Course: **Computational Fluid Dynamics**

Code: **KKKM 4213**

Lecturer: **Dr. Wan Mohd Faizal Wan Mahmood**

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**Time Table**

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| --- | --- |
| **3 hours** | Tuesday, 2:00 pm – 5:00 pm (BS9/Dept. Computer Lab) |

**Summary**

The course is aimed to provide knowledge and understanding on solution methods and application of fluid dynamics as well as computational software used to solve fluid flow and convective heat transfer problems. This course covers topics such as introduction to Computational Fluid Dynamics (CFD), governing equation of fluid flows, turbulence modeling and finite volume methods for diffusion, convection-diffusion, steady-flow and transient problems.

**Learning Outcomes**

1. To demonstrate understanding of CFD roles and to be able to apply constraints in solving fluid dynamics problems (*taxonomy level*: C3)
2. To apply concepts of CFD algorithms, grid generation and working principles in modelling CFD case studies (*taxonomy level*: C3)
3. To demonstrate understanding of differential form of conservation equations of mass, momentum and energy and to apply the concept in the analysis of one-dimensional cases (*taxonomy level*: C4)
4. To have capability in using the finite volume method to solve steady and transient one-dimensional advection-diffusion problems (*taxonomy level*: C5)
5. To demonstrate understanding of turbulent phenomena and to be able to adopt appropriate turbulence models in solving turbulent problems (*taxonomy level*: C5)
6. To have capability in modelling steady and transient two- and three-dimensional problems using CFD software using appropriate modelling strategies (*taxonomy level*: C6, A4)

**Topics and Teaching Plan**

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| **Week** | **Topic** | **Venue** | **Notes** |
| 1  24 Feb | Introduction to CFD | BS9 |  |
| 2  3 Mar | Lab Session (External Flow) | Dept. Computer Lab | 1st Individual Mini Project assigned |
| 3  10 Mar | Post-processing and Flow Kinematics | BS9 |  |
| 4  17 Mar | Lab Session (Internal Flow) | Dept. Computer Lab | 1st Individual Mini Project submitted  2nd Individual Mini Project assigned |
| 5  24 Mar | Basic Conservation Laws & Governing Equations | BS9 |  |
| 6  31 Mar | Lab Session (non-isothermal flow, multiphase flow) | Dept. Computer Lab | 2nd Individual Mini Project submitted |
| 7  3 Apr | Boundary Conditions & Meshing | BS9 | Main Project (Group of 3 students) assigned |
|  | MID- SEMESTER BREAK |  |  |
| 8  21 Apr | Turbulence | BS9 |  |
| 9  28 Apr | Lab Session (Combustion/Heat Transfer) | Dept. Computer Lab |  |
| 10  5 May | Introduction to The Finite Volume Method | BS9 |  |
| 11  12 May | The Finite Volume Method for Advection-Diffusion Problems | BS9 |  |
| 12  19 May | Lab Session (Additional topic) | Dept. Computer Lab |  |
| 13  26 May | The Finite Volume Method for Transient Problems | BS9 |  |
| 14  2 Jun | Presentation of Main Project | BS9 | Main Project submitted (Presentation and Final Report) |

**Evaluation**

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| --- | --- |
| Assignments/Mini Projects (3 titles) | 20 - 30% |
| Main Project with Presentation | 20 - 30 % |
| Final Semester Examination | 40 - 60 % |
| ***Total*** | 100% |

**References**

Versteeg, H.K. & Malalasekera, W. 2007. *An Introduction to Computational Fluid Dynamics: The Finite Volume Method*, 2nd edition. London: Prentice Hall.

Date, A.W. 2005. *Introduction to Computational Fluid Dynamics*, New York: Cambridge University Press.

Anderson, J.D. 1995. *Computational Fluid Dynamics: The Basics with Applications*. New York: McGraw-Hill.

Abbot, M.B. & Basco, D.R. 1990. *Computational Fluid Dynamics: An Introduction for Engineers*. London: Longman.

Schetz, J.A. & Fuhs, A.E. (eds.). 1996. *Handbook of Fluid Dynamics and Fluid Machinery. Experimental & Computational Fluid Dynamics*. Vol. 2. New York: John Wiley & Sons.