

# ES440/ES911: CFD

## *Computational Fluid Dynamics*

Dr Yongmann M. Chung

<http://www.eng.warwick.ac.uk/staff/ymc/ES440.html>

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# Introduction

# Office Hours

- Dr Yongmann M. Chung

- Tel.: 74367, Room A312

- E-mail: [Y.M.Chung@warwick.ac.uk](mailto:Y.M.Chung@warwick.ac.uk)

- [www.eng.warwick.ac.uk/staff/ymc/ES440.html](http://www.eng.warwick.ac.uk/staff/ymc/ES440.html)

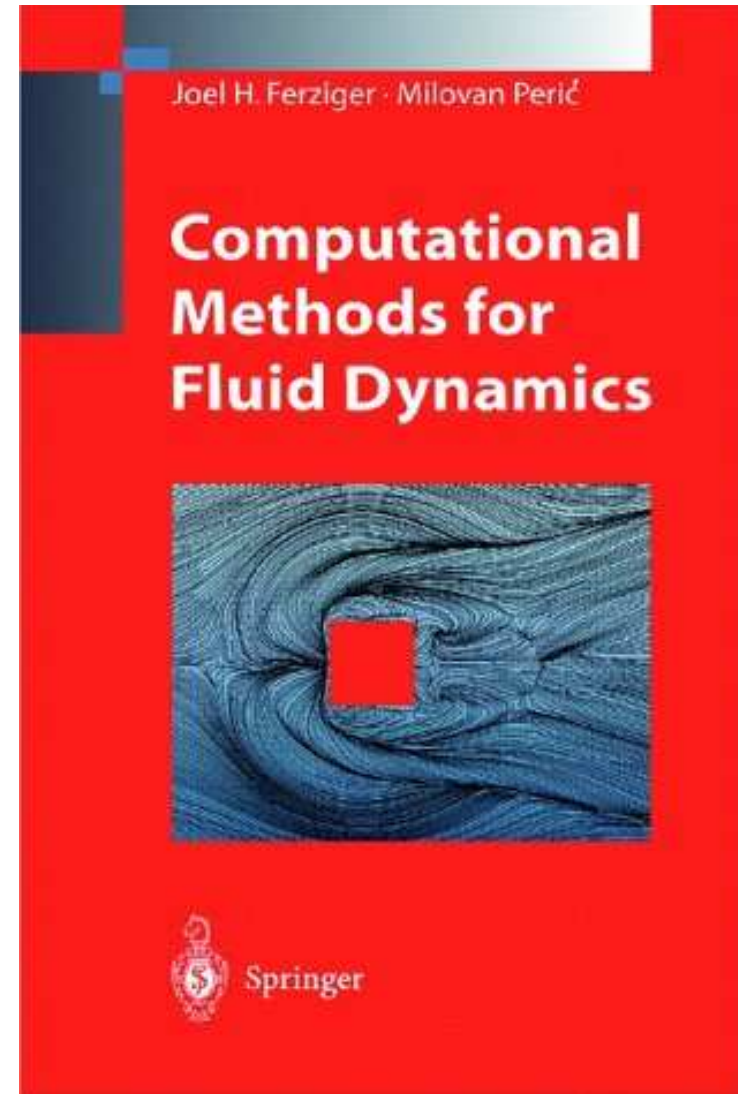
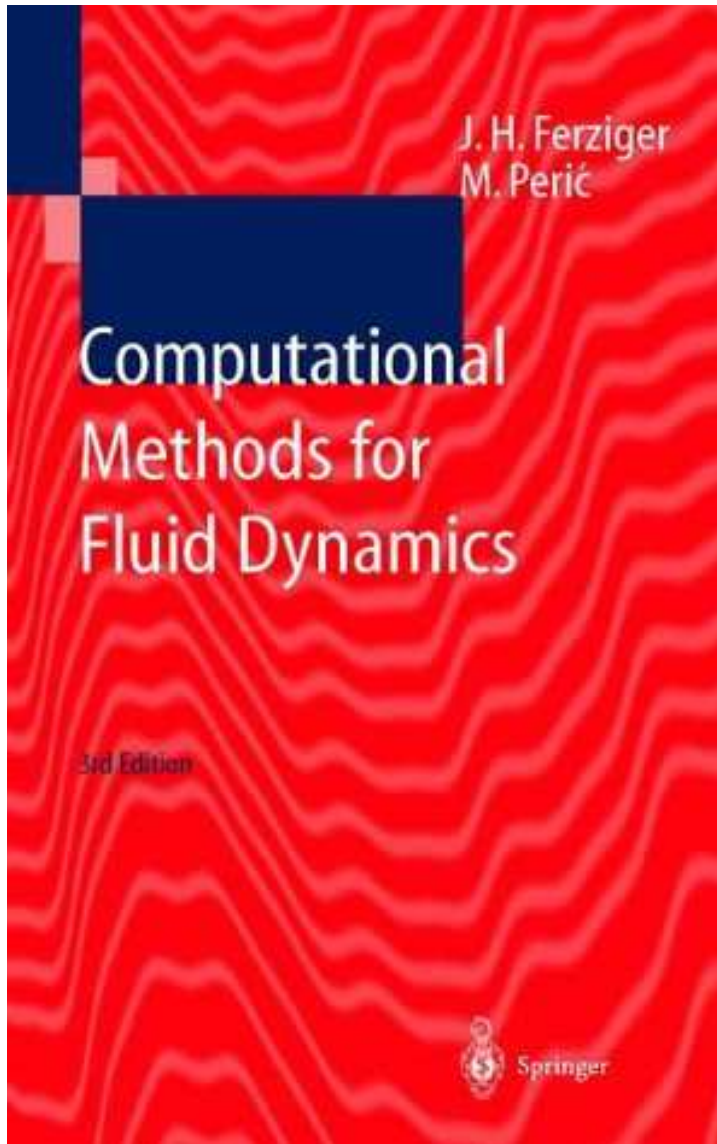
- Office Hours

- Monday 17:00-18:00

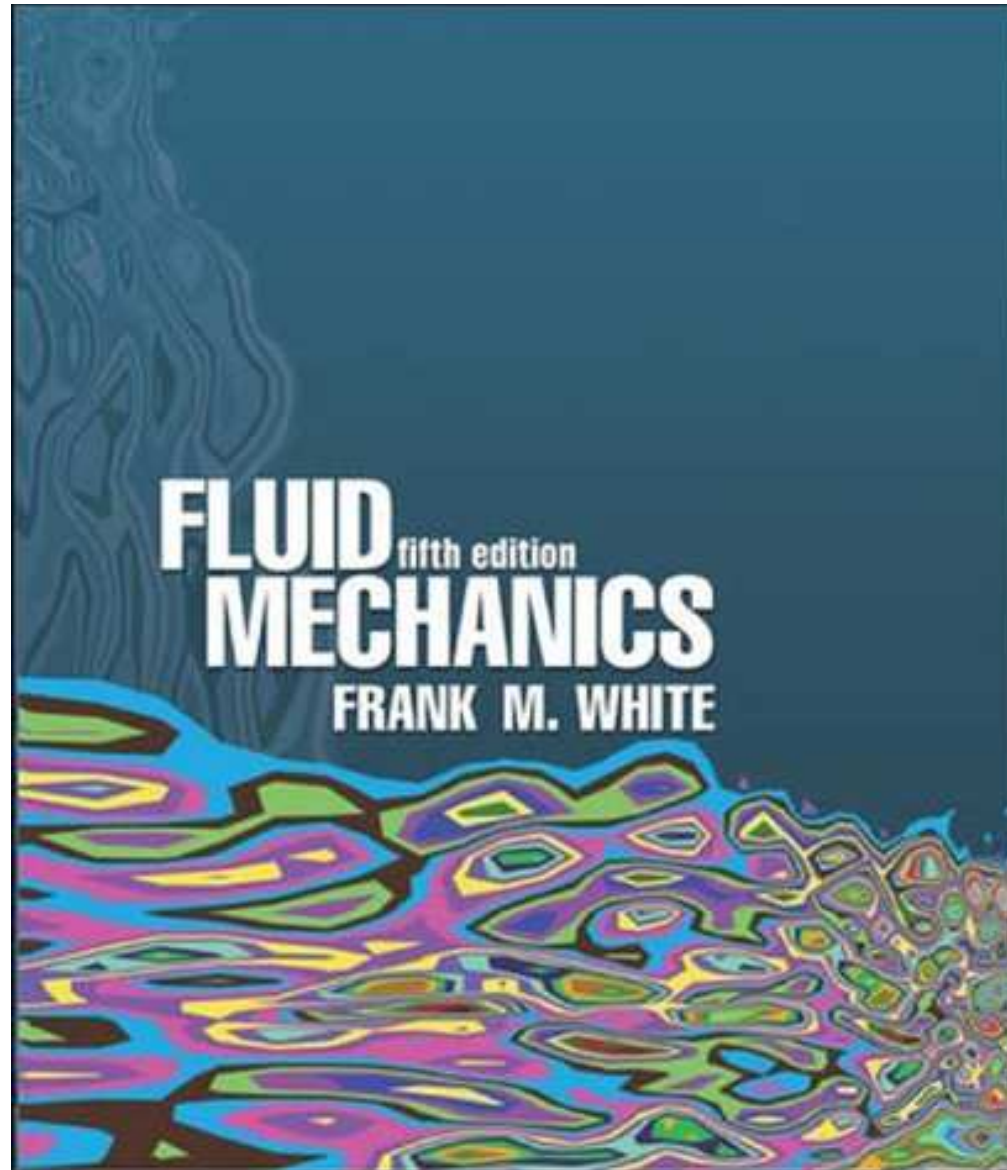
- Tuesday 17:00-18:00

- Friday 15:00-17:00

# ES440 Textbook 2004/05



# Fluid Mechanics



# ES440 BOKLIST 2004/05

## ● Textbook

- Ferziger, J. H. & Perić, M. *Computational Methods for Fluid Dynamics*. 3rd Edition, Springer-Verlag.  
QC 211.F3 (2 Copies in Library).
- Chapters 1-9.

## ● Numerical Analysis

- Ferziger, J. H. *Numerical Methods for Engineering Application*. Second edition, Wiley & Sons, Inc. (1998).  
ISBN: 0471116211
- Moin, P. *Fundamentals of Engineering Numerical Analysis*.  
Cambridge University Press (2001).  
ISBN: 0521805260

# ES440 BOKLIST 2004/05 - Cont'd

## ● References

- Fletcher, C. A. J. *Computational Techniques for Fluid Dynamics 1*. 2nd edition, Springer-Verlag (1991).  
QC 211.F5 (1 Copy in Library).
- Fletcher, C. A. J. *Computational Techniques for Fluid Dynamics 2*. 2nd edition, Springer-Verlag (1991).  
QC 211.F5 (1 Copy in Library).
- Tannehill, J. C. Anderson, D. A. & Pletcher, R. H. *Computational Fluid Mechanics and Heat Transfer*. 2nd edition, Taylor & Francis (1997).

# Assessment

- Examination (MEng ES440: 60%; MSc ES911: 0%)
  - Two-hour written examination.
  - **Three** questions out of **Five** will be required.
  - At least **Two** examination questions from example questions.
- Assignment (MEng ES440: 40%; MSc ES911: 100%)
  - Assignment 1: Essay & Oral presentation (5 minutes) (ES440: 10%; MSc ES911: 25%),
  - Assignment 2: Programming Development (ES440: 10%; MSc ES911: 25%),
  - Assignment 3: Commercial Code (**STAR-CD**) (ES440: 20%; MSc ES911: 50%).

# Assignment 1 (10%; 25%)

- A short essay no more than 1000 words on the use of CFD to any engineering problems, Week 14.
  - Flow around an aircraft
  - **CFD** in sports - Swimming, Car racing (F1), Yacht, etc.
  - Bio-fluid
  - Blood flow through a heart/artery system.
  - Air flow inside the wind-pipe.
  - Nano-fluid
  - Environmental fluid mechanics.
- Oral presentation (5 minutes) on Thursday, Week 18
- Report on Friday, Week 20

# Assignment 1 - Cont'd

- Key Points are
- Six Steps:
  - Background information - overview.
  - **Step 1:** Problem Definition - Governing equations.
  - **Step 2:** Computation Domain.
  - **Step 3:** Boundary Conditions.
  - **Step 4:** Computational Grid.
  - **Step 5:** Computer Simulation.
  - **Step 6:** Results & Discussion - Validation, Comparison & Analysis.
- Suggestions for Future Work.

# Assignment 2 (10%; 25%)

- Programming Development for a model problem, Week 15.

- 1 dimensional problem (Ch. 5)

$$\mathbf{Ax} = \mathbf{b}$$

- Programming Languages (Fortran, C++, Basic, Matlab, etc.)

- Report on Wednesday, Week 24

- Governing equations
- Boundary conditions
- Numerical method
- Results & Discussion
- Results validation

# Assignment 3 (20%; 50%)

- Using a commercial code (**STAR-CD**) for any engineering problems, Week 18.
  - Practical Session on Thursday
- Report on Wednesday, Week 24
  - The suitability of CFD over experimental methods
  - Governing equations
  - Boundary conditions
  - Numerical method
  - Results & Discussion
  - Results validation

# Lecture Programme

Timetabled sessions in Term 2 are

- Monday (16:00-17:00, Room B213/4),
- Tuesday (10:00-11:00, Room S019),
- Thursday (14:00-15:00, Room R1.13).
  - Practical Sessions with **STAR-CD** in Room F211
  - Reading Slots.
  - Programming Languages (Fortran & Matlab) in Week 14.
  - Assignment 1 Oral Presentations in Week 18.

# CFD

## ● Computational

- ES387 Mathematical and Computational Model
- ES904 Computational Mathematics for Engineers
- Programming Languages (Fortran, C++, Basic, Matlab.)

## ● Fluid Dynamics

- Energy & Fluids
- ES252 Fluid Mechanics
- ES30A,B & D Fundamental Fluid Mechanics I & II
- ES912 Turbulent Flow

## ● Mathematical

- ES157 Mathematics for Engineers

# CFD - Cont'd

- Need a solid background in both Fluid Mechanics & Numerical Analysis
- Computational
  - Chapters 2
- Fluid Dynamics
  - Chapter 1
- CFD
  - Chapters 3 to 12
  - We only cover Chapters 3-9.

END