



**NEW CONCEPT**  
**FOR THE**  
**ACCREDITATION OF THE**  
**ERASMUS MUNDUS**  
**DEGREE PROGRAMME**  
***“VINIFERA EUROMASTER “***

**Appendix 4-1**

**MODULE HANDBOOK**  
**First Academic Year (M1)**




# Contents

## MODULES OF THE FIRST ACADEMIC YEAR (M1)

jointly delivered by the EMaVE-Consortium at Montpellier SupAgro


<b>Module Title</b>	<b>ECTS- points</b>	<b>PAGE</b>
<u>Compulsory Modules</u>		
Economics for the Wine Industry	6	4
Enology	7	7
Project Management in Science	6	11
Vine Biology	5	14
Vine Ecology and Physiology	8	18
Viticulture	7	22
Wine Analysis	5	25
Wine Processing	7	28
Terroir and Company Auditing	5	33
Language (for second year of study) LV2	4	/
French as a Foreign Language (joint ECTS with LV2)		/
<u>Optional Additional Module</u>		
Study Trip	1	
<b>ECTS-points (total) for the compulsory modules of the degree programme</b>	<b>60</b>	
<b>ECTS-points for the optional additional modules</b>	<b>1</b>	

## **COMPULSORY MODULES**

	<b>Economics for the Wine Industry</b>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Luigi Galletto, Prof. PhD (University of Padova)
Lecturers:	<u>PU Wine Economics:</u> <u>Lecturer in charge:</u> Foued Cheriet, PhD (Montpellier SupAgro); <u>Additional lecturers:</u> Luigi Galletto, Prof. PhD (University of Padova); Dieter Hoffmann, Prof. Dr. (Geisenheim University); Etienne Montaigne, Prof. PhD HDR (Montpellier SupAgro); Luca Rossetto, Prof. PhD (University of Padova); Alejandro Gennari, Prof. PhD (University of Cujo de Mendoza, Argentina).
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	PU Wine economics 60h
Workload:	<u>PU Wine economics:</u> Face to face lectures: 48 h; Case Studies 3 h; Study trips 9 h  Student's personal study time in the module: 70 h
Credit points:	6 ECTS
Recommended prerequisites:	None
Targeted learning outcomes:	<u>PU Wine economics:</u> <ul style="list-style-type: none"> <li>- students have a macro and meso economic view of the wine markets, its structures and regulatory systems (OIV, CMO...)</li> <li>- they will understand the production and consumption situation, international trade, bulk wine markets, and the economics of international firms who operate in the wine sector.</li> <li>- Students have a managerial view of the wine market, with a special emphasis on international business strategies of wine companies, and marketing, both at strategic and operational level.</li> <li>- They know about the market planning, business positioning, marketing mix management,</li> </ul>

Content:	<p><u>PU Wine Economics:</u></p> <p>Introduction to economic analytical approaches and theoretical backgrounds: macro, meso and micro economics. Description and analysis of the wine production system, consumption, and international trade. Relevant drivers in these systems, including coordination and institutional devices at global or local levels. Global and local factors that influence wine prices, with a special insight into the bulk market.</p> <p>Performance drivers in different types of businesses (private and cooperative, large and family business). Introduction to marketing with a particular focus on marketing-mix techniques. Product launch, quality management, branding, communication, packaging, distribution and pricing in the wine sector. Wine tourism economics.</p>
Exam achievements:	<p><u>PU Wine economics:</u></p> <p>Written examination and presentation</p>
Forms of media:	<p>Powerpoint; whiteboard; reading programme, study visits; discussions</p>
Literature:	<p>AAKER D., (1996), Building Strong Brands, The Free Press.</p> <p>ANDERSON, K. (2004), The World's Wine Market – Globalization at Work, Edward Elgar Publishing Limited, Glensanda House, Montpellier Parade, Cheltenham, Glos GL 50 1 UA, UK (Available online on Google)</p> <p>COELHO A.; RASTOIN J.-L.(2006), Financial Strategies of Multinational Enterprises in the World Wine Industry, Agribusiness: An International Journal, 22, 3, Summer 2006, 417-429.</p> <p>COELHO A.; COUDERC J.-P.(2006), Globalisation + Financialisation= Concentration? Trends on Mergers, Acquisitions and Financial Investment in the Wine Sector, 3<sup>rd</sup> International Wine Business &amp; Marketing Research Conference, Montpellier, 6-8 July, 30 p.</p> <p>COELHO, A.; MONTAIGNE, E.; AIGRAIN, P.; SIDLOVITS, D.(2009), Wine, in CHALMIN P. (coord.), Cyclope: World Commodity Yearbook, Economica, Paris</p> <p>D'HAUTEVILLE F., COUDERC J.-P., HANNIN H., MONTAIGNE E., Bacchus 2005, 2006, 2008 (3 volumes), Enjeux ,Stratégies et pratiques dans la filière vitivinicole, Dunod, Paris.</p> <p>DESMOND J., (2003), Consumer Behaviour, Palgrave</p> <p>EVANS M., MOUTINHO L.(1999)., Contemporary issues in Marketing, MacMillan Business.HANNIN, H.; CODRON, J.-M.; THOYER, S. (2006), The International Office of Vine and Wine (OIV) and the World Trade Organization (WTO): Standardization Issues in the Wine Sector, in BINGEN J.; BUSCH L.(ed.), Agricultural Standards: The Shape of the Global Food and Fiber System, Springer, Netherlands, p.73-96.</p> <p>HEIJBROEK, A.(2007), Changing competitiveness in the wine industry, The rise and fall of wine countries, Rabobank Publishing, The Netherlands.</p> <p>INTERNATIONAL ORGANISATION OF VINE AND WINE</p>

	<p>(OIV), State of the Vitiviniculture World Market OIV Report (2002-2010), (Available online at <a href="http://www.oiv.int">http://www.oiv.int</a>)</p> <p>JENSTER P.V., SMITH D., MITRY D.J., JENSTER L., (2008), The Business of Wine. A Global Perspective, Copenhagen School Press 197 p.</p> <p>KOTLER P., ARMSTRONG G., (2006), Principles of Marketing, Prentice Hall, New York.</p> <p>MONTAIGNE, E.; COELHO, A. coordinators, (2006), The reform of the common market organization for wine, Policy Department and Cohesion Policies, European Parliament, Brussels, 75 p. + appendixes 120p. (Available online at <a href="http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_en.pdf">http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_en.pdf</a>; <a href="http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_annex_en.pdf">http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_annex_en.pdf</a>)</p> <p>MONTAIGNE, E ; RASTOIN, A., COELHO A.(2006), Globalization of the world wine market and restructuring of the supply side, INRA Sciences Sociales, N° 5-6, November 2006. (Available at <a href="http://www.inra.fr/internet/Departements/ESR/publications/iss/pdf_eng/iss06-5_7Globalization_Eng.pdf">http://www.inra.fr/internet/Departements/ESR/publications/iss/pdf_eng/iss06-5_7Globalization_Eng.pdf</a>)</p> <p>ROUZET E., SEGUIN G., (2003), Le marketing du vin, Savoir vendre le vin, Dunod, Paris.</p> <p>SCARPA R., THIENE M., GALLETTO L., (2009), Consumers WTP for Wine with Certified Origin: Preliminary Results from Latent Classes Based on Attitudinal Responses, Journal of Food Products Marketing, 15, 231-248. <a href="http://www.vitisphere.com">http://www.vitisphere.com</a></p>
Update:	<p>Accreditation document Feb. 2012</p> <p>Updated September 2016</p>


	<b>Enology</b>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Jorge M. Ricardo-da-Silva, PhD HDR (Universidade de Lisboa)
Lecturers:	<p><u>PU Grape and Wine Composition</u>  <u>Lecturer in charge:</u> Jorge M. Ricardo-da-Silva, Prof. PhD HDR (Universidade de Lisboa);  <u>Additional lecturers:</u> Antonio Morata, Prof. PhD (Universidad Politécnica de Madrid); Santiago Benito, Prof. PhD (Universidad Politécnica de Madrid); Alain Razungles, Prof. PhD HDR (Montpellier SupAgro)</p> <p><u>PU : Microbiology and Fermentation:</u>  <u>Lecturer in charge:</u> Bruno Blondin, Prof. PhD (Montpellier SupAgro);  <u>Additional lecturers:</u> Manfred Grossmann, Prof. Dr. (Geisenheim University); Doris Rauhut, Prof. Dr. (Geisenheim University), Isabelle Masneuf, PhD HDR (Bordeaux Sciences Agro)</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	In blocks 2 blocks (PU Grape & Wine composition: 40 h; PU: Microbiology and Fermentation: 31 h)
Workload:	<p><u>PU Grape &amp; Wine Composition:</u> Face to face lectures: 40 h</p> <p><u>PU Microbiology &amp; Fermentation:</u> Face to face lectures: 31 h</p> <p>Student's personal study time in the module: 91 h</p>
Credit points:	7 ECTS
Recommended prerequisites:	Basic knowledge in Enology as delivered in the module "Immersion" during the immersion period.
Targeted learning outcomes:	<p><u>PU Grape &amp; Wine Composition:</u> Students know:</p> <ul style="list-style-type: none"> <li>- the major and minor components in musts and wines</li> <li>- technical repercussion of must components</li> </ul>

	<ul style="list-style-type: none"> <li>- sensorial repercussion of musts and wine components</li> <li>- nutritional repercussion of musts and wine components</li> </ul> <p><u>PU Microbiology &amp; Fermentation:</u></p> <p>Students gain knowledge about:</p> <ul style="list-style-type: none"> <li>- the metabolism of yeast and bacteria relevant for wine making (alcoholic &amp; malolactic fermentations),</li> <li>- populations dynamics from vineyard to the fermentation processes (AF &amp; MLF), also comparing spontaneous fermentation with usage of microbial starter cultures</li> <li>- impact of yeast and bacteria nutrients on course of fermentation and formation of positive and negative aroma compounds</li> <li>- selection procedures for yeast and bacteria</li> <li>- impact factors on fermentations</li> <li>- construction of genetically engineered wine yeasts and their properties</li> <li>- microbial spoilage of grapes, musts and wine,</li> <li>- lagging and stuck fermentations and problem solving operations</li> <li>- Biochemistry of yeast autolysis and impact on wine aroma</li> </ul>
Content:	<p><u>PU Grape and Wine composition:</u></p> <p>Nitrogen compounds: Proteins. Peptides. Enzymes. Aminoacids.  Phenolic compounds I – Anthocyanins: Chemistry, Grape contents, Anthocyanins during fermentation and aging.  Organic acids: From grape and must. Formation during yeast fermentation. Formation during MAF.  Glucid compounds: Sugars, Polyalcohol, Polysaccharides.  Phenolic compounds II: Flavanols, flavanols, flavanols, phenolic acids, stilbens,  Varietal aroma and other volatile aroma compounds,  Mineral compounds.</p> <p><u>PU Microbiology and Fermentation:</u></p> <p>Yeast cell biology and taxonomy; special carbon metabolism and by-products of fermentations, fermentation cycle. Yeast physiology, nutrition and stress factors. Nitrogen and sulphur metabolism; sulfite production and sulfite management. Role and effects of fermentation additives on fermentation performance. Nutritional demands of yeasts and strain differences. Genetic improvement of wine yeast and risk assessment.</p> <p>Lactic acid bacteria: taxonomy, metabolism, nitrogen and oxygen management. Wine spoilage by yeast and bacteria.</p> <p>Targeted impact of yeast and bacteria on wine flavour (de novo synthesis of compounds and hydrolysis of bound aroma substances from precursors.</p> <p>Spontaneous fermentations versus usage of starter cultures; selection scheme for starters. Mixed yeast cultures and</p>




	simultaneous usage of yeast and bacteria starter cultures. Control of fermentation. Biochemical post-fermentation processes during yeast autolysis: formation of sensorially relevant compounds.
Exam achievements:	Written examination
Forms of media:	Power point, whiteboard
Literature:	<p><u>PU Grape and Wine composition:</u></p> <p>Boulton, R.B., Singleton, V.L., Bisson, L.F., Kunkee, R.E. 1996. Principles and Practices of Winemaking. Chapman and Hall, New York.</p> <p>Flanzy, C. 1998. Oenologie. Fondements Scientifiques et Technologiques, Tec&amp;Doc. Lavoisier, Paris.</p> <p>Fleet, G.H. 1993. Wine Microbiology and Biotechnology. Harwood Academic Publishers, Chur.</p> <p>Ribereau-Gayon, P., Y. Glories, A. Maugean, and D. Dubourdieu. (eds.). 2000. Handbook of Enology Volume 2: The Chemistry of Wine Stabilization and Treatments. John Wiley&amp;Sons, New York. (Chapt. 1-7)</p> <p>Waterhouse, A.L. and S.E. Ebeler (eds.). 1998. Chemistry of Wine Flavor. American Chemical Society, Washington, D.C.</p> <p>Reynolds, A.G. (Ed.), 2010 Understanding and managing wine quality and safety. Two Volumes 624p and 640p. Woodhead Publishing Ltd., Cambridge. Vol 1, Part 1</p> <p>SCI Journals for complementary references:  Am. J. Enol. Vitic.; S. Afric. J. Enol. Vitic.; Aust. J. Grape Wine Res; J.Sci.Food Agric.; J. Int. Sci. Vigne Vin.  J. Agric. Food Chem.; Food Chem.; Vitis</p> <p>Scientific Databases (Internet Sources):  VITIS- VITICULTURE AND ENOLOGY ABSTRACTS:  <a href="http://vitis-vea.zadi.de">http://vitis-vea.zadi.de</a>  CHEMICAL ABSTRACTS:  <a href="http://ovidsp.tx.ovid.com/spb/ovidweb.cgi">http://ovidsp.tx.ovid.com/spb/ovidweb.cgi</a>  ISI – WEB OF KNOWLEDGE: <a href="http://apps.isiknowledge.com">http://apps.isiknowledge.com</a>  SCIENCE DIRECT: <a href="http://www.sciencedirect.com/">http://www.sciencedirect.com/</a>  SCIRUS: <a href="http://www.scirus.com/">http://www.scirus.com/</a>  SCOPUS: <a href="http://www.scopus.com/home.url">http://www.scopus.com/home.url</a></p> <p><u>PU Microbiology and Fermentation:</u></p> <p>Fleet, G.H. Wine Microbiology and Biotechnology, 2002  Ribéreau-Gayon, P. et al.: Handbook of Enology Vol. 1, 2006  König, H., Uden, G., Fröhlich, J.: Biology of Microorganisms on Grapes, in Must and in Wine. Springer Verlag Heidelberg, 2009  SCI Journals for complementary references:</p>

	Am. J. Enol. Vitic.; S. Afric. J. Enol. Vitic.; Aust. J. Grape Wine Res; J.Sci.Food Agric.; J. Int. Sci. Vigne Vin.; Vitis; J. Appl. Microbiology; Appl. Environm. Microbiology; J. Ind. Microbiol. Biotechnol.
Update:	Accreditation document Feb. 2012 Updated September 2016

	<b>Project Management in Science</b>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
<b>Module coordinator:</b>	Elisa Marguerit, PhD (Bordeaux Sciences Agro)
Lecturers:	<p><u>PU Experimental methodology and statistics:</u>  <u>Lecturer in charge:</u> Suzana Ferreira- Dias, Prof. PhD HDR (Universidade Técnica de Lisboa )  <u>Additional lecturers:</u> Jorge Cadima, Prof. PhD HDR (Universidade Técnica de Lisboa); Bénédicte Fontez, PhD (SupAgro Montpellier); Meïli Baragatti, PhD (SupAgro Montpellier), Jacques Wery, Prof. PhD HDR (SupAgro Montpellier).</p> <p><u>PU Research project organisation:</u>  <u>Lecturer in charge:</u> Elisa Marguerit, PhD (Bordeaux Sciences Agro);  <u>Additional lecturers:</u> Suzana Ferreira-Dias (Universidade Técnica de Lisboa ); Jorge Cadima, Prof. PhD HDR (Universidade Técnica de Lisboa) and other lecturers of the Vinifera master degree programme as scientific supervisors</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	2 blocks: PU Experimental methodology and statistics 45 h; PU Research project organisation (continuous) 18 h
Workload:	<p><u>PU Experimental methodology and statistics:</u>  Face to face teaching 20 h; tutored application of statistic programmes 25 h  <u>PU Research project organisation</u>  Workshop on project definition and organisation 4 h; intermediate and final workshops with project presentation and discussion 14 h</p> <p>Student's personal study time in the module: 80 h</p>
Credit points:	6 ECTS
Recommended prerequisites:	Basic statistics and data organisation and basic worksheet skills
Targeted learning outcomes:	<u>PU Experimental methodology and statistics:</u> Students - can design simple experiments

	<ul style="list-style-type: none"> <li>- they know how to avoid observation errors and prejudice</li> <li>- know and can apply the statistical methods commonly used in viticulture, enology and wine economics</li> <li>- are able to interpret the results obtained by using statistics</li> <li>- they have knowledge in less common statistical methods (e.g. principal component analysis, cluster analysis, discriminant analysis)</li> </ul> <p>They can use statistical programmes for data analysis</p> <p><u>PU Research project organisation:</u></p> <p>Students</p> <ul style="list-style-type: none"> <li>- can identify the technical and scientific questions and problems</li> <li>- make a bibliography to know the current state of art on a specific topic</li> <li>- are able to propose experimental designs (factors analysed, measurements, replicates required)</li> <li>- can handle, analyse and discuss data</li> <li>- can present research results to a public</li> <li>- can write and summarise scientific reports</li> <li>- are able to work in research teams (coordination and structure, milestones)</li> </ul>
Content:	<p><u>PU Experimental methodology and statistics:</u></p> <p>Methodology of scientific research</p> <p>The scientific method and the experimental design</p> <p>Hypothesis testing</p> <p>Samples and populations, confidence limits</p> <p>Analysis of Variance (ANOVA)</p> <p>Linear and nonlinear regressions</p> <p>Modelling and optimisation (e.g. Response surface methodology)</p> <p>Data Analysis (e.g. Principal components analysis, Cluster analysis, Discriminant analysis)</p> <p>Applications of statistical programmes in case studies in viticulture, enology or wine economics.</p> <p><u>PU Research project organisation:</u></p> <p>Methodology of project organisation</p> <p>Scientific working methods (literature research, report writing)</p> <p>Presentation techniques</p>
Exam achievements:	<p>Written examination on statistics Experimental methodology and statistics (50 %)</p> <p>Project presentation and written report (50 %)</p>
Forms of media:	<p>Reading programme; Power Point; Excel; whiteboard; Computers, statistical programs incl. R-statistics, Statistica.</p>
Literature:	<p>Balaam, L.N. (1975) Response Surface Designs, <i>In: Developments in</i></p>

	<p><i>Field Experiment Design and Analysis</i>, (V.J. Bolfinger e J.L. Wheeler, eds.). Commonwealth Agricultural Bureaux, pp. 11-32.</p> <p>Burgard, D.R., Kuznicki, J.T. (1990), <i>Chemometrics: Chemical and Sensory Data</i>, CRC Press, Boston, pp. 135-185.</p> <p>Gacula Jr., M.C., Singh, J., 1984. Response surface designs and analysis, <i>In: Statistical Methods in Food and Consumer Research. Food Science and Technology. A Series of Monographs</i>, Academic Press, p. 214-273.</p> <p>Gomez &amp; Gomez. 1984. <i>Statistical Procedures for Agricultural Research</i>. John Wiley &amp; Sons. 680p.</p> <p>Little, T. M. and F.J. Hills. 1978. <i>Agricultural Evaluation, Design and Analysis</i>. John Wiley and Sons. 350p.</p> <p>Vuataz, L., 1986. <i>Statistical Procedures in Food Research</i>, In: <i>Statistical Procedures in Food Research</i>, (J.R. Piggott, ed.), Elsevier Applied Science, London e New York, p. 101-123.</p> <p>Goos, P. and Jones, B. 2011 <i>Optimal design of experiments</i> Wiley 287 p.</p> <p><a href="http://cran.r-project.org/">http://cran.r-project.org/</a> “Faraway, J.: Practical Regression and Anova using R”</p>
Update:	Accreditation document Feb. 2012 Updated September 2016

	<b>Vine Biology</b>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Enrico Peterlunger, Prof. (Università degli studi di Udine, Italy)
Lecturers:	<p><u>PU Vine Anatomy and Genetics:</u>  <u>Lecturer in charge:</u> Enrico Peterlunger, Prof. (Università degli studi di Udine);  <u>Additional lecturers:</u> Laurent Torregrosa, Prof, PhD HDR (Montpellier SupAgro), Serena Foria, PhD, Researcher (Università degli studi di Udine).</p> <p><u>PU Ampelography:</u>  <u>Lecturer in charge:</u> Jean-Michel Boursiquot, PhD (Montpellier SupAgro).</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	2 blocks: (PU Vine Anatomy and Genetics 30h; PU Ampelography 21h)
Workload:	<p><u>PU Vine Anatomy and Genetics</u>  Face to face lectures: 24 h; Directed exercises (laboratory course with stereo microscope): 4 h; Field visit: 2 h</p> <p><u>PU Ampelography:</u>  Face to face lectures: 9 h; Directed exercises 8 h; field visit 4 h  Student's personal study time in the module: 70 h.</p>
Credit points:	5 ECTS
Recommended prerequisites:	None
Targeted learning outcomes:	<p><u>PU Vine Anatomy and Genetics:</u></p> <ul style="list-style-type: none"> <li>- Students have acquired basic knowledge of higher plant internal and external anatomy, at a whole plant level, as well as organ and tissue level.</li> <li>- they understand the principles of grapevine development and adaptation mechanisms that determine usual practices of grapevine management (pruning, hedging, yield control...)</li> <li>- they are introduced to the principles of Mendelian, quantitative and molecular genetics and to the genetic peculiarities of the grapevine genome</li> </ul>

	<ul style="list-style-type: none"> <li>- they learn strategies for genetic improvement of a perennial heterozygous crop and how molecular/biotechnological approaches are applied to speed up breeding programmes</li> </ul> <p><u>PU Ampelography:</u></p> <p>Students</p> <ul style="list-style-type: none"> <li>- can apply the methods used in ampelography</li> <li>- know the systematics of species and rootstocks and main grapevine cultivars</li> <li>- can determine the main cultivars in the field</li> </ul>
Content:	<p><u>PU Vine Anatomy and Genetics:</u></p> <p>Morphology and anatomy of the grapevine organs. Root, trunk, shoot, cane, leaf, bud, leaf, flower, berry, seed. Systematics of the genus <i>Vitis</i> (basic knowledge). Cultivated species and their use. Annual cycle of the grapevine, vegetational phases. Qualitative and quantitative aspects of the annual cycle: description of the modification of organs and evaluation of biomass involved.</p> <p>Evolution of storage substances along the annual cycle. Foundations of classical genetics. General features of the grapevine genome. Origin and genetic diversity in domesticated grapevines. Conventional breeding and genetic engineering. Genetic control and improvement of agronomic traits.</p> <p><u>PU Ampelography:</u></p> <p>Ampelographic methods, Systematics and species, Rootstocks, Wine varieties and clonal selection</p>
Exam methods:	Written examination
Forms of media:	Power points; Stereo microscopes; Field visits
Literature:	<p><u>PU Vine Anatomy and Genetics:</u></p> <p><b>General books:</b>  Winkler et al. (1995) General Viticulture, University of California Press.  Mullins MG et al. (1992). Biology of the grapevine, Cambridge University Press.  Galet P. (2000) General viticulture. Oenoplurimedia, France.  Keller Markus (2011). The science of grapevines: anatomy and physiology. Academic Press-Elsevier.  Adam-Blondon et al (2011) Genetics, genomics, and breeding of grapes. Science Publishers.</p> <p><b>Specific papers:</b>  Pratt C. (1971) Reproductive anatomy in cultivated grapes: a review. AJEV 22: 92-109.  Pratt C. (1974) Vegetative anatomy of cultivated grapes: a review AJEV 5: 131-150.  Hardie WJ, O'Brien TP, Jaudzems VG (1992) Morphology, anatomy and development of the pericarp after anthesis in grape, <i>Vitis vinifera</i> L. AJGWR 2: 97-142.  Srinivasan C, Mullins MG (1976) Reproductive anatomy of the</p>

grapevine (*Vitis vinifera* L.): origin and development. *Ann Bot.* 40: 1079-1084.

Ojeda, H.; Andary, C.; Kraeva, E.; Carbonneau, A.; Deloire, A. 2002. Influence of pre- and postveraison water deficit on synthesis and concentration of skin phenolic compounds during berry growth of \**Vitis vinifera*\* cv. Shiraz. *AJEV.* 53 (4) 261-267

Ollat, N.; Diakou-Verdin, P.; Carde, J. P.; Barrieu, F.; Gaudillere, J. P.; Moing, A. 2002. Grape berry development : A review. *Journal International des Sciences de la Vigne et du Vin.* 36 (3) 109-131

Kliewer, W. M.; Dokoozlian, N. K. 2005. Leaf area/crop weight ratios of grapevines: Influence on fruit composition and wine quality. *AJEV.* 56 (2) 170-181

Bergqvist, J.; Dokoozlian, N.; Ebisuda, N. 2001. Sunlight exposure and temperature effects on berry growth and composition of Cabernet Sauvignon and Grenache in the central San Joaquin Valley of California. *AJEV.* 52 (1) 1-7

Schultz H.R., 1992. An empirical model for the simulation of leaf appearance and leaf development of primary shoots of several grapevine (*Vitis vinifera* L.). *Scientia Hort.* 52, 179-200

Lebon E., Pellegrino A., Tardieu F., Lecoœur J. 2004. Shoot development in Grapevine (*Vitis vinifera* L.) is affected by the modular branching pattern of the stem and intra- and inter- shoot trophic competition. *Ann. Bot.* 93: 263-274.

Pellegrino A., Lebon E., Simonneau T., Wery J. 2005. Towards a simple indicator of water stress in grapevine (*Vitis vinifera* L.) based on the differential sensitivities of vegetative growth components. *Aust. J. Grape Wine Res.:* 11, 306-315.

Pallas B., Louarn G., Christophe A., Lebon E., Lecoœur J. 2008. [Influence of intra-shoot trophic competition on shoot development in two grapevine cultivars](#) (*Vitis vinifera* L.) *Physiol. Plant.* 134, 49-63

Jaillon O, Aury JM, Noel B, Policriti A, Clepet C, Casagrande A, Choisne N, Aubourg S, Vitulo N, Jubin C, Vezzi A, Legeai F, Huguene P, Dasilva C, Horner D, Mica E, Jublot D, Poulain J, Bruyère C, Billault A, Segurens B, Gouyvenoux M, Ugarte E, Cattonaro F, Anthouard V, Vico V, Del Fabbro C, Alaux M, Di Gaspero G, Dumas V, Felice N, Paillard S, Juman I, Moroldo M, Scalabrin S, Canaguier A, Le Clainche I, Malacrida G, Durand E, Pesole G, Laucou V, Chatelet P, Merdinoglu D, Delledonne M, Pezzotti M, Lecharny A, Scarpelli C, Artiguenave F, Pè ME, Valle G, Morgante M, Caboche M, Adam-Blondon AF, Weissenbach J, Quétier F, Wincker P (2007) The grapevine genome sequence suggests ancestral hexaploidization in major angiosperm phyla. *Nature* 449:463–467

Myles S, Boyko AR, Owens CL, Brown PJ, Grassi F, Aradhya MK, Prins B, Reynolds A, Chia JM, Ware D, Bustamante CD, Buckler ES (2011) Genetic structure and domestication history of the grape. *Proc Natl Acad Sci USA* 108:3530–3535


Péros J-P, Berger G, Portemont A, Boursiquot J-M, Lacombe T (2010) Genetic variation and biogeography of the disjunct *Vitis* subg. *Vitis* (Vitaceae). *J Biogeography.* 38:471–486

This P, Lacombe T, Thomas MR (2006) Historical origins and genetic diversity of wine grapes. *Trends Genet* 22:511–509

Di Gaspero G, Cattonaro F (2010) Application of genomics to




	<p>grapevine improvement. Aust J Grape Wine Res 16:122-130  J.R. Vidal, C. Gomez, M.C. Cutanda, B.R. Shrestha, A. Bouquet, M.R. Thomas, L. Torregrosa (2010) Use of gene transfer technology for functional studies in grapevine. Aust J Grape Wine Res 138–151</p> <p><u>PU Ampelography:</u>  IFV – INRA – Montpellier SupAgro – Viniflor, 2007 – Catalogue de varieties et clones de vigne cultivés en France, 2<sup>e</sup> édition. Ed. IFV (ENTAV-ITV France), Le Grau du Roi, France, 455p</p> <p>Organisation internationale de la Vigne et du Vin, 2007 – 2<sup>nd</sup>e édition de la liste des descripteurs OIV pour les variétés et espèces de Vitis. Organisation Internationale de la Vigne et du Vin, Paris, 232p.</p>
Update:	Accreditation document Feb. 2012 Updated September 2016

	<b>Vine Ecology and Physiology</b>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Anne Pellegrino, PhD (Montpellier SupAgro)
Lecturers:	<p><u>PU Vine Ecology:</u></p> <p><u>Lecturer in charge:</u> Pilar Baeza Trujillo, Prof. PhD (Universidad Politécnica de Madrid)</p> <p><u>Additional lecturers:</u> Ana Iglesias Picazo, PhD (Universidad Politécnica de Madrid); Ignacio García de Cortázar-Atauri, PhD (INRA-Avignon), Philippe Hinsinger, PhD HDR (INRA Montpellier), Claire Marsden, PhD (Montpellier SupAgro), C. Jourdan, PhD (CIRAD Montpellier)</p> <p><u>PU Vine Physiology:</u></p> <p><u>Lecturer in charge:</u> Anne Pellegrino, PhD (Montpellier SupAgro);</p> <p><u>Additional lecturers:</u> Manfred Stoll, PhD (Geisenheim University); Hans Schultz, Prof. PhD. (Geisenheim University); Eric Lebon, PhD (INRA Montpellier), Cléa Houel, PhD (Montpellier SupAgro), Alain Deloire, Prof. PhD HDR (Montpellier SupAgro), Bruno Holzapfel, PhD (Charles Sturt University, Wagga Wagga, Australia)</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	In block (2 blocks: PU Vine Ecology 34 h and PU Vine Physiology 39 h)
Workload:	<p><u>PU Vine Ecology</u></p> <p>Face to face lectures 26 h; directed exercises (practices) 4 h; study trip 4 h</p> <p><u>PU Vine Physiology:</u></p> <p>Face to face lectures 29 h; directed exercises 3 h, Experimental project 7 h</p> <p>Student's personal study time in the module: 110 h</p>
Credit points:	8 ECTS
Recommended prerequisites:	- Basic knowledge in Viticulture as delivered in the module "Immersion" during the immersion period. Soil sciences basis

	- module of Vine Biology
Recommended prerequisites:	- Basic knowledge in Viticulture as delivered in the module “Immersion” during the immersion period. Soil sciences basis - module of Vine Biology
Targeted learning outcomes:	<p>PU Vine Ecology: The students</p> <ul style="list-style-type: none"> <li>- know how soil and climate factors influence vineyard performance in order to determine the best practices for quality and quantity in each particular environment</li> <li>- know how to evaluate the environmental parameters</li> <li>- know the soil characteristics that interact with viticultural practices: soil water management, irrigation, soil management and nutrients supply</li> <li>- know about correction of soil problems: soil acidity, pH, erosion, poor organic matter, salinity, nematodes</li> <li>- know about climate factors – temperature, light, rainfall, hail frost and wind – and its effects on vine performance along growing cycle</li> <li>- can characterize an actual or potentially winegrowing area</li> </ul> <p>PU Vine Physiology: The students</p> <ul style="list-style-type: none"> <li>- have theoretical knowledge of basic grapevine physiology, growth and development</li> <li>- understand the principles of stress physiology</li> <li>- are familiar with the interaction between environment, physiology, development and grape composition</li> <li>- know about the eco-physiological reactions of the major grapevine varieties</li> <li>- understand specific aspects of nutrient acquisition</li> <li>- can apply research methods in physiological studies</li> </ul>
Content:	<p>PU Vine Ecology: Climatic factors affecting vineyard development and ecophysiology</p> <ul style="list-style-type: none"> <li>- influence of solar radiation</li> <li>in - influence of temperatures</li> <li>- rainfall and relative humidity and wind</li> <li>- biotic factors: (e.g. birds)</li> </ul> <p>Climatology applied to winegrowing and climate change</p> <ul style="list-style-type: none"> <li>- Basic climatic index</li> <li>- Multicriteria climatic classification at different scales</li> <li>- Climatic zones in the world</li> <li>- Agrometeorology and production prognosis</li> </ul> <p>Soil</p>

	<ul style="list-style-type: none"> <li>- Ecology, Ecosystems services and Vineyard</li> <li>- Measurement of quality and sustainability of soils</li> <li>- Correction of soil problems</li> <li>- Soil pollution</li> </ul> <p>Concepts of ‘basic terroir unit’ and ‘viticulural terroir’</p> <ul style="list-style-type: none"> <li>- Basic terroir unit : interaction ‘climate vs soil’</li> <li>- Viticultural terroir unit: adaptation choices at the plot level</li> <li>- Viticultural terroir: scaling up to the territory</li> <li>- Example of ‘syrah network’ with wine responses</li> </ul> <p>PU Vine Physiology:</p> <ul style="list-style-type: none"> <li>- Photosynthesis and respiration</li> <li>- Water relations</li> <li>- Grapevine adaptation to climate changes</li> <li>- Vegetative growth and development</li> <li>- Berry development and hormones</li> <li>- Root to shoot signalling</li> <li>- Application of remote sensing approaches</li> <li>- Physiology and isotopes</li> <li>- Solar radiation and grapevine physiology</li> <li>- Fluxes and source-sink relationships of the whole plant</li> <li>- Nutrient acquisition</li> </ul>
Exam achievements:	Written examination (75 %) and report (25 %)
Forms of media:	Power point presentations; blackboard, scientific papers and technical documents on table; field trip, computer programmes, greenhouse experiment.
Literature:	<p><u>PU Vine Ecology</u></p> <p><b>Journals:</b>  American Journal of Enology and Viticulture  Australian J. of Grape and Wine Research  Le Progrès Agricole et Viticole  Scientia Horticulturae  South African Journal of Enology and Viticulture  Viti  Viticultura y Enología Profesional  Vitis</p> <p><b>Books:</b>  Coombe BG and Dry PR. 2001. Viticulture vol 2. Practices. Winetittles. Adelaide (Australia) 376pp  Huglin P. and C. Schneider. Biology and écologie de la Vigne. Pyot-Lausanne. Rustica. Gladstones J. 2002. Viticulture and Environment. Winetittles. Adelaide (Australia). 320pp. Jackson D. Monographs in Cool Climate Viticulture 2. Climate. 2001. Adelaide (Australia). 80 pp. Martínez de Toda f. 1991. Biología de la vid. Mundi-Prensa. Madrid. 346 pp  White RE.2003. Soils for Fine Wines. Oxford University Press. New York (USA).279pp  SmartR and Robinson M. 2006. Sunlight into Wine: A Handbook for Winegrape Canopy Management. Wintetittles. Adelaide (Australia) 96pp  C.A. Ingels, R.L. Bugg, G. T McGourty and L.P. Christensen. 1998. Cover Cropping in Vineyards: A Grower’s Handbook.</p>


	<p>Winetittles. Adelaide (Australia). 162 pp.</p> <p><u>PU Vine Physiology:</u>  Advances in Photosynthesis and Respiration: Plant respiration: From cell to Ecosystem (Lambers and Ribas-Carbo), Springer Berlin, 250pp  Biology of the Grapevine (Mullins, Bouquet, Williams) Cambridge University Press, 239 pp,  Viticulture, Volume 1 – Resources (Dry and Coombe) Winetittles Adelaide, Australia, 255pp  GiESCO proceedings  In excerpts: Photosynthetic adaptation – Chloroplast to landscape – Ecological Studies 178, Springer, 313pp  La Vigne : Physiologie, Terroir, Culture (Carbonneau.A, Deloire A., Jaillard B.), 2007, Dunod Ed., 442pp.  Plants and microclimate, third Edition (H.G. Jones) Cambridge University Press, 428 pp  Plants in Action: adaptation in nature, performance in cultivation (B.J. Atwell, P.E. Kriedemann, and C.G.N. Turnbull) MacMillan Education Australia, South Yarra, Victoria, Australia, 664 pp  Wine Science,- Principles and Applications- (Jackson) Academic Press, San Diego, 475pp  Jones, H. G. and Vaughan, R. A. (2010). Remote Sensing of Vegetation: Principles, Techniques, and Applications Oxford: Oxford University Press.  Iland, P.; Dry, P.R. Proffitt, T. and S. Tyerman (2011). The Grapevine: from the science to the practice of growing vines for wine; publisher: Patrick Iland Wine Promotions Pty Ltd</p>
Update:	Accreditation document Feb. 2012 – Updated September 2016

	<h2>Viticulture</h2>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Pilar Baeza Trujillo, Prof. PhD (Universidad Politécnica de Madrid); Manfred Stoll, PhD (Hochschule Geisenheim University);
Lecturers:	<p><u>PU Vineyard management coordinator:</u> Pilar Baeza</p> <p><i>Additional lecturers:</i> Jorge Queiroz, Prof. PhD (University of Porto); Anne Pellegrino, PhD (Montpellier SupAgro), Jesus Yuste, PhD (ITA Castilla y Leon, Valladolid); Aurélie Métay, PhD (Montpellier SupAgro); Alain Deloire, Prof. PhD HDR (Montpellier SupAgro), Thibault Scholasch, PhD (Fruition Sciences); Laurent Torregrosa, Prof. PhD HDR (Montpellier SupAgro)</p> <p><u>PU Vine pest control coordinator:</u> Serge Kreiter, Prof. PhD HDR (Montpellier SupAgro),</p> <p><i>Additional lecturers:</i> Beate Berkelmann-Loehnertz, Prof. Dr. (Geisenheim University); Véronique Marie-Jeanne, PhD (Montpellier SupAgro); Daniel Esmenjaud, PhD (INRA Sophia Antipolis); René Sforza, PhD (EBCL USDA / ARS), Marie-Stéphane Tixier, PhD HDR (Montpellier SupAgro).</p>
Language:	English
Classification curriculum:	Core module of the common first academic year
Teaching format:	In blocks: PU Vineyard management 30 h, Vine pest control 30 h,
Workload:	<p><u>PU Vineyard Management (3.5 ECTS)</u></p> <p>Face to face teaching: 24 h of lectures + 3 h of field visits (partly together with PU Vine pest control) + 3 half-day seminars          Personal study: 30 hours minimum.</p> <p><u>PU Vine Pest Control (3.5 ECTS)</u></p> <p>Face to face teaching: 27 h of lectures + 3 h of directed exercises          Personal study: 30 hours minimum.</p>
Credit points:	7 ECTS
Recommended prerequisites:	Basic knowledge in Viticulture as delivered in the module Terroir and Company Auditing and during the Vine Biology, Ecology & Physiology modules.

Targeted learning outcomes:	<ul style="list-style-type: none"> <li>- know about the choice of cultivation practices in relation to the ecophysiology of the vine and the environment</li> <li>- know innovative techniques closely linked to research</li> <li>- know about adaptation of the vineyard management to either the valuation of terroir in the context of sustainable viticulture, or to an industrial approach of wine productions and derivatives</li> <li>- know about global aspects of technical approaches for temperate, warm/dry and tropical viticulture</li> <li>- know about the biology and epidemiology of the main pests, diseases and weeds of vines in the world, how they interact and to understand integrated and organic strategies of control</li> <li>- know tools for the diagnosis of pests and diseases</li> </ul>
Content:	<ul style="list-style-type: none"> <li>- Techniques needed to set up a vineyard</li> <li>- Soil management strategies</li> <li>- Irrigation equipment and monitoring</li> <li>- Canopy management, trellising</li> <li>- Cool/dry/warm viticulture</li> <li>- Steep slope and tropical viticulture</li> <li>- Mites in vineyards</li> <li>- Cicadellids and transmitted pathogens</li> <li>- Grape moths and other insects</li> <li>- Viruses of vines</li> <li>- Coccoids and transmitted pathogens</li> <li>- Nematodes and transmitted pathogens</li> <li>- Grapevine wood diseases</li> <li>- Vine fungi and bacteria</li> <li>- Pedology and Soil zoning</li> <li>- Methodology of soil mapping</li> <li>- Study visits</li> </ul>
Exam achievements:	Evaluation of practical work and written examination
Forms of media:	Powerpoint, whiteboard, internet, field visit and practical work; field studies
Literature:	<p>Carbonneau A., Deloire A., Jaillard B., 2007. La Vigne : Physiologie, Terroir, Culture. 2007. Dunod Ed., 442p + annexes. Part B – Reasoning Grapevine cultivation and Terroir</p> <p>Coombe B., Dry P., 2006. Viticulture. Volume 2 Practices. Winetitles Ed. Chapters on Irrigation, Soil management, Fertilization.</p> <p>Goodwin, 1995. Irrigation of Vineyards: a Winegrape Grower's Guide to Irrigation Scheduling and Regulated Deficit Irrigation.</p> <p>Tiercelin J.-R., Vidal A., 2006. Traité d'irrigation (2<sup>ème</sup> édition). Lavoisier Ed., 1266p.</p> <p>GiESCO proceedings</p> <p>Compendium of grape diseases. Pearson, Lavoisier ed. 01-1988.</p> <p>Grape Pest Management. Second Edition. Publication 3343. Published 1992. 412 pages - ISBN 0-931876-96-6</p> <p>Integrated pest management of grapevines: Present and future strategies. Proceedings of the Nelson J. Shaulis Viticulture</p>


	<p>Symposium, March 5 and 6, 1991. New York State Agricultural Experiment Station, Cornell University, Geneva, New York.</p> <p>Diseases and Pests. Grape Production Series Number 1. Phil Nicholas. 1994. Winetitles</p> <p>Field Guide to Diseases, Pests and Disorders of Grapes. M.C. Kelly, A.M. McGregor, M.F. Wachtel, P.A. Magarey. 2000. Winetitles.</p> <p><a href="http://www.hort.uconn.edu/IPM/ipmgrapes.htm">http://www.hort.uconn.edu/IPM/ipmgrapes.htm</a></p> <p><a href="http://nrcgrapes.nic.in/Trg-Development%20of%20IPM%20in%20Grapes.htm">http://nrcgrapes.nic.in/Trg-Development%20of%20IPM%20in%20Grapes.htm</a></p> <p><a href="http://www.rakgrape.com/books.php">http://www.rakgrape.com/books.php</a></p> <p>Van Leeuwen C., Trégoat O., Choné X., Bois B., Pernet D. and Gaudillère J.-P., 2009. Vine water status is a key factor in grape ripening and vintage quality for red Bordeaux wine. How can it be assessed for vineyard management purposes? J. Int. Sci. Vigne Vin, <b>43</b>, n°3, 121-134.</p> <p>Van Leeuwen C. and Seguin G., 2006. The concept of terroir in viticulture. J. Wine Research, <b>17</b>, n°1, 1-1.</p> <p>Roby J.-P., Van Leeuwen C. et Marguerit E. 2008. Références Vigne. Références technico-économiques de systèmes de conduite de la vigne. 2<sup>e</sup> édition. Ed. Synthèse Agricole – Lavoisier, Paris. ISBN 978-910340-50-6, 269p.</p> <p>Van Leeuwen C., Bois B., Cellié N., Trégoat O. et Roby J.-P., 2009. Les modifications de l'expression du terroir induites par le changement climatique nécessitent une adaptation du matériel végétal et des techniques viticoles. Revue Française d'oenologie, <b>n°235</b>, 10-14.</p> <p>Roby J.-P. Et Van Leeuwen C., 2006. Mécanisation des vignes étroites : concilier qualité et maîtrise des coûts. Sitévinitech, Bordeaux, 28 novembre 2006. Avec actes.</p>
Update:	Accreditation document Feb. 2012 – Updated September 2016



	<h2 style="margin: 0;">Wine Analysis</h2>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Olga Laureano, Prof. PhD HDR (Universidade de Lisboa)
Lecturers:	<p><u>PU Wine analysis:</u>  <u>Lecturer in charge:</u> Olga Laureano, HRD PhD. (Universidade de Lisboa);  <u>Additional lecturer:</u> Piergiorgio Comuzzo, PhD (Università di Udine)</p> <p><u>PU Wine sensory analysis:</u>  <u>Lecturer in charge:</u> Alain Razungles, Prof. PhD HDR (Montpellier SupAgro)  <u>Additional lecturer:</u> Jean-Christophe Barbe, PhD, HDR (Bordeaux Sciences Agro).</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	In a block: (PU Wine Analysis 25 h) Continuous : (PU Sensory Analysis 9h lectures + 35 h TD)
Workload:	<p><u>PU Wine analysis:</u>          Face to face lectures 10 h; directed exercises 15 h;  <u>PU Wine sensory analysis:</u>          Montpellier: Face to face lectures 6 h; practical sensory analysis 28 h;          Bordeaux: 10h (3h lectures + 7h TD)          Student's personal study time in the module: 56 h</p>
Credit points:	5 ECTS
Recommended prerequisites:	NONE
Targeted learning outcomes:	<p><u>PU Wine Analysis:</u>  <u>students</u></p> <ul style="list-style-type: none"> <li>- understand the role of analytical chemistry on grape and wine quality control</li> <li>- are able to interpret the wine analyses results in order to decide and to control the wine treatments as well as the assessment of legal and commercial wine specifications.</li> </ul>


	<p><u>PU Wine Sensory Analysis:</u></p> <ul style="list-style-type: none"> <li>- students know the theoretical back ground of sensory analysis</li> <li>- they know the main principles and techniques applied in sensory analysis</li> <li>- they are aware of the flavor development and can distinguish the differences between varieties and the influence of the terroir and regions</li> <li>- with these principles and techniques they are able to carry out quality control from the harvest to the final product ready for the customer</li> <li>- they know how Descriptive Sensory Analysis permits product traceability</li> <li>- students know a vast field of application implying varied techniques covering comparative and descriptive tests</li> <li>- students will have indispensable skills in Sensory Analysis extremely useful in any field of vine.</li> </ul>
Content:	<p><u>PU Wine Analysis:</u></p> <p>Grape vine ripeness control: analytical control of sugars and acidity; concepts and analyses of technological and phenolic maturity indexes.</p> <p>Wines, quality and quality control: quality characteristics; critical control points in wine processing; legal and commercial wine specifications. Classical and modern wine analysis; regulatory requirements.</p> <p>Wine contaminants: ochratoxin A, biogenic amines and ethyl carbamate; occurrence and oenological strategies to reduce the risk of contamination.</p> <p><u>PU Wine Sensory Analysis:</u></p> <p>Introduction to Sensory Analysis in general and specially of wine; Data analysis Selection and training of judges called for Sensory Analysis; Make up of homogeneous jury adapted to the different test; Different tests applied in Sensory Analysis (parametric or not) and statistical analysis of results; Different steps of practical descriptive tastings; Semantics of descriptive Sensory Analysis and its various techniques of application in tastings, use of vocabulary (free or pre-established). Tasting grids. Descriptive Sensory Analysis versus the influence of quality factors (terroir, grape varieties)</p>
Exam methods:	<p><u>PU Wine Analysis:</u></p> <p>Evaluation of the written reports of the laboratory sessions and personal participation in the lab sessions.</p> <p><u>PU Wine Sensory Analysis:</u></p> <p>Continuous assessment of knowledge during tasting sessions</p>
Forms of media:	<p><u>PU Wine Analysis:</u></p> <p>Powerpoint slides, whiteboard, scientific and technological articles.</p>

	<p><u>PU Wine sensory analysis:</u> Practical sensory analysis in tasting room</p>
Literature:	<p><u>PU Wine analysis:</u>  Boulton, R.B., Singleton, V.L.; Bisson, L.F.; Kunkee, R.E. (1995) – Principles and Practices of Winemaking, Chapman &amp; Hall, New York.  Flanzy, C. (1998) – Oenologie, fondements scientifiques et technologiques. Tec &amp; Doc, Londres, Nova Lorque, Paris.  Jackson, R (1994) – Wine Science. Principles and Applications, Academic Press, New York.  O.I.V. (2008) – Compendium of international methods of wine and must analysis. O.I.V., Paris.  Ribéreau-Gayon, P. ; Glories, Y. ; Maujean, A. ; Dubourdieu, D. (1998) – Traité d’Oenologie. 2. Chemie du Vin, Stabilisation et Traitements, Dunod, Paris.  Zoecklein, B.W., Fugelsang, K.C., Gump, B.H., Nury, F.</p> <p><u>PU Wine Sensory Analysis:</u>  O’Mahony. Sensory evaluation of food – Statistical methods. 1986. Ed.: Marcel DEKKER, Inc. New York. 487p</p>
Update:	Accreditation document Feb. 2012 Updated September 2016

	<h2 style="margin: 0;">Wine Processing</h2>
Academic Year:	1 <sup>st</sup> academic year at Montpellier SupAgro
Module coordinator:	Aude Vernhet, Prof. PhD HDR (Montpellier SupAgro)
Lecturers:	<p><u>PU Wine making:</u>  <u>Lecturer in charge:</u> Antonio Morata, Prof. PhD (Universidad Politécnica de Madrid),  <u>Additional lecturers:</u> Monika Christmann, Prof. Dr. (Geisenheim Hochschule University), Alain Razungles, Prof. PhD HDR (Montpellier SupAgro), Santiago Benito, Prof. PhD (Universidad Politécnica de Madrid), Matthias Schmitt, PhD, (Geisenheim Hochschule University), Wendu Tesfaye, Prof. PhD (Universidad Politécnica de Madrid).</p> <p><u>PU Post-vinification:</u>  <u>Lecturer in charge</u> Aude Vernhet, Prof. PhD HDR (Montpellier SupAgro)  <u>Additional lecturer:</u> Mark Strobl, Prof. Dr.-Ing. (Geisenheim University).</p>
Language:	English
Classification within the curriculum:	Core module of the common first academic year
Teaching format:	In block (2 blocks: PU Wine making 43 h; PU Post-vinification 36 h)
Workload:	<p><u>PU Wine making:</u>  Face to face lectures: 43 h  <u>PU Post-vinification:</u>  Face to face lectures: 27 h; directed exercises 4 h; study visit 8 h</p> <p>Student's personal study time in the module: 100 h</p>
Credit points:	7 ECTS
Recommended prerequisites:	Basic knowledge in Enology as delivered in the module “Immersion” during the immersion period.
Targeted learning outcomes:	<p><u>PU Wine Making:</u></p> <ul style="list-style-type: none"> <li>- students know wine making process in white and rosé wines</li> <li>- they know wine making process in red wines</li> <li>- they understand ageing of white and red wines (vat/barrel)</li> <li>- and know other kinds of wines: Sparkling, fortified, sweet wines</li> </ul> <p><u>PU Post-vinification:</u></p> <ul style="list-style-type: none"> <li>- students know about the main physico-chemical changes and alterations liable to occur in wines;</li> <li>- they know the methods used to assess the risks and the stabilization</li> </ul>

	<p>methods (unit operations, fining, additives...) implemented to prevent them and ensure product conservation;</p> <ul style="list-style-type: none"> <li>- students have acquired theoretical and applied basis for the implementation and control of the unit operations used for wine (must) clarification and microbiological stabilization;</li> <li>- they know basics about wine packaging technologies.</li> </ul>
Content:	<p><u>PU Wine Making:</u></p> <p>Engineering of pre-fermentative processes</p> <p>White and rosé wines: Preparation of must and juice (Destem, Crush, Pressing, SO<sub>2</sub> addition.). Fermentation.</p> <p>Red Wines: Preparation of must and juice (Destem, Crush, SO<sub>2</sub> addition). Maceration/Fermentation. Maceration techniques-increasing the extraction, Pressing, MLF.</p> <p>Barrel Aging of white and red wines</p> <p>Special wines/Special techniques</p> <ul style="list-style-type: none"> <li>- Thermovinification</li> <li>- Flash expansion</li> <li>- Carbonic maceration</li> <li>- Special vinifications</li> <li>- Sparkling wines</li> <li>- Fortified wines</li> <li>- Botrytis spoiled wines</li> </ul> <p><u>PU Post-vinification:</u></p> <ul style="list-style-type: none"> <li>- Wine clarification and stabilization: necessity and objectives</li> <li>- Main colloidal instabilities in wines – risk assessment and stabilization methods.</li> <li>- Theoretical and practical aspects of wine fining.</li> <li>- Wine (must) clarification: principle of the different unit operations and their control in enology (centrifugation/floatation, dead-end filtrations, cross-flow microfiltration)</li> <li>- Crystallization of tartaric salts in wines: origin and stabilization methods (nucleation and crystal growth, impact of wine constituents, TID, Tsat and ISTC 50 tests, cold stabilization, electrodialysis, additives).</li> <li>- Microbiological stabilization (membrane filtration, flash pasteurization, pasteurization, hotfilling, tunnel pasteurization).</li> <li>- SO<sub>2</sub> and other additives.</li> <li>- Glass bottle production, PET bottle production, bottle inspection, bottling of glass bottles, PET bottles, Tetra Pak, Bag in Box and kegs, flash pasteurization, pasteurization, hot filling, membrane filtration, corks, crown corks, screw closures, Vino Lok, level adjustment and control, labelling.</li> </ul>
Assessment methods:	Written Examination
Teaching media:	PowerPoints; whiteboard; papers, industry films, pdf scripts
Literature:	<p><u>PU Wine Making:</u></p> <p>Boulton, R. B., Singleton, V. L., Bisson, L. F., Kunkee, R. E. 1996. Principles and Practices of Winemaking. Chapman and Hall, New York. Chapter 3. Preparation of musts and juice. Chapter 5. Red and white table wines. Chapter</p>

	<p>10. The maturation and aging of wines</p> <p>Ribereau-Gayon, P., Y. Glories, A. Maugean, and D. Dubourdieu. (eds.). 2000. Handbook of Enology Volume 2: The Chemistry of Wine Stabilization and Treatments. John Wiley &amp; Sons, New York. Chapter 13. Aging red wines in vat and barrel: Phenomena occurring during aging.</p> <p>Reynolds A.G. (Ed.), 2010 Understanding and managing wine quality and safety. Two Volumes 624p and 640p. Woodhead Publishing Ltd., Cambridge. Vol 1 Part 3. Vol 2 Part 1 and 2</p> <p>Butzke C.E. (Ed.), 2010. Winemaking problems solved. 398p. Woodhead Publishing Ltd., Cambridge.</p> <p>SCI Journals for complementary references</p> <p>Am. J. Enol. Vitic.; S. Afric. J. Enol. Vitic.; Aust. J. Grape Wine Res.; J. Int. Sci. Vin. Wine.; J. Agric. Food Chem.; Food Chem.</p> <p>Suggested reviews:</p> <p>Sacchi, K. L., Bisson, L. F. &amp; Adams, D. O. (2005). A review of the effect of winemaking techniques on phenolic extraction in red wines. Am. J. Enol. Vitic. 56, 197-206.</p> <p>Gómez-Plaza, E. &amp; Cano-López, M. (2011). A review on micro-oxygenation of red wines: Claims, benefits and the underlying chemistry. Food Chemistry, 125, 1131–1140.</p> <p>Garde-Cerdán, T. &amp; Ancín-Azpilicueta, C. (2006). Review of quality factors on wine ageing in oak barrels Trends in Food Science &amp; Technology, 17, 438–447.</p> <p><u>PU Post-vinification:</u></p> <p>Ribereau-Gayon, P., Y. Glories, A. Maugean, and D. Dubourdieu. (eds.). 2000. Handbook of Enology Volume 2: The Chemistry of Wine Stabilization and Treatments. John Wiley &amp; Sons, New York.:</p> <ul style="list-style-type: none"> <li>* Chapter 8. Chemical nature, origin and consequences of the main organoleptic defects.</li> <li>* Chapter 9. The concept of clarity and colloidal phenomena.</li> <li>*Chapter 10. Clarification and stabilization treatments: fining wines.</li> <li>* Chapter 11. Clarifying wine by filtration and centrifugation.</li> <li>* Chapter 12. Stabilizing wine physical and physicochemical processes</li> </ul> <p>- Gautier B. - Practical aspects of wine filtration – Avenir œnologie – France.</p> <p>SCI Journals for complementary references (Am. J. Enol. Vitic., J. Int. Sci. Vin. Wine, J. Agric. Food Chem., J. Membrane Science, Food chemistry,...)</p> <p>Reviews:</p> <ul style="list-style-type: none"> <li>- Cadot Y. New developments in crossflow filtration. The Australian Grapegrower &amp; Winemaker, August 2001, pp 101-105.</li> <li>- Daufin, G.Escudier, J. P.Carrere, H.Berot, S.Fillaudeau, L.Decloux, M., 2001. Recent and emerging applications of membrane processes in the food and dairy industry. Food and Bioproducts Processing, 79 (C2), 89-102.</li> <li>Waters, E.J., Alexander, G., Muhlack, R.Pocock, K.F.Colby, C.O'Neill, B.K.Hoj, P.B.Jones, P.(2005). Preventing protein haze in bottled white wine. The Australian Journal of Grape and Wine Research, 11, 215-225.</li> </ul>
Update:	Accreditation document Feb. 2012 Updated September 2016

	<b>Terroir and Company auditing</b>
Academic Year:	A module of the Immersion period that is delivered at the beginning of the Vinifera EuroMaster degree programme, and as an integrative course at the end of the M1.
Module coordinators:	Jean Philippe Roby (Bordeaux Sciences Agro) and Patrice Lallemand (Montpellier SupAgro)
Lecturers: (including immersion period)	Vittorino Novello, Prof. (Università degli studi di Torino); Aude Vernhet, Prof. PhD HDR (Montpellier SupAgro); Didier Olle, PhD (Montpellier SupAgro); Alain Razungles, Prof. PhD (Montpellier SupAgro), Laetitia Mous, PhD (University of Montpellier 1); Mark Strobl, Prof. PhD (Hochschule RheinMain); Eric Dubreucq, Prof. PhD HDR (Montpellier SupAgro); Bruno Blondin, Prof. PhD HDR (Montpellier SupAgro), Kees Van Leeuwen, Prof. Ph.D (Montpellier SupAgro), Anne Pellegrino, PhD (Montpellier SupAgro); Laurent Torregrosa, Prof. PhD HDR (Montpellier SupAgro); Patrice Lallemand, MSc. (Montpellier SupAgro) Jean-Philippe Roby, Ing. Agr. (Bordeaux Sciences Agro), Bernard Del'Homme, Ph.D (Bordeaux Sciences Agro); Isabelle Masneuf, PhD (Bordeaux Sciences Agro), Jean-Christophe Barbe, PhD (Bordeaux Sciences Agro).
Language:	English
Classification within the curriculum:	Compulsory module
Teaching format:	In 2 blocks: 1/ offered during the 2-week long Immersion period* at Montpellier SupAgro and Pech Rouge (experimental field station/winery in Gruissan, Aude):  * The aim of the Immersion Period is: - to organize all necessary administrative matters and to introduce the international dimension into the new study environment (local and regional) - to introduce the students to the structure and organization of the Vinifera EuroMaster degree programme - to offer the introduction and cultural learning module "Immersion"  2/ offered during the 4-week integrative module at the end of the M1 at Bordeaux Sciences Agro
Workload:	Lectures (55 h): viticulture 15 h; oenology 15 h; inter cultural workshops 5 h; auditing 20h Practical exercises: 10 h (tasting and wine-making) 10h

	<p>(auditing)</p> <p>Study trip: 1 day</p> <p>Personal studies including literature studies to bridge existing gaps and project 40 hours</p>
Credit points:	5 ECTS
Recommended prerequisites:	<p>Basic knowledge in chemistry, physic, biochemistry, botany and plant biology usually obtained in former Bachelor studies in plant production or Food Sciences.</p> <p>Knowledge of the economics module</p>
Targeted learning outcomes:	<p>Students</p> <ul style="list-style-type: none"> <li>- have a first overview concerning worldwide viticulture</li> <li>- know the history of viticulture and grape production</li> <li>- know the basic technologies for the cultivation of grapevine and the production of grapes for wine making</li> <li>- are aware of the main characteristics and challenges of the Wine Sector</li> <li>- understand the on-going activities in vineyards and cellars around Montpellier and know the special professional features of this region</li> <li>- have the chemical, biochemical and physical bases necessary to follow the enological courses. These bases are common to food science and processing in general and also in beverage and wine production.</li> <li>- know the basic technologies and equipment for winemaking</li> <li>- know about the diversity of the skills needed by oenologists</li> <li>- have experience in intercultural communication and in working in multicultural groups</li> <li>- have first experience in Sensory Analysis of wines</li> <li>- know about the financial aspects of wine company management</li> <li>- understand the interactions between vineyard, wine production and commercial aspects (systematic approach)</li> <li>- can apply practical methods in company auditing</li> </ul>
Content:	<p><u>Introduction to viticulture and enology</u></p> <ul style="list-style-type: none"> <li>- worldwide Viticulture</li> <li>- technologies and approaches in grapevine cultivation and grape production</li> <li>- history of viticulture and grape production</li> <li>- special features of the agriculture, viticulture and enology of the Languedoc-Roussillon region (including study trip)</li> <li>- workshops on harvest and wine-making at Pech Rouge research station</li> <li>- fundamentals in biochemistry and their application in wine making</li> <li>- fundamentals in chemistry in relation to wine making</li> <li>- laboratory analyses techniques</li> <li>- fundamentals in physics in relation to the application in wine making</li> </ul>



	<ul style="list-style-type: none"> <li>- extraction and separation techniques</li> <li>- biological transformations</li> <li>- temperature control</li> <li>- hygiene measures and materials</li> </ul> <p><u>Intercultural learning</u></p> <ul style="list-style-type: none"> <li>- workshops on intercultural communication</li> <li>- workshops on intercultural experience</li> </ul> <p><u>Company Auditing:</u></p> <ul style="list-style-type: none"> <li>- Methodology of company auditing (wine making aspects and economic aspects)</li> <li>- Audit coaching</li> <li>- Study visit</li> </ul>
Exam achievements:	<p>Auditing: Written examination (group and individual evaluation Powerpoint presentation on company audit 50 %) - 4 ECTS Group Project (1 ECTS)</p>
Forms of media:	<p>Field visits, power point, black board, scientific and technological articles, serious game and workshops. Script with pdf- files, films on CD</p>
Literature:	<p>During the Immersion Period the students will be introduced to the library of Montpellier SupAgro.</p> <p><u>ENOLOGY:</u> Introduction to Food Chemistry by Richard K. OWUSU-APENTEN (2004). CRC Press. Food: the chemistry of its components by T.P. Coutate Royal Society of Chemistry, 4 edition, 2001 Transport Processes and Separation Process Principles by Christie J. Geankoplis, Prentice Hall PTR, 4 edition, (March 2003) Physical principles of food preservation, by Marcus KAREL, Daryl B. Lund and Karel KAREL CRC (Marcel Dekker Ltd) 2003</p> <p><u>Web sources:</u> Unit operations in food processing, R.L. Earle and M.D. Earle, <a href="http://www.nzifst.org.nz/unitoperations/index.htm">http://www.nzifst.org.nz/unitoperations/index.htm</a></p> <p>Carbohydrates: 1/ Introduction to carbohydrates: <a href="http://web.indstate.edu/thcme/mwking/carbohydrates.html">http://web.indstate.edu/thcme/mwking/carbohydrates.html</a> 2/ Basic nomenclature of carbohydrates (including a test to evaluate its own knowledge): <a href="http://www.db.uth.tmc.edu/faculty/alevine/1521_2000/carborev.htm">http://www.db.uth.tmc.edu/faculty/alevine/1521_2000/carborev.htm</a></p>

3/ Biochemistry of carbohydrates:

<http://en.wikipedia.org/wiki/Carbohydrate>

4/ Disaccharides and Polysaccharides:

<http://dl.clackamas.edu/ch106-07/disaccha.htm>

5/ Reducing sugars:<http://dl.clackamas.edu/ch106-07/reducing.htm>

Other literature or internet links are given in the scripts provided by lecturers.

#### VITICULTURE:

Mullins, M. Bouquet, A. & Williams, L. E.: Biology of the Grapevine. Cambridge University Press 1992.

Coombe B.G., Dry P.R., Viticulture. Vol. 1. Winetitle, 1992

Winkler A. et al., General viticulture, University of California Press, 1975.

***Iland P., Dry P., Proffitt T., Tyerman S.: The Grapevine: from the science to the practice of growing vines for wines, Patrick Iland Wine Promotions Pty Ltd 2011.***

#### INTERCULTURAL LEARNING:

Council of Europe, T-Kit 11 Mosaic : The training kit for Euro-Mediterranean youth work : [http://youth-partnership-eu.coe.int/youth-partnership/publications/T-kits/T\\_kits](http://youth-partnership-eu.coe.int/youth-partnership/publications/T-kits/T_kits)

Publications of the Directorate of youth and of the Partnership between the Council of Europe and the European Commission : [http://www.coe.int/t/dg4/youth/resources/documents/bibliographies/intercultural\\_education\\_EN.asp](http://www.coe.int/t/dg4/youth/resources/documents/bibliographies/intercultural_education_EN.asp)

#### AUDITING:

AAKER D., (1996), Building Strong Brands, The Free Press.

ANDERSON, K. (2004), The World's Wine Market – Globalization at Work, Edward Elgar Publishing Limited, Glensanda House, Montpellier Parade, Cheltenham, Glos GL 50 1 UA, UK (Available online on Google)

C D'HAUTEVILLE F., COUDERC J.-P., HANNIN H., MONTAIGNE E., Bacchus 2005, 2006, 2008 (3 volumes), Enjeux ,Stratégies et pratiques dans la filière vitivinicole, Dunod, Paris. DESMOND J., (2003), Consumer Behaviour, Palgrave  
EVANS M., MOUTINHO L.(1999)., Contemporary issues in Marketing, MacMillan Business.HANNIN, H.; CODRON, J.-M.; THOYER, S. (2006), The International Office of Vine and Wine (OIV) and the World Trade Organization (WTO):

Standardization Issues in the Wine Sector, in BINGEN J.;

BUSCH L.(ed.), Agricultural Standards: The Shape of the Global Food and Fiber System, Springer, Netherlands, p.73-96.

HEIJBROEK, A.(2007), Changing competitiveness in the wine

	<p>industry, The rise and fall of wine countries, Rabobank Publishing, The Netherlands.</p> <p>INTERNATIONAL ORGANISATION OF VINE AND WINE (OIV), State of the Vitiviniculture World Market OIV Report (2002-2010), (Available online at <a href="http://www.oiv.int">http://www.oiv.int</a>)</p> <p>JENSTER P.V., SMITH D., MITRY D.J., JENSTER L., (2008), The Business of Wine. A Global Perspective, Copenhagen School Press 197 p.</p> <p>KOTLER P., ARMSTRONG G., (2006), Principles of Marketing, Pretince Hall, New York.</p> <p>MONTAIGNE, E.; COELHO, A. coordinators, (2006), The reform of the common market organization for wine, Policy Department and Cohesion Policies, European Parliament, Brussels, 75 p. + appendixes 120p. (Available online at <a href="http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_en.pdf">http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_en.pdf</a>; <a href="http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_annex_en.pdf">http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe369.020_annex_en.pdf</a>)</p> <p>MONTAIGNE, E ; RASTOIN, A., COELHO A.(2006), Globalization of the world wine market and restructuring of the supply side, INRA Sciences Sociales, No 5-6, November 2006. (Available at <a href="http://www.inra.fr/internet/Departements/ESR/publications/iss/pdf_eng/iss06-5_7Globalization_Eng.pdf">http://www.inra.fr/internet/Departements/ESR/publications/iss/pdf_eng/iss06-5_7Globalization_Eng.pdf</a>)</p> <p>ROUZET E., SEGUIN G., (2003), Le marketing du vin, Savoir vendre le vin, Dunod, Paris.</p> <p>SCARPA R., THIENE M., GALLETTO L., (2009), Consumers WTP for Wine with Certified Origin: Preliminary Results from Latent Classes Based on Attitudinal Responses, Journal of Food Products Marketing, 15, 231-248.<a href="http://www.vitisphere.com">http://www.vitisphere.com</a></p>
Update:	Accreditation document; Updated September 2016