

UNENE Graduate Course Reactor Thermal-Hydraulics Design

McMaster University
Whitby

March 1-2, March 15-16,
April 5-6, April 19, 2008

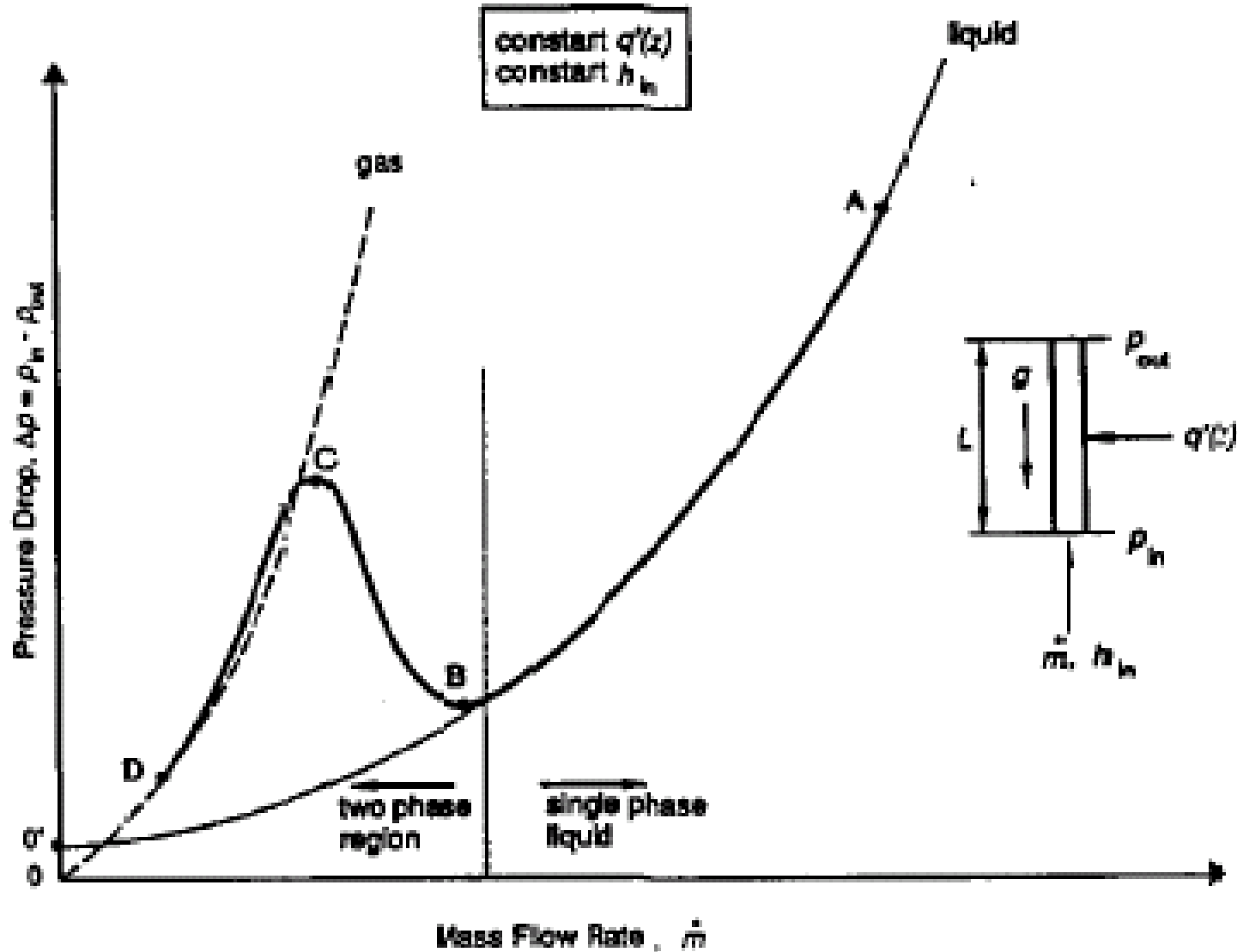
Instabilities

Dr. Nik Popov

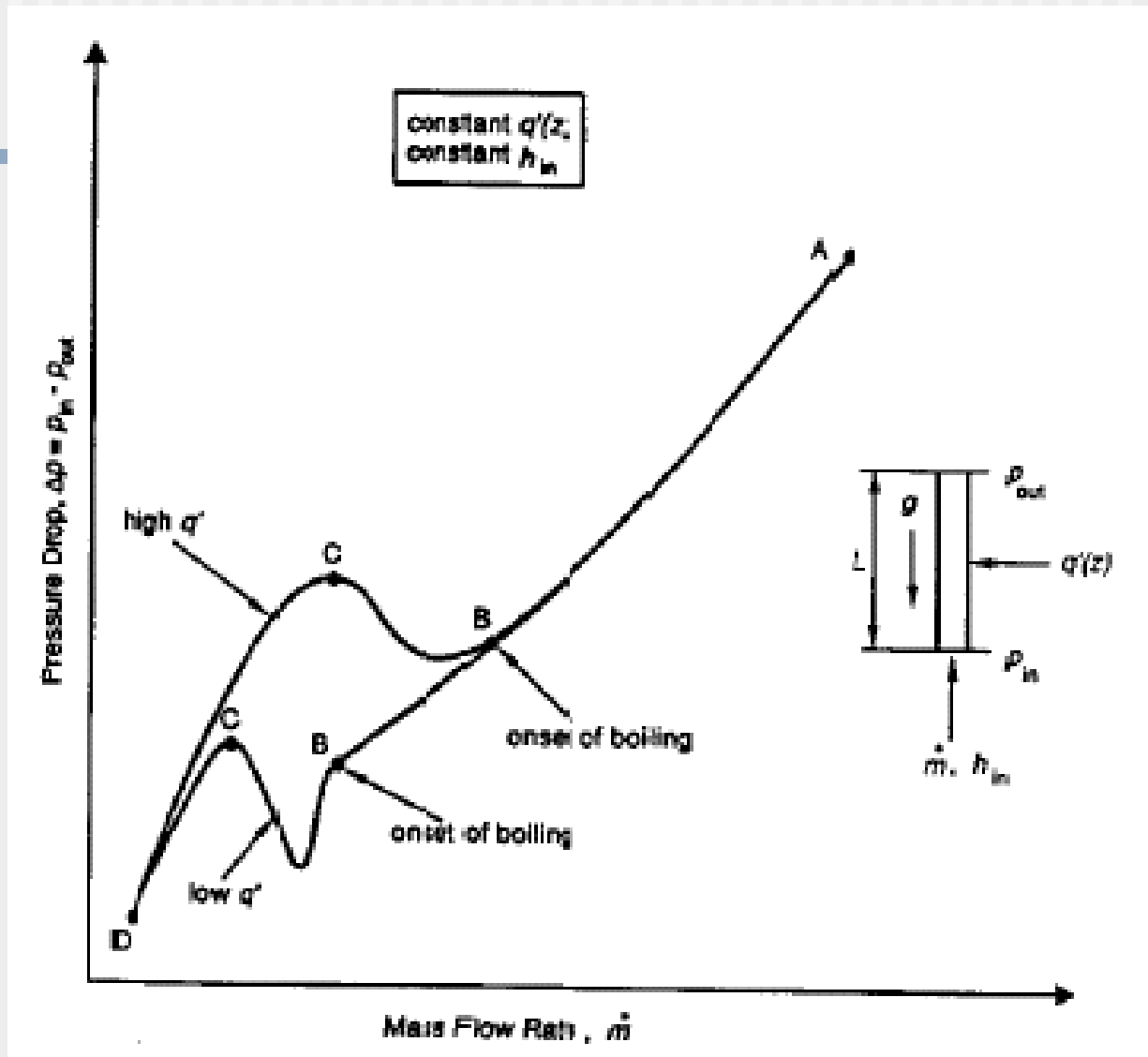
Flow Instabilities

- Understanding flow instabilities is instrumental to ensuring good understanding of thermal-hydraulics system behavior
- Scale-based grouping
 - Microscopic instabilities (occur locally)
 - Macroscopic instabilities (involve entire system)
- Process-based grouping
 - Static instabilities (unstable equilibrium states)
 - Flow excursions (Ledinegg instability)
 - Relaxation instabilities (flow pattern transitions, nucleation instabilities, bumping, chugging, and geysering)
 - Dynamic instabilities
 - Density wave oscillations
 - Pressure wave oscillations
 - Acoustic oscillations

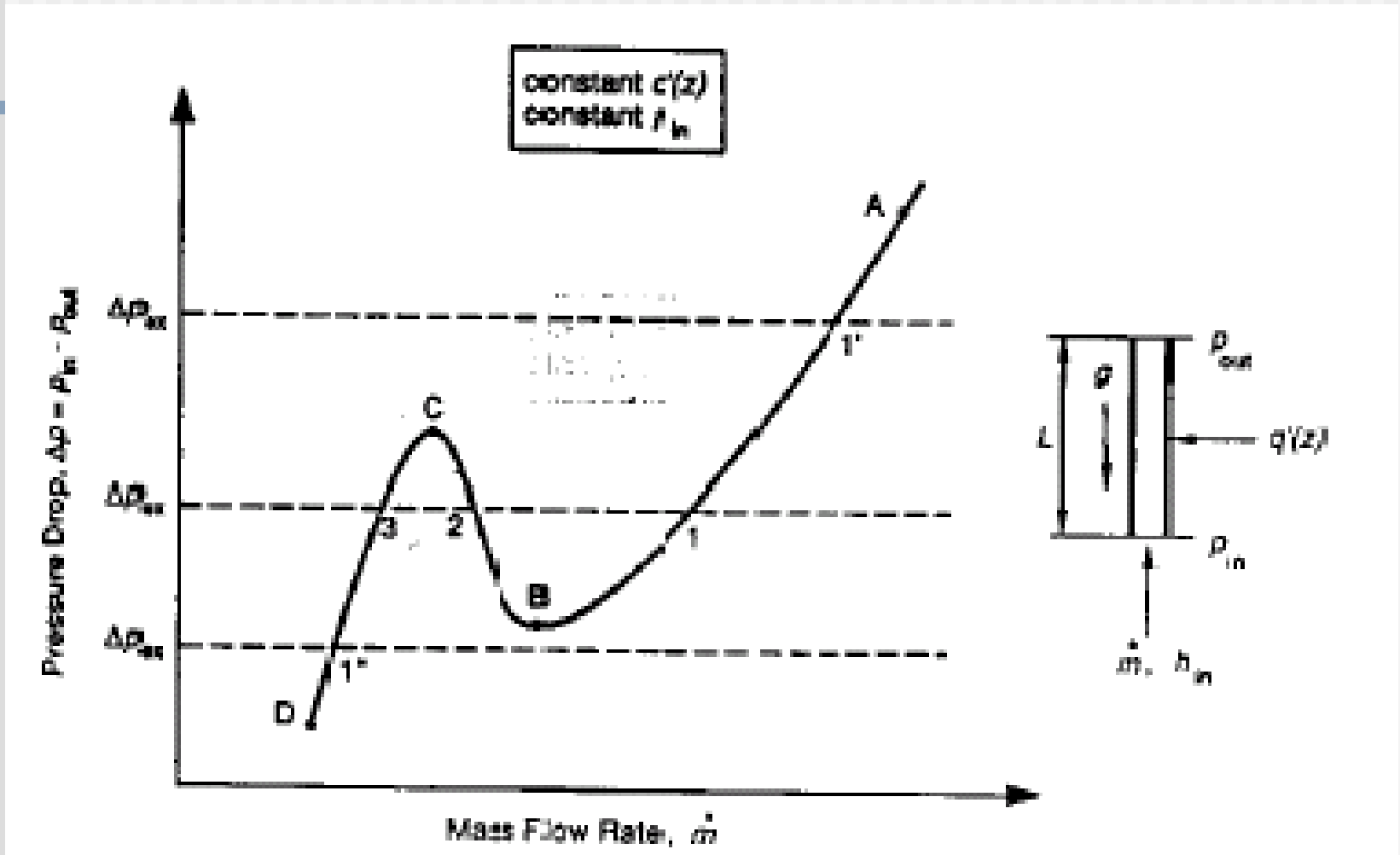
Flow Instabilities - Background



Flow Instabilities - Background



Flow Instabilities - Background



Flow Excursion Instability

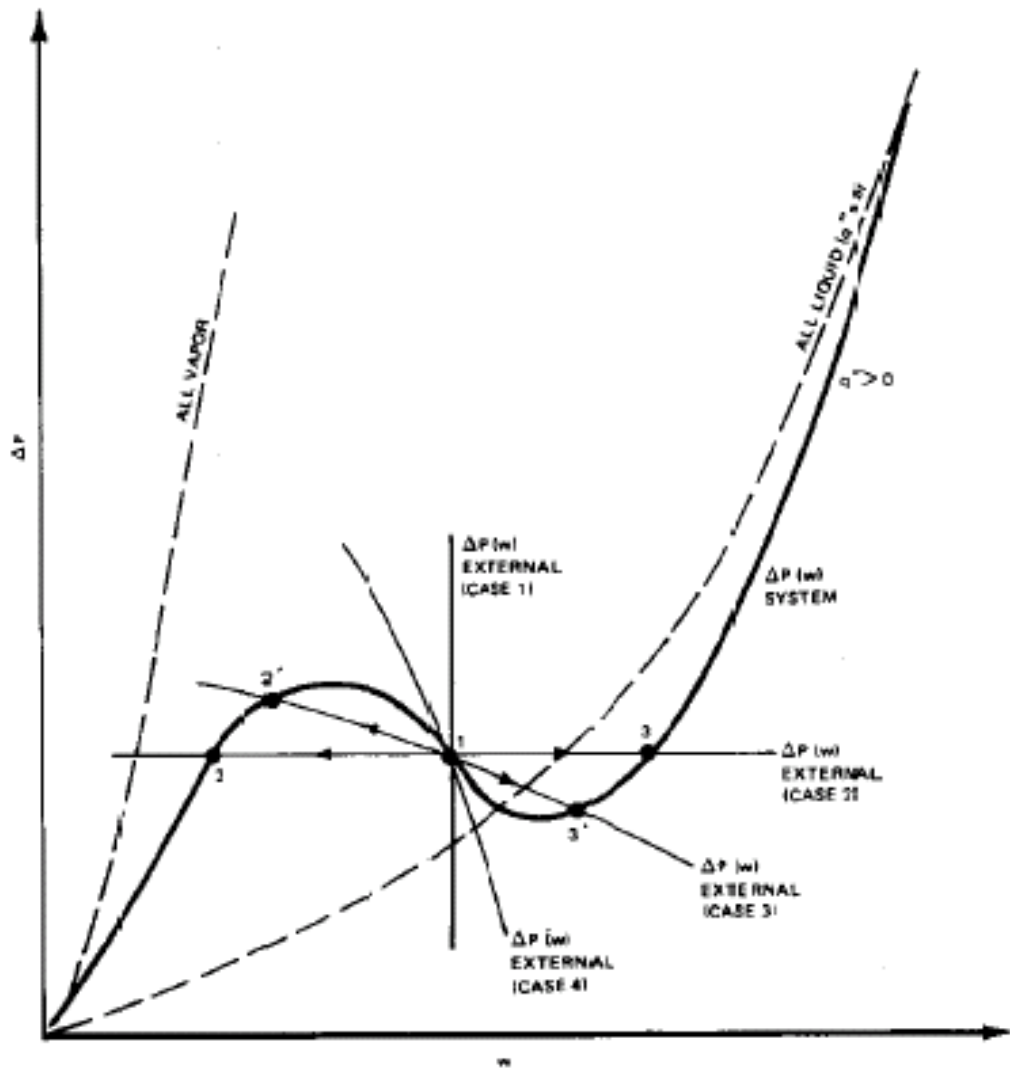


Fig. 7-1. Excursive instability.

$$\frac{\partial(\Delta P_{\text{SYSTEM}})}{\partial w} > \frac{\partial(\Delta P_{\text{EXT}})}{\partial w}$$

Case 1 – positive displacement pump

Case 2 – parallel channel situation

Case 3 – centrifugal or jet pump situation

Questions?
