## SEMESTER S6

## NANO BIOENGINEERING

| | | | |
|---|---|---|---|
| **Course Code** | **PEBBT632** | **CIE Marks** | 40 |
| **Teaching Hours/Week (L: T:P: R)** | 2:1:0:0 | **ESE Marks** | 60 |
| **Credits** | 3 | **Exam Hours** | 2 Hrs. 30 Min. |
| **Prerequisites (if any)** | NIL | **Course Type** | Theory |

**Course Objectives:**

1. Students will acquire necessary knowledge and skills in the frontier areas of nano Bioengineering
2. Students will be able to implement the bioengineering principles to Nano biotechnology

## SYLLABUS

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| Module No. | Syllabus Description | Contact Hours |
|---|---|---|
| 1 | Introduction to Nano Bioengineering, Organic and inorganic, Nanomaterials Nanostructures and Dynamics of Biocompatible surfactant monolayers and bilayers Bio-interface, Bioconjugation, Bio-matrix based on bioinspired phospholipids polymers. Self-assembly of ionic-complementary peptides and their applications | 9 |
| 2 | Nano biotechnology from nanocluster assays to optical biochips for nanobiotechnology bioactive nanomaterials in bone grafting and tissue engineering- inorganic polymer nano composites for dental restoration and bone replacement applications. DNA based artificial nanostructures: fabrication, properties and applications. Nucleic acid engineered nanomaterials and their applications- RNA, DNA | 9 |
| 3 | **Nanotechnology in medicine**- Nanomedicines for various disease conditions: infectious diseases, neurological diseases, pulmonary disorders, cardiovascular diseases, cancer: nano-chemotherapy, -radiation therapy, -immunotherapy, -nuclear medicine therapy, -photodynamic therapy, - | 9 |

| | | |
|---|---|---|
| | photothermal and RF hyperthermia therapy, gene therapy. Drug targeting strategies for site-specific drug delivery-passive and active targeting, time and rate-controlled drug delivery, Nanotoxicity- Experimental Models in Nanotoxicology- In vitro Models, In Vivo Models, Predicting Penetration and Fate of Nanoparticles in the Body, Toxicity Mechanisms. | |
| **4** | **Introduction to BioMEMS** - Bio- microelectromechanical systems (Bio-MEMS), cell manipulations, Microfluidics: Introduction, properties of biological fluids in microchannels, devices, Lab-on-a-Chip: Microanalytical systems in chemistry and biology, MEMS Implants and Bioelectric Interfaces: Implantable microelectrodes, shunts | **9** |

**Course Assessment Method**
**(CIE: 40 marks, ESE: 60 marks)**

**Continuous Internal Evaluation Marks (CIE):**

| Attendance | Assignment/ Microproject | Internal Examination-1 (Written) | Internal Examination- 2 (Written) | Total |
|---|---|---|---|---|
| **5** | **15** | **10** | **10** | **40** |

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**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

| Part A | Part B | Total |
|---|---|---|
| • 2 Questions from each module.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(4x9 = 36 marks)** | **60** |

## Course Outcomes (COs)

At the end of the course students should be able to:

| Course Outcome | | Bloom's Knowledge Level (KL) |
|---|---|---|
| **CO1** | Understand the challenges and opportunities associated with biology on the nanoscale, as well as the characteristics and applications of biologically relevant molecular nanostructures | **K1** |
| **CO2** | Apply the knowledge of biomolecules for designing nanostructures by understanding the principles of self-assembly and self-organization and apply them to biology | **K3** |
| **CO3** | Evaluate different nanomedicines used for various disease conditions, assess the drug targeting strategies, and understand the nanotoxicity mechanisms. | **K5** |
| **CO4** | Critically analyze the role of Bio-MEMS in various applications and assess their impact on healthcare and biomedical research. | **K4** |

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

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**CO-PO Mapping Table:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | 2 | 2 | | | | | 2 |
| **CO2** | 3 | 2 | 1 | 1 | | 2 | 2 | | | | | 2 |
| **CO3** | 3 | 2 | 1 | 1 | | 2 | 2 | | | | | 2 |
| **CO4** | 3 | 2 | 1 | 1 | | 2 | 2 | | | | | 2 |

| Text Books | | | | |
|---|---|---|---|---|
| **Sl. No** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
| **1** | Biological and pharmaceutical nanomaterials | Challa S.S.R. Kumar (Ed) | Wiley – VCH Verlag GmbH& Co, KgaA. | 2018 |
| **2** | Handbook of Nanostructured Biomaterials and their applications in Nanobiotechnology | H.S. Nalwa | American Scientific Publishers | 2005 |
| **3** | Essential of Stem Cell Biology | R. Lanza, J. Gearhart et al | Elsevier Academic press. | 2009 |
| **4** | Tissue Engineering | Palsson, B.O. and Bhatia, S | Pearson Prentice Hall | 2004. |

| Reference Books | | | | |
|---|---|---|---|---|
| **Sl. No** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
| **1** | Principles of Biochemistry 4th Edition ISE | Voet & Voet | Publisher Wiley | |
| **2** | Handbook of Stem Cells | R. Lanza, I. Weissman, J. Thomson, and R. Pedersen | Academic Press | 2012 |
| **3** | Tissue Engineering | Pallua, N. and Suscheck, C.V | Springer | 2010 |

| Video Links (NPTEL, SWAYAM…) | |
|---|---|
| **Module No.** | **Link ID** |
| **1** | https://onlinecourses.nptel.ac.in/noc22_mm33/preview |
| **2** | |
| **3** | https://onlinecourses.nptel.ac.in/noc21_bt30/preview |
| **4** | https://archive.nptel.ac.in/courses/118/107/118107015/ |

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