



# Ben-Gurion University of the Negev

The Jacob Blaustein Institutes for Desert Research  
The Albert Katz International School for Desert Studies

## 001-2-5063 Lab-course: New methods in biofilm characterization (3 Credits)

Intensive lab-course

**Lecturer:** Prof. Edo Bar-Zeev

### Abstract

Biofilm are defined as a sessile assemblage of diverse microbial communities, which are permanently attached to a surface and held together within a matrix of predominantly self-produced extracellular polymeric substances (EPS). Mature biofilms are often found as microbial micro-colonies separated from each other by interstitial water channels which form complex three-dimension structures. Once established, biofilms are notoriously resistant to removal by different treatments, causing adverse effects in different natural and engineered systems. Thus, numerous methods are used to study biofilm including: (i) molecular tools to identify bacterial species that comprise these consortiums or bacterial genes that coordinate different cellular activities; (ii) Biochemical extractions to characterize biofilm biomass and EPS composition. (iii) Different microscopy approaches are used to define the architecture, coverage and mechanical properties of the biofilm structure.

Course code	001-2-5063
Credits	3 credit points
Cycle	Graduate and undergraduate students
Department	Zuckerberg Institute for Water Research
Academic Year	XXXX
Semester	Summer – concentrated over 6 days
Campus	Midreshet Ben-Gurion, ZIWR
Teaching language	English
Coordinator name	Edo Bar-Zeev
Coordinator email	barzeeve@bgu.ac.il

Course description	This is a unique “hands-on” lab-course that introduces different methodological approaches to study biofilms. The course will span over 6 days during the summer-semester at BIDR, BGU, when various, state-of-the-art instruments will be used to characterize different types of biofilms. The course will be backed-up by theoretical classes which will discuss in details the background of the different analytical approaches. The course will be restricted to 12 students only.
Course aim	The overarching goal of the course is to introduce students with novel tools to study biofilms. The specific aims are to provide students with: <ol style="list-style-type: none"> <li>1. Solid theoretical background over each method and rational for using that approach.</li> <li>2. Preliminary experience in applying the different techniques.</li> <li>3. Tools to analyze the data obtained from the different approaches.</li> </ol>

The course will be divided to theoretical class that will be linked to intense lab-work according to the following topics:

Course content	Theoretical material	Lab-work
Day 1.	Background on bacterial biofilms: from the environment to water treatment.  Background on extracellular polymeric substances (EPS) composition: from proteins and TOC to polysaccharides.	<i>Initiating and running biofilm experiments:</i> Preparation of feedwater solutions, starter cultures, flow-cell setups and benthocosms.  Bacterial biomass: extraction and quantification of protein, polysaccharides and TOC, QCMD
Day 2	Background on measuring bacterial concentrations in biofilms, from extraction to CFU and flow-cytometry analysis.	<i>Bacterial abundance:</i> Extracting bacteria from biofilm and quantify abundance using different analytical technics such as CFU, OD <sub>600</sub> and flow cytometry. Identifying the benefits for each technique

Day 3.	<p>Background on high resolution imaging of biofilms using scanning and transmission electron microscopy (SEM and TEM).</p> <p>Background on using microscopy to study biofilms. Focus on epifluorescent, optical coherence tomography (OCT), atomic force microscopy (AFM) and confocal laser scanning microscopy (CLSM) including different types of fluorescent labeling.</p>	<p>Capturing biofilm structure in real time using CLSM and OCT. Image analysis of CLSM micrographs.</p> <p>SEM and TEM: fixation, embedding and specific staining of biofilms.</p> <p>AFM analysis of condition films</p>
Day 4	Background on using microscopy to study biofilms – Continue.	Capturing biofilm structure in real time using CLSM and OCT. Image analysis of CLSM data with various complementary softwares.
Day 5.	Background on community structure in different biofilms	DNA extraction from biofilms and amplifying total bacteria for community analysis
XXX	Theoretical home exam over the material that was conveyed during the course.	

Learning outcomes	<p>At the end of this concentrated course students will acquire:</p> <ol style="list-style-type: none"> <li>1. Comprehensive knowledge on biofilm properties including the architecture and the biochemical composition of bacterial biofilms.</li> <li>2. Theoretical insights over the different approaches that characterize biofilms</li> <li>3. Hands-on experience using different analytical approaches that characterize biofilm.</li> </ol>
Attendance requirements	100 %
Teaching arrangements	Frontal lectures (13 hours) and lab-work (39 hours)
Required Reading	TBD
Course/module Evaluation	Final exam – Home exam
Prerequisites	Introduction to microbiology

