SYLLABUS:

**Physical Nature of Surfaces (and Interfaces)**

BIOEN 7160 (3 credit hours), Spring Semester 2018

Time/Place: TH 12:25 - 1:45 pm, HSEB 4100A

**Instructor:** V. Hlady, Professor of Bioengineering  
**e-mail:** vladimir.hlady@utah.edu (preferred means of communication)

**Office:** 108A BPRB, phone: 581-5042  
**Office hours:** Thursday after lecture 1:45 - 2:45 pm, or by appointment

**Help - Grader:** TBA

**Prerequisite:** A physical chemistry course, or consent of the instructor (here is some remedial material)

**Textbook (also on reserve desk):**
- Handouts will be available for download from: http://afm1.pharm.utah.edu/PNSCourse/index.html
- The course notes follow the textbook; with additional material included as indicated.

**Grading (%):**
Midterm Tests I and II (in class, tentatively scheduled on Thursdays in Weeks 7 and 12) (20% + 20%),  
Final Exam (2 hr., during final exam week) (30%),  
Homeworks (10%)  
Surface Science Paper (15%) (link to a typical surface science paper) (here are some suggestions for the paper topics),  
Seminar reports (5%) (attendance of minimum 4 seminars in the field of surface and colloid science is required. In the case that there are no suitable seminars here is seminar substitution rule and some examples).

**Schedule of lectures:**

Week 1 (1/9) - **I. Introduction: Liquid Surfaces**  
Reading Assignments: Ch. 2 HJB, Capillary rise paper  
Handout: Surface curvature, Some solved problems

Week 2 (1/16) - **II. Thermodynamics of Interfaces**  
Reading Assignments: Ch. 3 HJB,  
Homework#1  
Handout: Remedial thermodynamics

Week 3 (1/23) - **III. The Electric Double Layer**
Reading Assignments: Ch. 4 HJB, remedial chapter on electrostatics
Homework #1 solutions
Handout: Hyperbolic Functions

Week 4 (1/30) – IV. Effects at Charged Surfaces, Electrokinetics
Reading Assignments: Ch. 4 HJB
Homework #2
Handout: Extras on definition of potentials, Some solved problems

Week 5 (2/6) – V. Technical lecture I: Electrophoresis and streaming potential; Van der Waals interactions;
Reading Assignments: Ch. 4.8; 5.1-2. HJB
Homework #2 solutions
Handout: Gecko adhesion

Week 6 (2/13) – VI. Surface Forces
Reading Assignments: Ch. 5 HJB
Handout: Excess Polarizabilities, Water on ice paper

Week 7 (2/20) – VII. Derjaguin approx; DLVO Theory; MIDTERM I
Reading Assignments: Ch. 5 HJB
Handout: Some solved problems for Week 7,
Solutions to the 1st MIDTERM

Week 8 (2/27) – VIII. Contact angle, Wetting and Applications;
Reading Assignments: Ch. 6 HJB
Homework #3
Handout: How to carry out Zisman plot experiment and analysis

Week 9 (3/6) – IX. Real Surfaces; Technical lecture II: XPS (ESCA);
Reading Assignments: Ch. 7 HJB
Handout:

Week 10 (3/13) – X. Adsorption (Langmuir, BET and other models),
Reading Assignments: Ch. 8 HJB
Homework #3 solution
Handout:

Week 11 (3/20) – Spring Break
Reading Assignments: Ch. 1 - 8 HJB
Handout:

Week 12 (3/27) – Surface Modifications; Protein Immobilization; MIDTERM II (topics);
Reading Assignments: Ch. 9 HJB
Handout: Solutions to the 2nd MIDTERM

Week 13 (4/3) – Macromolecular Adsorption, Protein Adsorption and Mass Transport Effects
Reading Assignments: Polymer Adsorption review, Interpreting SPR kinetics.
Handout:
Week 14 (4/10) – Surfactants, Micelles, Emulsions and Foams  
Reading Assignments: Ch. 11 HJB  
Homework #4  
Handout:

Week 15 (4/17) – XIV. Thin Film, Adhesion, Friction and Lubrication  
Reading Assignments: Ch. 5, 8, 10 & 12 HJB  
Homework #4 solution  
Handout:

Week 16 (4/24) – Presentations and recitations  
FINAL EXAM (May 2nd, 10:30 am - 12:30 pm), Final exam solutions

Here is some small print:  
**General Policy:** All examinations and assignments must be completed in accordance with the University of Utah Student Code. Materials disclosed to the instructor for evaluation must be the original work of the student. Use of material (such as equations, text or graphics) from the web or any other source without proper citation will be considered academic dishonesty.  
**Homework Policy:** Four homework assignments will be required. Each homework will be posted on-line on Tuesdays and will be due one week later before class time. Students are expected to have working knowledge of a mathematical package such as Mathematica, Maple, Matlab or IgorPro and to complete their homework assignments using computer. Presentation in addition to technical content will constitute part of the grade. Late homework generally will not be accepted since solutions will be posted shortly after the due date/time.