বাংলাদেশ আর্মি ইন্টারন্যাশনাল ইউনিভার্সিটি অব সায়েন্স এন্ড টেকনোলজি (বাইউস্ট), কুমিল্লা
BANGLADESH ARMY INTERNATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY (BAIUST), CUMILLA

Mid Term Examination, Spring 2025
Department of Computer Science and Engineering
Level-1, Term-I
Course Code: CHEM-111
Course Title: Chemistry
Credit Hour: 03

Notes:
a. Answer any **03 (three)** of the following **04 (four)** questions.
b. Each question carries 30 marks.
c. Figure on the right of each question indicate marks for respective question.

Time: 1 hour 30 minutes
Full Marks: 90

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1. a. **Show** the relation between the wave nature and particle nature of electron. 06

   b. **Explain** Pauli's Exclusion Principle and **describe** how it applies to the calculation of quantum states of 22^{nd} and 25^{th} electrons in the Fe^{2+} ($Z = 26$) and Co^{3+} ($Z = 27$) ions. 12

   c. A hydrogen atom emits light with a frequency of 6.16×10^{14} Hz for the Balmer series. **Determine** the energy, wavelength, momentum, and higher transition level (n_2) of this emission. 12

2. a. **Discuss** the mechanism of acidic and basic buffer solutions with proper chemical reactions. 06

   b. **Describe** the procedure for determining the concentration of a nanoparticle solution using the Beer-Lambert law. 12

   c. **Calculate** the buffer capacity and number of moles of HCl that must be added to 1 L of a buffer solution containing 0.5 M Acetic acid and 0.5 M Sodium acetate to lower the pH by 2 units ($pKa = 4.76$). 12

3. a. **Explain** the term nanotechnology and **discuss** the classification of nanomaterials according to source and dimension. 06

   b. **Describe** the synthesis of Titanium dioxide nanoparticles by the sol-gel method from Titanium Isopropoxide precursor solution. 12

   c. **Demonstrate** the scope of applications of nano-technology in modern industrial fields. 12

4. a. **Distinguish** among true solution, colloid, and suspension regarding particle size, Tyndall effect, Brownian motion, stability, nature, and visibility. 06

   b. **Describe** the factors affecting ionization energy and **interpret** the energy required to ionize an H atom if the electron occupies the 2^{nd} and 4^{th} orbit. 12

   c. **Calculate** the effective nuclear charge for the 3d and 4s electrons of the Manganese atom (Z = 25) applying Slater's rule. 12