



## THE SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

WS/CHM 305

3 credits (45 contact hours)

### CHEMISTRY AND BIOCHEMISTRY OF WINE PRODUCTION

#### COURSE DESCRIPTION

Course provides an introduction to the winemaking process with highlights on the chemical and biochemical transformation of grapes from their early growth stages to maturity and during the processes of vinification and wine aging. The course will explore the criteria of selection of cultivars and growing conditions, biochemical transformation of grapes and its relation to the edaphic and climatic conditions, the timing of harvest, the fermentation process common to all winemaking procedures and the chemistry of wine aging. The course discusses equally the possible consequences of global climate change on wine properties and international commerce.

In average, grape juice at maturity consists of 79% water, 20% carbohydrates, 1% organic acids and trace amounts of phenolics, vitamins, minerals and nitrogenous compounds. Wine, born from this same juice, is made roughly of 85% water, 12% alcohol and 3% of a multitude of chemical compounds including organic acids, phenolics, glycerol, higher alcohols, sugars and minerals. These 3% gives wines their unique flavours and consequent economic value and are of great concern for wine makers, traders and consumers.

The course consists of 3 teaching hours per week in addition to multiple visits throughout the semester to wineries and vineyards in the Provence region in the south of France and neighbouring wine-producing regions. Prerequisites to the course include basic knowledge in chemistry, biology, biochemistry and/or any related disciplines.

#### COURSE OBJECTIVES

- Understand the science of winemaking and its interdisciplinary nature
- Familiarize with techniques used for wine processing and aging and their consequences on wine properties
- Understand the link between global climate change and the future trends wine production
- Networking!

#### LEARNING OUTCOMES

Students taking this class are expected to:

1. Identify the key wine producing regions worldwide

2. Know the most common vine cultivars, especially those common in the south of France and in the Mediterranean basin
3. Understand the connection between environmental conditions and wine properties and quality
4. Understand the biochemical transformation in grapes from early growth to maturity and the conditions controlling the timing of harvest
5. Identify the principal chemical compounds in mature grape juice
6. Identify and describe the key steps in the process of vinification
7. Understand the basic steps in alcoholic fermentation and how it is kept under control
8. Recognize the key compounds influencing wine properties and quality
9. Describe the process of wine aging and the related transformation in wine properties
10. Familiarize with basic wine analysis
11. Explore the possible impacts of global climate change on the winemaking industry and international commerce
12. Familiarize with common vocabulary proper to viticulture and the science of winemaking

### **INSTRUCTIONAL METHODS AND ACTIVITIES**

- In-class lectures and discussions
- Fieldwork and visits to vineyards and wineries
- Meetings with local and regional wine producers
- Students' presentations and written reports

### **TEXTBOOKS**

Indicative. Additional references & readings will be provided during the semester

#### **The Chemistry and Biology of Winemaking (Main textbook)**

ian Hornsey Rober W. Christopherson  
The Royal Society of Chemistry 2007  
ISBN-13: 978-0-85404-266-1

#### **Wine Chemistry and Biochemistry**

Victoria Moreno-Arribas and Carmen Polo, Editors  
Springer Science & Business Media 2009  
ISBN: 978-0-387-74116-1

#### **Menace sur le vin : Les défis du changement climatique (Threat on Wine: the Climate Change Challenge)**

Valéry Laramée de Tannenberg and Yves Leers  
Dans le vif, Sept. 2015  
ISBN-13: 978-2283027943

### **EVALUATION AND GRADING**

- 10%: Attendance and class activity
- 10%: Assignments and short quizzes
- 15%: Oral presentation based on selected readings relevant to the course material
- 15%: Written reports based on fieldwork
- 25%: Midterm exam
- 25%: Final exam on materials treated after the midterm exam

## **LECTURES, SHOWS, EXHIBITS, WORKSHOPS, EVENTS, ETC.**

Commensurate with your study abroad, we should be constantly prepared to take advantage of any events that would enrich the material of the course and add to your learning experience. Over the semester, the syllabus may be adjusted according to the activities taking place in Aix or organized by IAU.

## **ATTENDANCE**

One of the primary requirements this semester is that you attend class. This is not a lecture class, and its success depends very much on your coming to class on time, prepared for the lesson, and ready to participate in discussion and activities. Attendance will be part of your final grade. About attendance: unexcused absences have a negative impact on your final grade. Each unexcused absence above two will lower the final grade by a half-letter grade. IAU excused absences: absences linked to IAU excursions; sickness (a medical certificate is required).

## **DETAILED SEMESTER PROGRAM**

### **Week 1: Introduction, History of Wine and Winemaking**

### **Week 2: Ecology of Viniculture**

- Climatic conditions
- Soil properties

### **Week 3: The Vine**

- Origin, Taxonomy and Biogeography
- The Grape structure
- The Maturation Processes

### **Week 4: The Yeast and Fermentation**

- The Yeast
- The Fermentation

### **Week 5-6: Winemaking Processes**

- Red Wine Production
- White Wine Production
- Sparkling Wine Production
- Cold Maceration
- Carbonic Maceration
- Thermovinification

### **Week 7: Midterm exam**

### **Week 8: Lactic Acid Bacteria and Malo-Lactic Fermentation**

- Lactic Acid Bacteria
- Malo-Lactic Fermentation

### **Week 9: Wine Clarification**

- Proteins
- Polyvinyl Polypyrrolidone
- Bentonite

### **Week 10: Wine Stabilisation**

- Static Cold Stabilisation
- Contact Cold Stabilisation
- Ion-Exchange Stabilisation
- Prevention of Crystallisation
- Protein Instability

### **Week 11: Wine Preservation**

- Sulfur Dioxide
- Dimethyldicarbonate
- Sorbic Acid
- Benzoic Acid

### **Week 12: Maturation and Ageing**

- Sur Lie Storage of Wine
- Oak and Wine
- Maturation Reactions in Red Wine
- Corks

### **Week 13: Wine production and global climate change**

- Effect on the Timing of Harvest
- Effect on the level of sugars and the degree of alcohol
- Projected modifications of the global wine production

### **Week 14: Final Exam (only on Materials covered after the Midterm exam)**

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