

D 121324**(Pages : 2)****Name.....****Reg. No.....****FOURTH SEMESTER M.Sc. (CBCSS) REGULAR/SUPPLEMENTARY DEGREE
EXAMINATION, APRIL 2025****Physics****PHY4E24—BIO PHYSICS****(2019 Admission onwards)****Time : Three Hours****Maximum Weightage : 30****Section A***(8 Short questions, each answerable with 7.5 minutes)**Answer **all** questions.**Each question carries a weightage 1.*

1. Explain the secondary and tertiary structure of proteins.
2. Write a short note on membrane transport mechanism in cells.
3. Explain how semiconductor quantum dots are used for bioimaging applications.
4. Explain how carbon nanotubes are used in biosensing applications.
5. Describe the principle and application of wireless biosensor networks.
6. Write a short note on bio-glasses and their biomedical significance.
7. Write a short note on materials used in dental adhesives and sealants.
8. What are bioinert ceramics ? Give one example.

(8 × 1 = 8 weightage)**Section B***(4 Essay questions, each answerable with 30 minutes)**Answer any **two** questions.**Each question carries a weightage 5.*

9. Explain the structural hierarchy of proteins and nucleic acids, highlighting their significance in biological functions.
10. Discuss the interface between biosciences, photonics, and nanotechnology in the context of Bionanophotonics.
11. Explain the principle of surface plasmon resonance and its use in optical biosensing.
12. Discuss the use of biomaterials in cardiovascular applications, including non-thrombogenic surface strategies.

(2 × 5 = 10 weightage)**Turn over**

Section C

(7 Problem questions, each answerable with 15 minutes)

Answer any **four** questions.

Each question carries a weightage 3.

13. Briefly describe the key differences between the primary and quaternary structures of proteins. What types of bonds are primarily responsible for stabilizing each of these structural levels ?
14. What is meant by the “sliding filament model” in muscle contraction ? Briefly explain the roles of actin and myosin in this process.
15. What are semiconductor quantum dots ? List two distinct advantages they offer over traditional organic fluorescent dyes for applications in biological imaging.
16. A carbon nanotube with a diameter of 20 nm has an elastic modulus of 1.2 TPa (1 TPa = 10^{12} Pa.). Determine the stress experienced by the nanotube when a tensile force of 5 μ N is applied along its length.
17. What properties of carbon nanotubes (CNTs) make them promising candidates for developing highly sensitive electrochemical biosensors ? Briefly describe one mechanism by which CNTs can enhance sensor performance.
18. How are bioresorbable polymers utilized in designing sutures for wound closure ? What is the primary advantage of using a bioresorbable suture over a non-resorbable one ?
19. A spherical biological cell has a radius of 0.08 mm and a membrane capacitance of 8 nF/mm.² It is immersed in a solution maintained at a temperature of 37° C. The membrane contains only potassium ion channels. The intracellular concentration of potassium ions is 160 mM, while the extracellular concentration is 5.5 mM. Initially, at time $t = 0$, the cell membrane potential is 0 mV and all potassium channels are closed. Suddenly, all the potassium channels are opened at time t_0 . What is the final steady-state membrane potential of the cell after a long time has passed since the channels opened ?

(4 $\times$ 3 = 12 weightage)