UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Nanomaterials for Biomedical applications

2526-116R-M06

Title

Nanomaterials for biomedical applications

Teacher(s)

Dr. Daniele Perilli
Dr. Paulo Siani

Language

English

Short description

The course offers an overview of the current advancements and future challenges in designing and developing nanostructured materials for biomedical applications. It covers key areas, such as drug delivery, therapeutics, bioimaging, biosensing, and diagnostics. Students will explore fundamental concepts and practical examples, focusing on cutting-edge nanomaterials, including carbon-based (e.g., graphene oxide and carbon nanotubes), metal and metal oxides nanoparticles (e.g., gold and iron oxide), and organic nanoparticles (e.g. lipid-based).
The first part of the course will cover topics related to nanomedicine, including types of emerging nanomaterials, nanoparticles characterization techniques, coating and targeting strategies to enhance circulation time and improve

efficacy of nanomedical devices. Key examples of recently developed nanosystems will then be showcased and analyzed as innovative solutions for precision medicine and non-invasive diagnostics.
The second part of the course will be devoted to the application of sensing nanomaterials in the medical field. First we will cover fundamental principles and main types of materials used for biosensing. Next, we will discuss gas-sensing systems, examining innovative nanomaterials with respect to established technologies. Finally, we will focus on their medical application for the diagnosis of specific diseases through the human exhaled breath analysis (breathomics).
Content:
• Nanomaterials and Properties: Various classes of nanomaterials used in nanomedicine and their physical and chemical properties. (1h)
• Nanoparticles Characterization: Characterization methods like Dynamic (DLS) and Electrophoretic (ELS) light scattering for size and zeta potential measurement. (1h)
• Coating and Targeting of Nanoparticles: Coating techniques for biocompatibility and stealth properties. Passive and active targeting strategies for enhanced selectivity and efficacy of medical treatments. (1h)
• Medical Applications of Nanoparticles: Practical examples of nanomaterials' use for drug delivery, bioimaging, therapeutics and diagnostics. (1h)
• Biosensing Devices: Fundamental concepts, working mechanisms, and main architectures of state-the-art biosensing systems. (1h)
• Nanomaterial-based Biosensors: Cutting-edge nanomaterials and their role in enhancing biosensors performance in medical application. (1h)
• Gas-sensing Devices: Principles of gas-sensing technology and the limitations of existing nanomaterials-based systems. (1h)
• Medical Application of Gas-sensors: Nanomaterials for the analysis of exhaled breath (breathomics) for diagnosis of diseases. Organized arrays of gas-sensors, i.e. electronic noses. (1h)

CFU / Hours

1 CFU/8 hours

Teaching period

20 November 2025 10.30-12.30 hrs
21 November 2025 10.30-12.30 hrs
24 November 2025 10.30-12.30 hrs
25 November 2025 10.30-12.30 hrs

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION