Biochemical- / Chemical Engineering Curriculum at TU Dortmund

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Our department

- Founded in 1969 as Department of Chemical Technology
- 2003 renamed in Biochemical and Chemical Engineering
- today more than 1600 students & 130 PhD students
- 14 professors from chemical, pharmaceutical, and engineering background
- no student fees
Our faculty – current structure

**Fundamentals**
- Thermodynamics
  - Gabriele Sadowski

**Unit Operations**
- Chemical Reaction Engineering
  - David W. Agar

**Process Design**
- Chemical Process Development
  - Dieter Vogt

**Process Engineering**
- Plant and Process Design
  - Gerhard Schenbecke

- Fluid Mechanics
  - Peter Ehrhard

- Fluid Separations
  - Andrzej Górak

- Bioprocess Engineering
  - Stephan Lütz

- Equipment Design
  - Norbert Kockmann

- Technical Biochemistry
  - Oliver Kayser

- Solids Process Engineering
  - Markus Thommes

- Process Dynamics and Operations
  - Sebastian Engell

- Technical Biology
  - Markus Nett

- Biochemical Engineering
  - Rolf Wichmann

- Biomaterials and Polymer Science
  - Jörg Tiller
Recent trends in BCI student numbers

TU Dortmund: 34 200 students in 2016
Recent trends in graduation / BSc. and MSc.

approx. 25% enter PhD position after MSc graduation
Chem Eng recommendations from

- Universities: fundamentals and methods (BA) and research (MA)
- more emphasis on ethics, responsibility, non-technical skills
- Graduates are able to
  - **design** specified machines, equipment, and processes
  - understand **design methods** and apply them
  - use literature search from various sources
  - plan and perform **experiments** on their own
  - **communicate** orally and in written form with colleagues
  - work and communicate in **teams** including international members
  - organize themselve and their time schedule …
Bio-/Chem Eng study at TU Dortmund

- Well-received by industry due to broad education
  - 91% of alumni have found a full-time job with an average income more than 4,000€ p.m. (INCHER-Kassel, Alumni Survey 2015 and 2016 among batches of 2013 and 2014)
  - almost 90% of the alumni describe their job as “near the studies”
  - almost 80% are highly satisfied with their professional situation
Bio-/Chem Eng study at TU Dortmund

- Main challenges and difficulties
  - Budget and staff issues (e.g. 110 students / professor)
  - approx. 40 – 50% drop out rate in Bachelor
  - only very few students finish in 7 semesters due to condensed lay-out (e.g. industrial internship between 6th/7th semester)
  - shorter life-cycle of contents
  - almost no possibilities for specialization during bachelor

- courses/topics eliminated in the last years
  - **energy** technology and power plants
  - **environmental** technology
Recent activities

- **Quality**: 10 Stars Service and teach’n teach as catalysts
- Solid brigdes between school and university (better motivation and less drop-out)
  - Self-assessment
  - BCI-driving licence
  - Mathematics offensive
  - PEP project work with poster presentation
  - more feedback during the semester
- Revision of lab courses
- Complete revision of Bachelor layouts (2019, coaching by VDMA)
Self Assessment before enrolement

Current situation
- approx. 40 – 50% drop out rate
- misinterpretation of ‘Bio-engineering’

Information modules with short movies
- show technical and engineering character of curriculum
- clarify false expectations, motivate interest in the subjects, and demonstrate possible job careers
- explain necessary motivation and effort

Task modules
- mathematics
- basic technical understanding
- logic thinking
- interest in subjects
- motivation / work attitude
bci driving license

- more „how to @university“ knowlegde
- Three modules / stamps
  - University and department (structure, who is who, regulations, module handbooks…)
  - How to study
  - How to to organise yourself
- mandatory before first exams
- Merger of existing offers of the university
- Structured interview during to project work as an early intervention during the first semester

http://www.bci.tu-dortmund.de/de/studium/studieninteressierte/erstis/bci-fuehrerschein
Poster presentation

- at the end of the 1st semester
- main topics on Megatrends
- team work of 5 students
- 4 page report + poster
- Topics on
  - CO₂ and climate change
  - Energy supply and storage
  - Energy efficiency
  - Health and life sciences
  - New materials
  - Food and water supply
  - …

Poster discussion with students
Praktikum 2.0 introduced in 2016

- **lab course didactics**
  - from understanding operations and phenomena to the understanding of processes
  - overview and linkage instead of "pressing buttons"
  - updated learning materials and infrastructure
  - better matching with courses given before

- clearly addressing **professional skills**
  - work in small teams
  - tandem experiments with related content, e.g. VLE measurement with LL-extraction
  - changed forms of attestations

- New format with semester structure

→ Unraveling the semester structure, better preparation for exams
Design project as highlight in Bachelor Curriculum

- Team work with 8-10 students
- 6 weeks to plan a production plant from the scratch
- Including plant layout, safety analysis, cost calculation, …
- Weekly presentations and reporting
- Final presentation at Faculty with discussion
- Final presentation at company with similar process/product

2013 group after final presentation

2014 at INVITE, Leverkusen
Conclusion

- Global challenges (Megatrends) shape Chemical Engineering
- Solving complex problems, no simple answers
- Better motivation of freshmen is necessary
- Integrated view of the whole curriculum from Intro course over Lab courses to Design project and Final thesis
- Highly motivated and skilled graduates, well-appreciated by industry

Next steps

- Continuous improvement (e.g. VDMA consultation)
- Continuous evaluation of courses and curriculum
- Identify weaknesses and improve curriculum
- Integrate research content with complexity of real world problems