

**Course offered for the PhD program  
in Civil, Chemical and Environmental Engineering  
Curriculum in Chemical, Material and Process Engineering –  
a.a. 2022/2023 (cycles XXXVIII, XXXVII e XXXVI)**

(possibility of participation for students in other PhD cycles or other PhD courses)

### **1. Title**

Characterization of powdered materials.

### **2. Course Description**

The course aims to provide to future PhDs notions and fundamentals on relevant techniques for material characterization. The course will include the following topics:

1. **Elemental composition**; atomic absorption and emission spectroscopies, X-ray fluorescence and Energy-dispersive X-ray (EDX) analysis.
2. **Structural properties of inorganic materials and their characterization**: X-Ray diffraction, vibrational and UV-vis spectroscopies.
3. **Morphology characterization**: Surface area and porosity and scanning electron microscopy (SEM).
4. **Analysis of the surface structure and composition**: X-ray photoelectron spectroscopy (XPS), surface acidity and basicity characterization using probe molecules and studies of the surface redox behavior.
5. **Laboratory training**: analysis of one sample of PhD student interest through vibrational spectroscopies at catalysis laboratories.

### **3. Course Organization**

The course, organized into a single module, will consist of classroom lessons and practical laboratory training. The course will be held in English.

### **4. Teacher**

The course teacher will be Prof. G. Garbarino (12 h) and Ing. Elena Spennati (6 h).

### **5. Duration and credits**

The course (18 hours) will consist of 5 lessons, 3 hours each, and a 3 hours tutorial in the laboratory, for a total of 3 credits.

### **6. Activation mode and teaching period**

The course will be held in January-February 2023 and a detailed calendar for lessons will be given to registered students.

### **7. Deadline for registration**

Registration to the course must be made before December 15th, 2022. Students are requested to inform teachers by e-mail ([gabriella.garbarino@unige.it](mailto:gabriella.garbarino@unige.it), [elena.spennati@edu.unige.it](mailto:elena.spennati@edu.unige.it)) about their registration.

### **8. Final exam**

The final exam will consist in an oral discussion on the topics covered by the course. The students are requested to contact the teacher by email to establish the date of the exam.