MSE 4335: Soft Nano/Bio Materials

Credit hours and contact hours: 3-0-0-3

Instructor: Vladimir Tsukruk

Textbook: Textbook not used. Lecture notes used.

Specific course information

Catalog description: Introduction soft nanomaterials and nanostructures that have been discovered and synthesized for prospective applications in nanotechnology.

Prerequisites: MSE 2001 – Principles & Applications of Engineering Materials

Course: Selected Elective

Specific goals for the course

Outcomes of instruction:

1. General principles of chemical and physical basis for soft nanomaterials
2. Thermodynamics of flexible long-chain molecules
3. Principles of surface and interface formation in soft nanomaterials
4. Assembly approaches to formation of organized soft nanomaterials
5. Major classes of soft nanomaterials and their fundamental properties
6. Current, emerging, and prospective applications of soft nanomaterials

Student Outcomes:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(3) An ability to communicate effectively with a range of audiences.
(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**Topics covered:**

**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
Surfaces and interfaces at confined states

**Module II: Organization and Assembly of Soft Nanomaterials**
Surface and interfacial organization
Colloidal assemblies
Nanoparticles and organic ligands
Molecular films
Layer-by-layer assemblies
Polymer Brushes

**Module III: Properties and Application of Soft Nanomaterials**
Responsive soft nanomaterials
Hybrid nanoparticles applications
Microcapsules and bio/synthetic membranes
Block-copolymers and reinforced nanomaterials
Soft membranes
Soft lithography
SPM Lithography
Controlled delivery
Flexible electronics
Organic photonics/electronics

**Correlation between Outcomes of Instruction and Student Outcomes:**

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<th>Outcomes of Instruction</th>
<th>Student Outcomes</th>
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<tr>
<td>1. General principles of chemical and physical basis for soft nanomaterials</td>
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<td>2. Thermodynamics of flexible long-chain molecules</td>
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