האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Biomimetics Problem solving learned from nature - 71166

Last update 19-12-2023

HU Credits: 2

Degree/Cycle: 2nd degree (Master)

Responsible Department: Plantsciences in Agriculture

Academic year: 0

Semester: 2nd Semester

Teaching Languages: English

Campus: Rehovot

Course/Module Coordinator: Dr. Kleiman Maya

Coordinator Email: mayakl@volcani.agri.gov.il

Coordinator Office Hours: By appointment

Teaching Staff:
Dr. Clayman maya

Course/Module description:
Biomimetics is a research field studying nature in order to mimic it to solve human problems. This research field includes various academic disciplines, specifically: biology, chemistry, physics and material sciences. During the course we will examine the process of studying nature by focusing on specific characteristics and transferring the basics to synthetic systems. We will discuss mimicking natural structures such as lotus leaf to form hydrophobic surfaces, as well as mimicking natural processes such as healing processes to form self-healing materials.

Course/Module aims:
General acquaintance with the field of biomimetics and understanding the research process in the field.

Learning outcomes - On successful completion of this module, students should be able to:
The students will learn how to study biological systems with a goal of finding the basis for a relevant characteristic. Additionally, they will learn a few techniques in chemistry and material sciences enabling the mimic of biological systems.

Attendance requirements(%):
none

Teaching arrangement and method of instruction: Frontal lectures and student presentations at the end of the course

Course/Module Content:
1. Structures that interact with innate materials:
a. The lotus leaf – super hydrophobicity, leaf surface structure, structural mimic in synthetic systems.
b. lungs as an example for gas exchange structure – what can be done in synthetic systems?
c. Root architecture for nutrient adsorption – how can the structure be mimicked to enable material transfer?
d. Vasculature systems in plants and animals – flow in nature and what does it teach us when moving to synthetic systems?
2. Structures that interact with biological entities:

a. anti biofouling structures – shark skin as an example to a synthetic mimic.
b. Using plant structures to understand the interaction between microorganisms and surfaces.
c. Materials mimicking extracellular matrix for tissue engineering – growing mammalian cells and what is done in the field of plant sciences.
3. Dynamic structures:
a. guard cells as a natural example for dynamic gas transport – what synthetic materials enable that? How can we learn from stomata?
b. reactive hydroscopic structures in plants (pinecone) – what exists in nature and what exists in the synthetic field?
c. Healing in plants and animals – an inspiration for self-healing materials.
d. Controlled release materials – materials that respond to their environment and release their load based on external cues. Inspiration from similar processes in nature.
4. Additional biomimetic examples given by the students in the final presentation.

Required Reading:
A list of papers that will be discussed throughout the course will be provided. For general reading: the issue:
Noble, D. & Kaminski, C. Introduction for bioinspiration. Interface Focus 5, doi:10.1098/rsfs.2015.0052 (2015).
And the book:
Bar-Cohen, Y. Biomimetics nature based innovation. CRC Press (2012).
Are recommended.

Additional Reading Material:
None

Grading Scheme:
Presentation / Poster Presentation / Lecture/ Seminar / Pro-seminar / Research proposal 100 %

Additional information:
None