GENERIC ELECTIVES (GE-15): Nanobiology
Zoo-GE-15

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title& Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Nanobiology Zoo-GE-15	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	NIL

Learning Objectives

The learning objectives of this course are as follows:

- to acquaint students with the basic concepts of Nanobiology.
- to equip the students with the concepts, properties and behaviour of nano-biomaterials.
- to provide a critical and systematic understanding of cutting-edge technology.
- to give an overall concept regarding the prominence of nanomaterials and their classification, synthesis process

Learning Outcomes

By studying this course, students will be able to

- better understand the interaction of biomolecules with surfaces of different chemical and physical species.
- appreciate the different applications of various types of nanostructured materials.
- gain knowledge of the types of nanoparticles based on size, shape, surface properties and composition.
- interpret/ analyse and get insight into the applications in the field of medicine.
- use basic principles of microfluidics to solve biotechnical and bioanalytical problems.
- appreciate the multidisciplinary nature of Nanobiology.
- develop skills in high-tech instrumental techniques suited for characterization of the micro/nano- structural properties.

SYLLABUS OF GE-15

UNIT- 1: Nanobiology **2 hrs**

Definition and concepts, Development of nanobiotechnology/nanobiology, timelines and progress.

UNIT- 2: Biomaterials **8 hrs**

Bulk materials *vs* nanomaterials. Different types of materials used to synthesize nanoparticles, Top-down approach, and bottom-up approach. Classification of

nanoparticles based on size, shape, surface properties and composition; bio-inspired nanomaterials. Nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus, diatoms, bacteria).

UNIT- 3: **Nanomedicine** **10 hrs**

Drug encapsulation, drug delivery and gene delivery, Active and passive targeting by ligands and receptor-mediated delivery, Interactions of nanoparticles with biological membranes and ion channels. Applications of nanomedicines in diagnostics: biosensor-based techniques like optical, colorimetric, and electrochemical, point-of-care diagnostics tools like lab-on-chip device, lateral flow immunoassay.

UNIT- 4: Environmental applications **6 hrs**

Nanoadsorbents, release of nutrients and pesticides, Nanoremediation, Nanopollution: air - water - soil contaminants, Treatment of industrial wastewaters using nanoparticles.

UNIT- 5: Nanotoxicity **4 hrs**

Effect of nanomaterials on human health, nanomaterial-cell interaction, Concept of cytotoxicity and genotoxicity, Future perspectives of Nanobiology.

Practical **(60 hrs)**

(Laboratory periods: 15 classes of 4 hours each)

1. Synthesis of silver/gold nanoparticles from plants extracts and follow up with visible spectroscopy.
2. Synthesis of Iron oxide nanoparticles by using chemical methods (Tyndall effect).
3. Characterization of nanoparticles: Electron microscopy (scanning and transmission), atomic force microscopy; nanoparticle analyzer, zeta potential measurement, electrochemical analyzer, flow cytometry, spectroscopic techniques including spectrophotometer, spectro-fluorimeter.
4. Cell counting and cell viability study of a non-adherent cell (Hepatocyte) culture.
5. Study of cell and nanoparticle interaction (video demonstration).
6. Antibacterial studies of nanoparticles by MIC method.
7. Assessing cytotoxicity of nanoparticles by MTT.
8. Isolation of DNA and demonstration of apoptosis by DNA fragmentation.
9. Nano microbial degradation of various xenobiotics (e.g. pesticides, organochlorines, pyrethroids, PAH).

Essential/recommended readings

1. Kesharwani, P., Singh, K. K. (Eds) (2021) Nanoparticle Therapeutics: Production Technologies, Types of Nanoparticles, and Regulatory Aspects; Academic Press Inc.
2. Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, (Eds) (2008) “Biomedical Nanostructures” Wiley-Interscience, John Wiley & Sons, Inc.
3. Niemeyer, C.M. (2006) Nanobiotechnology: Concepts, Applications and

Perspectives; Wiley VCH.
4. Ralph S. Greco, Fritz B. Prinz, R. Lane Smith Eds. (2005) Nanoscale Technology in Biological Systems, CRC PRESS, Taylor & Francis.

Suggestive readings

1. Stroeve, P and Mahmoudi (2018) Drug Delivery Systems, World Scientific Series: From Biomaterials towards Medical Devices, Vol I.
2. Hillery, and Anya M et al. (2010 "Drug Delivery and Targeting", CRC Press.
3. Hong-fan, M, Huang, C.P., Bland, A. E., Honglin, W. Z., Sliman,R., Wright, I (2010) Enviro-nanotechnology; Elsevier.

NOTE: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.