

B.E. ELECTRICAL ENGINEERING EXAMINATION, 2025

(4th Year, 1st Semester)

INTRODUCTION TO NANO-BIOTECHNOLOGY (HONS.)

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a **separate** Answer-script for each Part

PART-I

Answer *any three* questions

Two marks are reserved for neat and well-organized answer script

1. How does photo-induced electron transport occur in DNA? Compare it with respect to HOMO-control and LUMO-control. Illustrate how to design an experimental setup to detect genetic defects based on this phenomenon. 4+8+4
2. Describe the “top-down” and “bottom-up” approaches in nano-biotechnology. Explain how (i) rotary and (ii) linear motion molecular bio-motors can be implemented. Include suitable sketches to support your explanation. 4+6+6
3. a) Give the concept map of the applications of nano-biotechnology in various fields. 4
b) Highlight the key research topics in nanotechnology, highlighting their significance and future scope. 4
c) Explain the concept of the Artificial Red Blood Cell (Respirocyte). Include a labeled diagram. 4
d) Describe the Bioengineered Cell Rover. Provide a schematic illustration. 4
4. a) Draw a scaled diagram to explain nanoscale and nanostructures, incorporating examples of known articles for comparison. 4
b) Provide a schematic diagram of pharmaceutical nanosystems. 6
c) Illustrate a schematic representation of a dendrimer. Explain its principle of operation and describe its uses in nanotechnology and medicine. 6

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| 5. a) | Explain the advantages of nano-biotechnology. | 4 |
| b) | Describe the applications of nano-biotechnology in medical and clinical fields. | 6 |
| c) | Discuss the therapeutic applications of nano-biotechnology. | 6 |

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PART-II

Answer Any three questions

(Two marks are reserved for neatness and well organized answers)

1. Briefly explain the following tools used in the fabrication of nanostructures: 16
 - a) Dip Pen Nanolithography
 - b) Self-Assembly
 - c) Chemical vapor deposition
 - d) Scanning Probe Instruments
2. a) Provide a brief description of the structure of carbon nanotubes. 6
b) Explain the electrical, mechanical, and vibrational properties of carbon nanotubes. 10
3. In brief, explain the following nano-material characterization tools: 16
 - a) Atomic Force Microscopy
 - b) Fluorescence Microscopy
 - c) Electron Microscopy
4. a) What is Moore's law? What are the factors enabling Moore's law? 2+4
b) Explain the operation of a tunnel diode in the context of nanotechnology. Mention the advantages and disadvantages of tunnel diodes. Also, mention their applications. 10
5. Write short notes on **any two** of the following: 2×8=16
 - a) Different forces that play a vital role in the creation of stable nanostructures
 - b) Application of carbon nanotubes
 - c) Quantum Tunneling