

**M.Sc I. Biochemistry Semester I Paper II Analytical Techniques  
Question Bank**

**Unit I : Technology Fundamentals (Life Sciences)**

Q.1) Choose the correct alternative

- 1) Cell fractionation is used because
  - a) **it allows cellular components such as organelles to be studied in isolation.**
  - b) it allows cellular components to be view with a light microscope.
  - c) it allows for the study of interactions between all of the organelles.
  - d) mitochondria and endoplasmic reticulum cannot be studied together.
- 2) Cells have to be broken apart in detergent before they can be separated into different parts
  - a) **detergent ensure the reaction is sterile.**
  - b) detergent help dissolve the cell membrane.
  - c) detergent help separate the cellular components based on size and density.
  - d) detergent remove oil and other contaminants.
- 3) The following fractionation procedure separates the cell into its fractions
  - a) **centrifugation**
  - b) collection
  - c) lysing
  - d) purification
- 4) The marker enzyme of lysosome is
  - a) lysozyme (muramidase)
  - b) beta galactosidase
  - c) **acid phosphatase**
  - d) none of the above
- 5) Freeze drying is also known as
  - a) **lyophilisation**
  - b) cold pasteurisation
  - c) irradiation
  - d) liposuction
- 6) In the primary drying phase in freeze drying, amount of heat required is calculated using
  - a) **latent heat of sublimation**
  - b) latent heat of vapourisation
  - c) heat of enthalpy
  - d) latent specific heat
- 7) The following food cannot be freeze dried
  - a) foods with high fibre content
  - b) foods with high Vit.B12 content
  - c) foods with high protein content
  - d) **food with high fat content**

Q. 2) Fill in the blanks

- 1) Method of producing of plants through tissue culture is called **plant tissue culture**.
- 2) Recovery of healthy from diseased plant is possible by using single cell as **explant** in tissue culture.
- 3) The cytoskeleton is to animal cell as **cell wall** is to plant cell.
- 4) **Freeze drying** is also known as cryodesiccation.

Q.3) Answer in one sentence

1) Define bio-components.

**Answer:** The components that make up a living cell are known as bio-components. For example- cell wall, cytoplasm, and nucleus.

2) Define cell.

**Answer:** Smallest unit that can live on its own and that makes up all living organisms and the tissues of the body.

3) Define precipitation.

**Answer:** A chemical process in which solid material is separated from a liquid.

4) Define freeze drying.

**Answer:** freeze drying is a process that removes water from a frozen material via sublimation - the direct conversion of ice to vapour.

5) State any two applications of ultracentrifugation.

**Answer:** Applications of ultracentrifuges include the separation of small particles such as viruses, viral particles, proteins and/or protein complexes, lipoproteins, RNA, and plasmid DNA

6) State any two detergents used in analytical techniques.

**Answer :**

7) State any two bio-components of plant cell.

**Answer:** Nucleus and plastids and other cell organelles are the bio components of plant cell

8) Define enzymes.

**Answer:** Enzymes are biocatalyst which speed up the metabolic reaction without undergoing change in itself.

9) Define membrane proteins.

**Answer:** A membrane protein is a protein molecule that is attached to, or associated with, the membrane of a cell or an organelle.

10) Define freeze drying.

**Answer:** Freeze Drying is a process in which a completely frozen sample is placed under a vacuum in order to remove water or other solvents from the sample, allowing the ice to change directly from a solid to a vapor without passing through a liquid phase.

Q.4) Short answer questions

1. Explain marker enzymes.
2. Explain ultrafiltration.
3. Explain methods for lysis of animal cells.
4. Explain freeze drying techniques.
5. Explain subcellular fractionation.



6. Explain the use of detergents in isolation of membrane proteins.
7. Explain methods for subcellular fractionation of mitochondria.
8. Give the methods for isolation of membrane proteins.
9. Explain fractional precipitation.
10. Explain ultracentrifugation.
11. Explain isolation of membrane proteins.
12. Explain purification of proteins for biological matter.

Q5) Long answer questions

1. Explain freeze drying and state its applications.
2. Explain ultrafiltration and state its applications.
3. Explain fractional precipitation and state its applications.
4. Explain ultracentrifugation and state its applications.
5. Describe in detail general scheme for purification of biocomponents.
6. Describe in brief methods for lysis of plant and animal cells.
7. Describe in brief methods for lysis of plant cells and microbial cells.



## Unit II : Chromatography

### Q.1) Choose correct alternatives

- 1) Give the principle of paper chromatography ?
  - a) Partition
  - b) Adsorption
  - c) **Both A and B**
  - d) none of the above
- 2) Following is used as a spraying agent in paper chromatography?
  - a) conc. HCl
  - b) NaCl solution
  - c) **Ninhydrin solution**
  - d) CuSO<sub>4</sub> solution
- 3) The pattern on the paper in paper chromatography is called.....
  - a) Chroming
  - b) Chroma
  - c) Chromatograph
  - d) **Chromatogram**
- 4) capillary columns are open tubular columns constructed from which of the following material?
  - a) Glass
  - b) Metal
  - c) Stainless steel
  - d) **Fused silica**
- 5) Following is not used for detection in gas chromatography?
  - a) Infra-red spectroscopy
  - b) **NMR**
  - c) Flame ionisation
  - d) Electrical conductivity
- 6) The following ion get released from the cation exchange column?
  - a) **H<sup>+</sup>**
  - b) Na<sup>+</sup>
  - c) K<sup>+</sup>
  - d) Ca<sup>2+</sup>
- 7) Following method is used for preparing demineralised water?
  - a) Gas chromatography
  - b) **Ion exchange chromatography**
  - c) Mass spectroscopy
  - d) Complexometric titration
- 8) Following is not a highly specific biological interactions to be used in affinity chromatography?
  - a) **Cation-anion**
  - b) Antigen- antibody
  - c) Enzyme- substrate



- d) Receptor- ligand
- 9) The pressure used in HPLC is .....
- 1000-3000psi
  - 1000-5000 psi
  - 2000-6000 psi
  - 1000-6000psi**
- 10) Gel filtration media is used to purify alpha amylase by gel filtration?
- Biogel -P
  - Sephacryl S-300**
  - Biogel-A
  - Sephadex

Q. 2 Fill in the blanks

- Chromatography is a physical method that is used to separate and analyse complex mixture.
- In thin layer chromatography, the stationary phase is made of solid and mobile phase is made of liquid.
- Ion exchange chromatography is a technique for separating compounds based on their net charges.
- Gel filtration chromatography is a form of partition chromatography used to separate molecules of different molecular weight.
- In gel filtration chromatography, external volume is referred to as void volume.
- In HPLC, the pump can deliver solvent from reservoir to the detector.
- In reverse phase HPLC, stationary phase is non-polar and the mobile phase is polar.
- In gas chromatography, the solvent gas is used as inert gas.
- In gas chromatography, sample is injected by microinjection syringe.

Q.3 Answer in one sentence

- 1) Define chromatography.

**Answer:** Chromatography is a process for separating components of a mixture.

- 2) Describe the phases of chromatography.

**Answer:** Chromatography is a technique used to separate the different mixtures. It contains two phases they are stationary and mobile phase.

- 3) In HPLC, which type of detector is used for detection?

**Answer:** In HPLC, selective type of detector is used for detection.

- 4) Describe R<sub>f</sub> value.

**Answer:** The R<sub>f</sub> (retardation factor) value is the ratio of the solute's distance travelled to the solvent's distance travelled.

- 5) In Gas chromatography which type of gas is used in reservoir?

**Answer:** Inert gas is used in gas chromatography as a reservoir or solvent.

- 6) Name the paper is used in paper Chromatography?

**Answer:** Cellulose paper is used in paper chromatography.

- 7) Generally which column is used in Chromatography techniques?

**Answer:** Generally glass column is used in Chromatography techniques.

- 8) Name the gel which is used in gel permeation Chromatography.

**Answer:** dextran, polyacrylamide and dextran-polyacrylamide and agarose these gel are used in gel permeation Chromatography.

9) Define cationic exchanger.

**Answer:** A cation-exchange agent that can exchange its cation with the cation or cations of a solution passed through it and that consists of an insoluble saltlike or acidic substance.

10) Define ligand.

**Answer :** A ligand is an ion or molecule, which donates a pair of electrons to the central metal atom or ion to form a coordination complex.

#### Q.4 Short answer questions

- 1) Describe principal and application of gel filtration technique.
- 2) Describe principal and application of affinity chromatography.
- 3) Give applications and principal of ion exchange chromatography.
- 4) Describe thin layer chromatography along with principle and advantages.
- 5) Describe paper chromatography and types of paper chromatography.
- 6) Describe reverse phase HPLC.
- 7) Give advantages and disadvantages of chromatography.
- 8) Describe gas chromatography along with systematic diagrammatic representation.
- 9) Describe the process of demineralization of water.
- 10) Draw available diagrammatic representation of HPLC and paper chromatography along with its applications.

#### Q.5.Long answer questions

- 1)What is chromatography? Explain any two types of chromatography in detail.
- 2) Describe in detail principle, methodology and applications of HPLC.
- 3) Describe in detail Ion exchange chromatography with principal methodology and applications.
- 4) Explain in detail methodology instrumentation and application of gas chromatography.
- 5) Explain in detail gel filtration chromatography.
- 6) Describe in detail paper chromatography.
- 7) Describe in detail thin layer chromatography and give advantages.
- 8) Give principle working and application of affinity chromatography.
- 9) Give the principle working of antigen-antibody reaction in Chromatography technique.
- 10) Explain the following terms:
  - a) Hydrophobic interactions
  - b) Anionic exchanger
  - c) Zwitter ion
  - d) Detector



Unit IV –Spectrophotometric Techniques

Q1. Choose the correct alternative

- 1) The region for electromagnetic spectrum for nuclear magnetic resonance is \_\_\_\_\_
  - a) Microwave
  - b) Radio frequency**
  - c) Infrared
  - d) UV rays
- 2) Following is an application of molecular spectroscopy?
  - a) Structural investigation
  - b) Basis of understanding of colours
  - c) Study of energetically excited reaction products
  - d) All of the above mentioned**
- 3) The criteria for electronic spin resonance is \_\_\_\_\_
  - a) periodic change in polarisability
  - b) Spin quantum number of nucleI>0
  - c) presence of unpaired electron in a molecule**
  - d) Presence of chromophore in a molecule
- 4) The analysis of electromagnetic radiation scattered, absorbed or emitted by the molecule is called \_\_\_\_\_
  - a) Kaleidoscopy
  - b) Astronomy
  - c) Spectroscopy**
  - d) Anatomy
- 5) The energy level with lower energy is called \_\_\_\_\_
  - a) ground state energy level**
  - b) Initial state energy level
  - c) excited state energy level
  - d) all of the mentioned
- 6) The electronic spectra in the visible range span is \_\_\_\_\_
  - a) 25000-72000cm<sup>-1</sup>
  - b) 25000-50000cm<sup>-1</sup>
  - c) 12500-25000 cm<sup>-1</sup>**
  - d) 15000-30000 cm<sup>-1</sup>
- 7) Following region of IR spectra appears between (1400 -600)cm ?
  - a) Functional group region
  - b) Finger print region**
  - c) low frequency region
  - d) None of the mentioned
- 8) Presence of functional group in a compound can be established by using \_\_\_\_\_
  - a) Chromatography
  - b) IR Spectroscopy**
  - c) Mass spectroscopy

- d) X- ray diffraction
- 9) Following technique is used to determine the protein sequence?
- X-ray chrystallography
  - NMR Spectroscopy
  - Atomic Spectroscopy
  - Mass spectroscopy**
- 10) Following is not a component of mass spectrometric technique?
- Ion source
  - Analyzer
  - Detector
  - X-ray source**
- 11) Who discovered mass spectrometer?
- Erancis Aston
  - J .J Thomson**
  - Earnest O Lawrence
  - Walter Kaufmann
- 12)Following components are used to generate X-rays?
- Meyer tube
  - West tube
  - Anger tube
  - Coolidge tube**
- 13)The cathode in the Coolidge tube is made of which of the following elements?
- Quartz
  - Iron
  - Tungsten**
  - Barium

Q2.Fill in the blanks

- Any isolated covalently bonded Group that shows a characteristics absorption in the ultraviolet or visible region is **Chromophore**.
- Auxochrome is also known as a **Colourenhancer**.
- The instruments that are used to study the absorption or emission of that of recent electromagnetic radiation as a function of wavelength called **Spectrometers or spectrophotometres**
- In UV visible spectroscopy **Monochromaters** resolves polychromatic radiations into its individual wavelengths.
- In UV visible cuvettes used as a sample holders.
- IR** spectroscopy used to detect the presence of functional group.
- Twisting** is the bending vibration which takes place in different planes.
- Fluorescence** spectroscopy is the routinely used for studying Structural changes in conjugated systems.
- Nuclei having either the number of protons or neutrons as odd have **half integral** spin .
- Mass spectroscopy was discovered by **J.J Thomson**.



- 11) **Nebulizer** is a device that introduces a liquid sample into Atomic Absorption Spectroscopy.
- 12) X- ray diffraction provide **qualitative and quantitative** information about the compound present in solid sample.

Q3. Answer in one sentence

1) Write the definition of spectroscopy.

**Ans :** The study of the emission and absorption of light and other radiations by matter is known as spectroscopy.

2) State the main components of UV visible spectrophotometer .

**Ans :** The main components of UV visible spectrophotometer are (a) Light source (b) Monochromater (c) Sample holder (d) Detector (e) Recorder

3) Give Beer's law.

**Ans :** Beer's law states that 'The intensity of light decreases with respect to concentration.'

4) Give the range of Infrared spectrum .

**Ans :** The infrared range covers 700-1000 nm (wavelength), or 14,286-12,800 cm<sup>-1</sup> (wavenumber).

5) State the source of energy in NMR .

**Ans :** Radio waves which have long wavelength, low energy and low frequency are the source of energy in NMR.

6) Give the four main stages in Mass spectroscopy.

**Ans :** The main stages of mass spectrometry are Ionization, Acceleration, Deflection and Detection.

7 ) Who discovered Mass spectroscopy?

**Ans :** J.J Thomson in 1912 discovered Mass spectroscopy.

8) State the type of gas is used in Atomic Absorption Spectroscopy (AAS).

**Ans:** Nitrogen and Argon are the gases which are most commonly used in Atomic Absorption Spectroscopy.

9) State the instrument is used for X- ray diffraction.

**Ans :** X- ray diffractometer is the instrument used for X-ray diffraction

10) Give the type of spectroscopy is Fluorescence.

**Ans :** Fluorescence spectroscopy is the type of electromagnetic spectroscopy.

Q4. Short answer questions

1. Explain the principle of UV visible spectrophotometer .
2. Explain the instrumentation of UV visible Spectrophotometry
3. Give the applications of IR spectroscopy
4. Give the applications of Mass spectroscopy.
5. Explain in short atomic emission and absorption.
6. Explain the principle and Technique of ESR .
7. Explain NMR .
8. Explain X-ray diffraction.
9. Define and explain the principle of IR spectroscopy.
10. What are the advantages of mass spectroscopy.

Q5. Long answer questions

1. Describe UV visible Spectrophotometry with well labelled diagram.
2. Explain Fluorescence spectroscopy.
3. Explain IR spectroscopy.
4. Explain instrumentation of NMR and its applications.
5. X- ray diffraction with its applications.
6. Explain Mass spectroscopy.
7. Explain instrumentation of ESR and its applications
8. Define and explain NMR and mention its applications.
9. Describe concept of Atomic emission and absorption.





**Unit V : Tracer techniques**

**Q.1 Choose the correct alternative**

- 1) Following isotope is not a radio isotope?
  - a) **Carbon-13**
  - b) Carbon-14
  - c) Tritium
  - d) Sulphur-35
- 2) The half life of a radio isotope is .....
  - a) half the time taken for complete decay
  - b) half the time taken for half the decay
  - c) time taken for complete decay
  - d) **time taken for half the decay**
- 3) Liquid scintillation spectrometry is a method of detecting .....
  - a) X-rays
  - b) alpha emitters
  - c) **beta emitters**
  - d) gamma rays
- 4) An isotope that is used as a tracer in a chemical reaction is .....
  - a) Protium
  - b) Dueterium
  - c) **Tritium**
  - d)Ortho hydrogen
- 5) A compound containing some amount of radio isotope is
  - a) **tracers**
  - b) radioactive compound
  - c) non-radioactive compound
  - d) linear active compound
- 6) Nuclei bombarded with protons, neutron or alpha particles are changed to .....
  - a) isotopes
  - b) **radioisotopes**
  - c) both of above
  - d) none of above

**Q 2 Fill in the blanks**

- 1) The stability of an isotope of a given element is dictated by the ratio of neutrons to protons in the nucleus is called as radioactivity.
- 2) Same element with different atomic weight is called as isotopes.
- 3) The addition of neutron and positron is called as proton.
- 4) The unit of radioactivity is curie (Ci).
- 5) The process of formation of ion pair is known as ionization.

Q.3 Answer in one sentence

1) Define isotope and give examples of isotope.

**Answer :**The element having same atomic number but different atomic mass number are called as isotopes.  
Example Carbon 12, Carbon 13 and Carbon 14.

2) Give isotopic tracer techniques.

**Answer :**Any radioactive atom detectable in a material in a chemical, biological or physical system and used to mark that material for study.

3) Define radioactivity and give example of radioactive elements.

**Answer :**Radioactivity is the act of emitting radiation spontaneously. Uranium and carbon are radioactive elements.

4) Define autoradiography.

**Answer :**Autoradiography is a photographic method used to detect radioactive material.

5) Define isotopic labelling.

**Answer :** The substitution of an atom or an ion by an isotope of the same elements.

Q.4 Short answer questions.

1) Give principle and advantages of tracer techniques?

2) Describe isotopes and isotopic labelling?

3) Describe measurements of isotopic labelling?

4) Describe autoradiography.

5) What is spectrometry and describe about liquid scintillation spectroscopy?

6) Explain in detail principle and working of tracer techniques.

7) Describe isotopes with example and give its applications.

Q.5 Long answer questions

1) Write in detail about liquid scintillation counter and it's applications.

2) Write in detail principle and applications of tracer techniques.

3) Write in detail principle and application of autoradiography.

4) Describe isotopic labelling.

5) Explain in detail scintillation method used for measurement of radioisotopes.



## Syllabus

### **Paper - II (Analytical Techniques)**

- Unit I** : Technology Fundamentals (Life Science) - General Scheme for purification of bio-components methods for studying cells and organelles. Sub cellular fractionation and marker enzymes, Methods for lyses of plant, animal and microbial cell. Ultra centrifugation, Ultra filtration, Freeze drying and fractional precipitation. Use of detergents in isolation of membrane proteins.
- Unit II** : Chromatography - Basic principles and application of ION Exchange, gel filtration, purification, affinity, HPLC and Reverse phase chromatography, Gas chromatography, TLC and paper chromatography.
- Unit III** : Electrophoresis - Polyacrylamide/ starch / agarose gel electrophoresis, 2D-Electrophoresis, Isoelectric focussing, Southern, Northern and Western blotting.
- Unit IV** : Spectrophotometric techniques - UV, Visible and Infra Red, ESR, NMR, Mass Spectroscopy, Atomic emission and absorption, X-ray diffractions, fluorescence.
- Unit V** : Tracer Technique - Principle and application of tracer technique, Isotopic labeling and their measurements, Auto radiography, liquid scintillation spectrometry.