Course Syllabus – Academic Year 2016/17

COMPRESSIBLE FLOWS

COD: 1051403 SSD: ING-IND/06 CFU:9 (6+3)

REFERENCE WEB PAGE: HTTP://WWW.INGAERO.UNIROMA1.IT/

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Course Description and objectives

Module I

The main objective is to introduce the student to fundamental laws governing compressible flows, under subsonic and supersonic conditions. During a first phase the solution of quasi-1D flows will be approached, with application to nozzle, air intake and supersonic wind tunnels. In the following application to subsonic and supersonic wing will be conducted. Basic knowledge of hypersonic flows: Newtonian theory.

Module II

The main objective is to introduce the student to the modern techniques of numerical analysis applied to gas dynamics. The main focus is on the definition of general criteria for the development of numerical schemes and on their implementation in numerical codes for the solution of the equations governing the motion of compressible flows.

Required Textbooks and Materials

Module I

1. Primary: A.H. Shapiro `The dynamics and thermodynamics of compressible fluid flow'
2. Secondary: J.D. Anderson `Modern compressible flows: with historical perspective'

Module II

1. Primary: lecture notes available at the reference web page

2. Secondary: R.J. Leveque ‘Numerical methods for conservation laws’ and C. Hirsch ‘Numerical Computation of Internal and External Flows, Computational Methods for Inviscid and Viscous Flows’

Main topics

Module I

- Basic concepts of compressible flows
- Fundamental equations of fluid mechanics
- Steady and unsteady quasi-1D flows
- Nozzle, air intake and supersonic wind tunnel
- Small perturbation theory
- Bi-dimensional supersonic flows
- Hypersonic flows: Newtonian Theory

Module II

- Scalar conservation laws, characteristics method
- Finite difference and finite volume schemes
- Stability, accuracy and convergence
- Schemes for nonlinear conservation laws
- Godunov’s method. Riemann solvers
- Flux vector splitting methods
- High resolution schemes: TVD methods
- Sweby scheme and flux limiters

Final exam

These descriptions and timelines are subject to change at the discretion of the Professor.