CIVL42002: Computational Hydraulics SPRING 2024

Module coordinator: Dr David Apsley
Other staff: Prof Ben Rogers

CONTENTS

Part 1 (8 weeks) – Dr Apsley

Equations

1. Introduction to computational fluid dynamics (CFD)
2. Fluid-flow equations
3. Common approximations

Numerical Methods

4. The scalar-transport equation
5. Pressure and velocity
6. Time-dependent methods

Turbulence

7. Turbulence and Reynolds averaging
8. Introduction to turbulence modelling

CFD Practice

9. Pre- and post-processing

Part 2 (4 weeks) – Prof Rogers

Shallow-water flows

READING LIST

<u>CFD</u>

Versteeg, H.K. and Malalasekera, W., 2007, *An Introduction to Computational Fluid Dynamics: The Finite Volume Method*, 2nd Edition, Pearson.

Ferziger, J.H., Peric, M. and Street, 2019, *Computational Methods for Fluid Dynamics*, 4th Edition, Springer-Verlag.

<u>Turbulence modelling</u>

Leschziner, M.A., 2015, *Statistical turbulence modelling for fluid dynamics - demystified: an introductory text for graduate engineering students*, World Scientific.

Pope, S.B., 2000, *Turbulent flows*, Cambridge University Press.

ASSESSMENT

50% exam (2.5 hours)
50% coursework (4 equal-weight exercises)

Coursework exercises:

1. Star CCM+ intro (issue week 1, submit week 3)
2. STREAM: separated flow (issue week 4, submit week 6)
3. Star CCM+ advanced (issue week 7, submit week 9)
4. Shallow-water flows (issue week 9, submit week 11)

Exam format:

Answer all 4 questions (3 from Section A, 1 from Section B)

SCHEDULE (*Subject to change*)

Week	Content	
1	Introduction to CFD and the finite-volume method Fluid-flow equations – derivations Fluid-flow equations – alternative forms + 3-hour cluster session on StarCCM+	Coursework 1 (StarCCM+)
2	Fluid-flow equations – examples Common approximations Common approximations - examples	
3	Scalar-transport equation – diffusion and source Scalar-transport equation – advection Scalar-transport equation – advanced discretisation	
4	Scalar-transport equation – examples Scalar-transport equation – matrix solution Pressure and velocity – coupled equations	Coursework 2 (STREAM)
5	Pressure and velocity – pressure-correction methods Pressure and velocity – examples Time-dependence	
6	Time-dependence Turbulence – introduction Turbulence – modelling	
7	Turbulence – modelling and implementation Turbulence – examples Preprocessing and geometry + 2-hour cluster session on StarCCM+	Coursework 3 (StarCCM+)
8	Unstructured meshes Postprocessing and flow-visualisation Post-processing – examples	
9 – 12	Shallow-water flows	Coursework 4 (Shallow-water flow)