



## Study Plan

**School:** School of Sciences and Technology

**Degree:** Bachelor

**Course:** Oenology (cód. 666)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT11377L	Mathematics	Mathematics	6	Semester	156
QUI12208L	Chemistry	Chemistry	6	Semester	156
BIO10917L	Cell Biology	Biological Sciences	6	Semester	156
GEO00765L	Pedology	Geosciences	6	Semester	156
BIO00408L	Microbiology	Biological Sciences	6	Semester	156

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS00702L	General Physics	Physics	6	Semester	156
QUI12343L	General Biochemistry	Chemistry	6	Semester	156
BIO12215L	Plant Physiology	Biological Sciences	6	Semester	156
QUI13078L	Oenological chemistry	Chemistry	6	Semester	156
GES13086L	Eno-management	Management	6	Semester	156

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIT13091L	Crop Protection	Agronomy	6	Semester	156
FIT13084L	technology of the vineyard I	Agronomy	6	Semester	156
FIT13067L	Enology I	Agricultural and Food Engineering	6	Semester	156
GES02309L	Marketing	Management	6	Semester	156
QUI13081L	oenological microbiology	Chemistry	3	Semester	78
ERU13088L	Geomatics and Geographic Information Techniques	Rural Engineering	3	Semester	78

### 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIT13092L	Viticulture	Agronomy	6	Semester	156
FIT13095L	Vine Integrated Pest and Disease Management	Agronomy	6	Semester	156



### 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<a href="#">FIT13068L</a>	Enology II	Agricultural and Food Engineering	6	Semester	156
<a href="#">FIT13085L</a>	Technology of the Vineyard II	Agronomy	6	Semester	156
<a href="#">FIT13082L</a>	Enological Engineering	Agricultural and Food Engineering	3	Semester	78
<a href="#">ERU13077L</a>	Mechanization Applied to Viticulture	Rural Engineering	3	Semester	78

### 3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<a href="#">FIT13093L</a>	Integrated Practices in Viticulture	Agronomy	12	Year	312
<a href="#">FIT13090L</a>	Integrated Practices in Enology	Agricultural and Food Engineering	12	Year	312
<a href="#">FIT13069L</a>	Enology III	Agricultural and Food Engineering	6	Semester	156
<a href="#">GES13087L</a>	Product Design	Management	6	Semester	156
<a href="#">ERU13079L</a>	Cellar Equipment and Energy Efficiency	Rural Engineering	6	Semester	156

### 3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<a href="#">FIT13065L</a>	Sensorial Evaluation	Agricultural and Food Engineering	6	Semester	156
<a href="#">FIT13066L</a>	Analytical Quality Control	Agricultural and Food Engineering	6	Semester	156
<a href="#">FIT13083L</a>	Food Hygiene and Safety	Agricultural and Food Engineering	3	Semester	78
<a href="#">ERU13080L</a>	Valorization of Waste and By-Products of the Wine Industry	Rural Engineering	3	Semester	78



## Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME: Para obtenção do grau de licenciado em Enologia é necessário obter aprovação a 180 ECTS em unidades curriculares obrigatórias, distribuídas da seguinte forma:

1<sup>o</sup> Ano

1<sup>o</sup> Semestre:

5 UC Obrigatórias num total de 30 ECTS

2<sup>o</sup> Semestre

5 UC Obrigatórias num total de 30 ECTS

2<sup>o</sup> Ano

3<sup>o</sup> Semestre

6 UC Obrigatórias num total de 30 ECTS

4<sup>o</sup> Semestre

6 UC Obrigatórias num total de 30 ECTS

3<sup>o</sup> Ano

5<sup>o</sup> Semestre e 6<sup>o</sup> semestre

2 UC Obrigatórias anuais num total de 24 ECTS

5<sup>o</sup> semestre

3 UC Obrigatórias num total de 18 ECTS

6<sup>o</sup> Semestre

4 UC Obrigatórias num total de 18 ECTS \*\*\*

## Program Contents

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### Mathematics (MAT11377L)

Linear systems. Eliminations of Gauss. Matrices and vectors. Operations with matrices. Determinants. Inverse matrix. Cramer's Rule.

Functions, Limits, and Continuity. Inverse and composite functions. Limits of numerical successions. Continuous functions and their properties.

Differential Calculus and Applications. Derivatives of composite, implicit, and inverse functions. Logarithmic differentiation. Theorems of Fermat, Rolle, Lagrange and Cauchy. Rule of L'Hôpital. Taylor's formula. Numerical differentiation. Applications of derivatives.

Integral Calculus and Applications. Primitives. Methods of primitivation: by substitution and by parts. Primitives of rational functions. Integral. The fundamental theorem of integral calculus. Numerical integration. Applications of integrals. Improper integrals. Power series.

Ordinary Differential Equations. Euler's method. First order separable and linear differential equations. Applications in the natural sciences.



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### **Chemistry (QUI12208L)**

The composition of matter.

Periodic Table of the Elements. Atomic structure.

The Chemical bond. Ionic bonding. Covalent bonding.

Intermolecular forces.

The properties of Solutions

Chemical thermodynamics

The first law of thermodynamics.

Enthalpy change of chemical transformations. Second law of thermodynamics. Entropy.

Third law of thermodynamics. Gibbs energy

Homogeneous chemical equilibrium

Chemical equilibrium in heterogeneous systems

Solubility equilibria. The formation and dissolution of precipitates.

Equilibria in solutions of Acids and bases

Properties of acids, bases and salts. Buffer solutions. Acid-base titrations

Oxidation-reduction reactions. Electrochemistry

Chemical kinetics

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### **Cell Biology (BIO10917L)**

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### **Pedology (GEO00765L)**



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### **Microbiology (BIO00408L)**

Theoretical:

1. Historical context and Ubiquity
2. Diversity of the Microbial World
3. Microbial Growth and Death
4. Metabolism
5. Basics of Molecular Microbiology: Microbial genetics, Virology, Immunology
6. Microbes and disease; Normal flora, Pathology, infection and disease, Mechanisms of pathogenicity, Principles of epidemiology
7. Food microbiology: Hygiene and concept of indicator. Processing and storage of food. Foodborne diseases
8. Ecology and environmental microbiology: Soil and water, Biogeochemical cycles, Agricultural applications, Wastewater treatment, Biotechnology applications

Lab Practice:

Aseptic practice

Observation of bacteria, fungi and protists.

Demonstration of Ubiquity

Preparation and sterilization of culture media.

Isolation of pure culture.

Colonial and cellular morphology. Staining methods

Microbial counts

Environmental conditions for growth (pH, temp., O<sub>2</sub>)

Anaerobic Culture

Antibiograms

Microbial spreading simulation

Water and milk analyses

Plant symbiosis.

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### **General Physics (FIS00702L)**

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### **General Biochemistry (QUI12343L)**

Introduction to Biochemistry and its correlation with the other sciences. The importance of water and inorganic ions in biosystems.

Biological buffer systems. Methods and techniques used in biochemistry.

Nomenclature, structure and properties of biomolecules: carbohydrates, lipids, amino acids, peptides, proteins and nucleic acids.

Lipoproteins. Biomembranes. Enzymes and enzyme kinetics. Bioenergetics and bioelectrochemistry. The importance of ATP in metabolism. Anabolism and catabolism. The main metabolic pathways. Introduction to the metabolism of carbohydrate, fat and protein. Integration and metabolic regulation.



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### **Plant Physiology (BIO12215L)**

WATER RELATIONS: Functions and water movement. Responses to water stress.

TRANSPORT IN PHLOEM: Input and output of metabolites in phloem and transport. Distribution of assimilates.

MINERAL NUTRITION: Essential elements. Criteria of essentiality. Absorption of minerals. Ion movement in roots. Ion transport in membranes.

PHOTOSYNTHESIS: Reactions directly dependent on light. CO<sub>2</sub> reduction. Metabolism C<sub>3</sub>, C<sub>4</sub> and CAM. Photorespiration. Abiotic factors that affect photosynthesis.

RESPIRATION: Pentose phosphate pathway. Abiotic factors that affect respiration.

DEVELOPMENT AND PHYTOHORMONES: Growth and differentiation. Auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, salicylic acid and estrigolactonas.

PIGMENTS and Photo-Morphological Characteristics: The pigments of blue light receptors. The family of Phytochrome.

PHOTOMORPHOGENESIS AND FLOWERING

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### **Oenological chemistry (QUI13078L)**

Chemical characterization of the grapes and wine:

1. Organic acids from the grapes and the fermentation. Acid-base properties. Buffer effect.
2. Sugars coming from the grapes and sugars arising from the fermentation process. Fermentable and nonfermentable sugars.
3. Nitrogen compounds: organic and mineral nitrogen. Aminoacids, peptides e proteins. Bioamines.
4. Minerals present in the grapes and in the wine.
5. Alcohols of low and high molecular weight.
6. Chemical compounds related to the aroma. Terpenoids, pirazines e sulfur-based compounds. Alcohols esters, aldehydes e ketones.
7. Phenolic compounds: Phenolic acids and alcohols, stilbenes, coumarins e flavonoids. Tannins.
8. Alterations of the chemical composition of wines due to ageing.



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### **Eno-management (GES13086L)**

Module 1 – Introduction, context and levels of analysis of wine-business management

- Definition and key components
- Levels of analysis
- Wine business framework
- Markets for complementary products and services – Ex. tourism
- Context and challenges

Module 2 - Demand Management

- Consumption
- Sales and Marketing
- Competitive advantages for differentiation
- Analysis and application to the wine case

Module 3 - Supply Management

- Concepts of production and logistics (includes stocks)
- Raw materials, resources, processes and organizational skills
- Costs and investments
- Budgets and Finances
- Competitive advantages at cost

Module 4 - Strategy and analysis of industry and markets

- Concepts of markets and industries
- Analysis of industry and markets
- Key success factors
- Strategic marketing
- Horizontal and vertical integration - joint products and services
- Analysis, application and case of wine industry and markets

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### **Crop Protection (FIT13091L)**

Block A. Plant Pathology.

1. Definition of plant disease and types of causing agents.
2. Disease development and factors that favors them.
3. Symptoms and physiological alterations induced in hosts by pathogens.
4. Morphology and biological properties of the most important pathogens
5. Basic methods to use in the field and in the laboratory for tentative diagnosis and aetiology determination of a given disease.
6. Examples and brief description of diseases of important crops and some means of control.

Block B. Entomology.

1. Study of morphological and biological properties of the main orders of insecta.
2. Brief description of some important agricultural pests. Symptoms, biological cycles and control means.

Block C. Plant weeds.

Definition of weed and of plant parasite.

Type of damages caused to agricultural crops.

Botanical classification and biology of most important weeds and useful means of control.



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### **technology of the vineyard I (FIT13084L)**

1. Climatology. Parameters and phenomena of the climate. Climate formation. Types and Indices and climatic classification.
2. Water in biological systems. Soil water: characterization of soil water status; Distribution of soil water on agricultural land, infiltration, internal drainage and redistribution; surface runoff; evaporation, transpiration, evapotranspiration. Soil and crop water balance.
3. Plant material. Clonal selection and plant propagation. Rootstock. Breeds. Hybrids. Grafting, types, times and techniques.
4. Assessment of the physical environment. Characterization of the soil, and the conditions for the vineyard.
5. Cultural techniques and operations. Organizational model of the work. Soil mobilization systems and techniques. Seasons and implements. Cultural Technical Itinerary.
6. Installation of the Vineyard. Preparation of the terrain.
7. Planting. Complementary structures.
8. Soil maintenance. The vegetable cover. Sowing. Weed control and strategies.

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### **Enology I (FIT13067L)**

- 1- Framing of the national and international wine sector.
- 2- Maturity control. The vintage decision.
- 3- Pre-fermentative treatments, corrections and additives. Sulfur dioxide and alternatives.
- 4 – Vinification technology of white wine.
- 5 - Vinification technology of rosé wines
- 6 – Vinification technology of red wines. Malolactic fermentation.
- 7 - Physical-chemical analysis of grapes for maturation control. Wine analysis.

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### **Marketing (GES02309L)**

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### **oenological microbiology (QUI13081L)**

Microbiology overview of oenological processes. Microorganisms of interest in oenological processes.  
Importance of Microorganisms on the quality of wines. The wine microorganisms and their natural habitat.  
Vineyard/grapes and winery ecosystems.  
Microbial growth. Measures of microbial growth.  
Microorganisms of winemaking interest: biochemical, morphological and genetic differences  
The transformation of must into wine. Alcoholic fermentation. Biochemistry of fermentation. Malolactic fermentation.  
Bioconversion of malic acid. Biochemistry and physiology of the malolactic fermentation Winemaking, mixed populations: growth and kinetics. Microorganisms of wine spoilage. Microbiological stabilization of wines. Application of starters  
Practical: Observation of microorganisms of oenological interest. Cell count and preparation of inocula.  
Isolation of microorganisms from spontaneous fermentations of grape juice  
Characterization of the performance of a yeast strain during grape ferment

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### **Geomatics and Geographic Information Techniques (ERU13088L)**

1. Global navigation satellite systems (GNSS) in viticulture and oenology (Survey of geographic variables)
2. The study of GIS techniques to viticulture and oenology (creation, structuring and manipulation of geographic databases)
3. The use of remote (satellite images, drones, etc ...) and proximal (multispectral, geophysical, etc ...) sensors in the vine and wine management.
4. The application of image processing algorithms to viticulture and oenology.





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### **Viticulture (FIT13092L)**

- 1 - Introduction: Economic importance of viticulture and grape producing regions
- 2 - Systematic and morphology: Ampelideas Family. External morphology of branches, leaves, buds and inflorescences. Stem and root apex anatomy.
- 3 - Physiology and development of the vine. Vegetative development: dormancy and shoot growth. Reproductive development: Fertility and fertility rates. Flowering and fruit set. Berry shatter and other physiological problems. Berry growth and development. Environmental and cultural practices. Quality parameters and quality evaluation.
- 4 - Supports for vines: study of the vine microclimate and the vines responses to pruning -Discussion about the major important training systems.
- 5 - Ecology of the vine: Study of particular aspects of soil and climate important to define the grape production areas. Climate-indices.-Soil importance.-The concept of "Terroir". Quality potential.
- 6 -The production of table grapes and raisins: -Main varieties and cultural practices.

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### **Vine Integrated Pest and Disease Management (FIT13095L)**

Introduction. Fundamentals of vine Integrated Pest and Disease Management

Study of:

- a) main diseases of grapevine caused by fungi, bacteria, phytoplasmas, viruses and nematodes. Biological cycle, symptomatology and damages associated with its presence;
  - b) main pests of grapevine caused by mites and insects. Biological cycle, symptomatology and damages associated with its presence;
  - c) main species of spontaneous weeds with greater presence in vineyard. Biological cycle, identification, and methodologies for its management in culture
- Risk Assessment of grapevine enemies. Sampling process and methods
- Control methods to reduce damage caused by grapevine enemies in Integrated Pest and Disease
- Management context. Biological, Cultural, Biotechnical, Chemical control. Criteria for control methods selection. The pesticides selection
- Practical use of acquired knowledge to a specific vineyard. Pest and diseases identification and analysis of applicable control measures available for their limitation

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### **Enology II (FIT13068L)**

- 1- General considerations on clarification and stabilization of wines.
- 2 - Spontaneous clarification and clarification by fining. The different types of fining products. Fining technology
- 3 - Changes in the clarity of wines. Metallic precipitations, protein precipitations, tartaric precipitations, precipitation of coloring matter.
- 4 - Diseases and alterations of wines.
- 5 - The filtration of wines. The different types of filtering materials. The different types of filters. The centrifugation.
- 6 - Fining tests. Protein stability assays. Determination of the filterability and clarity of the wine. Tartaric stability assays. Identification of different precipitates.



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### **Technology of the Vineyard II (FIT13085L)**

1. Laws of vegetal growth and the fertilization as a factor of production
2. Mineral Nutrition. Absorption of nutrients and needs. Deficiencies and toxicities.
3. Soil Fertility. Soil reaction. Cycles of nutrients
4. Fertilization. Rational and Fundaments. Fertilizers. Mineral and organic correction
5. The use of water by plants. Evapotranspiration and water management. Water balance. Water needs and irrigation. Watering schedule. Supplementary irrigation and deficit irrigation. Situations of drought.

Technologies in irrigation management.

6. Watering Located. Characterization, utilization, economy and equipment. Evaluation of systems. Sizing of localized irrigation.
  7. Drainage, Salinity, Water quality of irrigation and Conservation of soil and water. Drainage technology.
- Networks and types of drainage. Origin, effects of excess and dynamics of salts in soil. Halomorphism.  
Protection and recovery of soils. Balance and soil salts. Risks of using salt water. Watering with waste water

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### **Enological Engineering (FIT13082L)**

This curricular unit aims to provide students with an overview of engineering concepts used in wine production. The topics related to wine production include:

- Mass and energy balances.
- Fluid and heat transfer systems.
- Solid separation operations.
- Concentration techniques

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### **Mechanization Applied to Viticulture (ERU13077L)**

Tractors for wine growing: drive transmission, organs of propulsion, safety devices. Basic concept of fluid power; three-point-linkage, power take off, external hydraulic service,

Equipment for soil and grass management: vineyard plough; in-the-row plough; disc harrow; cultivator; subsoiler; rotary spade; rotary harrow. Under vine tools; herbicide booms.

Equipment for plant protection: dusters, fan and tunnel sprayers, sprayer calibration, drift control.

Fertilizer spreaders and subsoil application attachment.

Equipment for vegetation managing: leaf stripping, topping, tying

Grape harvesting and transport equipment.

Equipment for pruning: pre-pruning; vine puller.

Precision wine growing.

Selection and machinery sizing criteria: work times; work rate and efficiency, operation costs.



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### **Integrated Practices in Viticulture (FIT13093L)**

1. Study of the technical viability of a vineyard.
2. Follow-up of vine phenology.
3. Pruning system. Control of vigour.
4. Multiplication and propagation of the vine. Grafting. Plant material in the Vineyard.
5. Ecology of the Vine; climatic, relief, soil and water resources.
6. Preparation and adaptation of land and soil. Organic and mineral corrections. Drainage.
7. Installation and planting of the Vineyard.
8. Soil maintenance. Cultural system, operations, machinery and equipment. Weed control.
9. Control of pests and diseases; techniques, and phytosanitary products.
10. Green pruning and vigour control.
11. Fertilization of the Vine.
12. Evaluation of water stress and irrigation.
13. Evaluation of production components.
14. Harvest; plan and harvest management.
15. Precision viticulture.
16. Farm management.

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### **Integrated Practices in Enology (FIT13090L)**

- 1 - monitoring grape maturation and harvesting
- 2 - techniques for obtaining and preparing white musts
- 3 - techniques for obtaining red must.
- 4 - Corrections and additives to be used during fermentations.
- 5 - control of alcoholic and malolactic fermentations
- 6 - wine stabilization and clarification techniques
- 7 - Sanitation of facilities and equipment.

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### **Enology III (FIT13069L)**

- 1 - Aging wines
- 2 - The woods in enology. The cooperage. Origin of the woods. The toasting and its importance in the quality of the wine. Use of alternatives to barrels
- 3 - Technology of Sparkling wines.
- 4 - Technology of spirits.
- 5 - Production of late harvest and liqueur wines
- 6 - Wine bottling: Packing and closing materials. Cork stoppers and synthetic stoppers. Manufacture of corks and treatments. Chemical contamination (TCA and others).
- 7 - Wine vinegars. Acetic fermentation. Fermentation methods.
- 8 - Physical-chemical and sensorial analyzes of wines for quality control



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### **Product Design (GES13087L)**

Part 1 – Concepts of design of product and process  
Alignment corporate strategy with product operations  
Product and process quality  
Quality management issues  
Statistical control  
Design of new products and services  
Management of flows and capacity  
Gant, CPM, PERT, Little Law  
Layout design

Part 2 – Design of new products  
Concepts of entrepreneurship and innovation  
Development of business models for new products  
Methods for generating ideas  
Canvas business model  
Business plan for new products  
Strategy and product description  
Marketing plan  
Production plan  
Financial plan  
Economic and financial indicators

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### **Cellar Equipment and Energy Efficiency (ERU13079L)**

- Design of wineries. Layout of processes.
- Oenological equipment (fermentation, storage, stabilization, reception equipment, presses, cooling tunnels).
- Cooling equipment. Cold applications in oenology. Estimated cold power.
- Energy consumption (in the vineyard and) in the winery.
- Energy efficiency (in the vineyard and) in the winery.
- Environmental control of different areas of the winery. Thermal insulation and ventilation.
- Monitoring, control and automation systems.

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### **Sensorial Evaluation (FIT13065L)**

Introduction to sensory analysis.  
Characteristics of a sensorial lab, principles to be observed in samples preparation.  
The errors in sensory analysis.  
The physiology of senses involved in sensory analysis. Threshold of sensation and perception.  
The taste: taste buds, elemental flavors, the influence of temperature on the perception of flavors.  
The nose: the direct nasal route and the retro-nasal route, recognition of aromas, primary aromas, prefermentation and fermentation aromas and aging aromas.  
Vision: mechanisms and its importance. The color of the wines.  
Wine tasting from different regions and different varieties.  
The different types of sensorial tests: discriminative or difference, descriptive and hedonic.  
Panels of tasters: type of panels, training and selection of tasters, formation of a chamber of tasters.  
Parameters and measures in sensory analysis, the sensorial sheets, the statistics in sensory analysis.  
The sensorial defects of wines, sensorial analysis of wines with def.



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### **Analytical Quality Control (FIT13066L)**

- 1 - Definitions and principles of quality control. Quality control in the different stages of wine analysis.
- 2 - The enology laboratory.
- 3 - Spectrophotometric methods of analysis. UV-VIS and ICPMS
- 4 - Chromatographic methods of analysis. Gas Chromatography and Liquid chromatography.

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### **Food Hygiene and Safety (FIT13083L)**

European and national regulation concerning food hygiene and food safety.  
Foodborne pathogenic microorganisms: grow conditions, prevention and destructive measures.  
Chemical contamination in oenologic drinks: preventive measures and control.  
The traceability: importance and legal obligations.  
The Hazard Analysis and Critical Control Points (HACCP) system.  
The hygiene and sanification in wineries.

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### **Valorization of Waste and By-Products of the Wine Industry (ERU13080L)**

- Notions of waste and by-products
- Legislative aspects
- Vineyard waste and by-products
- Waste and by-products from the Cellar
- Waste Treatment Systems
- Waste and by-products valorization from the perspective of the Circular Economy
- Industrial Symbiosis