

ACM 305

- Books: D J Acheson Elementary Fluid Dynamics (OUP 1990) £17.50
 AR Paterson A First Course in Fluid Dynamics (CUP 1983) reprinted 1992 £19.95 in Blackwells (Mech. Eng.!)
 * GK Batchelor An Introduction to Fluid Dynamics (CUP 1967) £30.00
 * More advanced

Chapter One THE GOVERNING EQUATIONS

§ 1.1 Résumé

- Refer to AMA 301.
- Use spatial description throughout.
- Use $\underline{u}(\underline{x}, t)$, not $\underline{v}(\underline{x}, t)$, for velocity of fluid element at position \underline{x} at time t (as in Acheson, Batchelor).

• Conservation of mass (eqn (3.5) of AMA 301):

Dρ / Dt + ρ ∇ · u = 0

Equation of continuity (1.1)

where ρ(x, t) is density and

D / Dt ≡ (∂ / ∂ t + u · ∇)

(1.2)

• Newton's 2nd Law (principle of linear momentum - eqn (3.20) of AMA 301):

ρ Du_i / Dt = ρ b_i + ∂σ_ki / ∂x_k

(1.3)

where (a) Du_i / Dt is i-th component of Du / Dt, which is acceleration of fluid element at position x at time t; (b) b_i is i-th component of b which is body force per unit mass so that force on a small volume of size δV is ρ b δV and, in all our applications, b = g = constant acceleration due to gravity; (c) σ_ki are the components of the stress tensor.

• Stress tensor

(i)



Element of surface of area δS, normal n. Force exerted by fluid on side towards which n points on fluid on other side is t δS, where t is the stress vector and

