

UNIVERSITÀ CATTOLICA DEL S.CUORE  
Dipartimento di Matematica e Fisica "Niccolò Tartaglia"

## MATHEMATICAL MODELS IN CARDIAC PHYSIOLOGY

Lecturers: *Luciano Teresi* (Roma Tre) and *Davide Ambrosi* (Politecnico di Milano)

### Program, ver 1.2

#### Monday

3pm-6pm (with floating break) LT

Basic cardiovascular physiology; internal anatomy; conduction system of the heart.

Cardiac cycle; Pressure-Volume loops; muscle physiology.

Cardiac medical imaging; Speckle Tracking; Diffusion Tensor MRI.

#### Tuesday

9.30am-12.30pm (with floating break) DA

Propagation of the electric signal in the myocardium:

excitable cells, nonlinear dependence on currents on voltage,

Hodgkin-Huxley and FitzHugh-Nagumo.

Spatial dynamics: diffusion, travelling fronts, travelling pulses.

lunch

3pm-6pm (with floating break) LT

Mechanical models of muscles:

Hill's three elements model; active contractions; sliding model.

Basics non-linear elasticity.

Social dinner

#### Wednesday

9am-12pm (with floating break) DA

Fluid-wall interaction: material and spatial representation of balance equations.

Transformation of elementary surfaces, Cauchy and Piola stress.

Navier-Stokes and Finite Elasticity in different coordinates. Interface conditions.

Stretch activated currents.

#### References:

J. Keener and J. Sneyd, *Mathematical Physiology*, Springer, second edition (1998).

I-Shih Liu, *Continuum Mechanics*, Springer (2002).

Katz M. Arnolf, *Physiology of the Heart*, Lippincott Williams & Wilkins (2006).