Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Bioinstrumentation
Semester : 2nd
Program: MSc Microbiology
Duration : 3 Hours
Course Code: HSCC 7021 **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q1	Define mobile phase in the context of HPLC.	**1.5**	**CO3**
Q2	The HPLC column pressure can achieve a value upto 5000 psi. Is this statement true or false?	**1.5**	**CO3**
Q3	The dispersion type of FTIR is more preferrable than the interferometric type. Is this statement true or false?	**1.5**	**CO2**
Q4	The phenomenon responsible for imaging specimen via electron microscopy is: a. Uncertainty principle b. Dual nature of matter c. de-Broglie theory d. Both (b)and (c)	**1.5**	**CO1**
Q5	The resolution of an optical microscope is given by: a. $(0.5\lambda)/n \sin\theta$ b. $\lambda/n \sin\theta$ c. $(1.5\lambda)/n \sin\theta$ d. None of the above	**1.5**	**CO1**
Q6	Which of the following is true for UV-VIS and FTIR spectroscopy?	**1.5**	**CO2**

	a. both of them involve electronic transitions b. both of them involve rotational transitions c. UV-VIS involves vibrational transitions and FTIR involves rotational transitions d. UV-VIS involves electronic transitions and FTIR involves vibrational transitions		
Q7	Which contrast agent is widely used in fluorescence microscopy?	**1.5**	**CO1**
Q8	A spectrophotometric detector cannot be used in a HPLC system. Is this statement true or false?	**1.5**	**CO3**
Q9	Illustrate the resolution of optical microscope, SEM and TEM.	**1.5**	**CO1**
Q10	The sharp peaks observed in XRD plot occurs due to high degree of X-ray diffraction from the crystal planes. Is this statement true or false?	**1.5**	**CO2**
Q11	The atoms in flame photometry undergo electronic excitation at the primary heating zone. Is this statement true or false?	**1.5**	**CO2**
Q12	Which of the following best describes Bragg's law of diffraction: (a) $\lambda = d \sin\theta$ (b) $\lambda = d \cos\theta$ (c) $n\lambda = d \sin\theta$ (d) $n\lambda = 2d \sin\theta$	**1.5**	**CO2**
Q13	Apart from XRD, the d-spacing of crystals planes can be analyzed by TEM as well. Is this statement true or false?	**1.5**	**CO1**
Q14	In flame photometry, which phenomenon does the ultrasonic nebulizer work on?	**1.5**	**CO2**
Q15	In UV-Vis spectroscopy, what is the wavelength range emitted by a hydrogen discharge lamp?	**1.5**	**CO2**
Q16	The flow range in a HPLC pump is 0.01 – 10 mL/min. Is this statement true or false?	**1.5**	**CO3**
Q17	The electrochemical detectors in HPLC can identify the presence of a species within pg-ng range. Is this statement true or false?	**1.5**	**CO3**

Q18	If Mo is magnification of objective lens and Me is the magnification of eyepiece, then the total magnification of an optical microscope is: (a) Mo + Me (b) Mo – Me (c) Mo x Me (d) Mo/Me	**1.5**	**CO1**
Q19	Mention one radiation source which can be used in FTIR spectroscopy.	**1.5**	**CO2**
Q20	A field emission electron gun is preferred for acquiring high resolution images in SEM.	**1.5**	**CO1**
	Section B **(4Qx5M=20 Marks)**		
Q 1	What do you mean by resolution? If the numerical apertures of two microscopes are 0.12 and 0.87, which of them will have higher resolution? Justify your answer.	**5**	**CO1**
Q2	a. Describe Beer-Lambert's law. b. A solution of tryptophan exhibits peak absorbance of 0.54 at 280 nm in a 0.5 cm length cuvette. What is the concentration of the solution if absorbance coefficient is 6.4×10^3 L/Mol/cm?	**5**	**CO1**
Q3	Discuss why FTIR spectroscopy is termed as one of the tools to study "molecular fingerprint"?	**5**	**CO2**
Q4	Explain why X-rays are suitable for probing the crystal structure of a particular sample.	**5**	**CO2**
	Section C **(2Qx15M=30 Marks)**		
Q 1	Examine how atomic absorption spectroscopy and flame photometry are different from each other for identifying the presence of trace metals in a sample.	**15**	**CO2**

Q2	(a) Explain how electrons can lead to the formation of microstructural image of a sample. (b) Discuss the working principle of scanning electron microscope with the help of a suitable diagram.	**15**	**CO1**
Section D (2Qx10M=20 Marks)			
Q 1	Discuss the various allowed as well as forbidden transitions in UV-VIS spectroscopy.	**10**	**CO2**
Q2	Explain the functioning of a Mass Spectroscopy instrument.	**10**	**CO3**