Intended Audience:
A sophomore level hands-on course for MAT, BIO, and ME majors, PHYS minors, or anyone interested in understanding phenomena governing the behavior of structures in the 1-100 nm size range.

Objective:
Throughout the Semester, we will make models to crystallize our thinking ---you know what, actually to start thinking. Via models we will develop intuition and heuristics to come up with conjectures/hypotheses to be tested by experiments (in wet lab and/or in silico). Accordingly, these will provide a helping hand towards having a knowledge base on how man-made nanostructures and biological nanomachines behave. At the end, we will have the insight for junior-senior level courses where both extensive measurements on materials and biological systems on all scales are made, and the formation of higher order structure is discussed.

Moderator:
Name: Ali Rana Atilgan
Office No.: MDBF 2093 | Kuleli Köşk Konutları, Kadıköy
Phone No.: +90 (216) 483 9525
e-mail: atilgan@sabanciuniv.edu
URL: http://people.sabanciuniv.edu/tilgan

Associates:
Dilsah Nur Elmacı: dilsahelmaci@sabanciuniv.edu

Course Data:
Hours: Mon 15.40-17.30/Thu 10.40-11.30
Office hours: TBA

Textbooks:

References:

Weeks Commencing/Topics:

Feb 22, Mar 1, and 8 Act I – A story from $1/r$ to $1/r^6$ and empirical energy functions

Coulomb’s law and charge interactions
  What do we mean by long range?
  How do they get weaker?
  The thermal energy steps on the stage
Dipoles – are they to stay fixed?
Polarizability
  Is it a material constant?
  Induced dipoles – are they ubiquitously observable?
van der Waals interactions
Hydrogen bonds

Mar 15, 22, and 29 Act II – Then surfaces get into the picture

Let’s first unify concepts in intermolecular and inter-particle forces
How do similar surfaces come together in a medium?
  Surface and interfacial energy
Forces between particles and surfaces
  SFA and AFM – are we getting serious, can we measure these forces?
Hamaker constants
Ions take a role again – they shield charged objects in water
  Debye length and Bjerrum length; any other length of similar spirit; would you suggest one?

Apr 5 Review and the Midterm
Apr 12, 19, and 26  Act III – Interactions lead to binding

Chemical kinetics – A quick recapitulation of NS 10X courses
   The effect of temperature; is this thermal energy again?
   How is it different from physical kinetics?
Binding and Adsorption Processes
   The Langmuir Model – we better recollect our thermodynamics fundamentals
   The Michaelis–Menten Model; yes, another old but not aged model
   Sabatier’s Principle – too many names floating around here! No worries just to shorten the syllabus
   Delicacy – binding should be neither too tight nor too weak

May 3, 10, and 17  Act IV – Multiple agents cooperatively in action

(First of all, Spring will have, hopefully with more people vaccinated, with all types of blossoms knocked on our door by now! Monday lectures will be the most favorable time period to go out – but c’mon it’s the day after the weekend)

Self-assembly
   Benjamin Franklin spirit
   Amphiphilic molecules – what shapes of micelles do they form and why?
Biological machines
   Are they different from thermodynamic cycles via which macro engines operate?
Time and length scales in the Nano-world
   And “Curtain!”

May 24  Review and the Final

Class Policies
   Course will be online.
   Zoom link: https://sabanciuniv.zoom.us/j/96294995289

Grading
   Quizzes: (6-best/7-8 of them), total is for 30% of the final grade
   Midterm: 30% of the final grade
   Final exam: 40% of the final grade; covers all the material