MSE 4335: Soft Nano/Bio Materials (required)

Catalog Description: (3-0-3)
Prerequisites: MSE 2001 Intro to Engineering Matls or instructor consensus
Introduction soft nanomaterials and nanostructures that have been discovered and synthesized for prospective applications in nanotechnology.

Textbook: Lecture notes

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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 1

Module II: Organization and Assembly of Soft Nanomaterials
Surface and interfacial organization 2
Colloidal assemblies
Nanoparticles and organic ligands 1
Nanoparticles and organic ligands 2
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 1
Organic photonics/electronics 2

Course Outcomes:

The student will develop an understanding of fundamentals and principles of soft/bio nanomaterials and their applications.

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

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	**Student Outcomes**										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1. General principles of chemical and physical basis for soft nanomaterials	x	x									
2. Thermodynamics of flexible long-chain molecules	x		x								
3. Principles of surface and interface formation in soft nanomaterials			x					x			
4. Assembly approaches to formation of organized soft nanomaterials	x	x									
5. Major classes of soft nanomaterials and their fundamental properties		x						x			x
6. Current, emerging, and prospective applications of soft nanomaterials			x	x	x	x	x	x	x	x	x
Entire Course	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**2**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

a) an ability to apply knowledge of mathematics, science and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice