

CFD Review Aid for Second Exam, 2017.  
Exam date Nov. 9.

## Chapters 2

- Methods for determining stability of F.D. schemes
- Be able to perform stability analysis using von Neumann method
- Concept of explicit and implicit schemes, and their general properties
- Method for dealing with multi-dimensional diffusion problems, stability of such schemes - direct extension, directional splitting and fractional step methods

## Chapter 3. Hyperbolic equations

- Linear convection – 1-D wave equation
- Courant-Friedrichs-Lewy (CFL) Stability Criterion for wave/advection equations
- PDE and FDE's domain of dependency
- Necessary conditions of stability based on domain of dependencies
- Stability analysis for wave/advection equations solved with various schemes
- Phase and amplitude errors for advection schemes
  - Modified equation
  - Definition of errors
  - Derivation of errors
- Computational modes of multi-time level schemes
- Methods for suppressing computational modes
- Asselin time filter
- Comparison of phase and amplitude accuracy of several common schemes
- Practical measure of dissipation and dispersion errors
- Concept of monotonicity
- Methods for multi-dimensional advection and their stability properties
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## **Chapter 4. Nonlinear Hyperbolic Problems**

- Nonlinear advection problem
- Aliasing, nonlinear instability – their origin and effects
- Methods for controlling nonlinear instability