

Programme: M.Sc. (Biochemistry)

Course Code: BCO 118

Title of the Course: NANOBIO TECHNOLOGY [T]

Number of Credits: 3

Effective from Academic Year: 2018-19

Prerequisites	It is assumed that students have a basic understanding of nanobiotechnology	
Objective:	The course develops the understanding of nanoparticles and nanomaterials, their biosynthesis, characterization and industrial and medical applications.	
Content:		
1	Introduction	(01)
	Definition; historical background; concepts.	
2	Biological cellular nanostructures	(06)
	Protein and Peptide based: Proteins; bilayers and membrane arrays; ATPase; archaeal S-layers, bacteriorhodopsins; eubacterial magnetosomes – greigite, magnetite. DNA based: DNA molecule; self-assembled DNA nanotubes Virus particles; diatoms.	
3	Nanomaterials	(05)
	Shapes, size and properties: spherical, triangular, prisms, rods, cubes. Nanoparticles, nanocrystals, quantum dots, nanotubes and nanowires. Miniaturized devices in nanobiotechnology - types and applications, lab-on-a-chip (LOC).	
4	Biosynthesis	(07)
	Concept of top-down versus bottom-up approach. Uniformity and heterogeneity. Agglomeration of nanoparticles: monitoring and control of agglomerates, collision efficiencies, agglomeration. Green technologies: nanoparticle biosynthesis using microbes, plant extracts, reductases	
5	Detection and characterization of nanoparticles	(04)
	Optical: Visual colour change; UV-Vis spectrum; Fluorescence. Size imaging: Electron microscopy (SEM, TEM), light scattering, Zetapotential Surface and composition: FT-IR, Raman spectroscopy, EDAX, AFM, XRD. Magnetic resonance methods: NMR, ¹³ C-NMR	

6	Medical Applications	(07)
	Drug development – Drug discovery; toxicity evaluation: cyto-toxicity, geno-toxicity. Diagnostics – LOC technology; Imaging agents: MRI; Nanosensors for early-stage cancer detection; Nano-optics and fluorescence-based assays; Drug delivery systems –Lipid and inorganic nanoparticles. Antimicrobials – Metal/metal oxide nanoparticles against bacteria, fungi, viruses. Therapeutics – Cardiovascular diseases; neurological disorders (Alzheimer's, Parkinson's). Cancer therapy – Quantum dots for targeted drug delivery-	
7	Industrial Applications	(06)
	Electronic – Photodiodes; semiconductor Quantum dots, Water purification – Nanoadsorbents and magnetic nanoparticles Oil industry – enhanced oil recovery Food industry – Magnetosomes for detection of pathogens Environment – nanobiosensors for pollution detection. Bioremediation – Quantum dots for degradation of biological pollutants: oil	
Pedagogy:	Lectures/ tutorials/ assignments/ students' seminars/ interactive learning/ self-study.	
References/ Readings	Nicolini, C. Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd.	
	Niemeyer C.M., & Mirkin, C.A, Nanobiotechnology, Concepts, Applications and perspectives, Wiley, Verlag GmbH & Co.	
	DeVilliers, M.M., Aramwit, P., & Kwon, G.S., Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press.	
	Yao, N., & Wang, Z.L., Handbook of Microscopy for Nanotechnology. Kluwer Academic Publishers.	
	Robert, A., & Freitas, Jr. Nanomedicine, Volume I: Basic Capabilities, Landes Bioscience.	
	Pradeep T., Nano, The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited.	
	Mirkin, C.A. & Niemeyer, C.M. Nanobiotechnology- II, More Concepts and Applications, Wiley, Verlag GmbH &Co.	
	Bulte, J.W.M., & Modo, M.M.J., Nanoparticles in Biomedical Imaging: Emerging Technologies and Applications, Springer Science Business Media, LLC	
	Shoseyov, O. & Levy, I., Nanobiotechnology-Bio Inspired Devices and Materials of the Future, Humana Press Inc.	
Learning Outcomes	Learning about characterization, biosynthesis, detection and application of nanoparticles; understanding the relevance of nanobiotechnology in medicine and industry.	