JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-II Semester (BT/BI)

COURSE CODE (CREDITS):18B11PH212 (04) MAX. MARKS: 35

COURSE NAME: Bioinstrumentation Techniques

COURSE INSTRUCTORS: Ragini Raj Singh MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems
(c)Calculators allowed.

Q.No	Question	CO	Marks
Q1	**(a)** A sample of a colored compound is analyzed using UV-Vis spectroscopy at its maximum absorbance wavelength (λ_{max} = 510 nm). The absorbance of the sample is found to be 0.75 in a 1 cm path length cuvette. If the molar absorptivity (ε) of the compound at this wavelength is 15,000 $L \cdot mol^{-1} \cdot cm^{-1}$, calculate the concentration of the compound in the solution. **(b)** A molecule absorbs light at 360 nm (excitation wavelength) and fluoresces (emits) at 450 nm. Using the Jablonski diagram as a reference: 1. Calculate the energy of the absorbed photon and the emitted photon in eV. 2. Determine the Stokes shift in **eV** and nm.	2	**2** **2**
Q2	Calculate the fundamental vibrational frequency (in cm^{-1}) of the carbon-oxygen (C=O) bond in a molecule using the harmonic oscillator model. Given: Force constant k=16.0 N/m ; Mass of Carbon m_C=12 amu ; Mass of Oxygen m_O=16 amu	3	**2**
Q3	(a) How does DLS measure the size of nanoparticles in a suspension? Define hydrodynamic diameter. How is it different from actual particle size? (b) How can you determine whether your DLS sample is monodisperse or polydisperse? A sample shows a bimodal distribution in DLS results. What could be the possible reasons?	3	**2** **2**
Q4	(a) What is Raman spectroscopy? Briefly explain its working principle.What is the difference between Rayleigh scattering and	4	**3**

	Raman scattering? (b) How does Raman spectroscopy differ from Infrared (IR) spectroscopy? What are the challenges in analyzing fluorescent samples with Raman spectroscopy, and how can they be overcome?		2
Q5	(a) What does a high absolute zeta potential value indicate about a colloidal system? How can zeta potential help in optimizing the formulation of drug delivery systems? (b) A nanoparticle sample shows a zeta potential of –5 mV. What does this suggest about its colloidal stability?	4	2 2
Q6	(a) What does FISH stand for, and what is its primary purpose?Briefly describe the principle of FISH. What type of probe is used in FISH, and how is it labeled? (b) How is a FISH probe designed to ensure specificity? Describe the role of FISH in detecting chromosomal translocations in cancer.	5	3 2
Q7	(a) What is the principle behind fluorescence-activated cell sorting? List at least three applications of FACS in biomedical research. (b) Describe the basic components of a FACS instrument explain with diagram.What is forward scatter (FSC) and side scatter (SSC), and what do they indicate? (c) How can FACS be used to isolate stem cells from a mixed cell population? Discuss the role of sheath fluid in FACS and its importance for single-cell analysis.	5	2 2 3
Q8	(a) What is mass spectrometry? What are the applications of mass spectrometry. Draw the mass spectra and explain it. (b) Explain the working of mass spectrometer with diagram.	5	2 2