Text Book Questions

Dept. of Botany

Dinakrushna College, Jaleswar, Balasore

Question Bank — Semester 1, Paper: Major-II

Paper II — Analytical Techniques in Plant Sciences

UG 1st Semester — Botany Honours

Pattern followed in every Unit —
Section A: Fill in the Blanks & Multiple-Choice Questions (with answers)
Section B: Very Short Answer Questions (2–3 sentences)
Section C: Short Notes (5 marks)
Section D: Long / Essay-type Questions (8 marks)

UNIT I — Microscopy, Non-optical Microscopes & Flow Cytometry

(Covers Chapter 1: Microscopy and Chapter 2: Non-optical Microscopes and Flow Cytometry)

Section A — Fill in the Blanks & Multiple Choice Questions

(i) Fill in the Blanks — Microscopy

1. The resolving power of human eye is _____ mm.

   Ans: 0.1mm or 100 μ

2. Maximum resolution occurs in _____ wave length of the visible spectrum.

   Ans: 450 nm

3. If the wavelength of light is 450nm, θ = 70º and the image is viewed under oil immersion, sin α = 0.94 then the resolving power of the microscope here is _____.

   Ans: 191.48

4. The 'n' value for air is _____.

   Ans: 1.0

5. Separation of defracted waves from the direct waves in a phase contrast microscope occurs by _____.

   Ans: Annular diaphragm

6. Fluorescent molecules are called _____.

   Ans: Fluorophores

7. _____ in a fluorescent microscope helps to remove contaminating light from the arc lamps.

   Ans: Excitation filter

8. Unstained living organisms can be viewed by _____ microscope.

   Ans: Phase contrast

9. In a confocal microscope the out-of-focus light are removed by the use of _____.

   Ans: Pin hole aperture

10. In a dark field microscope typically a _____ type condenser is used.

    Ans: Dark field (parabolic/special)

(ii) MCQ — Microscopy

1. What is the main principle of a phase contrast microscope?

   (a) Bright field illumination (b) Interference of light waves (c) Differential staining (d) Fluorescence

   Ans: (b)

2. Who is credited with the discovery of phase contrast microscope?

   (a) Robert Hooke (b) A.V. Leeuwenhoek (c) Ernst Abbe (d) Frits Zernike

   Ans: (d)

3. Fluorescence microscopy is used to detect

   (a) Scattered light (b) Absorbed light (c) Emitted light from fluorescent molecules (d) Phase shifts in light waves

   Ans: (c)

4. What type of condenser is typically used in a dark field microscope?

(a) Bright field condenser (b) Phase contrast condenser (c) Dark field condenser (d) Fluorescent condenser

Ans: (c)

5. Which component of a confocal microscope is responsible for scanning the specimen?

(a) Pin hole aperture (b) Objective lens (c) Laser (d) Scanning mirror

Ans: (d)

(iii) Fill in the Blanks — Non-optical Microscopes & Flow Cytometry

1. The process of change of water from liquid to a solid state without intermediate ice formation is known as _____.

Ans: Vitrification

2. The process of metal coating on the specimen for increasing contrast for EM viewing is called _____.

Ans: Sputter coating

3. The vacuum sublimation of ice from sample is called _____.

Ans: Freeze drying

4. The magnification in a SEM is given by _____.

Ans: Length of display / length of the sample

5. The machine by which metal coating is done is called _____.

Ans: Sputter coater

6. The temperature at particular pressure at which a fluid and its overlaying vapour will become indistinguishable is called _____.

Ans: Critical point of drying

(iv) Expand the Terms

1. Expand the terms: LaB_6

Ans: Lanthanum hexaboride

2. Expand the terms: HMDS

Ans: Hexamethyl disilazane, a drying agent

3. Expand the terms: FACS

Ans: Fluorescence Activated Cell Sorting

(v) MCQ — Non-optical Microscopes & Flow Cytometry

1. Which of the following is not an embedding material for sample preparation for electron microscopy?

(a) Acetone (b) Epon 812 (c) Methacrylate (d) Araldite 502

Ans: (a)

2. Critical point of water is

(a) 241ºC at 60.8 bar (b) 374ºC at 228.4 bar (c) 31ºC at 73.8 bar (d) 300ºC at 220.2 bar

Ans: (c)

3. Which metal is not used for sputter coating during sample preparation for SEM?

(a) Gold (b) Platinum (c) Tungsten (d) Chromium

Ans: (c)

4. The first type of electron microscope discovered by Knoll and Ruska was

(a) TEM (b) SEM (c) STMS (d) AFMS

Ans: (a)

5. Which of the following light is used for detecting the size of the particle in flow cytometry?

(a) Side scatter (b) Forward scatter (c) Fluorescence emission (d) None of the above

Ans: (b)

6. Granularity of cell is detected by

(a) Side scatter (b) Forward scatter (c) Fluorescence emission (d) Both a & b

Ans: (a)

Section B — Very Short Answer Questions (2–3 sentences)

Microscopy

1. What do you mean by microscopy and a microscope?
2. What is optical microscopy?
3. What are non-optical microscopes?
4. Name different types of optical microscopes
5. Name some non-optical microscopes
6. What is magnifying power of a microscope?
7. What is resolving power of a microscope?
8. State Abbe's equation.
9. What is a dark field microscope?
10. What is positive and negative interference in a phase contrast microscope?
11. What do you mean by fluorescence and fluorophore?
12. What is empty magnification?

Non-optical Microscopes & Flow Cytometry

1. Name important types of electron microscopes.
2. Write the components of a Transmission Electron Microscope.
3. Write the components of a SEM.
4. Write the applications of TEM.
5. Write the applications of SEM.
6. Write the function of electromagnetic condensers in EMs.
7. What is Wehnelts Cap?
8. Name the chemicals used for fixation of samples for EMs.
9. What is plunge freezing?
10. What is shadow casting?
11. Which metals are used for coating in SEM?
12. What is bright field imaging in TEM?
13. What is vapour fixation?
14. What is chemical drying?
15. What is freeze etching?

16. What is freeze fracture?
17. Write two disadvantages of TEM.
18. Write two disadvantages of SEM.
19. What is the magnification in SEM?
20. How contrast in image is increased in SEM?
21. What is a sputter coater?
22. Define chromosome painting.
23. What are the non-isotopic agents used for colouring the probes?
24. Write any two applications of FISH.

Section C — Short Notes (5 Marks)

Microscopy

1. Abbe's equation
2. Advantages of dark field microscope
3. Principles of phase contrast microscope
4. Application of phase contrast microscope
5. Dichroic mirror
6. Sample preparation for fluorescence microscopy
7. Applications of fluorescence microscopy
8. Write two functions of barrier filter in a fluorescent microscope.

Non-optical Microscopes & Flow Cytometry

1. Principles in electron microscopy.
2. Difference between TEM and SEM.
3. Source of electron in electron microscope.
4. Applications of SEM
5. Disadvantages of a biological sample
6. Cryofixation to be viewed in an electron microscope.
7. High pressure freezing
8. Negative staining
9. Positive staining
10. Shadow casting
11. Embedding
12. Chemical fixation
13. Critical point drying (CPD)
14. Freeze drying
15. Freeze fracture
16. Freeze etching
17. Magnification in SEM
18. Scanning Tunnelling Microscope

19. Flow Cytometry
20. FACS.
21. Chromosome painting
22. Applications of FISH

Section D — Long / Essay-type Questions (8 Marks)

Microscopy

1. What is a bright field microscope? Describe the working principle, advantage, limitations and uses of bright field microscopes.
2. Name some important light microscopes. Describe any one type with its principle, uses, advantages, and limitations.
3. Give a comparative account of bright field and dark field microscope.
4. What do you mean by phase contrast? Give an account of phase contrast microscope.
5. Give an account of a fluorescence microscope and its uses.
6. Discuss the principle of imaging in fluorescence microscopy and its applications.
7. Give an account of confocal microscopy.
8. Write short notes on Types of microscope. (essay form)
9. Write short notes on Magnification of a microscope. (essay form)
10. Write short notes on Resolution power of a microscope. (essay form)

Non-optical Microscopes & Flow Cytometry

1. Give an account of the basic principles of electron microscopy.
2. Write the different components of an electron microscope.
3. Give an account of a transmission electron microscope.
4. Give an account of a scanning electron microscope.
5. Describe biological sample preparation steps for viewing in TEM.
6. Discuss the steps of preparation of biological samples for viewing in a SEM.
7. Give an account of imaging principles of TEM and SEM.
8. What do you mean by freeze fracture technique. Discuss.
9. Discuss different drying techniques used during SEM sample preparation.
10. Give an account of fixation of samples for electron microscope viewing.
11. What is flow cytometry? Give an elaborate account of it.
12. What is the principle of flow cytometry? Discuss its application.
13. What do you mean by FISH? Describe the procedure and its applications.
14. Give an account of chromosome painting.

UNIT II — Cell Fractionation: Centrifugation & Radioisotopes

(Covers Chapter 3: Cell Fractionation – Centrifugation and Chapter 4: Radioisotopes)

Section A — Fill in the Blanks & Multiple Choice Questions

(i) Fill in the Blanks — Centrifugation

1. The process of disruption of suspended cells is known as _____.

   Ans: Cell fractionation

2. A suspension of cell organelle and other constituents after the cell disruption is known as _____.

   Ans: Homogenate

3. One Svedberg's unit (S) is equal to _____.

   Ans: 10^{-13} s

4. The maximum rpm of a standard Ultracentrifuge is _____.

   Ans: 65,000 rpm

5. In rate-zonal centrifugation particles are separated basing on _____. (a) size of the particles (b) both size and shape (c) only on shape (d) shape and density

   Ans: (c) only on shape

6. Separation of particles in isopycnic centrifugation is based on _____. (a) size of particles (b) shape of particles (c) density of particles (d) density and shape

   Ans: (c) density of particles

7. The particles in isopycnic centrifugation sediment till they reach the gradient zone _____. (a) greater than their density (b) lesser than their density (c) equal to their density (d) at any density

   Ans: (c) equal to their density

8. The marker enzyme of mitochondrial matrix is _____.

   Ans: Citrate synthetase

9. Catalase is the marker enzyme of _____.

   Ans: Peroxisome

10. High activity of amylase helps in diagnosis of _____.

    Ans: Acute pancreatitis

(ii) MCQ — Centrifugation

1. In rate zonal centrifugation, how are the particles arranged after centrifugation?

   (a) By charge (b) By molecular shape (c) By sedimentation rate (d) By temperature

   Ans: (c)

2. Which type of centrifugation allows for separation of particles purely based on their density?

   (a) Zonal centrifugation (b) Differential centrifugation (c) Rate-zonal centrifugation (d) Isopycnic centrifugation

   Ans: (d)

3. Which of the following type of centrifugation is used to determine the molecular weight of proteins?

   (a) Preparative centrifugation (b) Ultra centrifugation (c) Differential centrifugation (d) Isopycnic centrifugation

Ans: (b)

4. Which type of centrifugation is used for separating cellular organelles?

   (a) Differential centrifugation (b) Density gradient centrifugation (c) Analytical centrifugation (d) Ultracentrifugation

   Ans: (a)

5. Which of the following is a correct matching between Column A (1. Mitochondria matrix 2. Aldolase 3. Amylase 4. Mitochondrial inner membrane) and Column B (1. ATP synthetase 2. Acute pancreatitis 3. Muscular dystrophies 4. Citrate synthetase)?

   (a) 1-2,2-1,3-4,4-3 (b) 1-4,2-3,3-2,4-1 (c) 1-3,2-4,3-1,4-2 (d) 1-4,2-1,3-1,4-2

   Ans: (b)

(iii) Fill in the Blanks — Radioisotopes

1. In an atom of a non-radioactive element the number of electrons is 8 and the number of neutrons is 10. Then the atomic mass and atomic number of this element is _____ and _____ respectively.

   Ans: 18, 8

2. N : P ratio in a stable nucleus with small number of protons should be _____.

   Ans: 1:1

3. Elements having same atomic number but different atomic masses are called _____.

   Ans: Isotopes

4. Uranium is an example of _____ radionuclides.

   Ans: Primordial

5. When a radioisotope is going on releasing energy, then the radioisotope is under the process of _____.

   Ans: Decay / radioactive decay

6. Ra → _____ + He^{+2}.

   Ans: Rn (Radon)

7. During beta radiation the atomic number increases by one and particles are emitted with high speed electrons known as _____.

   Ans: Negatron

8. The positively charged beta particles are known as _____.

   Ans: Positron

9. In two days 20 gm of a radioactive element 'X' is converted to 10 gm of X and 10 gm of another element 'Y'. Then the half life of the element 'X' is _____.

   Ans: 2 days

10. 20 gm of Barium 139 is under the process of radioactive decay. If the half life is 90 minutes, then what amount of Barium 139 is left out after a period of 3 hr? (a) 5 gm (b) 10 gm (c) 2.5 gm (d) 0 gm

    Ans: (a) 5 gm

11. _____ isotope of Nitrogen was used by Messelson and Stahl in their experiment to find out the semi conservative method of DNA replication.

    Ans: N^{15}

12. In the pulse chase experiment, the radioactive element is introduced into the process at _____ phase of the process.

Ans: Pulse

(iv) MCQ — Radioisotopes

1. Which of the following is the main application of autoradiography?

(a) Identifying specific proteins in cell membrane (b) Tracking radioactive molecules in biological reactions (c) Analyzing DNA sequences (d) Their reactivity with organic compounds

Ans: (b)

2. In autoradiography what is used to visualize the distribution of radioactive materials in a sample?

(a) X-Ray film (b) UV light (c) Fluorescent dye (d) Spectrophotometer

Ans: (a)

3. What is the purpose of pulse phase in a pulse-chase experiment?

(a) To label a molecule temporarily with a radioactive isotope (b) To stop the process being studied (c) To eliminate non-radioactive isotopes from the sample (d) To fix cells for microscopic observation

Ans: (a)

4. What happens during the chase phase of the experiment?

(a) Cells are exposed to high energy radiations (b) Radioactive molecules are followed as they are processed or degraded (c) The entire cell structure is destroyed (d) The radioactive label is replaced with a non-radioactive one

Ans: (b)

5. Which property of the radioisotopes makes them useful in biological research?

(a) Their ability to fluoresce under UV light (b) Their instability which allows their easy detection (c) Their high binding affinity to more compounds (d) Their non reactivity with organic compounds

Ans: (b)

Section B — Very Short Answer Questions (2–3 sentences)

Centrifugation

1. What is cell fractionation?
2. State the relationship between centrifugal field, radius of the rotor and rpm.
3. Write the factors affecting sedimentation.
4. What is Svedberg's unit?
5. What is sedimentation rate?
6. What is the rpm of ultra centrifuge and high speed centrifuge?
7. What is preparative centrifugation?
8. Distinguish between differential centrifugation and density gradient centrifugation.
9. Write the advantages of sucrose use in density gradient centrifugation.
10. Name marker enzymes of peroxisome, microsomes, golgi bodies.

Radioisotopes

1. What are radioisotopes?
2. What is atomic number and atomic mass?
3. What are primordial radionuclides?
4. What are cosmogenic radionuclides?
5. What is radioactive decay?

6. Write two properties of alpha radiations.
7. Write two properties of beta radiations.
8. What are positrons and negatrons?
9. What do you mean by electron capture?
10. What is the difference between positron emission and electron capture?
11. What is half-life of an isotope?
12. Write two uses of ^{14}C isotopes in biology.
13. What are uses of isotopes in agriculture?
14. Name the radioisotopes used for different clinical diagnosis.
15. Define autoradiography.
16. What is pulse-chase experiment?
17. Name two important pulse-chase experiments in understanding molecular biology.

Section C — Short Notes (5 Marks)

Centrifugation

1. Theory of sedimentation
2. Svedberg's unit
3. Rotor
4. Types of rotors
5. Applications of centrifuge
6. Ultra centrifuge
7. Preparative ultra centrifuge
8. Application of density gradient centrifugation
9. Rate-zonal centrifugation
10. Isopycnic centrifugation (or equilibrium density gradient centrifugation)
11. Sucrose density gradient
12. CsCl density gradient
13. Marker enzymes.

Radioisotopes

1. Radionuclides
2. Radioactivity
3. Beta radiations
4. Alpha radiations
5. Gamma rays
6. Electron capture
7. Types of radionuclides
8. K-cell capture
9. Auger Effect
10. Nuclear decay

11. Half-life
12. Carbon dating
13. Radionuclide therapy
14. Radio-immuno assay
15. Autoradiography
16. Applications of autoradiography
17. Pulse-chase experiment
18. Applications of pulse-chase experiment

Section D — Long / Essay-type Questions (8 Marks)

Centrifugation

1. What is cell fractionation and centrifugation? Discuss the basic principle of centrifugation.
2. Give an account of the structure and types of Centrifuges.
3. Give an account of differential centrifugation and its application.
4. Give an account of density gradient centrifugation process and its application.
5. Give an elaborate account of rate-zonal and isopycnic centrifugation and their relative advantages and disadvantages.
6. Describe sucrose density gradient and cesium chloride density gradient centrifugation.

Radioisotopes

1. Explain the radioisotopes and radioactivity.
2. Give an account of radiation emitted by radioactivity.
3. Give an elaborate account of various uses of radioisotopes.
4. Discuss the uses of radioisotopes in biological research.
5. What do you mean by autoradiography? Discuss the principles, methods and its applications.

UNIT III — Spectrophotometry

(Covers Chapter 5: Spectrophotometry)

Section A — Fill in the Blanks & Multiple Choice Questions

(i) Fill in the Blanks

1. The unit of molar extinction coefficient is _____ when the length is measured in cm.
   Ans: $L.mol^{-1}.cm^{-1}$
2. IR spectrophotometer uses the light wave length range _____.
   Ans: 700–1500 nm
3. In a spectrophotometer the desired wavelength of light is selected by a component called _____.
   Ans: Monochromator
4. If the thickness of the cuvette is 1cm, then the relationship between absorbance and optical density is given by the equation _____.
   Ans: A = 2 − log T (Absorbance = Optical Density)
5. In atomic absorption spectroscopy, the element to be analyzed is typically introduced in the form of a _____.
   Ans: Vapour
6. In IR spectroscopy, the vibrational frequency of a bond is typically related to its bond strength and _____.
   Ans: Mass of the atoms
7. A flame photometer is mainly used to determine _____ in biological samples.
   Ans: Sodium and Potassium
8. A bomb calorimeter is used to measure the _____ of a sample.
   Ans: Heat of combustion
9. Chlorophyll a fluorescence is commonly used to assess the efficiency of _____ in photosynthesis.
   Ans: Photosystem II

(ii) MCQ

1. The relationship between absorbance (A) and transmittance (T) is given by the equation
   (a) A − 2 = log T (b) A − log T = 2 (c) A = 2 − log T (d) T = 2 − log A
   Ans: (c)
2. Which of the following regions of IR spectrum is most useful for identifying functional groups?
   (a) 4000-1400 cm^{-1} (b) 1400-900 cm^{-1} (c) 900-600 cm^{-1} (d) 400-200 cm^{-1}
   Ans: (a)
3. In atomic absorption spectroscopy which of the following is used as the radiation source?
   (a) Tungsten filament (b) Deuterium lamp (c) Hollow cathode lamp (d) Mercury vapor lamp
   Ans: (c)
4. What type of flame is typically used in a flame photometer?
   (a) Methane-Oxygen flame (b) Hydrogen-Oxygen flame (c) Acetylene-air flame (d) Propane-air flame
   Ans: (d)
5. In a bomb calorimeter, the sample is burned in the presence of which gas?

(a) Nitrogen (b) Oxygen (c) Carbon dioxide (d) Helium

Ans: (b)

6. The parameter Fv/Fm in Chl a fluorescence analysis indicates

(a) the maximum quantum efficiency of PS I (b) The maximum quantum efficiency of PS II (c) The minimum quantum efficiency of PS I (d) The maximum photochemical quenching

Ans: (b)

Section B — Very Short Answer Questions (2–3 sentences)

1. What is spectrophotometry?
2. What is optical density?
3. What is absorbance?
4. How absorbance is related to transmittance?
5. What is the formula derived for Beer-Lambert's law?
6. Draw a graph to explain the relation between concentration of a sample with absorbance and transmittance.
7. Name the components of a spectrophotometer.
8. What is UV-vis spectrophotometer?
9. Write the uses of spectrophotometer in agriculture.
10. Write the uses of spectrophotometer in microbiological studies.
11. What are the three zones of infra-red radiation and what are their wavelengths?
12. What is a dipole?
13. What are the components of a flame photometer?
14. What do you mean by Chl a fluorescence?
15. Write two advantages of a flame photometer.
16. What are the basic differences amongst visible spectrum spectrometer, IR spectrophotometer, flame spectrometer and atomic absorption spectrophotometer?

Section C — Short Notes (5 Marks)

1. Beer's law of absorption of light.
2. Lambert's law of absorption of light.
3. State Beer-Lambert's law of absorption of light.
4. Derive the relation between absorbance and transmittance.
5. Monochromator
6. Single beam spectrophotometer
7. Double beam spectrophotometer
8. Collimator
9. Optical density
10. Applications of spectrophotometry in clinical medicine.
11. Applications of spectrophotometry in biological research.
12. Infra-red
13. Applications of IR spectroscopy.
14. How to measure Chl a fluorescence?

15. Applications of flame photometer.
16. Uses of bomb calorimeter.

Section D — Long / Essay-type Questions (8 Marks)

1. Discuss the principles of spectrophotometry.
2. State and explain Beer-Lambert's law and its application in spectrophotometry.
3. Give an account of the structural components of a standard spectrophotometer and discuss the principles on which it works.
4. Give an account of the different applications of spectrophotometry.
5. Discuss the principle of IR spectroscopy.
6. Describe the structure of standard spectrophotometer.
7. Discuss the application of Chlorophyll a fluorescence.
8. Describe the principle of flame photometer.
9. Describe the structure of a bomb calorimeter.
10. Discuss the functioning of a bomb calorimeter.
11. Describe the structure and application of atomic absorption spectrophotometer.

UNIT IV — Chromatography & Characterization of Proteins and Nucleic Acids

(Covers Chapter 6: Chromatography and Chapter 7: Characterization of Proteins and Nucleic Acids)

Section A — Fill in the Blanks & Multiple Choice Questions

(i) MCQ — Chromatography

1. In size exclusion chromatography which is true

   (a) Larger molecules elute first (b) Small molecules elute later (c) Small molecules elute first (d) both (a) and (b)

   Ans: (a)

2. Ninhydrin is used to detect _____ in the paper chromatography.

   (a) Sugar (b) Proteins (c) Amino acids (d) All

   Ans: (c)

3. Generally the column used in column chromatography has the diameter to length ratio of

   (a) 1 : 10 (b) 2 : 10 (c) 1 : 200 (d) 1 : 50

   Ans: (a)

4. Sephadex contains

   (a) Agarose (b) Polyacrylamide (c) Cross linked dextrans (d) Polystyrenes

   Ans: (c)

5. Spacer arm in affinity chromatography

   (a) Facilitates efficient binding (b) Inhibits hydrocarbon chain between agarose bead and target molecules (c) Facilitates steric interference during the binding process of the target molecules to the ligand (d) Both (a) and (b)

   Ans: (d)

Section B — Very Short Answer Questions (2–3 sentences)

Chromatography

1. What is chromatography?
2. What do you mean by elution and eluate?
3. What is a spacer arm?
4. What do you mean by ligand?
5. What is distribution coefficient?
6. What is positive ion exchanger?
7. What is a negative ion exchanger?
8. Name the different types of mobile phase?
9. Name the different types of detectors used in different column chromatographic methods.
10. What do you mean by ascending chromatography?
11. Define Rf.
12. What is a stationary phase?
13. What is a carrier gas?

Characterization of Proteins & Nucleic Acids

1. What is characterization of proteins?
2. In one sentence write the basis of mass spectrometers.
3. What are molecular ions?
4. What is a negative ion?
5. What are metastable ions?
6. What is faraday's cup?
7. What do you mean by base peak?
8. What is a stick diagram?
9. What is soft X-rays?
10. Write Bragg's law.
11. What is the function of collimator?
12. What are the uses of XRC?
13. What are the advantages of PAGE over AGE.
14. What is the role of SDS in SDS-PAGE?
15. What do you mean by a discontinuous system of electrophoresis?
16. What is stacking gel?
17. What is the buffer requirement in stacking gel?
18. What is resolving gel?
19. What is the basis of protein resolution in resolving gel?
20. Write advantages of SDS-PAGE.
21. Write advantages of SDS-PAGE over native PAGE.

Section C — Short Notes (5 Marks)

Chromatography

1. Partition chromatography
2. Ion exchange chromatography
3. Affinity chromatography
4. Size exclusion chromatography
5. Preparative chromatography
6. Analytical chromatography
7. Relative flow (or retardation factor)
8. Advantages of TLC
9. Preparation of column in column chromatography
10. Open tubular columns.
11. Advantages of GLC
12. Application of HPLC
13. Ion exchangers

14. Distribution coefficient
15. Ligands in Affinity chromatography.

Characterization of Proteins & Nucleic Acids

1. Electron impact ionization
2. Chemical ionization
3. MALDI
4. APCI
5. Time of flight mass analyzer.
6. Electron multiplier
7. Photo multiplier
8. Mass spectrum
9. Laue's method of XRD
10. Bragg's X-ray spectrometer
11. Powder crystal method
12. Application of XRD
13. X-ray crystallography
14. Agarose

Section D — Long / Essay-type Questions (8 Marks)

Chromatography

1. What do you mean by chromatography? Briefly write on different types of chromatographic methods.
2. Give an account of paper chromatography.
3. Describe the technique of thin layer chromatography with its applications.
4. What do you mean by column chromatography? Give a detailed account of column chromatographic technique.
5. Give an account of gas liquid chromatography.
6. Describe the technique, application and advantages of HPLC.
7. What is ion exchange chromatography? Describe the method and its applications.
8. What do you mean by molecular exclusion chromatography? Describe the method and its advantages and application.
9. Give an account of affinity chromatography.
10. Describe the various principles used in chromatographic separation of different types of components from the sample.

Characterization of Proteins & Nucleic Acids

1. Give an account of the basic principles of mass spectrometry. Briefly describe the components of a mass spectrometer.
2. Give an account of different ionization process used in a mass spectrometer.
3. What is a mass analyzer? Discuss any two types of mass analyzer used in mass spectrometer.
4. Give a brief account of the different types of detectors used in the mass spectrometer.
5. What is a mass spectrum? Explain how inference is drawn from this.
6. Give an account of various applications of mass spectrometers.

7. What do you mean by X-ray diffraction and X-ray crystallography? Explain the principle of X-ray diffraction.
8. Discuss the various components of a X-ray diffraction instrument.
9. Give an account of various methods of X-ray diffraction.
10. Describe the principle and application of X-ray crystallography.
11. What is electrophoresis? Explain the basic principle of electrophoresis.
12. Give an account of a standard electrophoresis instrument.
13. Describe the Agarose gel Electrophoresis (AGE).
14. Describe the native PAGE.
15. Describe SDS-PAGE protocol in brief.
16. Explain the mechanism of electrophoresis in a discontinuous system of SDS-PAGE.
17. Give an account of polyacrylamide and SDS.