

## UNIVERSITY OF WARWICK School of Engineering

### ES440/ES911 CFD - Syllabus

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## 1 Preliminaries

### 1.1 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
  - Reading Slots.
  - Introduction to Programming Languages (Fortran) in Week 14.
  - Assignment 1 Oral Presentations in Week 18.

### 1.2 Office Hours

- Monday 17:00-18:00
- Tuesday 17:00-18:00
- Friday 15:00-17:00

## 2 Aims & Objectives

- This course introduces the fundamentals to Computational Fluid Dynamics (CFD) for the analysis of Mechanical and Aerospace Engineering flows.
- The scope of the course will be the solution to nonlinear partial differential equations.
- FDM and FVM analyses will be presented.

## 3 Assessment

- Two-hour written examination, which carries 60% (MEng ES440) of the course credit.
- **Three** questions out of **Five** will be required in the June examination.
- At least **Two** examination questions will be set on example questions.

## 4 Assignment

- There will be **Three** assignments, which is worth of (MEng ES440: 40%; MSc ES911: 100%) course credit.
- Marks will be split between the three assignments.
  - Assignment 1: Essay & Oral presentation (5 minutes) (10%),
  - Assignment 2: Programming development (10%),
  - Assignment 3: Commercial Code (STAR-CD) (20%).
- It should take no more than 40 to 50 hours to complete.

## 5 Lecture & Seminar Sessions

- **WEEK 11 Ch. 1 Introduction**
  - Thu. (1) General introduction & Ch. 1
    - \* Examination and Assignments.
    - \* Practical Sessions Arrangement (Dr. Paul Dunkley)
- **WEEK 12 Ch. 2 Introduction to Numerical Methods**
  - Mon. (2) Ch. 1-Continued and Ch. 2
  - Tue. (3)
  - Thu. (4) Reading assignment Ch. 2 & Practical Session with Star-CD.
- **WEEK 13 Ch. 3 Finite Difference Methods**
  - Mon. (5)
  - Tue. (6)
  - Thu. (7) Reading assignment Ch. 3 & Practical Session with Star-CD.
- **WEEK 14 Ch. 4 Finite Volume Methods**
  - Mon. (8)
  - Tue. (9)
  - Thu. (10) Introduction to Programming Languages (Fortran).
- **WEEK 15 Ch. 5 Solution to Linear Equation Systems**
  - Mon. (11)
  - Tue. (12)
  - Thu. (13) Reading assignment Ch. 5 & Practical Session.
- **WEEK 16 Ch. 6 Methods for Unsteady Problems**
  - Mon. (14)
  - Tue. (15)
  - Thu. (16) Reading assignment Ch. 6 & Practical Session.
- **WEEK 17 Ch. 7 Solution of the Navier-Stokes Equations**
  - Mon. (17)
  - Tue. (18)

– Thu. (19) Reading assignment Ch. 7 & Practical Session.

● **WEEK 18 Ch. 8 Complex Geometries**

– Mon. (20)

– Tue. (21)

– Thu. (22) Assignment 1 Oral Presentations.

● **WEEK 19 Ch. 9 Turbulent Flows**

– Mon. (23)

– Tue. (24)

– Thu. (25) Reading assignment Ch. 8 & Practical Session.

● **WEEK 20 Review & Other Issues**

– Mon. (26) Revision.

– Tue. (27) Case Study.

– Thu. (28) Reading assignment Ch. 9 & Practical Session.

## 6 Textbook

For the course you will need to have a copy of

- **FERZIGER, J. H. & PERIĆ, M.**  
*Computational Methods for Fluid Dynamics*, 3rd Edition, Springer-Verlag.
- ISBN: 3540420746
- There are 2 copies of **Ferziger & Perić**, 2nd Edition, in the library (QC 211.F3).
- We only cover Chapters 1-9.

### References

- Fletcher, C. A. J. *Computational Techniques for Fluid Dynamics 1: Fundamental and General Techniques* (Springer Series in Computational Physics) Publisher: Springer-Verlag; 2nd edition (1991) ISBN: 0387530584 QC 211.F5 Copies in Library 1
- Fletcher, C. A. J. *Computational Techniques for Fluid Dynamics 2: Specific Techniques for Different Flow Categories* (Springer Series in Computational Physics) Publisher: Springer-Verlag; 2nd edition (1991) ISBN: 3540536019 QC 211.F5 Copies in Library 1
- Tannehill, J. C. Anderson, D. A. & Pletcher, R. H. *Computational Fluid Mechanics and Heat Transfer* Publisher: Taylor & Francis; 2nd edition (1997) ISBN: 156032046X
- Anderson, J. D. Jr. *Computational Fluid Dynamics* Publisher: McGraw Hill (1995) ISBN: 0070016852
- Ferziger, J. H. *Numerical Methods for Engineering Application* Publisher: Wiley & Sons, Inc.; Second edition (1998) ISBN: 0471116211 QA 297.F3 Copies in Library 2
- Moin, P. *Fundamentals of Engineering Numerical Analysis* Publisher: Cambridge University Press; (2001) ISBN: 0521805260