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The miscible two-fluid flow down an inclined plane: Linear stability analysis R. USHA, Department of Mathematics, IIT Madras, Chennai-600036, India, RAMA GOVINDARAJAN, TIFR centre for Interdisciplinary Sciences, TATA Institute of Fundamental Research, Hyderabad-500075, India, OUTI TAMMISOLA, Department of Engineering, University of Cambridge, Trumpington Street, Cambridge, CB2 1PZ UK — The linear stability of a miscible two-layer free-surface flow of varying viscosity, down an inclined substrate is examined. We show that the stability characteristics are different from both immiscible two-layer flows and continuously stratified flows. A new instability mode, namely overlap mode, absent in either limiting case, arises when the critical layer of the disturbance overlaps the viscosity-stratified layer. At moderate miscibility, the configuration with less viscous fluid adjacent to the inclined plane is most stabilizing. This is also contrast with the limiting cases, in which the lubrication configuration is always destabilizing. The co-existence of several growing overlap modes, the usual surface mode and a Tollmien-Schlichting mode are observed and this presents interesting new possibilities for nonlinear breakdown.

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