جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Processes in Environmental Biotechnology - EnSE 341

Division	Biological and Environmental Sciences & Engineering Division
Course Number	EnSE 341
Course Title	Processes in Environmental Biotechnology
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Pascal Saikaly	Pascal.Saikaly@kaust.edu.sa	+966128084903	4237, 4, Al-Jazri (bldg. 4)	

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	A course that introduces graduate students from different engineering and science disciplines to the fundamental principles of microbiology and engineering (quantitative tools) and discusses example applications of microbiological processes (e.g. activated sludge process, nitrification, denitrification, anammox, enhanced biological phosphorous removal, granular activated sludge, and microbial electrochemical systems) for wastewater treatment and resource recovery (energy, water, nutrients).
Course Description from Program Guide	A course that introduces students from different engineering and science disciplines to the fundamental principles of microbiology and engineering (quantitative tools) and discusses example applications of microbiological processes (traditional and emerging) for wastewater treatment and energy generation.

Goals and Objectives	**Course Objectives:** 1. To introduce students to concepts in microbiology and biochemistry and enable them to translate and apply these concepts within a coherent engineering based framework to the broad areas of environmental biotechnology. 2. To present an overview of important environmental biotechnologies involved in treatment of pollutants and resource recovery. 3. Lay the foundation for building mathematical models of engineered bioreactors. **Learning Outcomes**: At the end of this course, students will: 1. Differentiate microorganisms according to their metabolism (e.g., electron acceptors, electron donors and carbon source). **Evaluation**: exam. 2. Describe the relationship between redox, thermodynamics, and microbial growth. **Evaluation**: exam. 3. Balance oxidation/reduction reactions of importance in engineered bioreactors (e.g. microbial fuel cells, nitrification, denitrfication). **Evaluation**: exam. 4. Write mass-based stoichiometric equations. **Evaluation**: exam. 5. Calculate growth yield using energetics. **Evaluation**: exam. 6. Have a detailed understanding of microbial kinetics and their application in mass balance of microbially mediated processes in engineered biological systems. **Evaluation**: exam. 7. Lay the foundation for building mathematical models of engineered bioreactors (batch, completely stirred tank reactor, plug flow reactor, biofilms). **Evaluation**: exam. 8. Gain knowledge of different microbiological processes (traditional and emerging) for wastewater treatment and energy generation (e.g. activated sludge process, nitrification, denitrification, anammox, enhanced biological phosphorous removal, granular activated sludge, anaerobic membrane bioreactors, and bioelectrochemical systems). **Evaluation**: discussion of peer-reviewed journal articles; term paper. 9. Gain knowledge of contemporary environmental issues. **Evaluation**: discussion of peer-reviewed journal articles; term paper. 10. Learn how to communicate (oral and written) effectively. **Evaluation**: discussion of peer-reviewed journal articles; term paper.
Required Knowledge	EnSE203, or permission of instructor.
Reference Texts	**Course Material:** Will be assigned from the following reference -E. Rittmann, P. L. McCarty, *Environmental Biotechnology: Principles and Applications*, McGraw-Hill, 2001. In addition to the above text, several handouts and papers will be used as reading assignments or study material. Lecture notes, special handouts, papers, and useful links will be posted on **Blackboard** as the course proceeds.
Method of evaluation	**10.00**% - Attendance and Participation **30.00**% - Midterm exam **60.00**% - Homework /Assignments

Nature of the assignments	**Discussion of peer-reviewed paper (30% of the grade):** Each student is responsible for choosing two peer-reviewed research articles that describe microbial-mediated processes for nutrient (nitrogen and phosphorous) removal (Paper 1) and converting waste streams (e.g., wastewater or CO2 waste) to valuable resources (Paper 2). The student will give a 20-minute presentation (Grade: 15 %) summarizing the chosen paper. In the presentation the student should: (1) include the research problem and/or hypothesis; (2) include the objective of the study; (3) include a description of the methodology used in the paper; (4) summarize the main findings of the study; and (5) critically evaluate the research paper. Following the presentation, there will be a 20-minute discussion of the paper where all students are encouraged to participate (class participation is 10% of the grade). The articles should be approved by the instructor. **Term paper (30% of the grade):** Each student is responsible for writing a review paper (Grade: 20%) on a topic in environmental biotechnology with emphasis on innovative microbial technologies for wastewater treatment and resource recovery (e.g. aerobic granular sludge, anaerobic membrane bioreactors, bioelectrochemical systems, anammox). Topics should be approved by the instructor. Papers will be ranked based on content, organization, style, grammar, punctuation, spelling, and neatness. The review paper should be 10 pages (including references, figures and tables), single-spaced, 12-point font Times New Roman, 1-inch margins, and formatted (e.g. in-text citations and references). At the end of the semester the student will give a 20-minute presentation (Grade: 10 %) summarizing the term paper. Following the presentation, there will be a 10-minute discussion of the paper where all students are encouraged to participate (class participation is 10% of the grade).
Course Policies	Attendance is mandatory. Class attendance will be taken, and students will be penalized for absence according to the following rules: A total of two absences for the semester will be permitted w/o penalty. These include instances of sickness and other valid excuses. For every absence beyond the two absences, 2 points will be deducted from the final course grade.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 01/29/2018 Wed 01/31/2018	Classification
2	Mon 02/05/2018 Wed 02/07/2018	Microbial metabolism and energetics
3	Mon 02/12/2018 Wed 02/14/2018	Problem sessions
4	Mon 02/19/2018 Wed 02/21/2018	Microbial growth and kinetics
5	Mon 02/26/2018 Wed 02/28/2018	Mass balance and reactor types
6	Mon 03/05/2018 Wed 03/07/2018	Problem sessions
7	Mon 03/12/2018 Wed 03/14/2018	Stoichiometry; growth yield
8	Mon 03/19/2018 Wed 03/21/2018	Problem sessions
9	Mon 03/26/2018 Wed 03/28/2018	Review sessions Exam
10	Mon 04/02/2018 Wed 04/04/2018	Biological wastewater treatment
11	Mon 04/09/2018 Wed 04/11/2018	Biological processes for nitrogen removal
12	Mon 04/16/2018 Wed 04/18/2018	Biological processes for phosphorous removal
13	Mon 04/23/2018 Wed 04/25/2018	Lab practical
14	Mon 04/30/2018 Wed 05/02/2018	Lab practical
15	Mon 05/07/2018 Wed 05/09/2018	Presentation & discussion of peer-reviewed papers
16	Mon 05/14/2018 Wed 05/16/2018	Presentation & discussion of peer-reviewed paper Term paper presentations
17	Mon 05/21/2018 Wed 05/23/2018	Term paper presentations
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Note

The instructor reserves the right to make changes to this syllabus as necessary.