

BHARATHIAR UNIVERSITY : COIMBATORE – 641 046



## **M.Phil. / Ph.D. Nanobiotechnology**

### **PART-I – SYLLABUS**

(effective from the academic year 2010-11 and onwards)

**PAPER - I : Research Methodology and Techniques in Nanobiotechnology**

**PAPER - II : Nanobiotechnology**

**PAPER- III: Biointerfacial Strategies, Nanofabrication and Processing**

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**BHARATHIAR UNIVERSITY-COIMBATORE. 641 046**  
**M.Phil./ Ph.D.-NANOBIOTECHNOLOGY**  
**PART-I SYLLABUS**

**PAPER-I- Research Methodology and Techniques in Nanobiotechnology**

**Unit 1: Introduction to research methodology-** What is research? Basic and applied research, essential steps in research, defining the research problem, research /experimental design, literature collection, literature citation, research report,: components, format of thesis and dissertation, manuscript/research article, review monographs, bibliography and reference, significance of Research.

**Unit 2: Microscopic techniques** – Optical microscopy of aggregates, Electron Microscopy- Scanning Electron Microscopy (SEM)-Modern advances in SEM-Transmission Electron microscopy (TEM)- Biological sample preparation for TEM-Environmental TEM- Scanning probe microscopy-STEM- Atomic Force Microscopy(AFM)-Confocal Microscopy- Scanning Near Field Microscopy- Nanoindentation.

**Unit 3: Spectroscopic and Electrochemical techniques-** UV-Vis Spectroscopy- Energy Dispersive X-ray Spectroscopy, Mass Spectroscopy-Types-Nuclear Magnetic Resonance (NMR) Spectroscopy, FT-IR Spectroscopy- X-Ray Diffraction (XRD)-Photoelectron Spectroscopy, Mossbauer Spectroscopy, Differential Scanning Calorimetry (DSC) - Electrochemistry fundamentals, Electro-analytical techniques- Polarography-Voltametry- Linear Scan voltametry-Cyclic Voltametry- Differential pulse voltametry-Impedance Spectroscopy- Applications.

**Unit 4: Techniques in Biomedical imaging and Nanostructuring**

Immuno Fluorescent Biomarker Imaging- Immuno gold labeling- Nanoprobess- BioPhotonics- Diagnostic Biosensors- Catalyst- Functionalized Metallic Nanoparticles And Their Applications in Colorimetric Sensing- Dip stick Tests- Nanoparticles as Catalysts for Signal Generation and Amplification- Iron Oxide Nanoparticles in Magnetic Resonance Imaging- Optical nanoparticles sensors for quantitative intracellular imaging. Cancer imaging- Nanophotonics. Design aspects of Nanostructures-Lithographic techniques- Nanoimprinting- Near Field Optical Methods of fabrication- Nanopolishing with diamond and Etching of nanostructures- Nanoindentation-Focused Ion beam.

**Unit 5. Statistical Methods:**

Measures of central tendency probability and dispersal; (Binomial, distributions Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis variance; of X<sup>2</sup> test; basic introduction to Multivariate statistics. etc.

**References:**

1. N. Yao And Zhong Lin Wang, Handbook Of Microscopy For Nanotechnology Kluwer Academic Publishers, 2005.
2. T.Pradeep, Nano, The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, 2007.
3. J. D. Bronzino, Tissue Engineering and Artificial Organs, Taylor & Francis Group, LLC, 2006.
4. Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology, John Wiley and Sons Inc, 2009.
5. C.A. Mirkin and C.M. Niemeyer, Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, Verlag Gmb H&Co, 2007.
6. E. David Reisner, Bionanotechnology- Global Prospects, Taylor & Francis Group, LLC, 2009.
7. J. W. M. Bulte, M.M.J. Modo, Nanoparticles in Biomedical Imaging: Emerging Technologies and Applications, Springer Science Business Media, LLC, 2008.
8. C.R.Kothari, IInd edition(2004) Research methodology: Methods and Techniques. New Age International (p) ltd publishers, New Delhi.
9. Jerrod H.Zar (1999) Biostatistical ananalysis by Prentice hall international Inc Press, London.

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**BHARATHIAR UNIVERSITY COIMBATORE 641-046**  
**M.Phil/ Ph.D Biotechnology**  
**Part-I Syllabus**

**Paper-II : Nanobiotechnology**

**Unit 1: Functional Principles of Nanobiotechnology-** Information-Driven Nanoassembly- Energetic- Chemical Transformation- Regulation- Traffic Across Membranes- Biomolecular Sensing- Self-Replication- Machine-Phase Nanobiotechnology

**Unit 2: Self assembling nanostructures-** Self-Assembled Artificial Transmembrane Ion Channels-types, Methods, Self-Assembling Nanostructures from Coiled-Coil Peptides, Synthesis and Assembly using Bio-Derived Templates- Self-Assembling for Patterned Molecular Assembly.

**Unit 3: Protein and Peptide based Nanostructures-** S-layers-Chemistry and structure, Assembly, recrystallisation, diagnosis- Engineered Nanopores- Methods of production-Supported bilayers and membrane arrays- Genetic Approaches- Microbial nanoparticles production- Magnetosomes- Bacteriorhodopsins- Nanoproteomics.

**Unit 4: DNA based Nanostructures-** DNA-protein nanostructures-Methods- Self assembled DNA nanotubes—Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties.

**Unit 5: Pharmaceutically important nanomaterials**

Drug Nanoparticles- Structure and Preparation, Liposomes, Cubosomes and Hexosomes, Lipid based Nanoparticles-Liquid nanodispersions- Solid Lipid Nanoparticles (SLP)- Biofunctionalisation of SLP, Characterisation- Nanoparticles for crossing biological membranes. Fundamentals- Physicochemical Principles of Nanosized Drug Delivery Systems-Nanotubes, Nanorods, Nanofibers, and Fullerenes for Nanoscale Drug Delivery, Carbon nanotubes biocompatibility and drug delivery

**References:**

1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.
2. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag Gmb H&Co, 2004.
3. S. David Goodsell, Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc, 2004.
4. Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press 2009.
5. Robert A. Freitas Jr. Nanomedicine, Volume I:Basic Capabilities, Landes Bioscience,1999.

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**M.Phil/ Ph.D Biotechnology**  
**Part-I Syllabus**

**Paper-III : Biointerfacial Strategies, Nanofabrication and Processing**

**Unit 1: Biological Nanomotors-** Nanomotors, Architecture of Motor Domain- Force Generation- Stepping, Hopping and Slithering- Directionality- MotorInteractions.

**Unit 2: Biologically Inspired Hybrid Nanodevices-** Membrane Proteins and their Native Condition- Protein Tool box- ATPase and Bacteriorhodopsin, Ion Channels and Connexin- Methods- Muscle Power, ATPase and BR Devices- Excitable Vesicles- Biochips.

**Unit 3: Bionanoelectronics-** Biocatalytic Growth of Nanoparticles for Sensors and Circuitry, Photoinduced Electron Transport in DNA: Toward Electronic Devices Based on DNA Architecture- DNA Nanowires- Charge Transport- DNA-Based Nanoelectronics- Electrical Manipulation of DNA on Metal Surfaces, Nanostructured Biocompartments- DNA-Gold nanoconjugates

**Unit 4: Bio-interface systems-** Lab on chip devices-their potentials for Nanobiotechnology- microfluidic devices- methods- materials for manufacturing microfluidic components- fluidic structures- fabrication and surface modification- spotting and detection mechanism- Microcontact printing of Proteins-Strategies- printing types- methods and characterization- Cell nanostructure interactions-networks for neuronal cells

**Unit 5: Nanoscale Applications in Health and Science-** Nanobio-crystallography- Radiation resistance-New protein structures-Three-dimensional engineering-Basics of crystal formation- Cell Nanobioscience- Nucleosome core- Protein stability to heat and radiation- -Nanomechanics and Nanooptics.

**References:**

1. O. Shoseyov, Ilan Levy, Nanobiotechnology-BioInspired Devices and Materials of the Future, Humana Press Inc, 2008.
2. C.A. Mirkin and C.M. Niemeyer, Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, Verlag Gmb H&Co, 2007.
3. David E. Reisner Bionanotechnology- Global Prospects, Taylor & Francis Group, LLC, 2009
3. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.

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