Physics of Fluids

I - What is a fluid ?
 I.1 - Molecular nature
 I.2 - Simple vs complex

II - How to describe its motion ?
 II.1 - Molecular dynamics
 II.2 - Continuous mechanics

III - Which equations to solve to predict the flow of simple fluids ?
 III.1 - Newton's equations for continuous media
 III.2 - Navier's closure relation
 III.3 - Navier-Stokes' equation
 III.4 - Equilibrium and the equation of hydrostatics
 III.5 - Perturbation of the equilibrium and acoustics
 III.6 - Measurement of the two viscosities.
 III.7 - Similitude

IV - Low Reynolds number flows
 IV.1 - Stokes' equations
 IV.2 - Unicity and reversibility
 IV.3 - Swimming at low Reynolds number
 IV.4 - Theory of Lubrication and the equation of Reynolds
 IV.5 - Hele-Shaw flows as potential flows !

V - High Reynolds number flows (part 1: How do wings work ?)
 V.1 - Euler's equation
 V.2 - Conservation of the circulation - Kelvin's theorem
 V.3 - Persistance of the irrotational character - Helmholtz's theorem
 V.4 - Potential flows
 V.5 - The Rayleigh-Plesset bubble
 V.5 - 2D potential flows ond the complex potential
 V.6 - Magnus effect and the d'Alembert's paradox
 V.7 - How to solve the d'Alembert's paradoxe: boundary layers
 V.8 - Slender bodies vs bluff bodies
 V.9 - The physical origin of vortices
 V.10 - Skin drag and pressure drag
 V.11 - The beauty of wings
 V.12 - Tartaglia vs parabola : the impact on the size of sports' fields

VI - High Reynolds number flows (part 2: vortices)
 VI.1 - Analogy between Euler's equations and electromagnetism
 VI.2 - Biot-Savart's law for vortices
 VI.3 - Structure of a vortex filament
 VI.4 - Vortex ring dynamics
 VI.5 - Tip vortices and induced drag: the optimal flight
 VI.6 - Kelvin-Helmholtz instability
 VI.7 - Physics of knuckleballs
 VI.8 - Turbulence as a gas of vortices

VII - High Reynolds number flows (part 3: waves)
VII.1 - The dispersion relation for water waves
VII.2 - Refraction of water waves
VII.3 - Shoaling
VII.4 - Physics of surfing and wave riding
VII.5 - Solitons

VIII Liquid surfaces
VIII.1 – First basic introduction
VIII.2 – Statistical approach : Cahn-Hilliard-de Gennes
VIII.3 – Wetting

VIII Liquid surfaces and long range forces
VIII.1 – Van der Waals forces and disjoining pressure
VIII.2 – Thin films stability
VIII.2 – Disjoining pressure measurement
VIII.3 – Wetting and precursor films

VIII Charged interfaces
VIII.1 Charged interfaces at equilibrium – Poisson Boltzmann & DLVO
VIII.2 Electrokinetic effects

IX Liquid entrainment

X Imperfec wetting