National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Conference Return Seminar on Effect of finite extensibility on the purely elastic hoop stress mode instability in Taylor-Couette flow (Presented at CompFlu – 2024, Indian Institute of Technology (IIT) Hyderabad)
Speaker	: Pratyush Kumar Mohanty
Supervisor	: 8260798925
Venue	: New Seminar Hall, Chemical Engg. Department
Date and Time	: 24 Dec 2024 (11.00 A.M.)
Abstract	: Viscoelastic fluids are known to exhibit 'purely elastic' linear instabilities in curvilinear geometries like the Taylor-Couette or Dean flow configurations. These instabilities, driven by hoop stresses, are even present in the absence of inertia. Previous research has shown the presence of hoop stress mode instability in Taylor-Couette flow for Oldroyd-B fluids in the narrow gap limit. The objective of the present study is to utilize a more rigorous constitutive equation (FENE-P) to accurately predict the purely elastic instability. While it might be anticipated that the Hoop Stress Mode (HSM) instability would occur in Taylor-Couette flow within the narrow-gap limit (where the gap width is much smaller compared to the radius of curvature of the channel), the present work demonstrates that the HSM instability persists even for finite and larger values of the gap-width ratio. We examine the effect of finite extensibility on the hoop stress mode instability in finite gap widths for both axisymmetric and non-axisymmetric disturbances. We show parameter regimes in the $Wi - \epsilon - \beta$ space where the HSM is present. Our results show that, within the Oldroyd-B model, in the narrow gap limit for HSM non-axisymmetric mode is more critical but as we move towards the finite gap ratio axissymmetric mode becomes more critical. In the Oldroyd-B limit at $\beta = 0.8$ the axissymmetric mode becomes critical at non-dimensional gap width ($\epsilon = 0.7$) but as we move towards the dilute limit ($\beta = 0.98$) even at $\epsilon = 0.3$ the axisymmetric mode becomes critical. In the FENE-P fluid, finite extensibility tends to stabilize HSM instability in comparison to the Oldroyd-B model.