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Linear stability analysis of miscible two-fluid flow in a channel with velocity slip at the walls SUKHENDU GHOSH, R. USHA, Department of Mathematics, IIT Madras, Chennai-600036, India, KIRTI CHANDRA SAHU, Department of Chemical Engineering, IIT Hyderabad, Yeddumailaram - 502205, Andhra Pradesh, India — The linear stability characteristics of pressure-driven three-layer flow of two miscible liquids with same density and varying viscosity in a channel with velocity slip at the wall are examined. The flow system is destabilizing when a more viscous fluid occupies the region closer to the wall with slip. For this configuration, a new mode of instability, namely, the overlap mode, similar to the one which appears in the corresponding flow in a rigid channel, occurs for high mass diffusivity of the two fluids, when the critical layer of the disturbance overlaps the viscosity stratified layer. The co-existence of several overlap modes, TS mode are also observed under certain circumstances. The flow is unstable at low Reynolds numbers for a wide range of wave numbers for low mass diffusivity. A configuration with less viscous fluid adjacent to the wall is stabilizing at moderate miscibility. It is possible to achieve stabilization or destabilization of miscible two-fluid flow in a channel with wall slip by appropriately choosing the viscosity of the fluid layer adjacent to the wall. In addition, the velocity slip at the wall has a dual role in stabilizing the flow system. The flow system can be either stabilized or destabilized by designing the walls of the channel as hydrophobic surfaces.

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