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international winter university

member of
EUT+
EUROPEAN UNIVERSITY OF TECHNOLOGY

Hessen:IWU – International Winter University 2027

More information: https://wup.h-da.de/

Syllabus:

Biotechnology in a Nutshell: From a DNA Sequence to the Product

PROFESSOR
Academic Directors:

- Prof. Dr. Vera Göhre
- Prof. Dr. Kai Lögering

Guest Lecturer:

- Prof. Dr. Karsten Schrobback, Queensland University of Technology

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COURSE DESCRIPTION

Genetic Engineering and Bioprocessing: From Seamless Cloning to Fed-Batch Cultivation is an intensive, multi-day laboratory practical designed to give students hands-on experience with modern genetic engineering and bioprocessing methods. The course integrates practical lab work with supporting theory seminars to guide students through the complete workflow of generating and cultivating genetically modified bacteria that express a fluorescent reporter protein for easy visualization and monitoring.

Students will employ a seamless cloning strategy—Golden-Gate Cloning—to construct and introduce fluorescent reporter genes into bacterial hosts. Using tools like Benchling for in-silico planning, students will learn to design, assemble, and verify cloning constructs. Following successful cloning and expression screening at the lab scale, the highest-expressing strain will be scaled up and transferred into a bioreactor for high-cell-density cultivation.

In parallel with the practical lab work, theory seminars cover essential topics such as the principles of Golden-Gate Cloning, fluorescent reporter constructs, bioreactor types and operation, cultivation and feeding strategies including fed-batch processes, and critical aspects of bioreactor cleaning and sterilization. Through regular sampling and data analysis during bioreactor operation, students will calculate growth rates and production yields, linking molecular biology with bioprocess engineering.

Combining molecular cloning, process design, and bioreactor operation, this course prepares students to plan and execute integrated genetic engineering and cultivation workflows—skills vital in modern biotechnology and industrial microbiology.

LEARNING OBJECTIVES

- Design and execute a seamless cloning strategy using Golden-Gate Cloning and digital tools like Benchling to generate genetically modified bacteria expressing a fluorescent reporter, and verify successful transformation and expression through laboratory analysis.
- Integrate theoretical and practical knowledge of bioreactor types, cultivation methods, and feeding strategies to plan, operate, and analyze lab-scale and fed-batch bioreactor processes, including calculation of cell growth rates and product yields, while addressing cleaning and sterilization requirements.

COURSE MATERIALS

- www.benchling.com
- Course script (will be provided upon arrival)

WORKLOAD

This course consists of 50 contact hours and 120 hours of guided self-study (45 minutes each). Self-study includes reading assignments, preparation and follow-up of lectures, independent research, case study work, project and presentation preparation, and exam preparation.

Date	*Topic*	*Location*
November 2026	Gene Construction and Cloning, Introduction into Benchling, design of cloning strategy Assignment	Workshops at QUT
December 2026	Sterility techniques & Bacterial Metabolism	Workshops at QUT
Jan 04, 2027	Safety introduction Pipetting practise Determine plasmid concentrations Set up one-pot reactions and controls	Lecture & Workshop at h_da
Jan 05, 2027	Transformation of E. coli to generate GMOs	Lecture & Workshop at h_da
Jan 06, 2027	Evaluate transformation and start cultures	Lecture & Workshop at h_da
Jan 07, 2027	Quantify mCherry-Fluorescence in the plate reader, select best colony Verify plasmids for correct integration of mCherry by boiling preparation of plasmids and control digest	Lecture & Workshop at h_da
Jan 08, 2027	Gel electrophoresis and final evaluation of GMOs Finish lab book	Lecture & Workshop at h_da
Jan 11, 2027	Theory bioprocess technology; inoculation of shake flask	Lecture & Workshop at h_da
Jan 12, 2027	Theory bioprocess automation; sterilization of stainless steel, bioreactor inoculation of bioreactor	Lecture & Workshop at h_da

Jan 13, 2027	Theory cleaning of bioreactors; sampling	Lecture & Workshop at h_da
Jan 14, 2027	Harvest, analysis of samples, discussion of results	Lecture & Workshop at h_da
Jan 15, 2027	Final test/presentations; Winter University Program Debrief	h_da

EXCURSIONS (subject to change)
Excursions in the Rhein Main area will be announced later.

ASSIGNMENTS

- Consistent active participation and engagement in group work are expected throughout the course.
- Plasmids in Benchling: illustration of starting materials and final plasmid including the Golden-Gate Cloning strategy.
- Written lab book for the cloning and strain generation according to GSP and GMO-standards in Germany due on Friday after the lab course Focus Week 1.

FINAL EXAM
Written exam & lab book.

PRACTICE MATERIALS
See the list of online resources to be used.

PROFESSIONALISM & CLASS PARTICIPATION
Students are expected to attend all class sessions and dedicate approximately 1–2 hours per day to preparation through assigned readings and independent study. This preparation will enable students to engage actively in class by answering questions, contributing their own ideas and perspectives, and participating in discussions in a meaningful and informed manner.

MISSED CLASSES
Students may not miss more than 10% of the total contact hours in order to successfully complete the course. In cases of absence, it is the student's responsibility to stay informed about the content and assignments covered during the missed sessions. Absences due to illness must be submitted as a written email before the course to the Winter University Program coordinator.

ACADEMIC STANDARDS
Upon successful completion, 6 ECTS will be awarded for the class.
According to the rules of ECTS, one credit is equivalent to 25-30 hours student workload.

GRADING SCALE

Percentage	Grade		Description
90-100%	15 points	1.0	very good: an outstanding achievement
	14 points		

	13 points	1.3	
80-90%	12 points	1.7	good: an achievement substantially above average requirements
	11 points	2.0	
	10 points	2.3	
70-80%	9 points	2.7	satisfactory: an achievement which corresponds to average requirements
	8 points	3.0	
	7 points	3.3	
60-70%	6 points	3.7	sufficient: an achievement which barely meets the requirements
	5 points	4.0	
0-60%	4 points	5.0	not sufficient / failed: an achievement which does not meet the requirements
	3 points		
	2 points		
	1 point		
	0 points		

This course description was issued/updated May 21, 2026. The program is subject to change.

More information about the program on our website