactions of transamination and deamination. 3. Transport of ammonia. 4. Urea cycle. 5. Degradation of the carbon skeletons of amino acids.

17. PHOTOSYNTHESIS

1. Overview of photosynthesis. 2. Light reactions. Photosystems. Electronic flux. 3. The Calvin cycle. CO_2 fixation and sugar production. 4. Cycle regulation.

8011 ELECTROTECHNICS

UNIT 1: ELECTRICAL CIRCUITS
TOPIC 1: ELECTRICAL CIRCUIT THEORY.
TOPIC 2: ALTERNATING CURRENT CIRCUITS.
TOPIC 3: THREE-PHASE CIRCUITS.

UNIT 2: ELECTRICAL MACHINES
TOPIC 4: GENERAL PRINCIPLES OF ELECTRICAL MACHINES.
TOPIC 5: TRANSFORMERS.
TOPIC 6: ASYNCHRONOUS OR INDUCTION MACHINES.
TOPIC 7: ASYNCHRONOUS MACHINES.
TOPIC 8: DIRECT CURRENT MACHINES.

UNIT 3: ELECTRICAL INSTALLATIONS
TOPIC 9: ELECTRIC ENERGY SYSTEMS.
TOPIC 10: ELECTRICAL TECHNOLOGY.

UNIT 4: LABORATORY PRACTICES
PRACTICE 1: NOTIONS OF ELECTROMETRY.
PRACTICE 2: ELECTRICAL ELEMENTS.
PRACTICE 3: MEASUREMENT OF CURRENT, VOLTAGE AND POWER.
PRACTICE 4: CHECKING LAWS AND THEOREMS.
PRACTICE 5: ALTERNATING CURRENT CIRCUITS.
PRACTICE 6: THREE-PHASE CIRCUITS.
PRACTICE 7: TRANSFORMERS.
PRACTICE 8: ASYNCHRONOUS OR INDUCTION MACHINES.
PRACTICE 9: DIRECT CURRENT MACHINES.
PRACTICE 10: ELECTRICAL TECHNOLOGY.

8012 GRAPHIC EXPRESSION

Initiation to graphic expression.
Technical drawing.
System of dimensioned drawings.
Computer resources.

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8013 AGROALIMENTARY MICROBIOLOGY

I. Introduction of Agroalimentary Microbiology

Topic 1: Introduction. Historical evolution. Importance of microbiology in the agroalimentary sector

Concepts of Microbiology and microorganism. Discovery of the
Invention of the microscope. Controversy over spontaneous generation.
Role of microorganisms in food. Importance of present-day microbiology and its relation with other sciences. Groups of microorganisms and their distribution in nature.

II. Role of microorganisms in food.

Topic 2: Food Bacteriology (I)

Presence of bacteria in food: morphological and physiological characteristics.
Main genera of agroalimentary bacteria. Most important bacterial groups that contaminate food.
Bacterial Systematics. Bergey's Manual.

Topic 3: Bacteriology of food (II): agroalimentary applications.

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

Topic 4: Mycology of foods. Moulds and yeasts

Main genera and species of moulds and yeasts: morphological and physiological character.
Culture media and isolation. Main types of moulds that contaminate food.
Main genera and species of moulds and yeasts: morphological and physiological.
Culture media and isolation.

Topic 5: Virology of foods

General information on viruses, viroids and prions in food. Most important viruses.

Topic 6: Introduction to Food Parasitology

General characteristics of the Protozoa and Helminths. Taxonomic classification.
Most important genus/species.

III. Factors affecting the survival and multiplication of microorganisms

Topic 7: Intrinsic factors (I): Water activity

Introduction. Effects of water activity on microorganisms. Use of
reduced water activities for the control of microorganisms in food.
Interactions between water activity and other factors.

Topic 8: Intrinsic factors (II): Oxide-reduction potential
Introduction. Effect of the oxide-reduction potential on the growth of aerobic and anaerobic microorganisms. Potential of O/R in the different foods.

Topic 9: Intrinsic factors (III): Acidity and pH
Introduction. Effects of pH on the growth of microorganisms. Effects of pH on altered microorganisms and pathogens. Use of acidity and lowering of pH for the control of microorganisms in food.

Topic 10: Intrinsic factors (IV): Nutrients, natural antimicrobial constituents and biological structures.
Nutrient content in food and its relationship to microbial growth.
Natural antimicrobial substances in food. Biological structures and their action against microorganisms.

Topic 11: Extrinsic factors: Growth temperature - Relative humidity
Modified atmosphere.
Introduction. Effects of low temperatures on the growth rate of the
Main microbial types dependent on the conservation temperature.
Effects of refrigeration and freezing temperatures for the control of altered microorganisms and pathogens.
Environmental relative humidity.
Modified atmospheres. Use of modified atmospheres in the inhibition of microorganisms.
Main gas mixtures used.

Topic 12. Factors dependent on technological treatments (I): Use of high temperatures in the inhibition of microorganisms. Sterilization and pasteurization. High pressures.
Introduction. Effects of high temperatures on microorganisms. Conserves and semiconserves.
Control measures. Effects of high pressures on inhibition of altered microorganisms and pathogens.

Topic 13: Factors dependent on technological treatments (II): ultraviolet radiation
Chemical preservatives with antimicrobial activity. Introduction. Effects of ultraviolet light on microorganisms. Effects and interactions. Main chemical agents and their salts used for the control of microorganisms in foods. Indirect antimicrobial agents. Organic Acids.
Antibiotics. Lactic antagonism. Antifungal agents.

IV. Introduction to foodborne pathogenic microorganisms transmitted by foods.
Topic 14: Pathogenic microorganisms (I): Agents responsible for food poisoning
Botulism: Clostridium botulinum and its toxins, clinical symptoms, control and prevention. Staphylococcal poisoning: Staphylococcus aureus and staphylococcal enterotoxins, clinical symptoms, control and prevention.
Clostridium perfringens, toxins, clinical symptoms, control and prevention.
Bacillus cereus, toxins, clinical symptoms, control and prevention.

Topic 15: Pathogenic microorganisms (II): Bacteria responsible for food poisoning

Campylobacteriosis. Genus Campylobacter, growth factors, clinical symptoms, control and prevention.

Salmonellosis: Genus Salmonella, biological factors, clinical symptoms, control and prevention.

Shigelosis: Genus Shigella, biological factors, clinical symptoms, control and prevention.

Escherichia coli enteropathogenic, enteroinvasive and enterohaemorrhagic, clinical symptoms, control and prevention.

Vibrio parahaemolyticus, growth factors, clinical symptoms, control and prevention.

Yersiniosis: Yersinia enterocolitica, growth factors, clinical symptoms, control and prevention.

Listeriosis: Listeria monocytogenes, growth factors, clinical symptoms, control and prevention.

Topic 16: Mycotoxin producing moulds

Introduction. Main genera and species of moulds producing mycotoxins in food.

V. Microbial changes in food

Topic 17: Meat and meat products.

Introduction. Initial contaminating microbiota. Contamination in primary processing. Development of microorganisms in chilled raw meat. Types of altered microorganisms in fresh meat packaged under vacuum and in a modified atmosphere. Raw-cured products. Meat products treated by heat.

Topic 18: Alteration of fish and shellfish

Introduction. Initial contaminating microbiota and its origin. Contamination in primary processing. Development of altered microorganisms in raw fish. Type of alteration they produce.

Topic 19: Alteration of raw milk and dairy products

Type of microorganisms that contaminate raw milk and dairy products.

Origin of the contaminating microbiota. Factors influencing the growth of these

Type of alterations they produce.

Topic 20: Eggs and egg products

Introduction. Initial microbiota. Contamination in whole eggs. Development and type of microorganisms. Alterations that are produced in egg products.

Topic 21: Cereals and their derived products
Introduction. Origin of microorganisms. Initial microbiota. Altered microorganisms and pathogens.
Collection, transport and storage. Flours and dry mixtures. Bread doughs. Cakes.

Topic 22- Spices
Introduction. Origin of the microorganisms producing their alteration. Initial microbiota.
Altered microorganisms and pathogens.

VI. Microbiological quality assurance
Topic 23- Fundamentals of microbiological analysis
Sampling and analysis of products. Reference values. Prevention of contamination.
Analysis of final products.

Topic 24: Functions of the microbiological laboratory
Verification of appropriate technological treatments: heat treatments, lethalness, reference values.
Sterilization. Sterilization controls: expendable material and culture broths.
Microbiological verification of the cleanliness and disinfection. Microbiological analysis of drinking water.

Topic 25- Analysis of critical points and their control
Definition of the system. Identification and control of critical points. Flow Diagram.
Benefits of its implantation. Practical application. Practices of Agroalimentary Microbiology.
Preparation of mediums and growth of bacteria in culture.
Staining of microorganisms and microscopic visualization.
Identification and characterization of fecal stroptococci.
Presence- absence of Staphylococcus aureus.
Count and characterization of Total Mesophilic Areobios.
Determination of Enterobacteria.
Determination of positive Lactose Enterobacteria (coliforms).
Counting of moulds and yeasts.

8014 ANIMAL PRODUCTION

Module I: Introduction and Immersion in Animal Production
Topic 1
Presentation of the subject Animal production: Concept, objectives, teaching team,
theoretical and practical program, evaluation of learning, evaluation of teaching, teaching material etc.
Graphic image of the contents of the course.
Topic 2
Justification and future challenges of animal production systems in their geographical
Environment.

Module II: Morpho-functional bases of animal production

Topic 3

External morphology and animal identification.

Topic 4

Anatomo-physiological bases of growth and development, digestion and reproduction.

Methods to improve reproductive efficiency.

Topic 5

Anatomical-physiological bases of milk production.

Module III: Basis of feeding, food and rationing

Topic 6

Chemical-bromatological composition. Digestibility. Use of energy and energy valuation systems.

Topic 7

Protein utilization and protein titration systems

Topic 8

Ingestion and intake assessment systems

Topic 9

Food: concentrates, grasses and fodder, by-products and feed. Nutrient and non-nutrient additives.

Module IV: Genetic improvement

Topic 10

Fundamentals of animal breeding.

Topic 11

Selection. Crossbreeding. Programs for the improvement of the main domestic species.

Topic 12

Biotechnology applications. Advanced techniques and the future of MGA

Module V: Production Systems and Animal Products

Topic 13

Characterization of extensive vs. intensive exploitation

Topic 14

Ruminant animals: Beef, dairy and ovine/caprine production

Topic 15

Monogastric animals: Porcine production

Topic 16

Monogastric animals: Production of hens and chickens.

Topic 17

Other animals: Production of rabbits, quails, partridges, ostriches.

Module VI: Safety in the livestock production chain

Topic 18

Animal Production and European Food Safety Policy.

Topic 19

Hygiene in livestock farms.

Topic 20

Health on livestock farms. Animal welfare.

Topic 21

Animal Production and Environment.

8015 MATERIALS ELASTICITY AND RESISTANCE

Chapter 1: Introduction.

1.1. Elasticity and Strength of Materials.
1.1.1. Objective of these disciplines.
1.1.2. Study Model: the deformable solid.
1.1.3. Fundamental hypotheses.
1.2. Review: concepts of Static.
1.2.1. Conditions of Equilibrium.
1.2.2. Degrees of freedom of a system.
1.2.3. Coercions.
1.2.4. Degree of external and internal indeterminate static.
1.2.5 Degree of total indeterminate static.
1.3. Review: Surface Properties.
1.3.1. Geometric centre and static momentum.
1.3.2. Moments and products of surface inertia.
1.3.3. Steiner's Theorem.
1.3.4. Main axes of inertia.

Chapter 2: Stress Analysis.

2.1. State of stress at a point.
2.1.1. Concept of stress: normal and tangential components.

2.1.2. Elementary Parallelepiped Equilibrium.
2.1.3. Stress Tensor.
2.2. Stresses and main directions.
2.2.1. Main stresses.
2.2.2. Main Directions.
2.3. Mohr's Circumferences.
2.3.1. Representation of stresses on planes parallel to a major axis.
2.3.2. Representation of stresses on any given plane.

Chapter 3: Analysis of deformations.

3.1. State of deformations at a point.

3.1.1. Concept of stress: longitudinal and transversal components
3.1.2. Deformation of the elementary parallelepiped.
3.1.3. Deformation Tensors.
3.2. Deformations and main directions.
3.2.1. Main deformations.
3.2.2. Main Directions.
3.3. Mohr's Circumferences.
3.3.1. Representation of deformations in perpendicular directions to a main axis.
3.3.2. Representation of deformations in any given direction.
3.4. Variations of length, area and volume.
3.4.1. Variations of length.
3.4.2. Area Variations.
3.4.3. Variations in volume.
3.4.4. Thermal expansion.

Chapter 4: The Elastic Problem.
4.1. Behaviour of materials.
4.1.1. The traction test.
4.1.2. Ductile and fragile materials.
4.1.3. Linear elastic behaviour: Hooke's Law.
4.1.4. Relationship between E, v and G.
4.1.5. Lamé Coefficients.
4.2. Design Conditions.
4.2.1. Design of components.
4.2.2. Safety and weighting coefficients.
4.2.3. Equivalent voltage.
4.2.4. Von Mises Criterion for Ductile Materials.
4.2.5. Mohr Criterion for Fragile Materials.
4.3 The Elastic Problem in Bars.
4.3.1. The Elastic Problem.
4.3.2. The Bar Element.
4.3.3. System of Coordinated Axes in a section.
4.3.4. Transversal section requirements.
4.3.5. Equilibrium of a slice.
4.3.6. Stress diagrams.
4.4. Bar Structures.
4.4.1. Bar Structure Analysis.
4.4.2. Symmetry and antisymmetry.

Chapter 5: Traction/Compression.
5.1. Solution of the Elastic Problem in Traction or Compression.
5.1.1. Bernoulli's Hypothesis.

5.1.2. Stresses.
5.1.3. Deformations.
5.2. Calculation of articulated structures.
5.2.1. Articulated Structures.
5.2.2. Resolution of Isostatic Structures.
5.2.3. Resolution of statically indeterminate Structures.
5.3. Calculation of tanks and rings under pressure.
5.3.1. Tanks.
5.3.2. Rings.

Chapter 6: Shearing.
6.1. Solution of the Elastic Problem in Shearing.
6.1.1. Simplifying Hypotheses
6.1.2. Stresses.
6.1.3. Deformations.
6.2. Bolted joints.
6.2.1. Behaviour of the shear joint.
6.2.2. Distribution of a centred shear load.
6.2.3. Distribution of an eccentric shear load.
6.3. Welded joints.
6.3.1. Welding behaviour.
6.3.2. Stresses due to a centred shear load.
6.3.3. Stresses due to an eccentric shear load.

Chapter 7: Pure, simple, and complex Bending.
7.1. Solution of the Elastic Problem in Pure bending.
7.1.1. Navier-Bernoulli Hypothesis.
7.1.2. Stresses: Navier's law.
7.1.3. Deformations: Elastic Equation.
7.2. Simple Bending
7.2.1. Stresses and deformations in Simple bending.
7.3. Complex Bending.

7.3.1. Complex Bending Stresses and deformations.

Chapter 8: Calculation of deformation in bending.
8.1. Methods of Calculation.
8.1.1. Double Integration Method.
8.1.2. Mohr's Theorems.
8.2. Indeterminate static in Bending.
8.2.1. Resolution of statically indeterminate bending.
8.2.2. Continuous Beams.

8.2.3. Gerber Beams.

Chapter 9: Bending instability: Buckling.
9.1. Introduction.
9.1.1. System Stability and Instability.
9.1.2. Instability of a Bar from Bending.
9.1.3. Linear and non-linear elastic buckling.
9.2. Linear elastic buckling.
9.2.1. Euler's Formula.
9.2.2. Influence of Links.
9.2.3. Slenderness Limit.
9.3. Non-Linear Elastic Buckling.
9.3.1. Tetmajer's Formula.

Chapter 10: Torsion.
10.1. Solution of the Elastic Problem in Circular Section Bar Torsion.
10.1.1. Coulomb Hypothesis.
10.1.2. Stresses.
10.1.3. Deformations.
10.2. Uniform Torsion in Non-circular Sections.
10.2.1. Membrane Analogy.
10.2.2. Elliptical, Equilateral, Triangular and Rectangular Sections.
10.2.3. Thin open sections.
10.2.4. Thin closed sections.

8016 BUSINESS ECONOMICS II

VALUATION
1.- ECONOMIC-FINANCIAL ANALYSIS
1.1.- Introduction.
1.2.- Methods to carry out the Economic-Financial analysis.
1.3.- Method of ratios.
1.4.- Types of effect analysis
1.5.- Methodology for a study by ratios.
1.6.- Plan of ratios for the analysis of a company.

2.- VALUATION I.
2.1.- Concept and purposes of valuation.
2.2.- Valuation of assets.

3.- VALUATION II.

3.1.- Valuation of companies.

3.2.- Valuation of damages.

COMMERCIALIZATION

4.- THE COMMERCIAL ANALYSIS

4.1.- The market and the environment.

4.2.- Demand.

4.3.- Market segmentation.

4.4.- Behaviour of the consumer.

4.5.- Buying behaviour of organizations.

4.6.- The information system and commercial research.

5.- COMMERCIALIZATION OF AGRICULTURAL PRODUCTS

5.1.- Introduction.

5.2.- Agents and marketing channels.

5.3.- Group actions.

5.4.- Forms of buying and selling.

5.5.- Recruitment centres.

5.6.- Consumer and production markets.

5.7.- Standardization of agricultural products.

5.8.- Law 12/2013 on measures to improve the functioning of the food chain.

8017 PHYTOTECHNY

Part I. CROPS, GENERAL PRODUCTION TECHNIQUES

INTRODUCTION TO AGRICULTURAL SYSTEMS

Concepts. Spanish agriculture: historical background, current social situation, policy, land distribution, types of agricultural exploitations, means of production and marketing. Classification of crops. Decision making in agriculture.

ALTERNATIVES AND CROP ROTATIONS

Concepts. Interest. Type. Establishment. Representation. Alternatives typical of Spanish agriculture. Cultivation systems: monoculture, multiple cultivation, mixed cultivation or polyculture, agroforestry systems.

SOWING AND PLANTING

Soil preparation. Realization: Season. Material. Density of sowing. Amount of seed. Sowing methods. Transplantation. Factors affecting crop emergence.

CULTIVATION TASKS AND OPERATIONS

Ground work. Tillage action. Objectives of tillage. Sowing time. Main preparation work: subsoil, breakup. Complementary tasks: straw harrowing, tine harrowing, chain harrowing, levelling, rolling. Implements. Modern techniques: reduced tillage, conservation tillage.
Cultivation tasks: harrowing, cultivator, weeding, rolling, coarse harrowing, blanching, water channels. Irrigation, cover fertilization. Herbicide treatments. Cultivation operations: thinning, grafting, pruning, trimming, blanching, defoliation, phytosanitary treatments.

TREATMENT AGAINST WEEDS

Nature of the damage: phenomena of competition. Relationship between weeds and pests and diseases. Difficulties in carrying out tasks. Influence on final crop results. Classification of weeds by their behaviour against herbicides. Weed control: steps, means mechanical and chemical weeding, economic thresholds. Application of herbicides.

HARVESTING AND CONSERVATION OF PRODUCTIONS

Species cultivated for their grains. Winter cereal harvest, summer cereals, grain legumes, sunflower. Processing of grains: pre-cleaning, drying, cleaning. Storage. Underground crops (beet and potato). Harvesting and conservation. Green fodder. Harvesting. Haymaking. Silage. Dehydration.

Part 2. CLIMATIC FACTORS IN PLANT PRODUCTION

INFLUENCE OF TEMPERATURE ON CROPS

Action on some phases and functions of the plant: germination. Transpiration.
Breathing. Photosynthesis. Net assimilation. Thermal integrals, calculation methods. The cold stimulator: action of thermoperiodism, interruption of fatigue. Vernalization.

ACTION OF UNFAVOURABLE TEMPERATURES. HEAT STROKE

Action of high temperatures on plants. Resistance to heat. The frosts in agriculture.
Resistance to cold. Types of frost.

PROTECTION OF CROPS AGAINST UNFAVOURABLE TEMPERATURES

Protection against high temperatures. Indirect methods: choice of sowing period, resistant species and varieties, cultivation work. Indirect Methods: shading, irrigation, greenhouses. Methods of protection against frost. Indirect Methods Direct methods: heating, dry heat, humid heat. Screens in the atmosphere. Agitation of the atmosphere. Biochemical methods. Roof protectors.

SOLAR RADIATION

Nature. Energy value. Energy balance of biomass. Luminous radiation. Duration of lighting.
Photojournalism. Intensity of lighting. Nature of luminous radiation. Interaction between available water,

light and temperature. Influence of lighting on the absorption of mineral elements. Possible influence of lunar phases on plant development.

ACTION OF ATMOSPHERIC COMPONENTS

Composition of the atmosphere and its influence on crops. Carbonic fertilization in Artificial atmospheres, advancement of phases of development, conservation of Forced cultivation.

THE WIND

Interest of the defence against the wind. Actions of the wind. Windbreakers: characteristics Wind speed and turbulence in the protected area. Microclimate in the protected area: radiation balance, air temperature, humidity, CO2 concentration, evapotranspiration, photosynthesis and water use efficiency.

ANALYSIS OF CLIMATE IN RELATION TO CROPS

The agricultural climate. Climographs. Thermopluviometric indices. Climatic classification of Thornthawaite. Bioclimatic classification of the F.A.O. Agroecological classification of Papadakis.

Part 3. THE SOIL IN PLANT PRODUCTION

TILLAGE AND SOIL CONSERVATION

Compaction and working ground. Erosion. Soil maintenance systems in fruit plantations.

SOIL MOISTURE CONTROL. IRRIGATION PARAMETERS

Forms of water in the soil. Moisture content. Water usable by plants.
Water profile. Humidity diagrams. Relationship between soil moisture and crop yields.
Irrigation parameters. Water demand of crops. Determination of the necessary irrigation water. Provision and frequency of irrigation. Duration of irrigation. Irrigation day. Characteristic flows. Irrigation modules. Irrigation programming. Deficit irrigation.

QUALITY OF WATER USED IN IRRIGATION

Origin of the irrigation water. Effect produced by the salts in dissolution of irrigation water.
Salinization. Alkalinisation. Phytotoxicity. Criteria to characterize the quality of water used in irrigation.
Use of saline water. Measures to avoid ground salinization and alkalinisation.

CONTROL OF ORGANIC MATTER IN CULTIVATED SOILS

Soil organic matter. Humification of organic waste. C/N ratio, agricultural interest. Balance of organic matter in cultivated soils. Calculations of organic fertilizers: manure and by-products, crop residues, peat and garbage.

CORRECTION OF ACID SOILS. LIMESTONE AMENDMENTS
Current acidity and potential acidity. Influence of soil acidity on crops. Correction of acidity. Determination of lime requirements. Products used with lime amendments. Incorporation of the soil amendment.

REHABILITATION OF SALINE AND SODIUM SOILS.
Classification of saline soils and characterization. Ground rehabilitation. Phytotechnical solution.

Part 4. CROP PROTECTION
AGENTS HARMFUL TO CROPS
Arthropods; mites; fungi; viruses; bacteria; nematodes. Systematic position. Characteristics and main groups. Diagnosis and detection methods.

NON-PARASITIC DISEASES
Physical and meteorological causes. Unfavourable soil causes. Deficiency diseases. Poisons and burns.

CONTROL OF PLAGUES AND DISEASES
Physical methods. Chemical methods. Phytosanitary products: practice of their use, toxicology, persistence, residues, phytotoxicity, mixtures, resistance, classification, characteristics. Cultural practices. Resistant varieties. Biological control. Integrated control.

MAIN PESTS AND DISEASES
Extensive crops, solanaceae, vines; fruit trees; grain legumes; and fodder crops; horticultural crops; greenhouses; industrial plants and other plants of interest.

8018 HYDRAULICS

1.- Introduction. Properties of fluids.
1.- Introduction.
2.-Properties of the fluids.
3.- Pressure.

2.- Hydrostatics and fluid kinematics.
4.- Fundamental hydrostatic equation.
5.- Pressures of a liquid on different surfaces.
6. Basic concepts of kinematics.
7. Equations of continuity, energy and amount of motion.

3.- Flow in pipes.

8.- Laminar and turbulent movements. Permanent and uniform movements.

9.- Continuous load losses and localized load losses.

10.- Piping systems in hydraulic systems.

4.- Free-flow regime. Channels.

11.- Basic concepts of the free-flow regime.

12.- Uniform, varied and variable movements in channels.

13. Hydraulic systems.

5. Irrigation hydraulics.

14. Irrigation. Basic issues

15. Irrigation systems. Channels. Pressure pipes. Pumps.

6. Legal and administrative issues of water in irrigation.

16. Legal issues.

17. Administrative matters.

8019 AGROALIMENTARY ANALYSIS METHODS

Classical Analysis

Topic 1.- Introduction to Analytical Chemistry

General process of analysis.

Classification of methods of analysis.

Topic 2.- Volumetric methods

Fundamentals of volumetric analysis.

Acid base volumetries.

Compound forming volumetries.

Redox volumetries.

Precipitation valuations.

Instrumental Analysis.

Topic 3.- Optical methods of analysis

Nature of electromagnetic radiation.

Interaction of electromagnetic radiation with material systems.

Topic 4.- Molecular absorption techniques

Absorption in UV-visible.

Infrared Absorption.

Topic 5.- Molecular Emission Techniques

Fluorescence.

Phosphorescence

Topic 6.- Atomic absorption techniques
Atomization with flame.
Electrothermal atomization.
Topic 7.- Atomic emission techniques
Flame photometry.
Emission spectroscopy with ICP
Topic 8.- Electroanalytical techniques
Electrochemistry Concept
Electrode reaction and electrochemical cells
Classification and description of electroanalytical methods
Topic 9.- General information on separation techniques
Classification and basis of separation techniques
Topic 10.- Separations by extraction
Liquid-liquid extraction
Solid-liquid extraction
Item 11.- Chromatographic separation techniques
Gas Chromatography
High-performance liquid chromatography (HPLC)
Practical classes
Laboratory practices
During the practical sessions the student will use the most common advanced instrumental techniques in the Analytical Chemistry laboratory (absorption spectrophotometry molecular and atomic, flame photometry, potentiometry, voltammetry, gas chromatography, HPLC, etc.).

8020 AGRICULTURAL MACHINERY AND ENGINES

Power transmission in machines.
Basic concepts
- Mechanisms and machines.
- Work and mechanical energy.
- Mechanical power and performance.
- Rolling and lubrication systems.

Transmission by gears
- Toothed wheels.
- Gear trains and transmission ratio.
- Reducers, multipliers and gearboxes.
- Epicyclic (planetary) gear trains.

Flexible transmissions
- Belts.
- Chains.

- Clutches
- Hydrostatic transmission.

Tractor and combustion engines.

Diesel combustion engine-

- Fixed constituent elements.
- Moving elements. Drive mechanism.
- Power supply systems.
- Cooling system.
- Lubrication circuit.

Tractor machine

- The agricultural tractor.
- Chassis.
- Engine.
- Clutch.
- Gearbox.
- Differential and reducers.
- Power take-off.
- Hydraulic elevator
- Brakes.
- Steering.

Lifting, sowing and planting equipment

Tillage tools

- Objectives of tillage.
- Deep and coarse harrows.
- Mouldboard ploughs.
- Disc ploughs.
- Combined tools.
- Tillage performance and necessary power.

Openings for complementary work

- Cultivators.
- Harrow graders and spiked harrows.
- Rotavator.
- Stone remover.
- Furrow ridger.
- Rollers.

Sowing equipment

- Seeds and types of sowing.
- Types of seed drills.

Planters and transplanters

- Tuber planters.
- Transplanting machines.

Treatment and harvesting equipment

Equipment for fertilizer supply
- Types of fertilizer spreaders.
- Equipment for manure handling.
- Slurry distributors.

Plant protection equipment
- Sprayers.
- Atomizers.
- Sprinklers.
- Machines for soil treatment.

Forage harvesting machinery
- Mowers and conditioners.
- Windrowers.
- Grinders and silage machines.
- Packing machines.

Harvesting machines
- Cereal harvester.
- Cotton harvesters.
- Potato harvesters.
- Beet harvesters.

Machines for harvesting fruits and vegetables.
- Harvesting machines.
- Fruit harvesting platforms.
- Vegetable harvesters.

8021 TOPOGRAPHY

GENERAL CONCEPTS

Notions of Topography.
Notions of Geodesy.
Notions of Cartography.
Topographic concepts.
Measurement units and topographic representation systems.
Measurement units. Angles. Scales.
Representation systems.
Errors.
Topographic instruments.
Surveys. Topographic methods.
Altimetric methods.
Planimetric methods.
Topographic applications for engineering projects.
Plotting.

Notions on Geographical Information Systems and Remote Sensing.

8036 STATISTICS AND NUMERICAL CALCULUS

Statistics

Descriptive statistics.

Statistical description of a variable.

Probability and Random Variables.

Probability. Discrete random variables. Continuous random variables. Models of probability distributions.

Confidence Intervals

Random and Statistical Samples. Specific estimation. Estimation by intervals.

Hypothesis testing

Elements of a contrast. Contrasts for normal populations. Contrasts for proportions.

Numerical analysis

Introduction to Numerical Analysis

Origins and objectives of the numerical analysis. Necessity of numerical analysis in engineering. Errors. Operating cost and efficiency. Introduction to MATLAB.

Interpolation

Lagrange interpolation. Piecewise polynomial interpolation.

Quadrature and Numerical derivation

Introduction. Quadrature rules and degree of accuracy. Simple and complex quadrature rules. Obtaining and errors of Numerical derivation.

Non-linear equations and resolution of systems.

Introduction. Methods using intervals: Iterative methods. Introduction to resolution of systems.

Introduction to numerical integration of differential equations

➢ 3rd year

8023 DESIGN AND EXPERIMENTS

Unit 1: Fundamentals

Topic 1: Normal distribution.

Normal distribution Sampling Distributions. Central limit theorem.

Topic 2: Inference.

Punctual and interval estimation. Statistical hypothesis testing.

Unit 2: Analysis of variance

Topic 3: One Factor Model.

Approach of the model. Estimation of parameters. Analysis of variance.

Topic 4: Two-factor models

Factor and block model and two factor model with interaction: estimation of parameters and variance analysis.

8024 QUALITY MANAGEMENT IN AGROALIMENTARY INDUSTRIES

General concepts.
Introduction.
Quality.
Agroalimentary quality.
Quality concept.
Specific characteristics of food quality. Food quality along the food chain.
Quality management.
Basic fundamentals of quality management.
Quality assurance.
Principles of the ISO 9001:2015 standard.
Figures of quality of agroalimentary products.
National and community quality figures.
Food safety.
Introduction.
General concepts.
Food safety management I.
Prerequisite programs, traceability.
Food safety management II.
HACCP system. Integrated management systems (GlobalGap, BRC, IFS, ...).

8025 FOOD ENGINEERING

INTRODUCTION TO FOOD ENGINEERING AND BASIC OPERATIONS IN THE AGRIFOOD INDUSTRY

TOPIC 1. Introduction to the basic operations of agroalimentary engineering processes. Historical Development of Industrial Processes. Basic operations. Classification and description of basic operations. Stationary and non-stationary regimes. Intermittent and continuous operation. Basic operations based on the transport of material, energy and quantity of movement. Physical-mathematical fundamentals and calculation techniques.

TOPIC 2. Macroscopic balances of matter. Balance equations. Application of material balances: stationary and non-stationary states without generation. Systems with chemical reaction.

TOPIC 3. Macroscopic balances of energy
Expression of the total energy balance. Energy associated with mass. Energies in transition.
Total energy balance. Energy balances in nonreactive chemical systems and with chemical reaction.

TOPIC 4. Macroscopic balances of mechanical energy. Bernoulli's Equation. Circulation of fluids through pipes. Flow around submerged bodies. Basic operations based on fluid flow: Filtration, Sedimentation, Centrifugation and Fluidization.

TOPIC 5. Introduction to heat transfer. Basic operations based on heat exchange.
Heat transfer mechanisms. Heat conduction in simple geometric solids
Heat transfer by convection. Coefficient of heat transfer. Heat exchangers Evaporation.

TOPIC 6. Introduction to the transfer of matter. Basic operations based on the transfer of matter. Fundamentals of matter transfer. Matter transfer coefficients. Balance between phases. Distribution coefficients. Separation factor. Some basic operations: Distillation and rectification of binary mixtures. Extraction. Drying

PROCESS INSTRUMENTATION AND CONTROL
TOPIC 7. Introduction to process instrumentation and control.
Definitions in control. Types of instruments. Identification code of instruments: diagrams P&I. The control loop. Measurement instruments. Transmitters. Final control elements. Controllers.

TOPIC 8. Measurement instruments.
Pressure gauges. Flow meters. Level meters. Temperature gauges. Tables of characteristics and selection parameters. Other Variables.

TOPIC 9. Final control elements. Control valves. Electronic end elements. Other final control Elements.

TOPIC 10. Applications in the Agroalimentary Industry.

8026 AGROALIMENTARY INDUSTRIES LOGISTICS

I.- CLASSIC MANAGEMENT MODELS
1.- Linear Programming.
1.1.- Introduction.
1.2.- Mathematical approach.
1.3.- Resolution methods.
1.4.- Application to the transport model.
1.5.- Application to distribution models.
2.- Stock Management Models.
2.1.- Introduction.
2.2.- Deterministic dynamic models.

2.3.- Probabilistic dynamic models.

3.- Quality control.

3.1.- Introduction.

3.2.- Process control.

3.3.- Acceptance control.

4.- Programming and Project Control.

4.1.- Basic concepts of the PERT method.

4.2.- The PERT algorithm.

II.- APPROACHES AND TECHNIQUES FOR OPERATIONAL PLANNING

5.- Material Requirements Planning (MRP).

5.1.- Introduction.

5.2.- Basic scheme and fundamental entries of the original MRP.

5.3.- Outputs of the original MRP system.

5.4.- The evolved MRP system.

6.- The JIT (Just in Time)

6.1.- Objectives and elements.

6.2.- Execution and control: The Kanban system.

6.3.- Reduction of preparation times (SMED system) and manufacturing times.

6.4.- Standardization of operations.

6.5.- Adaptation to demand through flexibility: Shojinka.

6.6.- Other aspects of interest.

8027 AGRICULTURAL CHEMISTRY

AGRICULTURAL CHEMISTRY THEORY

TOPIC 1. HISTORY OF AGRICULTURAL CHEMISTRY

Concept of Agricultural Chemistry. Historical foundations of agricultural chemistry.
Relationship of Agricultural Chemistry with other sciences.

TOPIC 2. SOIL FERTILITY

Concept of fertility and productivity. Natural and acquired fertility. Edaphic characteristics that influence the fertility of the soil.

TOPIC 3. DIAGNOSTIC METHODS

Diagnosis of the nutritional potential of edaphic agricultural systems. General methods of analysis and evaluation.
Diagnosis of available elements. Official MAPA methods.
Qualitative methods. Foliar analysis. Sap analysis. Biochemical diagnosis.

TOPIC 4. ESSENTIAL NUTRIENTS FOR PLANTS

Essential nutrients for plants

TOPIC 5. FERTILIZERS

Fertilizers. Basis and classification. Origin and manufacture. Classification.
Fundamentals and optimal selection.

TOPIC 6. NITROGEN

Nitrogen. Cycle. Distribution. Forms in the soil. Profit and loss.
Mineralization. Immobilization. Impact on health and the environment.
Functions in the plant. Deficiency symptoms. Nitrogen fertilizers.

TOPIC 7. PHOSPHORUS

Phosphorus. Cycle. Forms and dynamics. Distribution. Relationship with soil development.
Functions in plants. Deficiency symptoms. Phosphate fertilizers. Origin and manufacture.
Classification. Fundamentals and optimal selection.

TOPIC 8. POTASSIUM

Potassium. Cycle. Forms and dynamics. Distribution Functions in plants.
Deficiency symptoms. Potassium fertilizers. Origin and manufacture. Classification.

TOPIC 9. CALCIUM, MAGNESIUM AND SULPHUR

Calcium, magnesium and sulphur. Sources. Forms. Cycle. Dynamics. Functions in
Plants. Deficiency symptoms. Magnesium, calcium, and sulphated fertilizers. Origin and
Manufacture. Classification. Fundamentals.

TOPIC 10. TRACE ELEMENTS

Trace elements. Cycle. Source of trace elements in the soil. Forms. Needs in plants.
Causes of trace element deficiencies. Functions in plants. Deficiency symptoms. Trace element fertilizers.
Classification. Basis.

PRACTICES and WORK EXHIBITION

LABORATORY PRACTICES

The overall objectives of the practices are so that the student can apply the knowledge acquired in theoretical classes. Attendance at practical classes is obligatory.
At the end of the course, the students will present the practice notebook to be reviewed by the teacher.
EXHIBITION OF PROJECTS
The student will develop a project from among one of various ones that the teacher proposes.

8028 TECHNOLOGY OF STRUCTURES

MATERIAL STRENGTH

introduction to the strength of materials.
Steel and Concrete stress-strain diagrams.
Types of supports, unions. Isostatic and hyperstatic structures.
Types of stress. Strain in a section. Hypothesis calculation.
Articulated Structures. Method of joints.
Turns and Arrows in isostatic elements. Mohr's Theorems.

MATERIALS
Steel.
Types of steel.
Characteristics and Properties of Steel.
Typical usage of steel.
Advantages and disadvantages.
Concrete.
Types of Concrete.
Characteristics and Properties of Concrete.
Typical usage of concrete.
Advantages and disadvantages.
Precast Concrete.

ACTIONS IN BUILDING
Actions in Building.

CTE-DB-SE-AE
Classification of actions.
Calculation of actions.

DESIGN AND CALCULATION OF STRUCTURES
Metallic structures
CTE-DB-SE-A.
Steel limit states.
Calculation bases.
Concrete structures
Reinforced concrete.
EHE-08.
Limit states of concrete.
Basis of calculations.
Concrete durability. Control.
Foundations
Typology of foundations.
Checks to be carried out.
Applicable Regulations.
Calculation procedure.

8029 AUTOMATISMS AND INDUSTRIAL CONTROL

Automation and Industrial Control
1. Introduction to Automatisms and Industrial Control.

2. Electrical Automatisms.
3. Pneumatic Automatisms.
4. Electro-Pneumatic Automatisms.
5. Hydraulic Automatisms.
6. Control with industrial programmable controllers (PLCs).

8030 FOOD COMPOSITION.

I. GENERAL PRINCIPLES.

Topic 1. Introduction

Concept of Bromatology. Historical evolution of food. Development of the food sciences.

Topic 2. Food components

Nutrients: Concept and properties. Immediate principles of bromatological interest. Carbohydrates. Proteins. Fat. Mineral elements. Vitamins. Functions, properties, classification.

Topic 3. Food analysis

Objective. General information on food analysis. Fundamentals of the techniques applied to food analysis.

II. DESCRIPTIVE OF FOODS

Topic 4. Spanish Food Code

Definition. Purpose. Classification of foods. Other food legislation.

Topic 5. Meat and meat derivatives

Definition. Classification. Composition of meat. Nutritional value. Meat derivatives.

Topic 6. Fishery and aquaculture products

Definition. Classification. Composition of fish and shellfish. Nutritional value. Derivatives.

Topic 7. Eggs and derivatives

Definition. Structure of the egg. Quality Classification. Derivatives of the eggs. Composition. Nutritional value.

Topic 8. Milks and dairy products

Definition. Types of milk. Composition. Nutritional value. Milk derivatives.

Topic 9. Fats and oils

Definition. Classification. Animal fats. Vegetable fats. Hydrogenated and transesterified fats. Fat substitutes. Nutritional value.

Topic 10. Cereals and derivatives

Structure of the cereal grain. Composition. Nutritional value. Flours. Bread. Pasta products. Breakfast cereals.

Topic 11. Dried legumes

Definition. Classification. Composition. Nutritional value. Anti-nutritive compounds.

Topic 12. Tubers and starchy roots

Definition. Classification. Potato. Composition. Nutritional value.

Topic 13. Vegetables and mushrooms

Definition. Classification. Composition. Nutritional value. Sensory properties. Derivatives. Mushrooms

Topic 14. Fruits and dried fruits.

Definition. Classification. Composition. Nutritional value. Modification of its composition during maturity. Sensory properties. Derivatives.

Topic 15. Spices and condiments

Definition. Classification. Natural condiments. Spices or aromatic condiments. Prepared or seasoning condiments. Spice substitutes. Composition. Nutritional value.

Topic 16. Stimulating foods

Coffee and derivatives. Definition. Classification. Composition. Changes in composition due to roasting. Nutritional value. Tea. Definition. Classification. Composition. Nutritional value. Cocoa. Definition. Composition. Nutritional value. Chocolate and derivatives. Other stimulants.

Topic 17. Sweeteners

Definition. Classification. Natural sweeteners. Sugar. Honey. Alcohol sugars. Intense sweeteners. Confectionery products. Nutritional value.

Topic 18. Water

Definition. Classification. Permitted and prohibited manipulations. Ice. Ice-cream. Nutritional value.

Topic 19. Non-alcoholic beverages

Refreshing drinks. Definition. Classification. Nutritional value. Fruit juices. Nectars. Definition. Classification. Nutritional value. Isotonic drinks.

Topic 20. Alcoholic beverages

Fermentation drinks. Wine. Beer. Cider. Definition. Classification. Composition. Nutritional value. Spirit drinks.

Topic 21. Prepared dishes. Dietetic and dietary products

Cooked. Modifications produced by the cooking of food. Effect of the culinary technology on the nutritional value of foods. Special food products. Definition. Classification.

Topic 22. New foods

Functional foods. Organic food. Transgenic foods.

8031 CONSTRUCTION AND AGROALIMENTARY BUILDING.

Block I. General information on agroalimentary warehouses

General information on agroalimentary warehouses.

Block II. Preliminary Works and Earth Movement

Preliminary Works and Earth Movement.

Block III. Materials

Materials.

Block IV. Retaining walls

Retaining walls.

Block V. Foundations

Foundations.

Block VI. Building Structures

Building Structures.

Block VII. Floor slabs

Floor slabs.

Block VIII. Roofing, cladding and carpentry.

Roofing, cladding and carpentry.

Block IX. Sanitation facilities

Sanitation facilities.

Block X. Plumbing installations

Plumbing installations.

Block XI. Electrical installations

Electricity installations.

Block XII. Compressed air installations

Compressed air installations.

Block XIII. Fire protection installations

Fire protection installations.

8032 HERBACEOUS AND WOODY CROPS

BLOCK 1. HERBACEOUS CROPS

TOPIC 1. Introduction to Extensive Herbaceous Crops

Introduction to Extensive Herbaceous Crops.

TOPIC 2. Cereals

Botanical characteristics, vegetative and reproductive cycle, crop requirements, exploitation.

TOPIC 3. Winter cereals.

Wheat, Barley, Oats, Rye.

TOPIC 4. Spring Cereals.

Rice, Corn.

BLOCK 2. HERBACEOUS CROPS

TOPIC 5. Industrial Crops

General information

TOPIC 6. Sunflower

Botanical classification. Morphology, physiology and ecology of the species. Cultivation techniques and their influence on crop yields and quality.

TOPIC 7. Cotton

Botanical classification. Morphology, physiology and ecology of the species. Cultivation techniques and their influence on crop yields and quality.

TOPIC 8. Tobacco

Botanical classification. Morphology, physiology and ecology of the species Cultivation techniques and their influence on crop yields and quality.

TOPIC 9. Beetroot

Botanical classification of sugar beet. Morphology, physiology and ecology of the species.
Plant material and breeding objectives. Cultivation techniques and their influence on crop yields and quality.

TOPIC 10. Potato

Botanical classification of potatoes. Morphology, physiology, and ecology of the species.

TOPIC 11

Legumes. General characteristics of the crop. Comparative study of the ecology of the species of greatest interest. Cultivation techniques. Chickpea. Peas. Soya beans.

BLOCK 3. WOODY CROPS

TOPIC 12. Fruit orchards

General information

TOPIC 13. Physiology of fruit production.

Morphology and organography of the fruit tree. Radical system, branch growth.
Vegetative and reproductive cycle. Fruiting buds.

TOPIC 14. Propagation of woody plants

Sexual. Vegetative. Micropropagation

TOPIC 15. Cultivation techniques

Pruning. Soil maintenance. Nutrition and fertilization. Harvesting.

TOPIC 16. Main fruit species

8033 WASTE MANAGEMENT AND EXPLOITATION.

INTRODUCTION

TOPIC 0.- THE SOIL AS WASTE RECEPTOR. EVOLUTION OF ORGANIC MATTER.
Introduction.

WASTE MANAGEMENT

TOPIC 1.- ORIGIN AND CLASSIFICATION OF ORGANIC WASTE.
TOPIC 2.- CHARACTERIZATION OF WASTE FOR ITS AGRONOMIC APPLICATION.
TOPIC 3.- COMPOSTING.
TOPIC 4.- BIOMETHANATION.
TOPIC 5.- OTHER USES OF WASTE.
TOPIC 6.- USE CRITERIA OF WASTE IN AGRICULTURE. POSSIBLE NEGATIVE EFFECTS

STUDY OF DIFFERENT WASTE

TOPIC 7.- AGRICULTURAL AND FOREST WASTE
TOPIC 8.- WASTE FROM AGRARIAN AND AGRIFOOD INDUSTRIES
TOPIC 9.- URBAN WASTE

8034 BY-PRODUCTS MANAGEMENT AND EXPLOITATION.

TOPIC 1. INTRODUCTION

Current situation and need for the use of agroalimentary by-products.

Types, classification and volumes generated. By-product management tools.

Use of "clean technologies".

TOPIC 2. PROCESSES OF TRANSFORMATION AND RECOVERY OF SUBPRODUCTS

General information on treatment and recovery. Pre-treatment and storage. Chemical and biochemical transformation processes. Separation processes

TOPIC 3. BY-PRODUCTS OF THE DAIRY INDUSTRY

Processes and generation of by-products. Whey. Fermentation products. Curd washing water. Lactic acid, lactose and casein. New uses

TOPIC 4. BYPRODUCTS OF OLIVE INDUSTRIES

By-products obtained in the manufacture of olive oil: vegetable water, olive waste and eau-de-vie de marc (spirit). Use of by-products. By-products of other oleic industries.

TOPIC 5. BY-PRODUCTS FROM THE CANNING AND JUICING INDUSTRY

Use of by-products from canning industries: canned fish, canned vegetables and other vegetables, canned fruits and jams.

By-products of the manufacture of juices: recovery of pulp for animal feed, seed and essential oils, pectins.

TOPIC 6. BY-PRODUCTS OF THE MEAT AND FISH INDUSTRY

Use of bones, blood, hides, tanned leather, glands. Flour and fish oil.

TOPIC 7. BY-PRODUCTS OF WINE-GROWING INDUSTRIES, CEREALS AND OTHERS

Use of vine shoots and eau-de-vie de marc (spirits). Alcohol distillation products, obtaining tartrates, seed oils.

TOPIC 8. ENERGETIC EXPLOITATION OF BY-PRODUCTS

Biomass sources. Densification of biomass. Thermochemical processes: combustion, gasification, pyrolysis.

Biochemical processes: anaerobic and alcoholic fermentation.

Biodiesel production.

8035 FOOD TECHNOLOGY

1. Introduction

The agroalimentary sector.

Processes in the agroalimentary industry.

Types of agroalimentary industries.

2. Preliminary operations

Reception, cleaning, selection and classification of raw materials. Equipment in use.

3. Conversion operations

Conversion operations.

Size reduction and sieving.

Mixing and emulsion formation.

Filtration and membrane separation.

Centrifugation.

Solid-liquid extraction.

Pressing.

Crystallization.

4. Conversion operations

Application of heat treatments.

Scalding.

Pasteurization.

Sterilization.

Conservation by application of cold.

Refrigeration.

Freezing.

Conservation due to reduced water activity.

Concentration by evaporation.

Dehydration and lyophilization.

Other conservation operations.

Food Irradiation

High-pressure treatment

Fermentation

5. Food packaging and storage

Types of packaging.

Packaging possibilities and packaging equipment.

Use of gases in packaging and storage.

Practical contents

Laboratory practices.

Solid-liquid extraction. Extraction conditions.

Osmotic dehydration on fruits.

Vegetable scalding: detection of indicator enzymes.

Freezing of an ice cream mixture using cryogenic liquids.

Freeze-drying. Freeze-drying conditions during the process.

Air dehydration: preparation of dehydration curves.

Troubleshooting.

Solving thermobacteriological problems

Solving of psychrometric problems.

Assignments.

Exposure and defence of a (individual or in group) assignment on the application of a technology to specific foods.

8022 EXTENSION OF CALCULUS AND GEOMETRY

Differential and Integral Calculus in several variables

Differential calculus in several variables
Scalar and vector function of several real variables. Limit and continuity. Partial and directional derivatives. Differential. Tangent plane. Chain rule. Theorems of the implicit and the inverse function. Extremes of a real function of several variables.

Integral calculus in several variables
Double and triple integrals. Geometric interpretation. Fubini's theorem and change of variable. Applications.

Vector Calculus

Line and surface integrals
Basic definitions of curves and surfaces. Integration over curves. Conservative fields. Green's theorem. Integration on surfaces. Stokes' theorem. Gauss's theorem. Applications.

➢ 4th year

8038 FOOD PROCESSING INDUSTRIES

II.1.- General information

Topic 1.- The food industry
Structure of the Agroalimentary Industry. Types of industries. Types of products.

Production flow diagrams.

Topic 2.- Additives and technological aids
Most common groups in the food industries: classification, properties and uses.
Labelling of allergens.

II.2.- Industries of Products of Vegetable Origin

Topic 3.- Industries dedicated to the preparation and supply of fresh and frozen products
Fruit and Vegetable Processing: conditioning, treatments, packaging, conservation and transport. Frozen products.

Topic 4.- Canning industries of vegetable products
Preparation of vegetable conserves. Pickles. Jams.

Topic 5.- Industry of the potato and its derivatives
Conservation and transformation. Main derivatives.

Theme 6.- Industries of cereal derived products

Storage and conservation of cereals. Dry milling: obtaining flours.

Preparation of bread: raw materials and processes.

Topic 7.- Industries producing sugars and sweeteners - Sugar Factories

Process of obtaining sugar, equipment, final products. Honey processors.

Topic 8.- Fats and oils production industries

Obtaining olive oil and seeds: processes and equipment; alternatives. Obtaining hydrogenated fats.

Theme 9.- Non-alcoholic beverages (soft drink) industries

Production of cremogenates, juices, nectars and soft drinks.

Theme 10.- Alcoholic drinks industries

General processes for the production of low alcoholic beverages. Distillation, the basis for obtaining high alcoholic drinks.

II.3.- Industries of Products of Animal Origin

Theme 11.- Meat industries

Meat for direct consumption. Refrigeration and freezing. Packaging. Meat products: classification, raw cured meat products, cooked meat products.

Theme 12.- Dairy industries

Milk for direct consumption. Cheese. Yoghurt. Cream and butter. Ice-cream.

Topic 13.- Fish and fishery product industries

Chilled and frozen fish. Canned fish. Derived products, surimi.

Topic 14.- Egg and egg products industries

Fresh eggs. Egg products.

8039 AGROALIMENTARY MACHINERY AND PROCESS CONTROL

1.- Transport systems in agricultural industries.
2.- Power transmission.
3.- Machines for common processes in the agroalimentary industry.
4.- Machinery in specific industries.
5.- Process automation and control.
6.- Automated industrial processes.
7.- Programmable automated robots.

8040 VITICULTURE

INTRODUCTION CURRENT SITUATION OF THE VINEYARD

1.1.- History of viticulture.

1.2.- Global situation of viticulture.

1.3.- European situation of viticulture.

1.4.- Viticulture in Spain.

1.4.1.- Structure of Spanish Viticulture.

1.4.2.- Legal framework for viticulture in Spain.

MORPHOLOGY AND ANATOMY OF THE VINE

2.1.- BOTANICAL CLASSIFICATION. VINE SYSTEMATICS.

2.1.- PARTS OF THE VINE STOCK.

2.1.1.- Aerial part.

2.1.2.- Underground part.

2.2.- ROOT SYSTEM.

2.2.1.- Functions of the root system.

2.2.2.- Origin.

2.2.3.- Types of roots.

2.4.- AERIAL PART.

2.4.1.- Trunk and stems.

2.4.2.- Different stems or types of wood.

2.5.- VINE SHOOTS.

2.5.1.- Nodes.

2.5.2.- Internodes.

2.6.- TENDRILS.

2.7.- LEAVES.

2.8.-BUD.

2.8.1.- Types of buds.

2.8.2.- Fertility of buds.

2.9.- INFLORESCENCES OR BUNCHES.

2.10.- FLOWER.

2.11.- FRUIT.

VINE CYCLE. VEGETATIVE AND REPRODUCTIVE

3.1.- CYCLES ON THE VINE.

3.1.1.- Life cycle.

3.1.2.- Biannual cycle.

3.1.3.- Annual cycle.

3.2.- CONSTITUTION AND DIFFERENTIATION OF BUDS.

3.2.1.- Pre-dormancy phase.

3.2.2.- Dormancy entry phase.

3.2.3.- Dormancy phase.

3.2.4.- Dormancy exit phase.

3.2.5.-Post-dormancy phase.

3.3.- VEGETATIVE CYCLE.

3.3.1.- Bleeding.
3.3.2.- Budding.
3.3.3.-Shoot growth.
3.3.4.-Wilting.

3.4.- REPRODUCTIVE CYCLE.
3.4.1.- Floral initiation.
3.4.2.- Flowering.
3.4.3.-Pollinating.
3.4.4.-Fertilization.
3.4.5.-Cuajado and corrimiento.
3.4.6.-Berry development.

VITICULTURAL PRODUCTION FACTORS - CLIMATE AND SOIL

4.1.- VITICULTURAL PRODUCTION FACTORS.
4.2.- THE CLIMATE IN VITICULTURE.
4.2.1.- Climatic factors.
- Insolation.
*Sun Hours.
*Intensity.
- Temperature.
*Thermal limits.
- Rainfall.
*Hail.
-Wind.
-Relative humidity.
4.2.2.- Geographical factors.

- Latitude.
- Altitude.
- Topography.
- Exhibition.
- Orientation.
- Proximity of water and forest areas.
4.2.3.- Effects of climate on grape quality.

4.3.- THE GROUND IN VITICULTURE.
4.3.1.- Wine-growing land.
4.3.2.- Soil and Quality.
4.3.3.- Properties and effects on quality factors.
4.3.4.- Intrinsic and extrinsic factors.

ROOTSTOCKS

5.1.- INTRODUCTION.
5.2.- FACTORS TO BE TAKEN INTO ACCOUNT WHEN CHOOSING A ROOTSTOCK.

5.2.1.- Resistance to Phylloxera.
5.2.2.- Compatibility and good affinity with the scion (graft).
5.2.3.- Adaptation to the characteristics of the terrain.
- Resistance to limestone.
- Drought resistance.
- Resistance to excess humidity.
- Resistance to acidity.
- Resistance to soil compactness.
- Resistance to salinity.
5.2.4.- Ease of multiplication.
5.2.5.- Adaptation to the foreseen cultivation techniques.
5.2.6.- Resistance to nematodes.
5.2.7.- Quality of plant material.
.5.3.- CHARACTERISTICS OF THE MAIN ROOTSTOCKS.
5.4.- IDEAL ROOTSTOCK.

VARIETIES
6.1.- THE ORIGIN OF THE GRAPE VINE.
6.2.- ORIGIN AND DIFFUSION OF CULTIVATED VARIETIES.
6.3.- CHARACTERISTICS OF THE VARIETIES.
6.4.- CLASIFICACIÓN OF GRAPE VINE VARIETIES.
6.4.1.- By production destination.
6.4.2.- By ecological vocation.
6.4.3.-By place of origin.
6.4.4.- By administrative or legal situation.
6.5.- CHOICE OF WINE VARIETIES.

6.6.- LOCATION OF THE VARIETIES IN SPAIN.
6.7.- IDENTIFICATION OF VARIETIES.

REPRODUCTION OF THE GRAPE VINE
7.1.- INTRODUCTION.
7.2.- SEXUAL REPRODUCTION.
7.3.- ASEXUAL OR VEGETATIVE REPRODUCTION.
7.3.1.- Production of propagation material.
- Mother vineyards of patrons.
- Grafting mother vines.
- Production of rooted cuttings and rooted grafts.
7.3.2.- Production of graftable material in the field.
7.4. PHYSIOLOGICAL BASES OF CUTTINGS AND GRAFTING.
7.4.1.- Rizogenesis.
7.4.2.- Callogenesis.
7.5. CUTTING AND GRAFTING TECHNIQUES.

7.6. VINEYARD REGENERATION TECHNIQUES.

PRUNING AND VINE-TRAINING SYSTEMS

8.1.- VINE-TRAINING SYSTEMS.

- 8.1.1.- Definition and concepts.
- 8.1.2.- Classification and types.
- 8.1.3.- Influence of the vine-training system on the behaviour of plants.
- 8.1.4.- Choice of vine-training system.
- 8.1.5.- Frequent vine-training systems in Spain.

8.2.- PRUNING.

- 8.2.1.- Concept.
- 8.2.2.- Objectives.
- 8.2.3.- Determination of the load.
- 8.2.4.- Classification of vine pruning.
  - By stage of plant life.
  - By form of intervention.
  - By elements of fructification that are renewed.
  - By supporting elements of the fruit-bearing elements
  - By season of the year.

ESTABLISHMENT OF A VINEYARD

9.1.- STUDY OF THE CULTURE MEDIUM.

9.2.- STUDY OF THE INTENDED PURPOSE.

9.3.- LEGAL CONSIDERATIONS.

9.4.- CHOICE OF VARIETY.

9.5.- CHOICE OF ROOTSTOCK.

9.6.- PLANTING SYSTEM.

- 9.6.1.- Density of plantation.
- 9.6.2.-Provision of the plantation.

9.7.- WAYS OF TRAINING OF VEGETATIVE ORGANS.

9.8.- PREPARATION OF THE TERRAIN.

9.9.- MARKING OUT THE PLANTATION.

9.10.- DEFINITIVE PLANTATION.

9.11.-LATER CARE OF THE PLANTATION.

VINE PESTS AND DISEASES

10.1.-DISEASES.

- 10.1.1.- Mildew.
- 10.1.2.- Powdery mildew.
- 10.1.3.- Gray rot.
- 10.1.4.- Esca.
- 10.1.5.- Excoriose.

10.1.6.- Eutypa disease.

10.2.- PESTS

10.2.1.- Cluster moth.

10.2.2.- Vine leaf-roller moth.

10.2.3.- Thrips.

10.2.4.- Mediterranean grape leaf beetle.

10.2.5.- Brown beetle (Vespersus xatarti)

10.2.6.- Yellow Spider

10.2.7.- Citrus mealybug

10.2.8.- Aphids

8041 PRODUCTION MANAGEMENT

BLOCK 1: PRODUCTION BASICS

Production in a competitive global market.

Project Management.

BLOCK 2: STRATEGIC PILLARS.

Product and process.

Media Capacity and Distribution.

Localization and delocalization of production.

BLOCK 3: TACTICAL DECISIONS.

Organization of flows.

Planning of productive means.

Organization of people.

Excellence of productive system.

8037 ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Inventory

Bases of Ecology

Origin and evolution of Ecology. Spheres of study of Ecology. Relation of ecology with other disciplines. Ecological methods. Agricultural Ecology.

Resources and processes in the physical environment.

The climate and its variation. Geomorphology. The continental and marine aquatic environment. The ground. Extreme environments.

Study of the biotic environment.

Characteristics and qualities of vegetation. Classification of vegetation and cartography.

Characteristics and qualities of fauna. Abundance and diversity.

Ecosystem ecology.

Ecosystem concept. Trophic and spatial structure of biocenosis. Primary and secondary ecosystem productivity. Terrestrial biomes. Biogeochemical cycles.
Landscape Ecology.
Landscape concept. Corridors and metapopulations. Fragmentation of the ecosystems.
Environmental Impact Assessment.
Environmental Impact Assessment Methodologies.
Most commonly used terminology. Typology of Environmental Impacts. Environmental legislation. EIA administrative procedure. Most common methodologies to carry out an EIA.
General structure of Environmental Impact Studies.
Procedure and structure of the ESIA. Qualitative evaluation of the environmental impact.
Quantitative impact assessment. Prevention and correction of impacts. Final impact.
Alert system. Environmental monitoring program. Final report.
Environmental factors and indicators.
Air quality. Water quality. Noise and vibrations. Agrological and agrarian soil capacity
Soil erosion. Vegetable cover. Fauna. Landscape. Cultural values.
Quality of life. Demography and employment level.
Corrective measures to control environmental impact.
Correction of impact on the atmosphere.
Atmospheric pollution. Atmospheric pollutants generated in agrarian and agroalimentary activities.
Environmental effects. Systems of purification of atmospheric pollutants.
Correction of impact on the aquatic environment
Types of water pollutants. Pollution sources and effects on the environment.
Vulnerability of aquifers. Agronomic use of organic waste.
Pollution by nitrates and good agricultural practices.
Correction of impacts on the edaphic environment.
Land use and degradation processes. Diffuse agricultural pollution. Degradation and soil erosion.
Alternative agricultural practices. Concept of critical load and assessment.
Soil pollution. Decontamination of landscape.
Environmental evaluation of the landscape. Evolution of the agrarian landscape. Integration of agrarian activities in the landscape.
Protection of forest landscapes.
Environmental Impact Assessment Practices.
Practice I. Location of the project.
Use of digital maps and QSIG software for project location.
of the agroalimentary industry.
Practice II. environmental impact study.
Use of matrices for the qualitative evaluation of environmental Impact generated by an agroalimentary industry.
Use of software for quantitative environmental impact assessment.
Practice III. Proposal of Corrective Measures
Proposal of Corrective Measures to address different environmental impacts.

Preparation of an environmental monitoring program.
Drafting of the Environmental Impact Study and presentation.

8042 FORCED CROPS

FORCED CROPPING THEORY

Topic 1. INTRODUCTION

Past. Present. Future. Most complex features for its location.
Comparison of crops with and without soil.

Topic 2. Plant nutrition.

Constituents. Mineral and essential elements. Obtaining of the minerals and the water for the plants.
The upward movement of water and nutrients. Plant nutrition.

Topic 3. THE NUTRIENT SOLUTION

Inorganic fertilizing salts. Recommended compounds for a complete nutrient solution.
Analysis of chemical fertilizers. Impurities of fertilizers.
Formulation of nutrients. Stock nutrient solutions. Preparation of nutrient solutions.
Relationships of Plants and Causes of nutrient Solution Changes.

Topic 4. THE ENVIRONMENT

Characteristics of the environment. Water Characteristics. Irrigation. Pumping of nutrient solution to the cultivation trays. Sterilization of the cultivation medium.

Topic 5. TYPES OF MEDIUMS

Water. Nutrient Laminar Flow (NFT). Gravel. Sand. Sawdust. Rock wool. Other hydroponic cultivations (peat, vermiculite, perlite, pumite, mixtures, synthetic foams).

Topic 6. MISCELLANEOUS TYPES OF PROTECTIONS AND CONSTRUCTION MATERIALS

Types of protections. Material coatings. Support materials.

Topic 7. VARIATIONS OF ENVIRONMENTAL FACTORS IN GREENHOUSES

Temperature. Light. Relative humidity in the greenhouse. Carbon dioxide.
Growth and development of plants in the greenhouse. Air conditioning.

Topic 8. STRATEGIES FOR THE CONTROL OF DISEASES

Elimination of inoculants. Limitation of the spread of diseases. Prevention of diseases.
Resistant germplasm. Biological control. Integrated control of diseases.

PRACTICES, VISITS AND WORK

PRACTICES IN THE GREENHOUSE

The overall objectives of the practice are so that the student can apply knowledge acquired in the theoretical classes. Attendance at practical classes is obligatory.
At the end of the course, the students will present the practice notebook for
be reviewed by the teacher.

VISITS TO OTHER CENTRES/GREENHOUSES/NURSERIES

The student will become familiar with the preparation of different substrates (Pindstrub peat moss), forest crops in nurseries (Guindales Nursery JCyL) and ornamental plants (Aspanias Greenhouse). At the end of the visits, the students will present a report on the visits to be reviewed by the professor.

PRESENTATION OF PROJECTS

The student will develop a project on one of the main horticultural or ornamental greenhouse crops.

8043 ENGINEERING PROJECTS

Thematic Unit 1 Professional Scope

Topic 1. Professional Environment of the Agricultural Technical Engineer

Thematic Unit 2. The Engineering Process.

Topic 2. Engineering Projects.
Topic 3. The Engineering Process.

Thematic Unit 3. Design Process

Topic 4. Formulation of the Engineering Problem.
Topic 5. Alternative Generation Methods. Evaluation and Selection.

Thematic Unit 4. Design Engineering: PLANT LAYOUT

Topic 6. - Basic concepts. The SLP Method

Thematic Unit 5. Project Morphology.

Topic 7. The Project Document.
Topic 8. The Report Document.
Topic 9. The Plan Document.
Topic 10. The Specification Document.
Topic 11. The Budget Document.
Topic 12. Environmental regulations in force in Spain. Evaluation processes,
Environmental Report and Prevention.
Topic 13. Other Project documents

Thematic Unit 6. Project Implementation

Topic 14. Project Management.
Topic 15. Project Programming.
Topic 16. Control of the realization of Projects

Topic 17. Project Contracting.

Topic 18. Execution of Projects. Works Management.

8044 GRAPHIC EXPRESSION II

Mechanical sets

Introduction to industrial drawing.
Advanced design of set drawings, disassemblies.
Representation-dimensioning of threads.
Advanced design of joints. Types of joints. Their representation.
Removable joints. Types of joints. Their representation.
Representation and designation of the normalized elements. Other elements.

Dimensioning with tolerances

Surface qualities.
Dimensional tolerances.
Geometric Tolerances.

Drawing and design of installations

Drawing of construction and installations with pipes. Representation of constructive elements in the plans
Drawing and design of pneumatic and electrical installations in construction and in Industrial facilities
Plant distribution.

Drawing and computer aided design

Drawing of plans and diagrams of 2D installations.
3D Modelling.
Assembly of 3D parts.
Animation and 3D simulation.
Creation of realistic scenes.

8059 TECHNOLOGY OF ENOLOGY.

Introduction

Previous General considerations.

Definition of Oenology. Origin of oenology, fields of action, professional development.

Wine and its variations

Definition The origin of the wine: the grape. Types of wines, possible classifications.

Wine-making systems.

Wine-making

Elaboration of Still Wines

Traditional production of white, rosé and red wines.

Elaboration of Special wines

Traditional production of special wines such as: natural sparkling wines, matured wines, etc.

biological, fortified, carbonic maceration, etc.

Oenological Innovation

New technologies and oenological practices

Micro oxygenation, cryomaceration, aging on lees, new deposits, de-alcoholization, etc.

Other products and factors of interest to the sector

8060 MATHEMATICAL MODELS APPLIED TO AGROALIMENTARY ENGINEERING

Analysis of models based on equations. Adjustment of models to experimental data.

8061 CONTAMINATION AND SOIL DEGRADATION

Theoretical Program

Topic 1

The soil as a dynamic complex. Soil as an environmental component.
Soil quality. Physical and chemical indicators of soil quality. Soil
as an entity that evolves naturally and/or anthropically. Diagnostic properties
that characterize soil quality.

Topic 2

Physical degradation. Concept. Factors, processes and anthropic action in the physical degradation of the soil. Preventive measures. Regeneration measures. Soil compaction. Erosion processes and mechanisms. Types of erosion. Erosion factors.
Evaluation of soil erosion. Erosion control strategies.

Topic 3

Recognition and prediction of soil contamination. Concept of pollution. Causes and nature of pollution. Processes in the soil and pollution. Polluting agents: Origin. Redistribution and accumulation. Soil vulnerability and self-purification. Reference levels. Critical loads.

Topic 4

Interaction between pollutants and soils. Influence of components and properties. Sorption and desorption.

Topic 5

Soil contamination by salts. Salinity, sodicity and alkalinity. Irrigation and salinization. Quality and polluting potential of irrigation water. Effects on the soil. Salinity and growth of plants. Regeneration of saline soils and
alkaline.

Topic 6

Soil contamination by phytosanitary products I. Fertilizer problems. Dynamics of nitrates and phosphates in the soil. Effect on soil and water. Eutrophication.

Topic 7

Soil contamination by phytosanitary products II. Pesticide problems. Characteristics of pesticides. Persistence and evolution in the soil. Factors and degradation mechanisms.

Topic 8
Soil contamination by heavy metals. Forms and dynamics of metals in the soil. Factors affecting their mobility. Effects on plants.
Topic 9
Methodology for diagnosis and characterization of contaminated soils. Regeneration of contaminated soils. Different types of techniques. Bio-regeneration.
Topic 10
Sample design. Spatial distribution of pollution. Techniques of pollutant mapping. Data processing.
Topic 11
Current legislation on different aspects of pollution.

Practices Program
Practices and Seminars
LABORATORY Practices
Practices for the determination of some edaphic parameters in normal soils and in degraded soils
FIELD PRACTICE
Excursions to visit the normal and degraded soils of the urban environment.
SEMINARS AND EXHIBITION OF WORKS

Seminar 1. Search for knowledge: books, scientific journals, reports; computer searches. Information processing. Writing a bibliographic section.
Seminar 2. Oral presentation of projects. Interpretation of field practice. Scientific criticism and debate.

8062 AGRICULTURAL INFRASTRUCTURES

Block I. Basic concepts of geotechnics.
Basic concepts of geotechnics.

Block II. Classification of rural roads.
Classification of rural roads.

Block III. Elements of the geometry of a rural road.
Elements of the geometry of a rural road.

Block IV. Grading and pavement.
Grading and pavement.

Block V. Masonry work.
Masonry work.

Block VI. Land concentration
Land concentration

8063 POST-HARVEST TECHNOLOGY

INTRODUCTION
T 1.- INTRODUCTION
Introduction: situation of the sector, types of companies linked to post-harvest management of vegetable products.

POST-HARVEST TECHNOLOGY
T 2.- FRUIT RIPENING
Factors that influence the ripening and senescence of vegetable products
T 3.- POST-HARVEST ALTERATIONS OF VEGETABLE PRODUCTS POST-HARVESTING
- Causes of post-harvest alterations to vegetable products.
- Mechanical damage.
- Transpiration.
- Physiological alterations: cold damage.
- Alterations produced by nutritional deficiency.
- Microbiological alterations.
- Postharvest treatments.

HORTICULTURAL COMPANIES
T 4.- HORTICULTURAL COMPANIES
- Horticultural companies: locality, location, building.
- Handling in fruit and vegetable companies.

CONSERVATION OF FRESH FRUITS AND VEGETABLES
T 5.- CONSERVATION OF FRUITS AND VEGETABLES BY REFRIGERATION
- Effect of temperature on enzymatic activity.
- Useful life of fresh fruits and vegetables.
- Storage conditions: temperature and relative humidity.

T 6.- CONSERVATION OF FRUITS AND VEGETABLES THROUGH MODIFIED ATMOSPHERE
- Storage in controlled atmosphere.
- Modified atmosphere storage.

T 7.- CONSERVATION OF MINIMALLY PROCESSED FRUIT AND VEGETABLES
- Conservation with Gamma IV.
- Packaging innovations.
- New trends in conservation systems for minimally processed fruit and vegetables.

CONSERVATION OF FRUIT AND VEGETABLES GAMMA V
T 8. GAMMA V PRODUCTS
Conservation in Gamma V.

8064 COMPUTER-ASSISTED DESIGN

Computer-assisted design.

Data entry: Topographic. Images. Etc.
Plan management.
Design of facilities.
Notions of 3D CAD.
Geographic information systems.

8065 RENEWABLE ENERGIES

TOPIC 1. Energy, environment and sustainability.
TOPIC 2. Solar thermal energy.
TOPIC 3. Wind power.
TOPIC 4. Hydraulic energy.
TOPIC_5. Photovoltaic energy.
TOPIC_6. Biomass.
TOPIC_7. Economics of renewable energy facilities.
TOPIC_8. Hydrogen economy.

8066 ENGINEERING OF GREEN SPACES

Block I. Soil
Soil.

Block II. Green spaces. Typology
Green spaces. Typology.

Block III. Plant material in gardening
Plant material in gardening.

Block IV. Bioengineering
Equipment. Bioengineering.

Block V. Design and maintenance
Design and maintenance.

➢ 5th year

8046 QUANTITATIVE METHODS I

CHAPTER 0. Introduction
Introduction.

CHAPTER 1. Linear Programming
Linear programming.
Formulation of models. Graphic solution

CHAPTER 2. Sensitivity Analysis
Sensitivity Analysis.
Sensitivity Analysis.
Theory of Duality.
Application of sensitivity analysis.

CHAPTER 3. Simplex method. Troubleshooting
Simplex method.
Simplex method. Problem resolution.

CHAPTER 4. Problems and Practical Cases
Problems and Practical Cases.
Transportation problems.
Assignment Problems.

Other problems.

CHAPTER 5. Network Analysis
PERT-CPM.
PERT.
PERT-COST.
PERT- cost.

CHAPTER 6. Projects
Projects.
Planning, Programming, monitoring and Control of Projects.
Earned Value Technique.
Critical Chain.
Computerized Project Management.
Project Management Practice.

8048 INDUSTRIAL MARKETING

Industrial Marketing.
Introduction to business management.
Marketing function.
Market.
Product.
Price.
Distribution.
Communication.
Commercial investigation.
Sales force.

Customer satisfaction.
Marketing plan.
Social responsibility.

8049 ENTERPRISE STRATEGY AND POLICY

Strategy and strategic management.
Strategic analysis.
Strategic choice.
Strategic implementation.
Planning and strategic control.

8050 PRODUCTION AND MANUFACTURING SYSTEMS

INDUSTRIAL PRODUCTION AND MANUFACTURING SYSTEMS. STANDARDIZATION

1.Definition and purpose of standardization. 2. Advantages of the standardization. 3. General principles of the standardization. 4. National standardization bodies. 5. Standardization in Spain. UNE standards, 6. The international standardization. ISO standards.

NORMAL NUMBERS

1. Introduction. 2. Fundamental series. 3. Properties of normal numbers.

DIMENSIONAL TOLERANCES

1. Introduction. 2. The system of fundamental ISO tolerances. Fundamental concepts. 3. Group of nominal ISO sizes up to 500 mm. 3.1. Fundamental tolerances. 3.2. Tolerance positions. 3.2.1. Fundamental reference differences in axes. 3.2.2. Fundamental reference differences in holes. 3.2.3. Standard tables of tolerance positions. 4. Group of ISO nominal dimensions greater than 500 mm. 4.1. Fundamental tolerances. 4.2. Positions of tolerances 5. Designation of dimensions with tolerance. 6. Free measurement tolerances.

ADJUSTMENTS

1. Definition. 1.1. Mobile or game adjustment. 1.2. Fixed or interference adjustment. 1.3. Indeterminate adjustment. 2. Base-hole adjustment. 3. Base-axis adjustment. 4. Mixed system. 5. Adjustment normalization. 6. Calculation of normalized adjustment.

OPERATIONS WITH DIMENSIONS

1. Introduction. 2. Addition of dimensions. 3. Size Transfer.

MANUFACTURING PROCESS SELECTION

1. Introduction. 2. Stages in product design. 3. Factors influencing the selection of processes.

3.1. Materials. 3.2. Manufacturing Processes. 4 Strategy in the process selection. 5. Process information maps. 6. Selection of manufacturing process. 7. Information on raw materials. 8. Cost Designs. 8.1. Basic manufacturing costs. 8.2. Relative cost coefficients. 8.3. Material costs.

FUNDAMENTALS OF MOLDING PROCESSES

1. Introduction. 2. Fundamentals of sand casting. 2.1. Model Design. 2.2. Mould Construction. 2.3. Design of distribution systems. 2.3.1. Sprue design. 2.3.2. Riser design. 2.4. Casting temperature. 2.5. Solidification.

PATTERNS, INSTRUMENTS AND DIMENSIONAL MEASUREMENT MACHINES

1. Introduction. 2. Standard lamps and lasers. 3. Interferometry. 3.1. Interpretation of images. 3.2. Fizeau Interferometer. Measurement of Gauge blocks. 4. Edge patterns. 4.1. Gauge Blocks or Johansson blocks. 4.1.1. Qualities and characteristics of pattern blocks. 4.1.2. Materials and care of gauge blocks. 4.2. Gauge end bars or rods. 5. Trace measuring equipment. 5.1. Rulers. 5.2. Calliper 5.3. Exterior micrometres. 5.3.1. Interior micrometres. 5.4. Measurement machines. 6. Indirect comparison measurement instruments. 6.1. Comparison clock.

AMPLIFICATION SYSTEMS

1. Introduction. 2. Mechanical amplification. 3. Pneumatic amplification. 4. Electronic amplification. 5. Optical amplification.

LENGTH VERIFICATION

1. Introduction. 2. Gap gauge tolerances. 3. Tolerances of buffer calibres. 4. Tables.

PATTERNS AND ANGULAR MEASUREMENT INSTRUMENTS

1. Introduction. 2. Angular patterns. 2.1. Graduated circle. 2.2. Squares and rulers. 2.3. Angular gauge blocks. 2.4. Gauge polygons or optical polygons. 2.5. Formation of angular gauges. 3. Instruments for measuring angles. 3.1. Goniometer or angle protractor. 3.2. Bubble level. 3.3. Sine bar. 3.4. Indexing plate. 3.5. Autocollimator.

UNITS OF MEASUREMENT

1. Definitions. 2. International system of units of measure. 3. Gauges.

TRACEABILITY

1. The traceability concept. 2. Calibration plan. 2.1. Level diagram. 2.2. Instruction file or calibration procedures. 2.3. Data archiving. 2.4. Calibration labels. 2.5. Exterior traceability chart. 3. Participation in inter-comparisons.

INFLUENCE OF UNCERTAINTY ON MEASUREMENT

1. Qualities of measuring instruments. 2. Relationship between the tolerance of a dimension and the uncertainty of the measurement. 3. Relationship between uncertainty of measurement and scale division. 4. Selection of measuring instruments.

PRACTICES

PRACTICE 1. Measurement of a part with a calliper.
PRACTICE 2. Measurement of a part with an exterior micrometre.
PRACTICE 3. Measurement of a part with a profile projector.
PRACTICE 4. Measurement of dimensions by comparison.

INTRODUCTION TO PRODUCTION SYSTEMS

1. Concept of production systems. 2. Types.

PLANT LAYOUT

1. Factors. 2. Plant layout by product. 3. Plant layout by process.

CLASSIC PRODUCTION SYSTEMS

1. Systems Q. Systems P. Procurement policies. 4. Safety stock. 5. Service companies.

ERP SYSTEMS

1. MRP I. 2. MRP II. 3. ERP

JIT SYSTEMS

1. JIT Fundamentals. 2. JIT Tools.

8055 QUANTITATIVE METHODS II

DECISION ANALYSIS

Decision analysis.

SIMULATION

Simulation.

THEORY OF QUEUEING

Queueing theory. Introduction.
Exponential distribution.
Basic models of queues m / m / s.
Other queue models.
Application of queueing theory.
Application of queueing theory.

8051 MAINTENANCE MANAGEMENT

Introduction.
Maintenance in the early twenty-first century.

Theoretical framework.
Maintenance indicators.
What are maintenance audits?
Process of auditing maintenance.
Maintenance and human factor audits.
The process of continuous improvement applied to maintenance.
Practical framework.
Heuristics applied to maintenance.
Presentation of real maintenance cases.

8057 LOGISTICS

Introduction.
Supply chain (SC).
Flows and elements of the Supply Chain.
Supply flow.
Productive flow.
Distribution flow.
Economic flow.
Information flow.
Strategic aspects in the SCM.
Product design and unitization.
Information systems in the management of the SC.
Logistic nodes and strategic location.
Maintenance and storage.
Facilities.
Warehouse design.
Plant distribution.
Warehousing Techniques.
Picking, cross-docking & co-fabrication (and co-packing).
Shelves.
Means of maintenance.
Transport.
Air, Maritime, Railway and Maritime and Fluvial Transport.
Air.
Railway.
Highway.
Multimodal.
Distribution.
Network design.
Capillarity vs. costs.
Administration of the Supply Chain.
Supplies.
Prices and administration.
ICT's.
Coordination of the SC.

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8052 THERMAL ENGINEERING

THERMODYNAMICS

TOPIC 1: ENERGY, TECHNOLOGY AND SOCIETY

Useful Power Production. Energy models in history. Power sources.
Power Production Systems. Thermal and nuclear power plants. Management
Energy Management in Industry. Energy and the environment

TOPIC 2: FUNDAMENTAL CONCEPTS

Object of Thermodynamics. System and wall. State Properties. Thermodynamic Process and change of state. State of equilibrium.

TOPIC 3: PRINCIPLE 0. EQUATION OF THERMAL STATE AND TEMPERATURE

Principle 0 of Thermodynamics. Thermal balance. Equation of Thermal state. Thermometers and temperature scales. Thermometric scale of the ideal gas. Equation of thermal state of the ideal gas.

TOPIC 4: FIRST PRINCIPAL OF THERMODYNAMICS

Work in Thermodynamics. First Principle: formulation in closed systems. Formulation in open systems. Formulation in cyclical processes.

TOPIC 5: THERMODYNAMIC PROPERTIES OF PURE SUBSTANCES

Ratio p - v - T. Pressure-Temperature Diagram. Pressure-Volume Diagram. Specific heat under pressure and constant volume. Compressibility Factor. Polytrophic processes.

TOPIC 6: SECOND PRINCIPLE OF THERMODYNAMICS

The transformation of energy. Carnot´s Theorems. Thermodynamic temperature and entropy.
Generation of entropy. Irreversibility. Temperature diagrams - Entropy, Enthalpy - Entropy and pressure – Enthalpy.

TOPIC 7: PROCESSES IN OPEN SYSTEMS

Discharge Processes. Valves, nozzles and diffusers. Heat Exchange Processes. Adiabatic work processes. Turbines, compressors and pumps. Work in non-adiabatic processes. Scaled compressions and expansions. Thermotechnology.

TOPIC 8: INTRODUCTION TO HEAT TRANSFER

Basic heat transfer mechanisms: conduction, convection, radiation. Importance of heat transfer. Thermal conductivity. Density. Viscosity. Specific Heat. Tables of Thermophysical properties of materials.

TOPIC 9: UNIDIMENSIONAL CONDUCTION IN A STATIONARY REGIME

Equation Fourier. Flat, cylindrical and spherical geometry. Analysis of one-dimensional conduction in a steady state: Flat symmetry; Cylindrical symmetry; Spherical Symmetry. Overall transfer coefficient.

TOPIC 10: FLUID MECHANICS OF CONVECTION

The problem of the heat convection. Dimensionless numbers. Forced convection.
Experimental correlations for heat transfer in forced convection.
Natural convection. Experimental correlations for heat transfer in forced convection.
Natural convection. Heat transfer in phase changes.

TOPIC 11: HEAT EXCHANGERS

Classification of heat exchangers. Temperature profiles in exchangers. Mean Logarithmic Temperature Difference.

TOPIC 12: THERMAL RADIATION

Thermal radiation. Fundamental laws. Radiation in Nonabsorbent media.

TOPIC 13: COMBUSTION

Fuels and their Properties. Stoichiometry of combustion. Control of combustion. Environmental aspects of combustion.

8053 MECHANISMS

1. Topological analysis of mechanisms.
2. Articulated mechanisms.
3. Graphic synthesis of mechanisms.
4. Graphic and algebraic kinematics of flat mechanisms.
5. Machine static.
6. Machine Dynamics.
7. Power transmission systems in machines.

8054 FUNDAMENTALS OF ELECTRONICS

Thematic Unit 1.

Introduction to digital electronics applications.
Introduction.
Applications.

Thematic Unit 2. Components - Diodes and transistors

Applications.
Passive components.
Diode semiconductor.
Transistors.
Applications.

Thematic Unit 3. Fundamentals of analogue circuits

Amplifiers.

Operational amplifiers.

Thematic Unit 4. Fundamentals of digital circuits

Digital representation of information.

Switching algebra. Logical functions.

Combinational circuits.

Sequential circuits.

Thematic Unit 5. Fundamentals of communications

Signs. Transmission channels.

Guided and unguided transmission means.

Transmission of signals.

Errors in the transmission.