NC STATE UNIVERSITY

ENGINEERING ONLINE

Lecture Notes

Course Number: NE 577

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Date: 2/6/23

Lecture Number: 05

①

Surface tension.

For solid boundaries w/ prescribed velocities, the condition (28) (along w/ boundary & initial conditions) is sufficient to find a well-defined solution to N.S. eq. (8), (17)

For a free surface, another condition is needed. This condition comes from a momentum balance across the interface which states:

"jump in surface tractions $\underline{t} = \underline{\underline{\sigma}} \cdot \underline{n}$ combined with the momentum fluxes must be balanced by the action of surface tension"

$$\underline{\underline{\sigma}} = -p\underline{\underline{I}} + \underline{\underline{\tau}}$$

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Dimensionless groups.

$$\underline{x} = L\,\underline{x}^*; \quad t = \tau t^*; \quad \underline{u} = U\underline{u}^* \quad (1)$$

$*$ ← dimensionless.

Let:

$$\nabla p = \frac{\Delta P}{L}\,\underline{\nabla}_* p^*; \quad \underline{f} = \mathcal{f}\,\underline{f}^* \quad (2)$$

$\underline{\nabla}_*$ is gradient w.r.t. $\underline{x}^*$

ΔP is pressure difference scale

$\mathcal{f}$ is representative value of $\underline{f}$.

The continuity eq.: $\underline{\nabla}_* \cdot \underline{u}^* = 0$ (3)