211207

2021년 12월 7일 화요일 오전 10:00

Last lecture

Diffuser
Nozzle
Flowmeters } Ch. 6

Energy seminar

Final Exam 11–13:30 Thurs Dec 9 Location: 301 – 204

↳ everything except seminar

Ch. 1 → Definitions fluid, properties, etc. → γ, θ

Lagrangian vs. Eulerian

Material
Total
Substantial } derivative $\frac{DQ}{Dt} = \frac{\partial Q}{\partial t} + V \cdot \nabla Q$

Reynolds #

Flow lines

Types of flow

Ch. 2 → Pressure in a stationary (static) fluid (liquid) → hydrostatics
- rotating
- constant linear $\vec{a}$

F, X_{cp}, Y_{cp}, → on surfaces

Pascal's Principle

Buoyancy, stability

Ch. 3. — MOST IMPORTANT (analytical) algebraic equations

Control volume analysis (Eulerian)

Lagrangian (particle) → Reynolds Transport Theorem → Eulerian (control volume)

mass
momentum
energy } conservation

Control volume moving at constant velocity

Bernoulli Equation.

Ch. 4.
(analytical) differential equations

Differential control volume
differential equations for
mass conservation → continuity eqn.
momentum conservation → Navier-Stokes eqn.
Solutions for special cases
ψ, ϕ
vorticity $\nabla \times \vec{V}$ & angular velocity
(numerical section → not covered)

Ch. 5
(experimental)

Dimensional analysis, dimensions vs. units
Principle of dimensional homogeneity
Buckingham π Theorem → π's
Similarity between model & prototype
Difficulties in achieving similarity
Nondimensionalization of equations

Ch. 6.
application to internal flows

Internal flow
$Re_d = \frac{\rho V d}{\mu}$
laminar vs. turbulent flow.
h_f
$f(Re_d)$ for laminar & turbulent flows
Moody Chart
Hagen-Poiseuille flow, etc.
structure of laminar boundary layer vs. turbulent boundary layer
- inner
- overlap
- outer

boundary layer
hydraulic diameter for non-circular ducts
minor losses → bends, valves, etc.
diffusers/ nozzles
flowmeters.

diffusers/ nozzles

flowmeters.

Ch. 7
application to external flows.

external flows → boundary layers

streamlined (slender) vs. bluff bodies

attached vs. separated flows

laminar vs. turbulent flat plate flows

integral analysis of [laminar / turbulent] flat plate attached boundary layers

$D \propto \theta$ & $\tau_w \propto \frac{d\theta}{dx}$

$\frac{\delta}{x}, \frac{\delta^*}{x}, \frac{\theta}{x}, \tau_w, D = \int_A \tau_w \, dA$

$$C_f \equiv \frac{\tau_w}{\left(\frac{\rho U_0^2}{2}\right)}$$

$$C_D \equiv \frac{D}{\left(\frac{\rho U_0^2}{2}\right) A}$$

$H \equiv \delta^* / \theta$ → condition of boundary layer