

**PHYSICOCHEMICAL TECHNIQUES IN BIOTECHNOLOGY
(BTC5102)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) What is the interaction that exists between the side chains of Lys and Asp residues in a protein popularly called?
(a) Salt bridge (b) Solvation
(c) Hydrogen bond (d) Hydrophobic
- (ii) The major stabilizing force for a double stranded DNA is
(a) Base stacking interaction (b) Hydrophobic force
(c) Hydrogen bond (d) Solvation
- (iii) What is T_m of an alpha-helix?
(a) It is the temperature where the denaturation of an alpha-helix starts
(b) It is the temperature where the denaturation of an alpha-helix is complete
(c) It is the temperature where 50% denaturation of an alpha-helix takes place
(d) It is the beyond temperature at which an alpha-helix is hydrolysed
- (iv) The pitch of alpha-helix is
(a) 0.54 nm (b) 0.36 nm
(c) 5.4 nm (d) 5.4 μm
- (v) What is the range of UV wavelength?
(a) 10-100nm (b) 100-400nm
(c) 400-700nm (d) 700-1700nm
- (vi) Lambert-Beer Law is applicable for
(a) UV-visible spectroscopy (b) IR spectroscopy
(c) NMR spectroscopy (d) Scanning electron microscopy
- (vii) Which of the following component combinations is NOT a part of a dual beam UV spectrophotometer?
(a) Sample, reference cuvette (b) Beam selector
(c) Prism and grating (d) Michelson interferometer

- (viii) Which statement is correct for fluorescence?
 (a) Light emission stops when the source of the light is removed
 (b) Light emission continues when the source of the light is removed
 (c) Emitted light has the same wavelength as that of excitation beam
 (d) It is an absorption spectroscopy
- (ix) The correct path of light in a spectrofluorometer is
 (a) Light source -> excitation filter -> sample holder -> emission filter -> detector
 (b) Light source -> sample holder -> excitation filter -> emission filter -> detector
 (c) Light source -> emission filter -> sample holder -> excitation filter -> detector
 (d) Light source -> excitation filter -> sample holder -> detector-> emission filter
- (x) Which of the following statement is NOT correct for SEM?
 (a) SEM gives topographic information of the sample
 (b) Vacuum is needed inside the microscope to do the SEM
 (c) Osmium tetroxide is used as the secondary fixing agent in SEM
 (d) To do SEM, the sample must be an electrical conductor

Fill in the blanks with the correct word

- (xi) The enzyme that takes part for crosslinking the Lysine residues in collagen is _____
- (xii) The chemical used for primary fixation of samples in electron microscopy is _____
- (xiii) In the UV-Visible spectroscopy, proteins absorb at _____ nm.
- (xiv) In UV-Visible spectroscopy, most energetically favourable electron transfer is from highest occupied molecular orbital to _____.
- (xv) The quantum efficiency is expressed as _____.

Group - B

2. (a) Discuss the origin of van der Waals force and its role in maintaining the structure of DNA. [[CO1](Understand/IOCQ)]
- (b) DNA molecules have a large number of phosphate groups which are protruded outside the double helix. Discuss how these large number of negative charges are stabilized in a DNA molecule. [[CO1](Reasoning/HOCQ)]
- (c) In the membrane proteins, hydrophobic amino acids are found on the surface of the protein and not in the core. Comment on the anomaly. [[CO1](Comment/HOCQ)]
(3 + 2) + 3 + 4 = 12
3. (a) Describe Anfinsen experiment. [[CO1](Describe/IOCQ)]
- (b) Discuss why all the proteins do not give positive results with Anfinsen experiment. [[CO1](Understand/IOCQ)]
6 + 6 = 12

Group - C

4. (a) Draw a diagram with all possible electron transitions from lower to higher orbitals of a molecule. Among those transitions, which are possible with UV-Visible wavelengths? *[[CO2](Understand/IOCQ)]*
- (b) Draw and describe a schematic diagram of a spectrophotometer. *[[CO2](Understand/IOCQ)]*
- (4 + 2) + 6 = 12**
5. (a) Discuss the use of IR spectroscopy in the following areas: (i) progress of a chemical reaction, (ii) detection of impurities. *[[CO2](Understand/IOCQ)]*
- (b) Draw a schematic diagram of FTIR spectrometer. Label the diagram. *[[CO2](Understand/IOCQ)]*
- (c) What is the fingerprint region of the IR spectrum? Which structural feature of a molecule can be determined by this region? *[[CO2](Remember/LOCQ)]*
- (d) How IR can be used for determination of the shelf life of a substance? *[[CO2](Understand/IOCQ)]*
- (2 + 2) + 4 + (1 + 1) + 2 = 12**

Group - D

6. (a) Draw and explain the idealized absorption and emission spectrum. *[[CO3](Understand/IOCQ)]*
- (b) Why the idealized absorption and emission spectrum is not obtained in real experiments? *[[CO3](Understand/IOCQ)]*
- (c) Discuss how fluorescence molecules are used for development of genetically modified organisms. *[[CO4](Understand/IOCQ)]*
- (2 + 3) + 3 + 4 = 12**
7. (a) With a schematic diagram, describe the arrangement of the basic components of a spectrofluorometer. *[[CO3](Explain/IOCQ)]*
- (b) State four criteria that an analyte should meet for spectrofluorometric analysis. *[[CO3](Remember/LOCQ)]*
- 8 + 4 = 12**

Group - E

8. (a) Define resolution and magnification power of a microscope. *[[CO4](Remember/LOCQ)]*
- (b) Compare a light microscope and an electron microscope with respect to the following: (i) electromagnetic wave used, (ii) resolution, (iii) lenses, (iv) interior medium. *[[CO4](Remember/LOCQ)]*
- (c) Discuss the role of electron gun and condenser lenses in a scanning electron microscope. *[[CO4](Understand/IOCQ)]*
- (2 + 2) + 4 + (2 + 2) = 12**
9. (a) Describe the objective lenses and projector lenses of TEM. *[[CO4](Describe/IOCQ)]*
- (b) Describe the image translation system in TEM. *[[CO4](Describe/IOCQ)]*

- (c) Compare SEM and TEM with respect to: (i) electron beam, (ii) voltage, (iii) thickness of specimen, (iv) imaging, (v) image rendering. *[(CO4)(Compare/HOCQ)]*

4 + 3 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	15	73	12