



BRAINWARE UNIVERSITY

Term End Examination 2023-2024

Programme – M.Sc.(BT)-2022/M.Sc.(BT)-2023

Course Name – Optical Instrumentation

Course Code - MBTC104

(Semester I)

Full Marks : 60

Time : 2:30 Hours

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question)

1 x 15=15

1. Choose the correct alternative from the following :

- (i) What does the Franck-Condon principle describe in the context of molecular spectroscopy
 - a) The tendency of molecules to absorb light of specific wavelengths
 - b) The relationship between a molecule's electronic transitions and its vibrational motion
 - c) The emission of light when an excited molecule returns to its ground state
 - d) The scattering of light by molecules in the gas phase
- (ii) Which of the following is a common application of Polarization Microscopy?
 - a) Counting bacteria in a sample
 - b) Identifying elements in a mineral sample
 - c) Measuring the temperature of a liquid
 - d) Examining crystal structures in materials
- (iii) A boy uses spectacles of focal length -50 cm. Name the defect of the vision he is suffering from
 - a) Astigmatism
 - b) Hypermetropia
 - c) Myopia
 - d) Presbyopia
- (iv) Two lenses of focal lengths 5 cm and 50 cm are to be used for making a telescope. Interpret the lens that you will use for the objective?
 - a) Both
 - b) Neither
 - c) 5 cm
 - d) 50 cm
- (v) In a phase transition energy diagram, where is the potential energy typically the lowest
 - a) Reactants state
 - b) Products state
 - c) Transition state
 - d) Activation energy peak
- (vi) According to the Beer-Lambert Law, what is the relationship between the absorbance of a sample and its concentration
 - a) Absorbance is directly proportional to concentration
 - b) Absorbance is inversely proportional to concentration
 - c) Absorbance and concentration are unrelated
 - d) Absorbance increases exponentially with concentration

- (vii) Choose from following: In proton NMR spectroscopy, hydrogen bonding results in
- Shielding effect
 - De Shielding effect
 - Peak splitting
 - All of the above
- (viii) Compound A has greater shielding constant than compound B. Which of them will have more chemical shift?
- Compound A
 - Compound B
 - Both will have equal chemical shifts
 - Chemical shift has no relation with shielding constants
- (ix) Identify from following: Zeeman effect is
- Separation of charges in electrical field
 - Separation of charges in magnetic field
 - Decoupling of spinning nucleus
 - Separation of spin states in magnetic field
- (x) Identify the signal of proton that is interfered by adjacent ^{13}C nucleus is known as
- Homonuclear spin coupling
 - Heteronuclear spin coupling
 - Homonuclear shielding
 - Homonuclear shielding
- (xi) Which of the following is used in electron microscope?
- electron beams
 - magnetic fields
 - light waves
 - electron beams and magnetic fields
- (xii) Glutaraldehyde is a
- metal
 - fixative
 - Non metal
 - atomic species
- (xiii) In TEM, the tissue is stained by floating on drops of which one
- hydrocarbons
 - slow-molecular weight stains
 - heavy metal solutions
 - None
- (xiv) What is the purpose of the annular diaphragm in Phase Contrast Microscopy?
- To produce a hollow cone of light
 - To enhance fluorescence
 - To eliminate spherical aberration
 - To increase the working distance
- (xv) In DIC microscopy, what happens when light passes through regions of a specimen with varying refractive indices?
- Light intensity remains constant
 - Light is absorbed by the specimen
 - Light is phase-shifted and creates contrast
 - Light is reflected off the specimen

Group-B

(Short Answer Type Questions)

3 x 5=15

- Generalise the theory of Spin Energy of a magnetic field? (3)
- What is the central, positively charged particle in an atom. How many protons are there in carbon, oxygen and nitrogen. (3)
- Explain the meaning of HOMO and LUMO and describes what Chromophores are. (3)
- Draw a diagrammatic view of different kind of transition of antibonding, bonding and non bonding with sigma pi and n excitations. (3)
- Measure the experimental limitations of CD? (3)

OR

- Evaluate the difference between scanning electron microscopy and transmission electron microscopy. (3)

Group-C

(Long Answer Type Questions)

5 x 6=30

- What is meant by Stokes shift and anti stokes shift and stokes fluorescence? (5)
- Write the phenomenon of differential interface contrast (DIC) of microscopy. (5)
- Compare and contrast the advantages and limitations of ultraviolet (UV) microscopy and interference microscopy for imaging cellular structures in cell biology research. (5)

10. Describe the concept of electronic transitions in atoms and molecules. How do electronic transitions relate to the absorption and emission of light, and what factors influence the energy of these transitions? (5)
11. Derive the mathematical relationship between energy (E), wavelength (λ), and the speed of light (c) for electromagnetic waves. How does this relationship help explain the energy-wavelength behavior in various regions of the electromagnetic spectrum? (5)
12. Discuss how the energy-wavelength relationship applies to the concept of color in visible light. Explain how different colors of light are associated with varying wavelengths and energies, and provide examples of colors at specific wavelengths. (5)

OR

Discuss the impact of ionizing electromagnetic radiation, such as X-rays and gamma rays, on proteins and DNA. Explain the mechanisms by which these high-energy radiation types can cause damage to biomolecules and the potential consequences for cellular function and genetic stability. (5)
