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Stability of three-layered core-annular flow[1] DIPIN PILLAI, Univ of Florida - Gainesville, SUBRAMANIAM PUSHPAVANAM, T SUNDARARAJAN, Indian Institute of Technology Madras, India — Stability of a three-layered core-annular flow is analyzed using the method of modal linear stability analysis. A temporal analysis shows that the flow becomes unstable to two modes of instability when inertial effects are negligible. An energy budget analysis reveals that these two modes correspond to capillary instability associated with each fluid-fluid interface. With an increase in Reynolds number, the system exhibits additional Reynolds stress modes of instabilities. These modes correspond to the Tollmien-Schlichting type of waves associated with high Reynolds number shear flows, and are considered precursor to transition to turbulence. An investigation of the parameter space reveals that the system may simultaneously show up to 5 distinct modes of instability, viz., the two capillary modes at each interface and three Reynolds stress modes in the bulk of each phase. In addition, a spatio-temporal analysis shows that the Reynolds stress modes are always convectively unstable whereas the capillary modes may undergo a transition from convective to absolute instability with decrease in Weber number. To obtain encapsulated droplets in experiments, the operating parameters must be chosen such that the system lies in the regime of convective instability.

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