University of Cyprus
Department of Mathematics and Statistics

Seminar of the Department of Mathematics and Statistics, University of Cyprus

Room: 037, ΣΘΕΕ01. **Date**: 28/03/2018 **Time**: 11:00

Speaker : Pavlos Stefanou (University of Cyprus)

Title : *A constitutive rheological model for agglomerating blood derived from non-equilibrium thermodynamics*

Abstract:

Many deaths are the result of cardiovascular diseases associated with unusual blood rheological properties in the circulatory system. Thus, understanding the rheological behavior of blood is paramount in providing insights on the causes of various diseases and the tailor-design of the transport of drugs directly to the infected area. Blood is mainly a suspension of elastic particulate cells in plasma (usually considered as a Newtonian fluid), among which red blood cells (RBCs) dominate. The RBCs are deformable since they consist of an elastic membrane enclosing a hemoglobin solution (also considered a Newtonian fluid). It has been observed that under quiescent conditions, when the shear rate is not high enough (0.1-1 s-1) RBCs aggregate, forming column-like structures called rouleaux. As the shear rate increases, rouleaux break and, after a critical shear rate, eventually only individual RBCs can be observed. A constitutive model capable of predicting this dynamical behavior is the one suggested by Owens and coworkers in which each rouleaux are modeled as elastic dumbbells and their time evolution is described using the Smoluchowski equation accounting for the formation and destruction of rouleaux.

In the present seminar, we derive Owens model within the framework of non-equilibrium thermodynamics, particularly using the generalized bracket formal-

ism. An advantage of using such a thermodynamically-based approach is that the formalism allows us to derive self-consistent expressions for the aggregation and disaggregation rates, whereas in the kinetic theory-based network model of Owens were absent and had to be specified separately. Despite this, we are in a position of verifying the thermodynamic admissibility of Owens model. Possible drawbacks of Owens model will be highlighted and propositions as to how they may be obviated will be presented.