Topics – Cardiovascular Biomechanics

Cardiovascular Anatomy & Physiology (Weeks 1 – 3)
Midterm at end of week 3

Basic concepts in mechanics and fluids (Weeks 4 - 5)
Mass transfer
Mechanics
Stress and strain
Hookean –vs- non-linear materials
Viscoelasticity
Fluid mechanics
Momentum and continuity
Navier stokes equations
Non-dimensional parameters / Scaling
Reynolds number
Laminar –vs- turbulent flow

Mechanics of arteries (Weeks 5 – 7)
Thin and thick walled assumptions
Constitutive modeling
Experimental methods

Blood rheology (Weeks 7 – 9)
Newtonian –vs- Non-Newtonian fluids
Blood composition
Models of RBC
Fahreus-Lindquist effect

Arterial flow dynamics (Weeks 9 – 12)
Cylindrical tube
Steady flow - the Poiseuille flow equations
Oscillatory flow – the Womersley equations
Branching
Flow separation and recirculation
Flow in a curved tube
Secondary flow; The Dean number

Fluid-structure coupling (Weeks 12 - 14)
Basic concepts
1D methods

Cardiac dynamics (Weeks 14 – 15)
Ventricular shape assumptions
Diastolic function
Valvular regurgitation and stenosis

Prosthetics & optimization (Weeks 15 - 16)
Stent
Valve
Artificial Heart

Microcirculation (If time permits)