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

Course Syllabus: Advanced Environmental Microbiology - B 317

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 317
Course Title	Advanced Environmental Microbiology
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Wed , 01:00 PM - 02:30 PM | Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
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Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The course introduces the ecological principles and the potential for biotechnology of 'complex microbial communities' for any kind of environmental application and frames the presentation under the concepts of 'Microbial Resource Management'. In the last twenty years the exploitation of microorganisms has conceptually moved forward from the 'single strain' concept to that of the 'microbial consortia' and the complex microbial communities they are made of. Beneficial microbial communities are a huge resource with a far larger metabolic potential than a single microbial strain. However, the exploitation of such complex communities is dependent on the understanding of the mechanisms regulating their functioning. The course illustrates the biology, ecology, production and application of microorganisms for sustainable agriculture and environmental bioremediation and cleanup. The course is divided in four sections, the first providing general principles and the other three dissecting specific areas including applications: Section 1) "*Microbial diversity and ecology of complex microbial communities*" illustrates prokaryote diversity and phylogeny and discusses the principles of microbial ecology regulating the assembly and functioning of complex microbial communities. Section 2) "*Microorganisms and soil fertility, antagonism and biocontrol*" deals with the role of microorganisms in the soil/plant ecosystem and the interactions they play with the plant roots. The section is also discussing the biology, ecology and biotechnology of symbiotic and antagonistic microorganisms against phytopathogens and insects. In section 3) "*Microbial technologies for environmental bioremediation*" the role of microorganisms in decontamination of polluted and deteriorated environments is illustrated. The section discusses the microbial metabolic pathways for the degradation of major pollutant classes and the technologies for their exploitation in aquatic and terrestrial ecosystems. The last section 4) "*The industrial production of microorganisms*" provides information on the principles of industrial microbiology and biotechnology for production of microorganisms and microbial biomasses for applications. The overall vision of the course is to provide a comprehensive view of the complex environmental microbial communities from their ecology, to the function, their biomass production and the potential sustainable exploitation.

Course Description from Program Guide	The course introduces the principles and applications of microbial biotechnology for the environment under the concepts of Microbial Resource Management. The course illustrates the biology, ecology, production and application of microorganisms for sustainable agriculture and environmental bioremediation and cleanup. The course is divided in four sections: 1) "Microbial diversity and soil fertility" illustrates prokaryote phylogeny and the microbial role in the soil/plant ecosystem. 2) "Microbial antagonism and biocontrol" deals with the biology, ecology and biotechnology of symbiotic and antagonistic microorganisms against phytopathogens and insects. 3) "Microbial technologies for environmental decontamination and bioremediation" introduces the metabolic pathways for pollutants degradation and the technologies for their exploitation in aquatic and terrestrial ecosystems. 4) "The industrial production of microorganisms for environmental applications" illustrates the principles of industrial microbiology including strain selection, microbial growth, and the fermentative process.
Goals and Objectives	The course teaches the students on basic and applied concepts of microbial ecology and the factors steering the assembly and functioning of complex environmental microbial communities. The students will learn the principles for using complex microbial communities for environmental applications in the light of the Microbial Resource Management. Specific objectives includes: Acquisition of knowledge on the wide microbial diversity in terrestrial and aquatic environments; learning the functions and applications of microorganisms in agriculture for fertility improvement and biocontrol of pests; learning the role and applications of microorganisms for bioremediation of polluted and deteriorated environments; learning the principles for the productions of microbial biomass.
Required Knowledge	Basic knowledge in general microbiology are required
Reference Texts	“Brock Biology of Microorganisms” (ed. Madigan, Martinko, Bender, Buckley & Stahl) Reference to scientific papers will be provided during the course
Method of evaluation	**20.00**% - Attendance and Participation **20.00**% - Research Project **5.00**% - Oral presentation **20.00**% - Midterm exam **10.00**% - Group Project(s) **25.00**% - Final exam
Nature of the assignments	Written Assignement (2 pages research project); Group written project (5 pages research project); Assigned readings (Papers); Group project oral presentation
Course Policies	Assignements are mandatory.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Wed 01/30/2019 Thu 01/31/2019	Bacterial phylogeny and the species concept in prokaryotes
2	Wed 02/06/2019 Thu 02/07/2019	Culturability and unculturability and microbial ecology principles
3	Wed 02/13/2019 Thu 02/14/2019	The plant/root/soil system, the rhizosphere and the endosphere
4	Wed 02/20/2019 Thu 02/21/2019	Root colonization, plant hormone interference, PGPB
5	Wed 02/27/2019 Thu 02/28/2019	Bacterial antagonism against phytopathogens
6	Wed 03/06/2019 Thu 03/07/2019	Microbial insecticides. *Bacillus thuringiensis*, Cry and Vip toxins
7	Wed 03/13/2019 Thu 03/14/2019	Sporulation and regulation of Bt toxin expression
8	Wed 03/20/2019 Thu 03/21/2019	Biotechnology for improving Bt, Biosafety of GMM
9	Wed 03/27/2019 Thu 03/28/2019	Spring Break
10	Wed 04/03/2019 Thu 04/04/2019	Insect symbionts, reproductive manipulators, symbiotic control and mid term exam
11	Wed 04/10/2019 Thu 04/11/2019	Tutorial activities and written project assignements
12	Wed 04/17/2019 Thu 04/18/2019	Oil hydrocarbon degradation pathways, cometabolism
13	Wed 04/24/2019 Thu 04/25/2019	Aerobic & reductive dehalogenation, catabolic complementation
14	Wed 05/01/2019 Thu 05/02/2019	Bioremediation and phytoremediation technologies
15	Wed 05/08/2019 Thu 05/09/2019	Bioventing, air sparging, reactive barriers, bioaugmentation
16	Wed 05/15/2019 Thu 05/16/2019	Industrial microbiology, screening, batch, fed batch, continuous culture. Chemostat & fermentation
17	Wed 05/22/2019 Thu 05/23/2019	Final exam

Note

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