2008-2009

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Professor Dennis Siginer

Distinguished University Professor of Mechanical Engineering at the Petroleum Institute

Dr. Dennis Siginer is presently Distinguished University Professor of Mechanical Engineering at the Petroleum Institute in Abu Dhabi, United Arab Emirates. He also serves as Assistant Provost and Dean of the College of Arts and Sciences. Previously he served as Dean of the College of Engineering and Professor of Mechanical Engineering at Wichita State University in Wichita, Kansas. Prior to his appointment to the position of Dean at Wichita State he was Chair of the Mechanical Engineering Department at the New Jersey Institute of Technology in Newark, New Jersey. Before joining New Jersey Institute of Technology he held the position of Professor of Mechanical Engineering at Auburn University in Alabama. Dr. Siginer held several Visiting Professor positions abroad in Institutions in France, Japan, Korea, Chile, Brazil and the Russian Academy of Sciences, and NASA in this country. He holds a PhD and ScD from the University of Minnesota and the Technical University of Istanbul, respectively. His research interests lie with Continuum Mechanics and Fluid Mechanics and in particular with the mechanics of Non-Newtonian Fluids. Contributions include a new method to invert Fredholm integral equations of the first kind when the data is experimental, the discovery of novel effects in porous media flow, the stability of some popular constitutive equations for viscoelastic fluids and the stability of some non-affine visco-elasto-plastic constitutive equations with yield stress as well as the introduction of the novel concept of the inverse problem with time varying yield stress fluids to optimize the performance of magnetorheological dampers.

Dr. Siginer is active in several professional societies APS, ASME, AAM, SES, ASEE and played/plays a leadership role in various capacities in particular in ASME, which honored him with the Distinguished Dedicated Service Award this year. He is a fellow of ASME, AAM, and NYAS.

Thursday, Nov. 20, 2008 3:00 – 4:00 p.m. Room 112, ME-EM Bldg.

Heat Transfer Asymptote in Laminar Flow of Non-Linear Viscoelastic Fluids in Straight Non-Circular Tubes and Interplay of Elasticity and Inertia in Heat Transfer Enchancement

A survey, including recent work, of secondary flows of viscoelastic liquids in straight tubes point at striking analogies with transversal deformations associated with the simple shearing of solid materials. I mportance and implications of these secondary flows of viscoelastic fluids in heat transfer enhancement are explored. Work by the speaker and colleagues, for both the steady and unsteady pressure gradient driven secondary flows of constitutively non-linear simple fluids in straight pipes of non-circular shape, is discussed. Specifically the steady secondary flow of non-affine viscoelastic fluids in pipes of unconventional contours together with the structure of the secondary flow field in straight tubes of arbitrary cross-sections is summarized.

The fully developed thermal field in constant pressure gradient driven laminar flow of a class of non-linear viscoelastic fluids constitutively represented by a class of single mode, non-affine constitutive equations with instantaneous elasticity in straight pipes of arbitrary contour ∂D with constant wall flux is investigated. The driving forces can be large. Asymptotic series in terms of the Weissenberg number Wi are employed to expand the field variables. A continuous one-to-one mapping is used to obtain arbitrary tube contours from a base tube contour $\partial D0$. The method is capable of predicting the velocity and temperature fields in tubes with arbitrary cross-section. Heat transfer enhancement due to shear-thinning is identified together with the enhancement due to the inherent elasticity of the fluid. The latter is to a very large extent the result of secondary flows in the cross-section but there is a component due to first normal stress differences as well. Increasingly large enhancements are computed with increasing elasticity of the fluid and order of magnitude larger enhancements are possible even with slightly viscoelastic fluids. It is shown that the coupling between inertial and viscoelastic nonlinearities is crucial to enhancement.

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