Syllabus for 'Industrial training program in CFD'

Course phasing

Sl. No.	Topic Name	Number of hours
1	Theory in CFD	25
2	**Two Written Examinations**	2
3	Training on grid generation	14
4	Training on flow solvers	7
5	Training on post processing software	4
6	Total	52

Theory contents

Topic 1: <u>Introduction to CFD</u> (2 hours)

- What is CFD ?
- History and early view points

Topic 2: <u>Fluid Mechanics Preliminaries</u> (6 hours)

- Mathematical preliminaries
- Reynold's transport theorem
- Equations of mass, momentum and energy conservation in integral and difference forms

Topic 3: <u>Basics of discretization in CFD</u> (6 hours)

- Finite difference formulation with introduction to
  - Consistency
  - Stability
  - Order of accuracy
- Understanding discretization techniques using Linear Convection Equation

Topic 4: <u>Finite volume formulation</u> (4 hours)

- Finite volume state update formulae in 1D and 2D
- Higher order procedures

Topic 5: <u>Introduction to turbulence</u> (4 hours)

- Reynold's averaged Navier-Stokes equations and closure problem
- Prandtl's mixing length theory and eddy viscosity
- Turbulence models
  - k-epsilon
  - k-omega

Topic 6: <u>Practical aspects of CFD</u> (3 hours)

- Grid generation: Introduction to structured, unstructured, Cartesian meshes
- A case study on CFD technology readiness for an industrial application

Practicals

1. Training on grid generation software

Introduction to software

Sr. No.	Contents	Number of hours
1	Geometry import, Geometry clean up, Building computational domain, Edge meshing, Surface meshing, Quality check for surface mesh, Volume meshing, Quality check for volume mesh, Setting boundary conditions, Volume Mesh export	4

Tutorials

Sr. No.	Contents	Number of hours
1	Inviscid unstructured mesh generation for NACA 0012 airfoil	4
3	Viscous unstructured mesh generation for NACA 0012 airfoil	1
5	Inviscid unstructured mesh generation for a convergent divergent nozzle	4
6	Viscous unstructured mesh generation for a convergent divergent nozzle	1
Total number of hours for tutorials		10

2. Training on flow solver: HiFUN

Introduction to software

Sr. No.	Contents	Number of hours
1	Basic formulation, Formulation for higher order, Schemes for inviscid flux computation, Schemes for viscous flux computations, Initial conditions, Boundary conditions, Explicit state update, Implicit state update	4

Tutorials

Sr. No.	Contents	Number of hours
1	Inviscid transonic flow past NACA 0012 airfoil	1
2	Viscous transonic flow past NACA 0012 airfoil	1

3	Viscous supersonic flow through convergent divergent nozzle	1
	Total number of hours for tutorials	3

3. Training on post processing software: Paraview

Sr. No.	Contents	Number of hours
1	Introduction to the software	1
2	Inviscid transonic flow past NACA 0012 airfoil	1
3	Viscous transonic flow past NACA 0012 airfoil	0.5
4	Viscous supersonic flow through convergent divergent nozzle	1.5
	Total number of hours for tutorials	4