

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**Even Semester Mid-Term Examination, 2022-23****Course Code:** CYC401

Full Marks: 25

Course Name: Biochemistry: Structure and Function

Time: 90 Minutes

Instructions: Answer all the questions.**Materials to be supplied:** NA

Question No.	Body of the Question	Marks	Mapped CO
1	(a) How convergent synthesis strategy can be used for the synthesis of longer polypeptide chain? (b) What were the disadvantages of Merrifield's method of solid phase peptide synthesis? How they were corrected later? (c) What are essential amino acids and non-standard amino acids? (with examples)	2+(2+2)+(2+2)=10	CO1
2	(a) Explain how can you estimate the molecular weight of an unknown protein sample using gel electrophoresis. (b) Give one example of a resin used in ion-exchange chromatography of protein purification.	4+1=5	CO1-CO4
3	(a) Show the chemical digestion of one nucleic acid molecule to its basic constituents. (b) Draw the structures (with names) of all the different nucleobases and sugar units found in nucleic acids. (c) Write short notes on Replication, Transcription and Translation.	3+4+3=10	CO1-CO3

Course Outcomes

CO1: : Understanding the Chemistry behind biological processes

CO2: Development of basic knowledge of cell structure and function

CO3: Learning of different chemical aspects of biomolecules such as Carbohydrates, Lipids, Proteins, Nucleic acids

CO4: Generation of concepts on molecular mechanics amongst biomolecules as a stepping-stone towards Biophysical Chemistry.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**EVEN SEMESTER MID SEM EXAMINATION**

Course Code: CYC402

Full Marks: 25

Course Name: Phase-Equilibrium, Chemical Kinetics and Catalysis

Question Paper no. NITDGP/22-23/CYC402/1

Time: 90min

Instructions: Answer all questions, Calculator allowed.

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Q. No.	Body of the Question	Marks	CO															
1	<p>(a) Draw the Pressure vs. Temperature Phase Diagram of H₂O showing the stability regions of three phases explaining the order of <u>magnitudes</u> and <u>signs</u> (+ve or -ve) of the slopes of solid ↔ vapour; solid ↔ liquid; liquid ↔ vapour equilibrium lines. Mark the Triple point of water. Show the effect of increasing pressure on Boiling point, Freezing point. [Ignore the different phases of ice].</p> <p>(b) Under what pressure (report in atm) will water boil at 110°C? [Latent heat of vaporization of water is 536 cal/gm].</p> <p>(c) What is Osmotic pressure? Derive the van't-Hoff Equation of Osmotic pressure. Explain briefly the principle of Reverse Osmosis.</p> <p>(d) A mixture contains 0.550gm of Camphor and 0.045gm of an organic solute (containing 93.46% of C and 6.54% of H) freezes at 157°C. Calculate the molecular formula of the organic compound. [At this pressure Camphor's freezing point is 178.4°C and Cryoscopic constant is 37.7 K kg mol⁻¹].</p>	(2+1)+2+(1+3+1)+3 = 13	CO1															
2	<p>(a) Industrial production of NO by the reaction N₂(g)+O₂(g)⇌2NO(g) is carried out at elevated temperatures to drive the reaction toward the formation of the product. After sufficient product has formed, the reaction mixture is quickly cooled. Why?</p> <p>(b) For the gas-phase reaction I₂⇌2I, show that the total pressure (P_T) is related to the equilibrium partial pressure of I₂ (P_{I₂}) by the following equation:</p> $P_T = \sqrt{K_P P_{I_2}} + P_{I_2}$ <p>(c) For a certain series of reactions, if [OH⁻][HCO₃⁻]/[CO₃²⁻]=K₁ and [OH⁻][H₂CO₃]/[HCO₃⁻]=K₂, what is the equilibrium constant expression for the overall reaction? Write the overall equilibrium equation.</p>	2+2+2 = 6	CO2															
3	<p>(a) Benzoyl peroxide is a medication used to treat acne. Its rate of thermal decomposition at several concentrations was determined experimentally, and the data were tabulated as follows:</p> <table><tr><th>Experiment</th><th>[Benzoyl Peroxide]₀ (M)</th><th>Initial Rate (M/s)</th></tr><tr><td>1</td><td>1.00</td><td>2.22 × 10⁻⁴</td></tr><tr><td>2</td><td>0.70</td><td>1.64 × 10⁻⁴</td></tr><tr><td>3</td><td>0.50</td><td>1.12 × 10⁻⁴</td></tr><tr><td>4</td><td>0.25</td><td>0.59 × 10⁻⁴</td></tr></table> <p>What is the reaction order with respect to benzoyl peroxide? What is the rate law for this reaction?</p> <p>(b) How one can monitor the kinetics of hydrolysis of ethyl acetate in acidic medium?</p>	Experiment	[Benzoyl Peroxide] ₀ (M)	Initial Rate (M/s)	1	1.00	2.22 × 10 ⁻⁴	2	0.70	1.64 × 10 ⁻⁴	3	0.50	1.12 × 10 ⁻⁴	4	0.25	0.59 × 10 ⁻⁴	3+3 = 6	CO4
Experiment	[Benzoyl Peroxide] ₀ (M)	Initial Rate (M/s)																
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CO1: Concept of phase rule and phase diagram of multi-component system. **CO2:** Understand the fundamentals of chemical kinetics and corresponding theoretical treatment. **CO3:** Concept of catalysts towards reaction rate and its applications. **CO4:** Numerical analysis of the effect of various parameters on reaction kinetics.

2022-23

CHEMISTRY OF ELEMENTS AND RADIOACTIVITY**CYC - 403**

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer all the questions.

Graph paper shall be supplied, if required.

1. (a) Qualitatively plot the trends of ionisation energy as a function of atomic number from Li to Ar.
(b) Comment on the stability of peroxides and superoxides of the alkali metal ions. 2+3 [CO1, CO2]
2. (a) Comment on the solubility of the following salts in water $\text{CsF} > \text{RbF} > \text{KF} > \text{NaF} > \text{LiF}$ and $\text{LiI} > \text{NaI} > \text{KI} > \text{RbI} > \text{CsI}$.
(b) Comment on the stability of BH_3 .
(c) H_3BO_3 is a weak acid but behaves as a strong acid in presence of glycerol, Explain. 2+1+2 [CO2, CO3]
3. (a) Fission of heavier nuclides and fusion of lighter nucleides are expected from the nuclear binding energy curve. Explain.
(b) Calculate the energy liberated in the fission of 0.5 gm of

P.T.O.

(2)

^{235}U . Average binding energy per nucleon (MeV): ^{235}U = 7.6, Fission products = 8.5

4. (a) What do you mean by artificial transmutation? Give one example with its application.
- (b) When a nucleus should undergo a α (Alpha), β^- and β^+ decay. Give one example of each. 2+3 [CO5]
5. (a) Discuss the principle of 'Radiocarbon dating'.
- (b) Comment on the possibility to find out the age of a flowering plant by this method. 3+2 [CO6]

Course Outcomes :

- CO1 : Knowledge of periodic properties and their variation in period and group.
- CO2 : General trends of elements and their compounds for s, p, d and f block elements.
- CO3 : Knowledge of the structure and function of s, p, d and f block elements.
- CO4 : Concept of radioactive nuclei and their properties.
- CO5 : Measurement of radioactivity.
- CO6 : Various uses of radioactive elements.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**EVEN SEMESTER MID SEM EXAMINATION****Course Code: CYC601****Full Marks: 25****Course Name: Basics of photochemistry, spectroscopy, group theory and data analysis****Question Paper no. NITDGP/22-23/CYC601/1****Time: 90 min****Instructions: Answer all questions, Calculator allowed.**

Q. No.	Body of the Question	Marks	CO																																						
1	<p>(a) What are the basic requirements for a molecule to be IR and microwave active?</p> <p>(b) Show with diagram how dipole moment changes with time during the different vibrations of water molecule and from there conclude about their IR activity.</p> <p>(c) Find the difference in energy for two consecutive vibrational levels. Do you find any difference from rotational energy levels?</p>	2+6+5	CO2																																						
2	<p>(a) Find the Mean, Median and Mode of the following frequency distribution:</p> <table border="1"><tr><td>Class interval</td><td>20-30</td><td>30-40</td><td>40-50</td><td>50-60</td><td>60-70</td><td>70-80</td></tr><tr><td>Frequency</td><td>3</td><td>5</td><td>20</td><td>10</td><td>5</td><td>4</td></tr></table> <p>(b) Find the mean deviation from mean and standard deviation of an Arithmetic Progression: $a, (a+d), (a+2d), (a+3d), \dots, (a+2nd)$ and verify that the standard deviation is greater than the mean deviation from mean.</p> <p>(c) Suppose the last week temperatures of Kolkata and Durgapur at 8PM was recorded as follows:</p> <table border="1"><tr><td>City</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td><td>Sun</td></tr><tr><td>Kolkata</td><td>20</td><td>20</td><td>21</td><td>22</td><td>23</td><td>23</td><td>24</td></tr><tr><td>Durgapur</td><td>19.5</td><td>21</td><td>21</td><td>22.5</td><td>22.5</td><td>23</td><td>23.5</td></tr></table> <p>Which city observed relatively more consistent weather last week?</p> <p>(d) Suppose probability of finding a particle within the position x and $x+dx$ is given by $f(x) dx$, where $f(x) = \begin{cases} cx^2, & (-1 \leq x \leq +1) \\ 0, & (\text{otherwise}) \end{cases}$.</p> <p>i. Find the constant, c.</p> <p>ii. Find Mean: $\langle x \rangle$.</p> <p>iii. Find Variance: σ_x^2.</p> <p>[Hint: Use normalization condition, Total probability, $\int_{-\infty}^{+\infty} f(x)dx = \int_{-1}^{+1} f(x)dx = 1$ for solving c. Use proper limits where the function is defined to solve the other two questions.]</p>	Class interval	20-30	30-40	40-50	50-60	60-70	70-80	Frequency	3	5	20	10	5	4	City	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Kolkata	20	20	21	22	23	23	24	Durgapur	19.5	21	21	22.5	22.5	23	23.5	3+3+3+3	CO5
Class interval	20-30	30-40	40-50	50-60	60-70	70-80																																			
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City	Mon	Tue	Wed	Thu	Fri	Sat	Sun																																		
Kolkata	20	20	21	22	23	23	24																																		
Durgapur	19.5	21	21	22.5	22.5	23	23.5																																		

CO1: Physical understanding of photochemistry and photophysical processes. CO2: Fundamentals of different molecular spectroscopy. CO3: Introduction to symmetry and concept of point group. CO4: Application of spectroscopy and symmetry to unravel the molecular structure. CO5: Concept of data analysis and its applications.