V/D/TZ

Reg. No: [redacted]

VIT
Vellore Institute of Technology

Final Assessment Test – April 2026

Course: BBIT206L - Analytical Techniques in Biotechnology
Class NBR(s): 2442 /2521 Slot: A2+TA2
Time: Three Hours Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Illustration of solution preparations and application of different tools on quantification.
CO2	Enumerate the usage and maintenance of analytical instruments.
CO3	Distinguish the analytes by using appropriate tools.
CO4	Interpret the data to predict unknown compounds.
CO5	Suggest analytical technique/instrument to solve real-life problem.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. a) Provide the missing information in the following table. [3] CO1 BL2

Type of acid	Molarity (M)	Normality (N)	Number of moles in 100 mL of solution	Number of gm-equivalent in 100 mL of solution
H_2SO_4	0.1			
NaOH		0.5		

b) A volumetric titration is carried out by adding 0.05 M NaOH to 25 mL of 0.05 M HCl. Calculate the pH of the solution after the addition of (i) 5 mL of NaOH and (ii) 15 mL of NaOH. [7]

2. a) Comment on the sample holders (cells/cuvettes) used in UV, Visible, and IR spectroscopy from the material point of view. [2] CO5 BL4

b) What is meant by atomization in atomic absorption spectroscopy? Why is it important? [3]

c) The absorbance of a pure enzyme solution at 100 µg/mL was 0.2 at 280 nm in a 1 cm path-length cuvette. In a subsequent experiment, 20 mL of this purified enzyme solution was obtained, which showed an absorbance of 0.23 at 280 nm with the same cuvette. Calculate the total amount of enzyme present in the 20 mL solution. [5]

6. Suppose you are asked to purify a target protein from a complex mixture of proteins that differ in their isoelectric points (pI). The protein of interest has a pI of 5, a molecular weight of 50 kDa, and is unstable at pH ≥ 8. **CO4 BL3**

a) Which separation technique would you select for its purification? Justify your choice based on the physicochemical properties of the protein.

b) Design a detailed purification strategy, including selection of buffer system and pH.

c) How will you evaluate the purity and confirm the identity of the purified protein? Mention at least two analytical techniques.

7. a) What is resolving power in microscopy? Will increasing the magnification increase the resolution in a microscope? **[2] CO3 BL2**

b) Which microscope is generally used to observe individual components of cells? Elucidate the working principle and construction of the choicest microscope. Draw neat diagrams to support your answer. **[8]**

8. Explain the principle and instrumentation of scintillation counting methods. Discuss their applications in biological research. Compare their advantages and limitations with Geiger–Müller counters. **CO5 BL2**

9.a) Differentiate the following: **CO1 BL1**

i. SEM and TEM

ii. Denaturing and non-denaturing electrophoresis

OR

9.b) Differentiate the following: **CO1 BL**

i. Determinate and Indeterminate Errors

ii. Electron impact ionization and chemical ionization

10.a) Write short notes on: **CO4 B**

i. Accuracy of precision

ii. MALDI-TOF

OR

10.b) Write short notes on: **CO4**

i. Conductivity meter

ii. Size exclusion chromatography

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3. a) Calculate the energy (in joules) of (i) UV radiation with a wavelength of 600 nm and (ii) IR radiation with a wavenumber of 1500 cm^{-1}. (Note: $h=6.626\times10^{-34}$ J.s; $c=3.0\times10^{8}$ m/s) [4] CO4 BL4

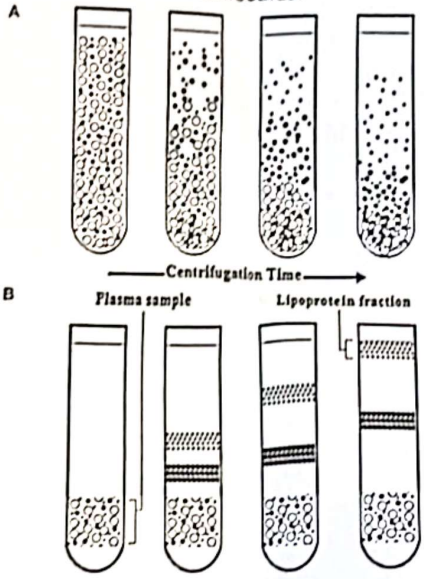
b) Based on the knowledge acquired in NMR spectroscopy, discuss the possible differences in the ^1H NMR peaks (number of peaks and splitting) of propanol [$CH_3CH_2CH_2OH$] and isopropanol [$(CH_3)_2CHOH$]. [6]

4. a) A centrifuge is operated at 10,000 RPM with a rotor of diameter 21 cm. [3] CO2 BL3

i. Calculate the maximum RCF experienced at the outer edge of the tube.

ii. Suppose the desired separation requires an RCF of 12,000×g. Determine whether the current operating condition is sufficient.

b) Identify the two centrifugation techniques illustrated in Figures A and B. Differentiate between these two based on their principles and separation mechanisms. With at least one example, explain how each technique is useful for the sedimentation of biomolecules. [7]



5. a) Suppose two HPLC runs of the same sample give different retention times and resolution. Evaluate the factors responsible for these differences and explain how they relate to the principle of separation in HPLC. [5] CO3 BL4

b) Suppose a gas chromatographic analysis of cinnamaldehyde gives a peak with a retention time of 10.25 min and a baseline width of 0.35 min. If the fused-silica column was 30 cm long, calculate the number of theoretical plates and the height equivalent to a theoretical plate. [5]