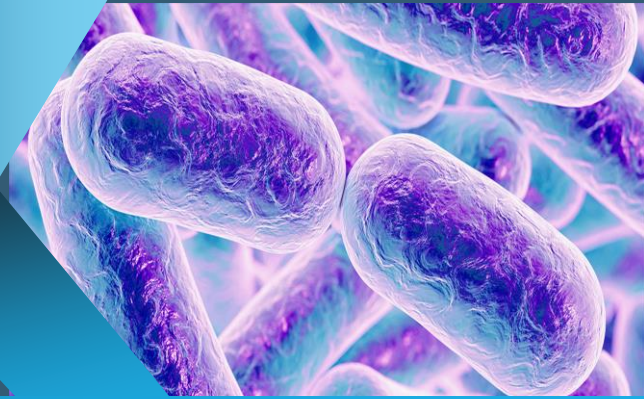


# BIOTECHNOLOGY & ENGINEERING LEARNING PROGRAMME



## Course applicability

Students holding a M.Sc. degree in Biological and Computer Sciences or other related disciplines.

## Course structure

LO3. Biosensors & Biochips for Sustainable Future – Basic & Advanced levels

LO4. Green ICT & Energy: From Smart to Wise Strategies – Basic & Advanced levels

LO5. Scientific resources open access: digital databases – Advanced level

LO7. Environmental benefit from modern biotechnology and ICT application – Advanced level

## Course authors

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## Course outline

In the last decade, rapid strides have been made to take advantage of the applications of biotechnology across various fields. The idea of designing the next generation of technological devices that integrate the knowledge coming from various fields such as biology, chemistry, electronics, and engineering is already gathering increasing attention. Informatics can contribute for solving environmental issues by implementing IT solutions. This can be done by reducing energy consumption, rising environmental awareness, offering efficient communication on environmental issues, and facilitating environmental monitoring and surveillance systems, as a tool to protect and restore natural ecosystems’ potential. In

this respect, the educational goals of this course are focused to provide trainees with a reliable background on:

- ✓ Basic overview of biochip and biosensor technology; classification of different types of biosensors and biochips; advantages and disadvantages of their use.
- ✓ Practical applications of specific types of biosensors and biochips.
- ✓ Explaining green energy – types and resources.
- ✓ Energy Consumption in ICT Sector.
- ✓ Rising awareness about the future ICT trends: from green to wise.
- ✓ The global trends in green ICT development.
- ✓ The world directions in green ICT policies.
- ✓ The green informatics contribution to green energy.
- ✓ The advanced cooperation for green ICT solutions.
- ✓ The advanced design of a Database.
- ✓ The structure of a Database and how to make relations between Database tables.
- ✓ The specific language used to make queries (SQL) to retrieve data from a Database.
- ✓ New insights in biogas and bioethanol production.
- ✓ Bioplastics as a new sustainable way to replace petrol-derived materials.
- ✓ New technologies for microbial-based technologies.
- ✓ Alternatives strategies to solve problems and fight diseases in a sustainable way.

## Keywords

DNA biosensor; Electrochemical biosensor; Enzyme-based biosensor; Gene chip; DNA microarray; Microfluidic chip; Protein microarray; Glucose biosensors; Cardiovascular diseases detection biosensors; Cancer detection biosensor; Tuberculosis biochips; Nutrient detection; Nanomaterials; Pathogens detection; Toxins detection; Pesticides detection; Endocrine-disrupting chemicals detection; Green energy; Green ICT; Cloud computing; Computer power management; IT virtualization; Greening of ICT; Greening with ICT; Green Informatics; Knowledge-Based Economy (KBE); Knowledge-Based Bio-Economy (KBBE); Centralised database system; Distributed database system; Database; Data Definition Language (DDL); Database Management System (DBMS); Data Model; Data redundancy; Normalisation; Recovery; Anaerobic digesters; Bioreactors; Bioplastics; New technologies to study the microbiota; Probiotics.

## Learning outcomes

### Knowledge & Skills

- ✓ Explain the biosensors and their basic properties.
- ✓ Demonstrate an understanding of fundamental principles of biochips design and operation.
- ✓ Recognize and apply different biochip and biosensor technology.
- ✓ Recognize the types of biosensors/biochips.
- ✓ Define properties of ideal biosensor/biochip and their measurement systems.
- ✓ Analyze and match needs with available technology.
- ✓ Demonstrate an understanding of how biochips and biosensors could be successfully applied in medical diagnostics.
- ✓ Characterize different medical biosensors and biochips: for the detection of diabetes, cardiovascular diseases, cancer, tuberculosis, etc.
- ✓ Recognize and apply different biochips and biosensors employed in food and agriculture.
- ✓ Define properties and operate with biosensors and biochips utilized for environmental monitoring.
- ✓ Explain what green energy is.
- ✓ Distinguish between the variety of green energy types and sources.
- ✓ Know the major trends in energy consumption in ICT Sector.
- ✓ Comprehend the fundamentals of green energy provisioning for ICT.
- ✓ Define the Green ICT and going green in ICT.
- ✓ Understand the importance of being 'green'.
- ✓ Realize the benefits of going green.
- ✓ Explain the contribution of ICT to reduce energy consumption and gas emissions.
- ✓ Give examples of the different ways of greening ICT.
- ✓ Understand and discuss the future ICT trends.
- ✓ Understand the global green ICT trends, their current dynamics, and directions.
- ✓ Know the main characteristics of the local conservation approach, the corporate social responsibility for pollution control, and the need for transformative change and sustainability.
- ✓ Outline the green ICT-related policy trends at the EU and global levels.
- ✓ Distinguish between greening of ICT and greening with ICT.
- ✓ Know the alternative approaches to greening with ICT.
- ✓ Explain green informatics contribution to the environment and environmental sustainability, with special emphasis on sustainable environmental governance.
- ✓ Recognize the 'ICT for sustainable growth' main policy areas.
- ✓ Make relation between ICT and the Economy-Defining Technologies.
- ✓ Discuss green ICT impact at the governmental level.
- ✓ Understand the mode of usage of different Scientific Databases.
- ✓ Design a simple Database for scientific usage.
- ✓ Use database models' languages.
- ✓ Work with common databases found on the market.

- ✓ Highlight the main plant and reactor configuration for biogas production (anaerobic digesters).
- ✓ Know and develop the main plant and reactor configuration for bioethanol production (fermenters inoculated with the target organisms).
- ✓ Know the main bioplastics on the market (Starch-derived plastics, PLA, and PHB) and the use of biotechnology tools for their production.
- ✓ Understand the importance of the study of the soil microbiota for the evaluation of soil health and how anthropogenic factors may influence the soil microbiota composition.
- ✓ Be in contact with new applications of microbial-based technologies, the importance of bees for the whole ecosystem balance, and how their collapse can be detrimental to the environment and to agriculture are discussed.

### *Autonomy & responsibility*

- ✓ **Problem-solving skills**
- ✓ **Communication skills:** good verbal and written communication skills.
- ✓ **Computing skills:** competencies and skills in the use of modern technological tools.
- ✓ **Use of media:** knowledge of the principles of preparation and delivery of messages through media; ability to develop written and oral presentations.
- ✓ **Personal issues:** logical thinking capabilities; being independent and organized.
- ✓ **Collaborative working:** capable of teamwork.

### **ECTS points**

Successful completion of the course will result in the participant being awarded 15 ECTS (European Credit Transfer System) points.

### **Credit transfer within Partners' countries**

- Bulgaria – 12.5 – 15 ECTS
- Germany - 12.5 – 15 ECTS
- Greece – 12.5 ECTS
- Italy – 15 ECTS