

BIOPROCESS ENGINEERING (ELEONORA SFORZA)

Organizzazione della didattica

Anno accademico	20XX/XX
Corso di studio	XXX
Curriculum	XXX

Syllabus

Prerequisiti:	Contents of chemical reaction engineering
Conoscenze, abilità e competenze da acquisire:	<p>This course is aimed to provide the students with:</p> <ul style="list-style-type: none">• Knowledge regarding the features and operation characteristics of industrial bioreactors and fermenters, both qualitatively and quantitatively.• Basic knowledge of the specific features of microorganism's application in the bio-based industry.• Ability to design biobased processes• Ability to evaluate the performances of biobased processes• Ability to select the proper operative conditions for biobased processes, including pharmaceuticals, biomass production and wastewater treatment.
Modalità di esame:	<p>1) written exam with one exercise on biological reactor and process and discussion about two questions randomly selected</p> <p>2) delivery of a written report about the exercise activities and results. The exam can be taken only after the fulfilment of laboratory requirements.</p>
Criteri di valutazione:	<p>The student performance evaluation is based on:</p> <p>1) proven comprehension of concepts and methods proposed for bioprocess modeling, with special emphasis on mass balances for biological reactors (written exam)</p> <p>The final marks are calculated as an average of the marks of the two questions and one exercise, rounded on the base of the evaluation of lab reports.</p>
Contenuti:	<p>Introduction to Bioprocess Engineering: bio-based industry, the use of biochemical and biological reactors, examples of typical bioprocess schemes of the biobased industry.</p> <p>Fundamentals of biotechnology: microbiology, metabolism, cell regulation, genetic modifications.</p> <p>Biochemical and biological kinetics evaluation: kinetic models for enzyme and microorganisms, experimental measurements and kinetic parameter correlation. Yield term and its application to biological reactors.</p> <p>Basics of biochemical processes, schemes for enzyme-based processes. Immobilized enzymes and cell technology. Effect of immobilization on the reaction kinetics. Thiele Module and its application on enzymatic reactors.</p>

	<p>Basics of biological reactor engineering (including process control in bioreactors and specific technical features including sterilization), instruments to monitor the reactors, schemes for biological reactors (chemostat, turbidostat, plug flow reactor with recycle). The problem of the washout. Role of the residence time on the composition of the biomass.</p> <p>Oxygen supply for aerobic processes: measurement of the mass transfer coefficient, respirometry.</p> <p>Fed-batch reactors: application in the pharmaceutical processes.</p> <p>Application of biological processes for wastewater treatment: introduction to wastewater and chemical characterization; process scheme of a conventional wastewater treatment plant; processes with thickening and recycling of biomass; Activated sludge; Solid retention time; removal of organic carbon, nitrogen and phosphorus; nitro-denitro process; application of biofilm-based bioreactors; anaerobic digestion.</p> <p>Internal accumulation of nutrients: Droop model and application (examples).</p> <p>Accumulation of products of industrial interest in stationary phase – product inhibition (lactic fermentation as an example, process scheme).</p> <p>Application of genetically modified microorganisms in the pharmaceutical industry: concept of number of generations, genetic stability, operative conditions.</p> <p>Basics of separation in biobased processes: separation of the biomass, purification of protein.</p> <p>Exercise: application of mass and energy balances on a case study of biotechnological interest.</p> <p>Lab activities: biological reactors for photosynthetic microorganism, analytical techniques to measure growth and composition.</p>
<p>Attività di apprendimento previste e metodi di insegnamento:</p>	<p>1) classroom lectures with examples on how to write and solve simple mass balances about biochemical reactors. 2) laboratory teaching and activities 3) exercise: elaboration of case studies</p>
<p>Eventuali indicazioni sui materiali di studio:</p>	<p>lecture notes, ppt of the lesson</p>
<p>Testi di riferimento:</p>	<ul style="list-style-type: none"> • Shijie Liu, Bioprocess Engineering (Second Edition): Kinetics, Sustainability, and Reactor Design. --: Elsevier, 2017. •

Didattica innovativa: Strategie di insegnamento e apprendimento previste:

- Lavori di gruppo
- Problem solving
- Case study
- Project work
- Problem based learning
- Utilizzo delle tecnologie per la didattica (moodle e/o altri strumenti per la didattica, software, video, quiz, wooclap)
- Feedback
- Attivita' di valutazione durante il corso

Obiettivi Agenda 2030 per lo sviluppo sostenibile:

- Istruzione di qualita'
- Uguaglianza di genere
- Energia pulita e accessibile
- Industria, innovazione e infrastrutture
- Citta' e comunita' sostenibili
- Agire per il clima