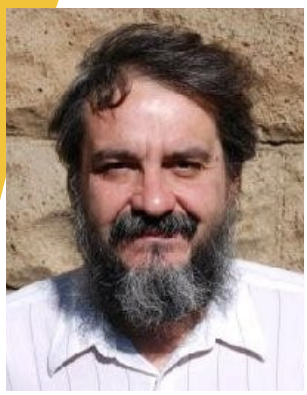
College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:30-4:20pm, Friday, April 17th, 2015
Frank H. Walk Design Presentation Room



Bio-macromolecules and their Complexes – An Inspiration for Statistical Thermodynamics

by Leonardo Golubovic*

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Biological macromolecules are inherently capable of forming physically interesting self-assembled structures with biologically significant functionalities. We overview the efforts to theoretically understand and possibly control some of these fascinating structures and phenomena. Prominent recent examples for this are novel partially ordered liquid crystalline phases, such as the sliding phases of DNA-cationic lipid complexes used for gene therapy applications in the battles against cancer. Other examples discussed in this talk involve the conformational behavior of DNA molecules adsorbed on lipid membranes that are supported on grooved nanostructured surfaces. Aided by theoretical insights, experimental researchers have discovered that the edges formed on these supported membranes can adsorb and completely orient (stretch) very long DNA molecules. This stretching allows direct imaging (by the common fluorescence microscopy) of fundamental biological processes of the interactions between DNA and single protein molecules. In the last part of this talk, we describe our theoretical quest to elucidate the interactions of antimicrobial peptide molecules with biological membranes. Antimicrobial peptides are secreted by organisms of plants and animals, and they serve as defense weapons (natural antibiotics) in the battles against bacteria. We elucidate a rich variety of cell membrane morphological changes induced by peptides, such as pore formation, membrane corrugation and Euler buckling, and we try to answer a very basic question on how these peptide molecules kill bacteria.

* Leonardo (Leo) Golubovic is a professor at West Virginia University. He received his PhD in Physics from University of Belgrade, 1987. Leo held postdoctoral positions at the University of Pennsylvania, UCLA, and Caltech. He joined West Virginia University in 1992. Leo was Visiting Professor at Harvard University 1999-2000, and Visiting Scholar at Ludwig Maximillians University, Munich, 2002. Leo's research is in Statistical Physics of Condensed Matter, with a focus on Soft Condensed Matter and the Physics of surfaces, interfaces, membranes, and liquid crystals. Leo received 2001 Marko Jaric Award for outstanding scientific achievements in physics. In 2005, Leo was named Fellow of the American Physical Society with the Citation: For seminal contributions to the theory of condensed matter systems including prediction and elucidation of the properties of novel partially ordered phases in Liquid Crystal Elastomers and DNA-lipid membrane complexes.