



Name :

Roll No. :

Invigilator's Signature :

**CS/M.Tech(BT)/SEM-3/MBT-302/2009-10
2009**

**ADVANCED INSTRUMENTS AND TECHNIQUES
IN BIOTECHNOLOGY**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

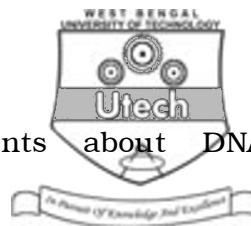
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) Capillary Electrochromatography (CEC) is a hybrid technique coupling
- a) CIE with HPLC b) CGE with HPLC
- c) CZE with HPLC d) EKC with HPLC.
- ii) is a technique which allows amphoteric molecules, such as proteins, to be separated by electrophoresis in a pH gradient generated between the cathode and anode.
- a) Capillary gel electrophoresis
- b) Capillary zone electrophoresis
- c) Capillary iso-electric focusing
- d) Isotachophoresis.



iii) Which of the following statements about DNA microarrays is not correct ?

- a) Fluorescently labeled mRNA from the organism hybridizes to the DNA on the glass slide
- b) DNA microarrays contain thousands of DNA segments on a support, such as a glass slide
- c) The amount of fluorescence correlates with the amount of mRNA in the sample.
- d) Hybridization to a DNA microarray can only occur once.

iv) Which of the following is not a soft ionization technique ?

- a) ESI
- b) EI
- c) MALDI
- d) TANDEM.

v) What is the term used to describe the process of synthesizing oligonucleotides directly on the glass slide ?

- a) Photosynthesis
- b) Photolithography
- c) Light-activated oligosynthesis
- d) On-chip oligosynthesis.

vi) In solid phase peptide synthesis the amino group is protected by

- a) Boc
- b) Bac
- c) Toc
- d) Tac.



- vii) $R = L_I / L_s$ is the resolution and is expressed by
- a) $1/\epsilon + MK$ b) $\epsilon/\epsilon + MK$
- c) $\epsilon + MK$ d) $\epsilon + MK/\epsilon$.
- viii) The time taken for a solute to elute off the HPLC column is known as
- a) residual time
- b) rejection time
- c) elution time
- d) retention time.
- ix) Prism based TIR microscopy is useful for
- a) single particle FRET studies
- b) IgE binding studies
- c) Pyrosequencing studies
- d) Carboxylic acid detection.
- x) The applied current in an STM tip is of the order of
- a) $pA - nA$ b) $\mu A - nA$
- c) $mA - \mu A$ d) $A - mA$.
- xi) Using image processing, the resolution of a confocal microscope in the XY dimension is given by
- a) $1.6 \mu m$ b) $0.05 \mu m$
- c) $0.25 \mu m$ d) $0.3 \mu m$.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Mention the applications of capillary electrophoresis in genomics and proteomics research. 5
3. What is the resolution limit of an electron microscope ? Define all the terms in the equation. Calculate how a spatial resolution of 0.1 to 0.2 nm is obtained in a TEM ? 1 + 2 + 2
4. Explain the mode of operation of an atomic force microscope in terms of non-covalent (weak) interactions as the cantilever tip approaches a sample surface. Use diagram as appropriate. 5
5. What is the general strategy for chemical synthesis of peptide bond ? 5
6. Describe the basic principles of a DNA microarray and its applications. 5
7. Illustrate the operation of an HPLC to separate a binary mixture of proteins. 5



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

8. a) What do you mean by forward scatter and side scatter ? 4
- b) Explain with an example the application of FACS in biotechnology research. 4
- c) Discuss with a diagram the working principle of a capillary DNA sequencer. 5
- d) Differentiate between Capillary Gel Electrophoresis (CGE) and Capillary Zone Electrophoresis (CZE). 2
9. a) Draw a design diagram of a scanning nearfield optical microscope (SNOM) with optical and electronic parts specifically labelled. 6
- b) Explain the working principle of a SNOM. 4
- c) What optical hardware innovations have made SNOMs capable of overcoming the resolution limit of classical optics ? 5
10. a) What is Edman sequencing of protein ? Describe it in detail ?
- b) Describe the steps of solid phase peptide synthesis by Merrifield method in detail. 7 + 8



11. a) Describe peptide and protein sequencing by quadrupole mass spectrometry, using a diagram.
- b) Describe the nomenclature of peptide fragments and draw a mass spectrum by tandem MS.
- c) A new protein isolated from human tissue. Relative Mol. Mass ~ 12 Kd by SEC and 13 Kd by gel electrophoresis. After purification a sample was subjected to ESI MS and following data obtained :

m/z	773.9	825.5	884.3	952.3	1031.3
Abundance	59	88	100	66	37

Given that $n_2 = (m_1 - 1) / (m_2 - m_1)$ and $M = n_2 (m_2 - 1)$, and assuming that the only ions in the mixtures arise by protonation, deduce an average Mol. Mass for the protein by the method. 5 + 5 + 5

12. a) What are the basic optical properties of the reporter molecule GFP ? What is the specific unique structural elements in GFP ? Briefly describe 3 major applications using GFP. (e.g. evolutionary relationships through phylogeny). 2 + 2 + 6
- b) Describe the principle and distinguishing characteristics of a substrate labelled fluorescence immunoassay (SLFIA) using an example. (e.g. β -galactosidase enzyme kinetics) 5



13. a) What are the factors that decide contrast in an electron microscope ? Outline the steps needed to 'prepare a specimen' for EM analysis. 3 + 4
- b) Draw a labelled diagram of the components of an isocratic HPLC system. Why is a loop injector used for application on to a HPLC column ? 4 + 4

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