

# **Scuola Superiore di Catania**

**Classe delle Scienze Sperimentali  
Corso specialistico  
ambito disciplinare: Scienze e Tecnologie**

## **"Sistemi piezo-elettromeccanici"**

### **Programma**

Recent advances of the technology of piezoelectric transducers allow for the design of new kinds of smart structures. They are based on the concept of distributed control of mechanical vibrations by means of an array of piezoelectric transducers which are connected to structural members and are electrically interconnected by means of suitably designed electric circuits. The concepts want to exploit the efficiency and precision of electric circuits in order to construct a multimodal resonator which can extract mechanical energy from the considered structural element and dissipate it in its electrical form by means of suitably designed resistances.

Crucial in this process are

- 1) the concept of analog circuit of a given structural element
- 2) the common description of mechanical and electrical systems by means of the concepts of Lagrangian mechanics
- 3) the idea of multimodal control made possible by the distributed array of transducers

The proposed course will include the following lectures

- 1) Lagrangian description of physical systems
- 2) Hamilton-Rayleigh dissipation functionals
- 3) Generalized principle of virtual works
- 4) The concept of distributed arrays of piezoelectric transducers
- 5) Internal resonance and the phenomenon of acoustic or mechanical beats
- 6) piezoelectromechanical beats
- 7) analog circuits and optimal mechanical energy extraction
- 8) the design of piezoelectromechanical (PEM) structures and their applications (description of an USA patent)
- 9) PEM structures as microstructured continua
- 10) Nano and micro PEM structures