24BY101 Biology for Engineers

Category: Basic Sciences (BS) 3L 0T 0P 3C

Course Outcomes: At the end of the course, the student will be able to …

CO1: demonstrate a fundamental understanding of basic biological principles, such as cell biology, genetics, and physiology, and their application in engineering contexts.

CO2: analyse and evaluate biomaterials based on their mechanical properties and design biomedical devices using biomechanical principles.

CO3: apply bio-inspired design principles and synthetic biology techniques to propose innovative engineering solutions and understand their practical applications in biotechnology.

CO4: develop proficiency in using bioinformatics tools, constructing computational models, and applying systems biology approaches to study and interpret biological data and systems.

CO5: critically analyse and evaluate current research trends and innovations in advanced areas of biological engineering, demonstrating the ability to apply advanced concepts in real-world engineering scenarios.

COURSE CONTENTS

Unit 1: Introduction to Biology for Engineers

- Overview of interdisciplinary nature and importance of biology for engineers
- Basic biological concepts relevant to engineering applications
- Introduction to engineering challenges addressed by biology-inspired solutions
- Introduction to the structure and functions of Biomolecules

Unit 2: Biomaterials and Biomechanics

- Properties and applications of biomaterials in engineering (e.g., tissue engineering, drug delivery systems)
- Biomechanical principles applied to engineering (e.g., mechanics of bones and joints, biomechanics of tissues)
- Case studies: Design and development of biomaterials for medical implants, prosthetics, and tissue engineering

Unit 3: Bio inspired Design, Synthetic Biology and Biotechnology

- Introduction to bioinspired design, biomimicry, synthetic biology and genetic engineering (Genetically modified Crops & Animals)

- Examples of biological systems inspiring engineering innovations (e.g., bird flight, gecko adhesion, shark skin, human eye camera)
- Applications of biotechnology in engineering (e.g., bioprocessing, bioremediation, biosensors)
- Case studies: Biomimetic design in robotics, materials science, architecture, Development of biofuels, bioplastics, and biopharmaceuticals

Unit 4: Bioinformatics and Systems Biology

- Introduction to bioinformatics tools and databases
- Engineering applications of bioinformatics (e.g., genome sequencing, protein structure prediction, drug discovery)
- Systems biology approaches to understanding complex biological systems and networks
- Case studies: Computational modelling of biological systems, personalized medicine, and synthetic biology

Unit 5:Advanced Topics in Biology for Engineers

- Emerging trends and cutting-edge research in biology for engineers
- Advanced applications and case studies in specific engineering fields (e.g., nanotechnology, energy, environmental engineering)
- Ethical considerations (Bio-Safety) and societal implications (Biopiracy & Bio patent)

Textbook(s) / Reference(s):

Textbooks:

1. Johnson, A. T. (2011). Biology for Engineers. CRC Press.
2. Renneberg, R. (2017). Biotechnology for Engineers: Biological Processes and Technologies (1st ed.). Elsevier.
3. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis (2nd ed.). Cold Spring Harbor Laboratory Press.

References:

1. Enderle, J., & Bronzino, J. (2011). Introduction to Biomedical Engineering (3rd ed.). Academic Press.
2. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. (2012). Biomaterials Science: An Introduction to Materials in Medicine (3rd ed.). Academic Press.
3. Benyus, J. M. (2002). Biomimicry: Innovation Inspired by Nature. Harper Perennial.