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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS- 2026

B.Tech-II Semester (BT/BI)

COURSE CODE (CREDITS): 25B11PH212 (04) MAX MARKS: 35

COURSE NAME: Biophysical Techniques

COURSE INSTRUCTOR: Dr. 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) Use of calculator is allowed

Q.No	Question	CO	Marks
Q1	**(a)** In a SAED pattern, the distance between the central spot and the (111) ring is 4.5 millimeter, the d-spacing of (111) plane is 0.209 nanometer, electron wavelength is equal to 0.025 angstrom. Calculate the camera length.	*2*	**1.5**
	(b) If the accelerating voltage of a TEM is halved, how does the electron wavelength change?	*3*	**1**
	(c) Discuss all the possible electronic and observed transitions in ultraviolet spectroscopy. Also discuss the applications of UV spectroscopy.	*3*	**2.5**
Q2	**(a)** What do you understand by functional group and what is the importance of functional group studies? Why FTIR is preferred analysis? Discuss the conditions must be met for IR absorbance by a molecule.	*4*	**3**
	(b) Discuss three different types of molecular transitions occurred in IR. Also discuss all the available vibrational modes in FTIR.		**3**
	(c) Discuss i. radiation source in FTIR ii. application of Fourier Transform in infrared spectroscopy. iii. Fellgett's or multiplex advantage, iv. Conne's advantage,		**4**
Q3	**(a)** Calculate the minimum mirror displacement required to achieve a spectral resolution of 0.5 cm inverse in a FTIR spectrometer.	*5*	**1**
	(b) An FTIR spectrometer uses a mirror velocity of 0.2 cm per second. Determine the modulation frequency for radiation at 4500 cm inverse and 500 cm inverse.		**1**

	(c) The fundamental absorption peak of CO occurs at 2143 cm inverse. Calculate the force constant K of the bond, where atomic masses of carbon and oxygen are 12 amu and 16 amu respectively. **(d)** The fundamental and first overtone of a molecule are found at 3000 cm^{-1} inverse and 5800 cm^{-1} respectively. Calculate the anharmonicity constant x_e and the equilibrium frequency $\overline{\nu_e}$.		**2** **2**
Q4	**(a)** What is dynamic light scattering and its applications? Also, discuss the working of dynamic light scattering. Discuss any two key dynamic light scattering applications in the field of biotechnology. **(b)** Discuss in detail the electrical double layer and zeta potential with the help of proper diagrams. Also discuss the factors those affect the zeta potential of particles. **(c)** At 298 K, viscosity η=0.001 Pa·s, diffusion coefficient $D=5.25\times10^{-11}$ m^2/. Find particle radius. $K = 1.38 \times 10^{-23}\ m^2 kg\ s^{-2} K^{-1}$ **(d)** Calculate the zeta potential when Particle velocity = 4×10^{-5} m/, electric field = 1200 V/m; $\epsilon=7\times10^{-10}$ C^2/Nm^2 and η=0.001 Pa.s. **(e)** Given is DLS intensity distribution dataset Size (nm) Intensity (%) 20 10 50 25 100 40 200 25 Calculate intensity-weighted mean size.	5	**2.5** **2.5** **1** **1** **1**
Q5	**(a)** Discuss FACS in detail with proper diagram and explanation and its applications. **(b)** What is FISH test and its main features? Detailed discussion about the steps involved in FISH testing with suitable diagram with applications. **(c)** Explain the concept and working of mass spectrometry with diagram. Also discuss in detail MALDI and its applications.	*5*	**2** **2** **2**