

Course Syllabus
The History, Culture, and Science of Beer and Brewing
INTD 300/ENGR 300

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SECTION 1

Course Introduction

Credit Hours: 3 U.S. semester credits

Prerequisite Courses: none

Course Introduction: This course bridges the gap between historical tradition and industrial logic, exploring how engineering milestones—from medieval thermodynamics to modern biotechnology—have shaped the world’s most iconic beer styles. Through a blend of immersive history, light engineering principles, and integrated sensory labs, students will analyze the chemistry of raw materials and the physics of fermentation. Designed for both engineers and curious scholars, this experiential course transforms the study of producing beer into a case study of innovation, sustainability, and German heritage.

Course Learning Outcomes

Successful students should:

1. Trace the socio-technical evolution of brewing from ancient civilizations to modern industrial Germany.
2. Evaluate the chemical impact of raw materials (water, malt, hops, yeast) on the final flavor and stability of beer.
3. Describe the core engineering principles behind mashing, boiling, and fermentation processes.
4. Apply systematic sensory analysis to identify technical characteristics and quality markers in various beer styles.
5. Differentiate European brewing traditions based on their historical regulations and regional technological innovations.
6. Analyze environmental impact and circular economy models: Evaluate the sustainability challenges of the modern brewing industry, focusing on water conservation, energy recovery, and the repurposing of solid waste (*spent grain*).

Assessment

- A Achievement that is outstanding relative to the level necessary to meet course requirements.

- B Achievement that is significantly above the level necessary to meet course requirements.
- C Achievement that meets the course requirements in every respect.
- D Achievement that is worthy of credit even though it fails to meet fully the course requirements.
- P Achievement that is satisfactory, which is equivalent to a C- or better (achievement required for a P is at the discretion of the instructor but may be no lower than equivalent to a C-.)
- NP Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (see also I).
- I (Incomplete) - Assigned at the discretion of the instructor when, due to extraordinary circumstances, e.g., hospitalization, a student is prevented from completing the work of the course on time. Requires a written agreement between instructor and student.

Grading Scale (Based on points)

95 – 100	⇒ A	77 – 79	⇒ C+	59 – Lower	⇒ E
90 – 94	⇒ A-	74 – 76	⇒ C		
87 – 89	⇒ B+	70 – 73	⇒ C-		
84 – 86	⇒ B	67 – 69	⇒ D+		
80 – 83	⇒ B-	60 – 66	⇒ D		

Weight/Distribution of Course Points:	Points (100%)
Final written exams	25%
Oral presentation	25%
Written report	25 %
Class attendance and participation	25%

Due to the experiential nature of this course, active presence in lectures and sensory labs is essential for achieving the learning outcomes, as real-time analysis of chemical and cultural markers cannot be replicated outside the classroom.

Academic Policies

All program participants recognize and accept that the **CEPA ESC Academic Policies** apply to this course as well as to any other course offered through the European Study Center. These policies, which govern academic standards, expectations, and requirements for all CEPA ESC program participants, are published on the **CEPA ESC website** and are also accessible at any time through the **Policies tab** in the CEPA mobile app. You are required to read and understand these policies as they form part of the binding academic framework for this program.

Please ensure you **review the full CEPA ESC Program Policies** document as soon as possible and inquire with CEPA support staff or your faculty if you have questions, requests or concerns.

Course-Specific Applications and Clarifications

While all CEPA ESC Academic Policies apply uniformly across ESC programs, the instructor may provide additional course-specific details or clarifications regarding how certain policies are implemented in this course (for example, participation expectations, assignment formats, or submission procedures). Any such course-specific guidance is intended to supplement—not replace or contradict—the official CEPA ESC Academic Policies. In cases of discrepancy, the CEPA ESC Academic Policies take precedence.

SECTION 2

Class Meets: 4–5 days per week (Summer Program)

Duration: 1.75 hours per session (standard) / 3.5 hours (excursions)

Session	Expected Timeline of Major Assignments/Assessments and Topics/Units
1	Course Introduction & Syllabus review.
2	Distribution of Reading Materials (Monastic Brewing History).
4	Deadline: Selection of "Beer Style" for Oral Presentations.
6	In-class quiz on Raw Materials (Knowledge Check).
9	Excursion I: Technical Brewery & Historical Center.
12	Deadline: Submission of Written Report Outline.
15	Assessment: Written exam (Theoretical content Units 1-6).
16	Excursion II: Industrial Malthouse or Technical Malting Lab.
18	Compilation of sensory notes for final report workshop
20	Assessment: Oral presentation (Group A).
21	Assessment: Oral presentation (Group B).
22	Excursion III & final deadline: Submission of Written Report.

Class Schedule and Sequence of Instruction

Session	Date	Content
1	1.75 hours	1.1 <u>Liquid Bread: The Socio-Technical Origins of Beer</u> ➤ Discussion: Fermentation as a driver of agricultural settlement vs. nomadic life.
2	1.75 hours	1.2 <u>The Monastic System</u> ➤ Abbeys as Europe's first R&D centers for biotechnology. Lab: "The Ancestor" tasting (Witbier/Gruit) to identify pre-hop flavor profiles.
3	1.75 hours	2.1 <u>The German Soul: Reinheitsgebot & Purity Culture</u> ➤ The 1516 Purity Law: Political protectionism vs. early food safety regulations.
4	1.75 hours	2.2 <u>Water & Terroir</u> ➤ Selection of Beer Style for Oral Presentations. ➤ Lab: "The Gold Standard" – Comparing Helles vs. Pilsner and the chemistry of water.
5	1.75 hours	3.1 <u>The Malt & The Kiln: Engineering Color and Flavor</u> ➤ The Maillard Reaction: How thermal energy transforms starch into pigments and sugars. ➤ Reading of required instructional materials on malt enzymatic activity.

6	1.75 hours	<p><u>3.2 The Malthouse Tradition</u></p> <ul style="list-style-type: none"> ➤ Assessment: In-class Quiz on Raw Materials. ➤ Active Learning: "The Grain Chew" workshop with base, caramel, and roasted malts.
7	1.75 hours	<p><u>4.1 The Hops Revolution: Preservation & The British Empire</u></p> <ul style="list-style-type: none"> ➤ Botany & Biosecurity: Hops as a biological tool for long-haul maritime logistics.
8	1.75 hours	<p><u>4.2 The Engineering of Bitterness</u></p> <ul style="list-style-type: none"> ➤ Lab: "The Alpha Acid Trip" – Comparing English Pale Ale vs. American IPA.
9	2.5 hours	<p><u>Excursion: Traditional Brewery & Historical Center</u></p> <ul style="list-style-type: none"> ➤ Site visit: Technical visit of a traditional brewery. ➤ Focus on historical decoction mashing vessels and open fermentation architecture. ➤ Discussion on the urban integration of breweries in German city centers. ➤ In-situ analysis of brewery architecture and its impact on local urban design.
10	1.75 hours	<p><u>5.1 Cold Chain & Industrial Might: The Lager Revolution</u></p> <ul style="list-style-type: none"> ➤ Carl von Linde and the thermodynamics of refrigeration: Ending seasonal brewing.
11	1.75 hours	<p><u>5.2 The Physics of the Cave</u></p> <ul style="list-style-type: none"> ➤ Lab: "The Cold Side" – Tasting Bocks and Doppelbocks (the physics of cold maturation).
12	1.75 hours	<p><u>6.1 Yeast: The "Unseen" Engineer</u></p> <ul style="list-style-type: none"> ➤ Pasteur's Microscope: The cultural shift from "Divine Intervention" to Microbiology. ➤ Submission of Written Report Outline.
13	1.75 hours	<p><u>6.2 Esters & Phenols</u></p> <ul style="list-style-type: none"> ➤ Lab: "The Yeast Effect" – Identifying esters and phenols in Weissbier vs. Saison.
14	1.75 hours	<p><u>Mid-Term Synthesis</u></p> <ul style="list-style-type: none"> ➤ Review of required instructional materials for the written exam.
15	1.75 hours	<p><u>Assessment: WRITTEN EXAM</u></p> <ul style="list-style-type: none"> ➤ Theoretical content evaluation Units 1-6.
16	2.5 hours	<p><u>Excursion: Technical Visit to Malthouse or Malt Lab</u></p> <ul style="list-style-type: none"> ➤ Technical tour of germination floors and industrial drying kilns. ➤ Discussion on energy efficiency and heat recovery in industrial malting. ➤ Physical inspection of the malting supply chain. ➤ Workshop: Technical analysis of barley modification and heat efficiency in kilning.
17	1.75 hours	<p><u>7.1 Packaging, Pouring & The Physics of the Bar</u></p> <ul style="list-style-type: none"> ➤ Gas Laws (Henry's Law): Engineering the solubility of CO₂ and Nitrogen.
18	1.75 hours	<p><u>7.2 The Science of Service</u></p> <ul style="list-style-type: none"> ➤ Active Learning: "The Perfect Pour" workshop – Glass geometry and foam physics. Compilation of sensory notes.
19	1.75 hours	<p><u>8 Sustainability & The Future of the Global Pint</u></p> <ul style="list-style-type: none"> ➤ The Circular Brewery: CO₂ recovery and the German "Zero Waste" model (<i>Pfand</i>).
20	1.75 hours	<p><u>Assessment: ORAL PRESENTATIONS (Part I)</u></p> <ul style="list-style-type: none"> ➤ Group A
21	1.75 hours	<p><u>Assessment: ORAL PRESENTATIONS (Part I)</u></p>

		➤ Group B
22	2.5 hours	<p><u>Excursion: Large-scale industrial Production Plant</u></p> <ul style="list-style-type: none"> ➤ Final "Blind Sensory Challenge" ➤ Observation of high-speed automation and "Industry 4.0" systems. ➤ Inspection of CO₂ recovery plants and circular waste management (Sustainability in action). ➤ Laboratory: Overview of industrial quality control (QC) and microbiological safety protocols. <p>Submission of Written Report Outline.</p>

Instructional Materials

Required Instructional Materials:

- The Reinheitsgebot: 500 Years of the German Beer Purity Law (Official History & Articles) <https://www.brauer-bund.de/purity-law-500th-anniversary/>
- Brewing Science and Practice: Principles of Mashing, Boiling, and Enzyme Activity <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/brewing-science>
- Louis Pasteur and the Pasteurization of Beer: The Discovery of Yeast as a Living Organism <https://www.pasteur.fr/en/pasteur-foundation/pasteur-centenary/pasteur-beer>
- The Circular Economy of Brewing: Case Studies on \$CO₂\$ Recovery and Waste Management https://ec.europa.eu/environment/ecoap/about-eco-innovation/good-practices/eu/brewing-sustainability_en
- The Brewers of Europe: 2024 Statistics and Market Trends Report <https://brewersofeurope.org/site/media-centre/stats.php>

Optional Instructional Materials:

- The Physics of Beer Foam: Nucleation, Stability, and the Chemistry of Bubble Formation <https://www.acs.org/content/acs/en/pressroom/reactions/videos/2016/the-chemistry-of-beer-foam.html>
- A Pilsner Pilgrimage: The Craft Beer Revolution in the USA and Europe <https://www.newyorker.com/magazine/2008/11/24/a-pilsner-pilgrimage>
- The Geography of Beer: Culture and Economics of Regional Brewing Traditions - <https://link.springer.com/book/10.1007/978-94-007-7787-3>