**Exams:** There will be two mid-term exams and a term paper scheduled during the semester, each of them closely related to a particular module. Each exam contributes 33.3% towards the final grade.

**Final term paper:** Undergraduate students will form team (if possible) and will deliver an oral presentation of their term papers. Student teams will prepare a review report for a scientific paper(s) assigned by the instructor and deliver oral presentations which contribute 33.4% towards the final grade. These critical reviews will be on one paper selected from a list of published seminal articles in soft nanomaterials filed provided by the instructor. A graduate student will also prepare a written report (individual) which will be submitted prior to their oral presentation (individual).

**Final grades:**

| | |
|---|---|
| Exam 1 | 33.3% |
| Exam 2 | 33.3% |
| Final Term paper | 33.4% |
| **Total** | **100%** |

**Reference books:**
**Reference book will be provided in the beginning of class. Also recent relevant science and technology reviews and papers will be cited during the course**

**Fundamentals of Soft Nanomaterials and Nanostructures**

**School of Materials Science and Engineering**

**MSE 4803B/8803B**

**Tuesday, Thursday, 4-5.30pm**
**G021, Molecular Science and Engineering Bldg**

**Prerequisites:** MSE 2001 or instructor consensus

## Course Overview

The purpose of this course is to introduce the various types of soft nanomaterials and nanostructures that have been discovered and synthesized for prospective applications in nanotechnology such as flexible nanostructures, soft nanoparticles, hybrid nanomaterials, soft lithography, colloidal assemblies, self-assembled organic structures, and biological complexes.

## Course Description

The multi-disciplinary aspect of nanotechnology crosses the traditional disciplines of physics, chemistry and biology. A description and the correlation between different phenomena, synthesis protocols and physical/chemical properties of soft nanomaterials will be discussed with particular emphasis on organic, polymeric, biological, and hybrid (organic-inorganic) assemblies at a length scale ranging from 1 nm to 1000 nm. The course will be composed of three different but closely related modules with emphasis on soft matter fundamentals (I), organization and dynamics (II), and properties and applications (III).

**Instructor:** Prof. Vladimir V. Tsukruk

**Module I**
**Soft Matter Fundamentals**
**Review and Exam 1**

**Module II**
**Organization and Assembly of Soft Nanomaterials**
**Review and Exam 2**

**Module III**
**Properties and Application of Soft Nanomaterials**
**Term papers reports**

**Teaching method:** In-class lectures and presentations.

**Topical Outline of Course**

Module I
Soft Matter Fundamentals
Introduction in soft nanomaterials-general principles
Introduction -general principles and chemical structures
Configuration, conformation, local/global flexibilities
*Entropy, enthalpy, & multi-length scale dynamics*
Solutions and solid states of soft matters
Thermal and mechanical properties
Surface and interfacial energy and confined states.
Module Review
Exam 1

Module II
Organization and Assembly of Soft Nanomaterials
Surface and interfacial organization
Colloidal assemblies
Paper selection
Nanoparticles and organic ligands
Nanoparticles and organic ligands, continue
Molecular films
Layer-by-layer assemblies
Teams for research presentations are finalized
Brushes
Module Review
Exam 2

Module III
Properties and Application of Soft Nanomaterials
Responsive soft nanomaterials
Hybrid nanoparticle applications
Microcapsules and bio/synthetic membranes
Block-copolymers and reinforced nanomaterials
Membranes
Elements of soft lithography
Term papers I
Term Papers II
SPM Lithography
Photonic and LEDs
Flexible electronics + Controlled delivery