

## TUM Certificate Program

(English)

June – September 2025

| Date/Week                                       | Content                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 June 2025 (Thu)<br>18:00-19:00 CEST           | <b>Kick Off Session</b> <i>online</i>                                                                                                                                                                                                                                                                                                                                 |
| 10 June 2025 ( <b>Tue</b> )<br>18:00-20:00 CEST | <b>Module 1   Part 1 - Raw Material Barley and Malt (Prof. Gastl)</b> <i>online</i><br>Barley and Malt Quality Requirements   Malting Technologies and Processes                                                                                                                                                                                                      |
| 12 June 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 1   Part 2 - Raw Material Barley and Malt (Prof. Gastl)</b> <i>online</i><br>Malt Analysis   Evaluation of Malt Quality   Malt Types and other Specialty Malts                                                                                                                                                                                              |
| 19 June 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 2   Brewing Water (Dr. Eizaguirre)</b> <i>online</i><br>Water Quality and Water Chemistry   Requirements for Brewing Process   Permanent Hardness and Residual Alkalinity   Water Improvement and Quality Control   Influence of Water Quality on Beer Styles                                                                                               |
| 26 June 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 3   Raw Material   Hop (Dipl.-Ing. Neugrodda)</b> <i>online</i><br>Hop Varieties   Growing Conditions and Regions   Composition and Properties   Hop Products   Influence of Hops on Beer                                                                                                                                                                   |
| 3 July 2025 (Thu)<br>18:00-20:00 CEST           | <b>Module 4   Beer Styles, Alternative Raw Materials and Adjuncts (Dr. Zarnkow)</b> <i>online</i><br>Important Beer Styles   Belgien, English, American   Alternative Raw Material for Wort – other non-traditional Grains, Rice, Fruit, etc.   Additives and Adjuncts                                                                                                |
| 10 July 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 5   Brewing 1 - Wort Production (Milling, Mashing, Lautering) (M.Sc. Hör)</b> <i>online</i><br>From Malt to Wort   Theory and Technology of Mashing   Mashing Processes: Infusion/Decoction   Milling, Mashing-In   Lautering (Mash Vessels, Lauter Tun, Mash Filters)   Brewhouse Technologies   Quality, Economical Considerations                        |
| 17 July 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 6   Brewing 2 - Wort Boiling and Cooling (M.Sc. Hör)</b> <i>online</i><br>Chemical Processes during Wort Boiling, Addition of Hops   Wort Boiling Systems – Comparison   Principles of Wort Separation, Clarification, Hot Break   Theory and Praxis of Wort Cooling   Wort Aeration   Small Batch Brewing                                                  |
| 24 July 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 7   Workshop - Wort Production, Boiling and Cooling (M.Sc. Hör)</b> <i>online</i><br>Review the Process   Discuss Technology Options   Quality Considerations                                                                                                                                                                                               |
| 31 July 2025 (Thu)<br>18:00-20:00 CEST          | <b>Module 8   Beer Production 1 - Fermentation and Maturation (Dr. Hutzler)</b> <i>online</i><br>Yeast Taxonomy   Characteristics and Metabolism   Top and Bottom Fermenting Yeasts for Brewing   Yeast Propagation and Management   Alcoholic Fermentation   Conventional Fermentation and Maturation   Processes and Techniques   Carbonization   Storage and Aging |

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| 7 August 2025 (Thu)<br>18:00-20:00 CEST     | <b>Module 9   Beer Production 2 - Filtration, Stabilization, and Filling (Dr. H. Schneiderbanger) online</b><br>Theory of Filtration, Stabilization and Filling   Introduction into Technologies and Systems   Filtration Types (Kieselgur / Membrane Filtration), Filtration Aids   Stabilizing Agents   Flavor Stability   Filling Principles   Analytics for Quality Control |
| 14 August 2025 (Thu)<br>18:00-20:00 CEST    | <b>Module 10   “Design your first brews!” (Dr. Werner) online</b><br>Brewing Math   Brewing Calculations, Recipe Formulation   What Parameters are Important for Planning a Brew Batch?   Design and Calculate Your First Recipe – A Practical Guide   Introduction to Beer Styles   Troubleshooting                                                                            |
| 21 August 2025 (Thu)<br>18:00-20:00 CEST    | <b>Module 11   History of Brewing (Dr. Zarnkow) online</b><br>History of beer production<br>Development of Technologies and Regional Beer Styles   Characteristics   Microbiology of Brewing   Beer Culture and Social Impacts   Ongoing Challenges and Future Prospects                                                                                                        |
| 28 August 2025 (Thu)<br>18:00-20:00 CEST    | <b>Module 12   Analytics (Dr. J. Schneiderbanger) online</b><br>Introduction to Water, Malt, Wort, and Beer Analysis   Measuring Technologies and Devices   The Brewing Process – Correct Interpretation and Analysis of Key Measurements   Quality Issues                                                                                                                      |
| 2 September 2025 (Tue)<br>18:00-20:00 CEST  | <b>Module 13   Sensory Science (Dr. Lehnhardt, M.Sc. Kienitz) online</b><br>The Human Sensory System   Introduction into the Sensory Science   Development and Sources of Flavors and Off-Flavors in Beer   Overview of Selected Flavors and Off-Flavors: Importance, Problem Areas and Troubleshooting                                                                         |
| 4 September 2025 (Thu)<br>18:00-20:00 CEST  | <b>Module 14   Draft Beer Dispensing Systems (Dr. Werner) online</b><br>Overview of Dispensing Systems   Components   Gas Systems and Types   Risks and Safety   Dispensing Unit Physics and Optimum Settings   Cleaning and Maintenance   Dispensing the Best Beer – Practical Tips                                                                                            |
| 9 September 2025 (Tue)<br>18:00-20:00 CEST  | <b>Module 15   Cleaning and Sanitizing (Dr. Werner) online</b><br>The World of Microorganisms   Microbiology in a Brewery   Danger of Biofilms   Principles of Cleaning, Sanitizing and Disinfection   CIP Systems                                                                                                                                                              |
| 11 September 2025 (Thu)<br>18:00-20:00 CEST | <b>Module 16   Brewing-AI (Prof. Schlechter) online</b><br>Current and Future Role of AI in Brewing Better Beer   Machine Learning Technology for Stable Beer Quality   Opportunities for Sensory Science                                                                                                                                                                       |

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| 15 – 19 September 2025<br>(Mon – Fri) | <b>On-Campus Program - TUM Research Brewery, Weihenstephan  </b><br>Hands-On Brewing, Sensory Science, Beer Analytics Lab, Draft Beer Dispensing Systems  <br>Excursion 1: Malting Plant, Hop Growing Region, Local Breweries  <br>Excursion 2: Visit DrinkTec Exhibition Munich  <br>Presentation of Certificates |
| 20 September 2025<br>(Saturday)       | <b>Brewery Tour   Erdinger Weißbräu (optional)</b>                                                                                                                                                                                                                                                                 |
| 21 September 2025<br>(Sunday)         | <b>Brauer Cursus Stammtisch at Paulaner Brauerei München -<br/>Octoberfest 2025 (optional)</b>                                                                                                                                                                                                                     |

For more information and registration <https://www.lll.tum.de/certificate/brauer-cursus/>