Syllabus & Policies

Course: Bio-inspired Surfaces, MAE 589/789

Meeting Time & Location: Mon & Wed 1:30-2:45 pm (136 Monteith Engineering Research Center Building).

Instructor: Prof. Arun Kota
akota2@ncsu.edu
Office: 3286 Engineering Building 3
Phone: 919-515-5241

Instructor Office Hours: By appointment. Please email with your availability for the week.

Textbook: There is no specific textbook. The lecture slides will be posted on Moodle and you will be pointed to the relevant book chapters or journal papers as and when appropriate.

Course Website: Syllabus, lecture slides, homework & exam solutions, grades will be posted on Moodle.

Recorded Lectures: The recorded lecture videos can be accessed at:
https://ncsu.hosted.panopto.com/Panopto/Pages/Sessions/List.aspx#folderID=7cce71cc-ec8c-482f-8d33-b1c200a34ed0

Course Description

This course will present and analyze the surfaces of a wide range of biological species, including lotus leaves, rose petals, water striders, arctic spring tails, sharks, desert beetles, and pitcher plant leaves. We will understand the unique surface functionality associated with each of these biological species by examining the roles of surface composition and surface texture. Subsequently, we will discuss how this fundamental understanding can be used to design bio-inspired surfaces for various applications such as spill resistant fabrics, microrobots, stain resistant displays, drag reduction, fog harvesting and de-icing.

Course Objectives

Upon successful completion of this course, each student will be able to:

- **Identify and describe** the unique surface functionalities associated with a wide range of biological species.
- **Explain** the fundamental concepts of surface and interfacial energies, contact angle, reentrant texture, hierarchical structure, superhydrophobicity, superoleophobicity, icephobicity, nucleation and slip length.
- **Use** equations for Cassie-Baxter state (single scale and hierarchical structures), Wenzel state, Vollmer's nucleation theory and Stokes' drag in order to analyze surfaces.
- **Determine** the appropriate surface composition (materials) and surface texture to obtain the desired surface functionality.
- **Apply** the principles learnt in this course to design bio-inspired surfaces for various applications such as spill resistant fabrics, microrobots, stain resistant displays, drag reduction, fog harvesting and de-icing.

Grading (custom plus/minus grades will be used)

Homework – 20%
Exams – 40%
Presentation – 40%

Homework (20% of the total grade)

There will be ***two homework assignments*** in this course**.** Late assignments will not be collected (Late = 0). All homework assignments have to be turned in via Moodle.

Exams (40% of the total grade)

There will be ***two take home exams***, approximately in the 7th week and the 12th week of the course. There is ***no final exam***. All exams have to be turned in via Moodle.

Tips to Maximize your Grades

Clearly list out the assumptions and known quantities in your solutions. Use sentences (text) to clearly describe what you are doing. ***Students have one week after graded homework (or a graded exam) is returned to question the grade.***

Project Presentation (40% of the total grade)

There will be ***one presentation per group*** starting late Oct or early Nov and continuing until the very last day of classes. The order of presentations (who goes 1st, 2nd etc.) will be decided by the instructor.

The presentation will be based on a topic (a primary paper and multiple relevant papers) related to the concepts covered in this course. The topic and papers chosen by the group ***must have the instructor's approval by mid to late Oct***.

All students must turn in their project presentations (both pptx and pdf). Each presentation will be graded by the instructor and by other students in the class.

Other Policies

Students are expected to read the assigned papers, go through the lecture slides as well as the lecture videos to understand the content.

Synchronous attendance (during regular class days/times) is mandatory for all lectures and project presentations.

Academic Integrity Policy

All students taking this course are required to adhere to the Code of Student Conduct - https://studentconduct.dasa.ncsu.edu/code/. Prior access to solutions or solution manuals related to this course is prohibited. At a minimum, violations will result in a grading penalty and may also lead to a report to appropriate authorities, which can result in disciplinary actions.