Very Similar Test (VST) Sets 1–5

DINAKRUSHNA COLLEGE, JALESWAR, BALASORE, ODISHA

DEPARTMENT OF BOTANY

UG 1st SEMESTER (HONOURS) — CORE 1, PAPER – MAJOR II (BOTANY)

ANALYTICAL TECHNIQUES IN PLANT SCIENCES

Full Marks: 100 **Time: 3 hours · Answer all questions**

Section A — Fill in the blanks, 1 × 10 = 10 marks

Section B — Short answer questions, 2 × 9 = 18 marks

Section C — Notes (answer any eight of nine), 5 × 8 = 40 marks

Section D — Essay-type answers (answer any four of five), 8 × 4 = 32 marks

DINAKRUSHNA COLLEGE, JALESWAR

VST – 1

Botany

Class – UG 1st Semester **Paper – Core1 Major- II**

Full Marks : 100 **Time : 3 hours**

Answer all questions

The figures in the right-hand margin indicate marks

SECTION – A

1. Answer the following: ***1 × 10***

(a) _____ is the phenomenon in which a molecule absorbs light of one wavelength and re-emits it at a longer wavelength.

(b) The Scanning Electron Microscope produces images using a beam of _____ scanned across the specimen surface.

(c) _____ is the sample preparation technique in which frozen tissue is fractured to expose internal membrane surfaces.

(d) In isopycnic density gradient centrifugation, _____ is commonly used to separate nucleic acids by buoyant density.

(e) The unit of sedimentation coefficient is named after _____.

(f) _____ chromatography separates biomolecules on the basis of molecular size using a porous gel matrix.

(g) In SDS-PAGE, proteins migrate through the gel strictly according to their _____.

(h) _____ Law states that absorbance is directly proportional to the concentration of the absorbing species and the path length.

(i) _____ is the technique used to localise radioactively labelled molecules in a tissue section using a photographic emulsion.

(j) A _____ photometer is used to estimate alkali and alkaline-earth metals such as sodium and potassium in biological samples.

SECTION – B

2. Answer the following questions : ***2 × 9***

(a) What is negative staining used for in electron microscopy?

(b) Distinguish between differential centrifugation and density gradient centrifugation.

(c) What is a pulse-chase experiment?

(d) Define resolving power of a microscope.

(e) What is the principle of flow cytometry?

(f) What is Rf value in paper chromatography?

(g) What is the role of SDS in SDS-PAGE?

(h) Define optical density.

(i) What is the principle of ion-exchange chromatography?

SECTION – C

3. Write notes on any eight of the following: ***5 × 8***

(a) Shadow casting technique in electron microscopy

(b) Sucrose density gradient centrifugation

(c) Fluorescence microscopy

(d) Autoradiography

(e) Atomic Absorption Spectrophotometer

(f) HPLC

(g) Affinity chromatography

(h) PAGE (Polyacrylamide Gel Electrophoresis)

(i) Bomb calorimeter

SECTION – D

4. Answer any four of the following: ***8 × 4***

(a) Describe the principle, working and applications of the Scanning Electron Microscope.

(b) Explain the principle of ultracentrifugation and describe its applications in biomolecule separation.

(c) Discuss the principle, components and working mechanism of UV-Visible spectroscopy.

(d) Give an account of column chromatography with its applications in separating biomolecules.

(e) Describe the principle of Agarose Gel Electrophoresis (AGE) and its application in nucleic acid analysis.

DINAKRUSHNA COLLEGE, JALESWAR

VST – 2

Botany

Class – UG 1st Semester **Paper – Core1 Major- II**

Full Marks : 100 **Time : 3 hours**

Answer all questions

The figures in the right-hand margin indicate marks

SECTION – A

1. Answer the following : ***1 × 10***

(a) The _____ microscope uses a beam of electrons focused by electromagnetic lenses to form a magnified image of ultra-thin specimens.

(b) _____ is the technique of coating a specimen with a thin layer of heavy metal at an angle to reveal its surface topography under TEM.

(c) In centrifugation, the _____ rotor holds tubes at a fixed angle to the axis of rotation.

(d) Radioactive isotopes such as ^{35}S or ^{14}C are commonly used as _____ in pulse-chase experiments.

(e) _____ spectroscopy measures the vibrational and bending motions of chemical bonds using radiation in the 4000–400 cm^{-1} range.

(f) Chlorophyll a shows a characteristic fluorescence emission in the _____ region of the visible spectrum.

(g) _____ is the solvent (mobile phase) pumped at high pressure through a packed column in HPLC.

(h) _____ is the anionic detergent that imparts a uniform negative charge to proteins in SDS-PAGE.

(i) _____ chromatography separates charged molecules based on their interaction with a charged resin.

(j) The full form of AGE is _____.

SECTION – B

2. Answer the following questions : ***2 × 9***

(a) What is cryofixation?

(b) What is the function of a monochromator in a spectrophotometer?

(c) What is the principle of TLC?

(d) Define half-life of a radioactive isotope.

(e) What is the difference between AGE and PAGE?

(f) What is the working principle of flame photometry?

(g) What is meant by stationary phase and mobile phase in chromatography?

(h) What is the application of mass spectrometry in protein analysis?

(i) What is a marker enzyme? Give one example.

SECTION – C

3. Write notes on any eight of the following : ***5 × 8***

(a) Freeze etching technique

(b) $CsCl_2$ density gradient centrifugation

(c) Flow cytometry (FACS)

(d) Radioisotopes in biological research

(e) Fluorescence spectroscopy

(f) Paper chromatography

(g) Molecular sieve chromatography

(h) X-ray diffraction

(i) Critical point drying

SECTION – D

4. Answer any four of the following : ***8 × 4***

(a) Give an account of the Transmission Electron Microscope and its applications in plant cell biology.

(b) Describe the principle of density gradient centrifugation and explain its use in cell fractionation.

(c) Explain the principle and applications of fluorescence spectroscopy.

(d) Discuss the principle and working of HPLC and its advantages over conventional column chromatography.

(e) Describe SDS-PAGE and explain how it is used to determine the molecular weight of proteins.

DINAKRUSHNA COLLEGE, JALESWAR

VST – 3

Botany

Class – UG 1st Semester **Paper – Core1 Major- II**

Full Marks : 100 **Time : 3 hours**

Answer all questions

The figures in the right-hand margin indicate marks

SECTION – A

1. Answer the following: ***1 × 10***

(a) _____ microscopy uses specialised optics to enhance contrast in unstained living cells.

(b) The resolving power of the unaided human eye is approximately _____.

(c) _____ is the process by which sub-cellular organelles are separated on the basis of size and density using differential centrifugation.

(d) In analytical ultracentrifugation, sedimentation is monitored in _____ time using optical systems.

(e) A _____ calorimeter measures the total heat of combustion of a biological sample.

(f) _____ is the marker enzyme commonly used to identify peroxisomes during cell fractionation.

(g) _____ chromatography uses silica gel or alumina coated on a glass or plastic plate as the stationary phase.

(h) The positively charged particles emitted during radioactive beta decay are known as _____.

(i) _____ is used to visualise DNA fragments separated by agarose gel electrophoresis under UV light.

(j) _____ is the technique that uses the diffraction pattern of X-rays to determine the three-dimensional structure of crystallised macromolecules.

SECTION – B

2. Answer the following questions : ***2 × 9***

(a) What is the principle of TEM?

(b) What is negative staining? How does it differ from shadow casting?

(c) Define ultracentrifugation.

(d) What is the significance of the pulse-chase technique in tracing metabolic pathways?

(e) What is optical density and how is it measured?

(f) What is the working principle of an Atomic Absorption Spectrophotometer?

(g) What is affinity chromatography? Give one example of its use.

(h) Distinguish between paper chromatography and column chromatography.

(i) What is the role of ninhydrin in paper chromatography?

SECTION – C

3. Write notes on any eight of the following : ***5 × 8***

(a) Negative staining

(b) Ultracentrifugation

(c) Chlorophyll a fluorescence

(d) Ion-exchange chromatography

(e) Autoradiography

(f) IR spectroscopy

(g) Molecular sieve chromatography

(h) Mass spectrometry

(i) Cryofixation

SECTION – D

4. Answer any four of the following : ***8 × 4***

(a) Give an essay on the principle, sample preparation and applications of Scanning Electron Microscopy.

(b) Explain the principle of sucrose density gradient centrifugation and its role in separating cell organelles.

(c) Describe the principle and biological applications of autoradiography.

(d) Give an account of ion-exchange chromatography with its applications in biomolecule purification.

(e) Describe the principle, procedure and applications of SDS-PAGE in protein characterisation.

DINAKRUSHNA COLLEGE, JALESWAR

VST – 4

Botany

Class – UG 1st Semester **Paper – Core1 Major- II**

Full Marks : 100 **Time : 3 hours**

Answer all questions

The figures in the right-hand margin indicate marks

1. Answer the following: ***1 × 10***

(a) _____ microscopy uses fluorochromes and specific wavelengths of light to visualise labelled cellular structures.

(b) _____ is the technique of rapidly freezing a specimen without ice-crystal formation, often using liquid nitrogen or propane.

(c) The maximum speed attainable by an ultracentrifuge is expressed in _____.

(d) _____ is a radioactive tracer technique in which cells are briefly exposed to a labelled precursor and then "chased" with an unlabelled one.

(e) A/An _____ spectrophotometer estimates the concentration of an element by measuring the absorption of light by free atoms in a flame.

(f) The full form of PAGE is _____.

(g) _____ is a polymer of galactose used as the gel matrix for agarose gel electrophoresis.

(h) Gas chromatography, often coupled with a mass spectrometer, separates _____ compounds based on their affinity for a stationary phase inside a column.

(i) _____ is the phenomenon used in X-ray diffraction studies to determine molecular structure from the scattering pattern of a crystal.

(j) The _____ lens of a compound microscope gathers and focuses light rays coming from the specimen.

SECTION – B

2. Answer the following questions: ***2 × 9***

(a) What is the freeze fracture technique?

(b) Define sedimentation coefficient.

(c) What is the difference between differential and density gradient centrifugation?

(d) What is the principle of fluorescence spectroscopy?

(e) What is a bomb calorimeter used for?

(f) What is the principle of gel filtration (molecular sieve) chromatography?

(g) What is the significance of Rf value in identifying compounds in chromatography?

(h) What is X-ray crystallography used for in biomolecule characterisation?

(i) What is the role of a photomultiplier tube in a spectrophotometer?

SECTION – C

3. Write notes on any eight of the following: ***5 × 8***

(a) Shadow casting

(b) $CsCl_2$ gradient centrifugation

(c) Flow cytometry

(d) Flame photometer

(e) Column chromatography

(f) Affinity chromatography

(g) Agarose Gel Electrophoresis (AGE)

(h) Radioisotopes in biological research

(i) Freeze etching

SECTION – D

4. Answer any four of the following: ***8 × 4***

(a) Describe the principle and working mechanism of fluorescence microscopy with its applications in cell biology.

(b) Explain the principle of density gradient centrifugation and describe the isopycnic ($CsCl_2$) method.

(c) Discuss the principle, components and applications of IR spectroscopy.

(d) Give an account of affinity chromatography and its use in protein purification.

(e) Describe the principle and procedure of paper chromatography with its applications.

DINAKRUSHNA COLLEGE, JALESWAR

VST – 5

Botany

Class – UG 1st Semester **Paper – Core1 Major- II**

Full Marks : 100 **Time : 3 hours**

Answer all questions

The figures in the right-hand margin indicate marks

SECTION – A

1. Answer the following: ***1 × 10***

(a) _____ is the minimum distance by which two points can be separated and still be seen as distinct under a microscope.

(b) The first electron microscope was developed by _____.

(c) _____ centrifugation separates particles purely on the basis of size and mass by sequential increases in centrifugal force.

(d) _____ isotopes are unstable atoms that decay while emitting radiation, and are used as tracers in biological research.

(e) The _____ is the (SI-independent) unit expressing the sedimentation rate of a particle in a centrifugal field.

(f) _____ is a rapid method of drying biological specimens for SEM that avoids surface-tension damage.

(g) _____ spectroscopy is used to study molecules that emit light after excitation by radiation of a shorter wavelength.

(h) In electrophoresis, charged molecules migrate towards the electrode of _____ charge.

(i) _____ chromatography separates a mixture of amino acids or sugars on a paper strip by differential partition between two phases.

(j) _____ is the technique that combines chromatographic separation with mass-based detection of ionised molecules.

SECTION – B

2. Answer the following questions: ***2 × 9***

(a) What is the principle of scanning electron microscopy?

(b) Define cell fractionation.

(c) What is the significance of the $CsCl_2$ gradient in isolating nucleic acids?

(d) What is autoradiography used for?

(e) State Beer-Lambert's Law.

(f) What is the working principle of a flame photometer?

(g) What is the difference between TLC and HPLC?

(h) What is the role of the resolving gel and stacking gel in PAGE?

(i) What is X-ray diffraction used for in structural biology?

SECTION – C

3. Write notes on any eight of the following: ***5 × 8***

(a) Negative staining

(b) Analytical ultracentrifugation

(c) Pulse-chase experiment

(d) UV-Visible spectroscopy

(e) Bomb calorimeter

(f) TLC (Thin Layer Chromatography)

(g) SDS-PAGE

(h) Mass spectrometry

(i) Cryofixation

SECTION – D

4. Answer any four of the following: ***8 × 4***

(a) Give an account of the principle, sample preparation and applications of Transmission Electron Microscopy.

(b) Describe the principle and working of an ultracentrifuge, and explain its analytical and preparative applications.

(c) Explain the principle, working mechanism and applications of fluorescence spectroscopy, with reference to chlorophyll a fluorescence.

(d) Describe the principle and applications of HPLC in the separation and analysis of biomolecules.

(e) Give an essay on the principle and procedure of Agarose Gel Electrophoresis (AGE) and its role in nucleic acid analysis.

ANSWER KEY

Section – A (Fill in the Blanks) — All Sets

VST – 1

(a) Fluorescence
(b) electrons
(c) Freeze fracture
(d) Caesium chloride ($CsCl_2$)
(e) Svedberg
(f) Molecular sieve / Gel filtration
(g) molecular weight (size)
(h) Beer-Lambert's
(i) Autoradiography
(j) Flame

VST – 2

(a) Transmission electron
(b) Shadow casting
(c) fixed-angle
(d) tracers
(e) Infra-red (IR)
(f) red (~680 nm)
(g) eluent
(h) Sodium dodecyl sulphate
(i) Ion-exchange
(j) Agarose Gel Electrophoresis

VST – 3

(a) Phase contrast
(b) 0.1 mm (100 μm)
(c) Cell fractionation
(d) real
(e) bomb
(f) Catalase
(g) Thin Layer (TLC)
(h) positrons
(i) Ethidium bromide
(j) X-ray crystallography

VST – 4

(a) Fluorescence microscopy
(b) Cryofixation
(c) rpm (revolutions per minute)
(d) Pulse-chase experiment
(e) Atomic Absorption
(f) Polyacrylamide Gel Electrophoresis
(g) Agarose
(h) volatile
(i) Diffraction
(j) objective

VST – 5

(a) Resolving power (resolution)
(b) Ernst Ruska and Max Knoll
(c) Differential
(d) Radioactive
(e) Svedberg unit (S)
(f) Critical point drying
(g) Fluorescence
(h) opposite
(i) Paper
(j) Mass spectrometry (e.g. GC-MS / LC-MS)