

**Sylhet Engineering College, Sylhet**  
**(Shahjalal University of Science & Technology)**  
**Department of Computer Science and Engineering**

Final Examination, 2023

Course No: ENG 101

Time: 02 (Two) hours

1<sup>st</sup> Year 2<sup>nd</sup> Semester

Course Title: English Language

Full Marks: 60

N.B. : (i) Answer all the questions from each PART  
(iii) Marks allotted are indicated in the margin

(ii) Use separate answer scripts for each PART  
(iv) Special Instruction (if any)-----N/A-----

**Part A**

**Read the following passage and answer the questions below.**

Artificial Intelligence (AI) is revolutionizing many industries, and education is no exception. As technology continues to advance, AI is playing an increasingly important role in enhancing educational systems, transforming how students learn, and how educators teach. The integration of AI in education has introduced innovative solutions that personalize learning, improve accessibility, and assist teachers in managing administrative tasks. One of the most significant benefits of AI in education is its ability to create personalized learning experiences. With AI, learning platforms can adapt to the unique needs of each student, offering customized lesson plans, quizzes, and feedback based on individual progress. For example, AI-powered systems can assess a student's strengths and weaknesses and adjust the curriculum accordingly. This ensures that students receive the right level of challenge and support, maximizing their learning potential.

AI also plays a critical role in improving accessibility for students with different learning abilities. Speech recognition software, real-time translation tools, and AI-generated captions make educational content more accessible to students with disabilities or those who speak different languages. In this way, AI helps break down barriers to learning, creating more inclusive educational environments.

Another notable application of AI in education is its ability to reduce the administrative burden on teachers. AI-powered tools can automate tasks such as grading exams, managing schedules, and tracking student progress. This automation allows teachers to spend less time on routine tasks and more time on direct student interaction and lesson planning. For instance, AI-driven grading systems can evaluate multiple-choice tests or even provide feedback on essay writing, saving educators time while offering students detailed, timely feedback.

Despite its many advantages, the use of AI in education also raises concerns. Some fear that the overreliance on AI may reduce the human element in teaching, as face-to-face interaction is an essential part of learning. Others worry about data privacy issues, as AI systems often require access to personal student information to function effectively.

In conclusion, AI is shaping the future of education by providing personalized learning experiences, improving accessibility, and streamlining administrative tasks for educators. While there are concerns to address, the potential of AI to enhance education is undeniable. As this technology continues to evolve, it is expected to play an even greater role in creating more efficient, inclusive, and effective learning environments.

1. (a) **Identify True/ False/ Not Given from the passage.** 5×2
- i. AI can help create personalized lesson plans for students.
  - ii. AI has completely replaced human teachers in some educational settings.
  - iii. Real-time translation tools are one way AI helps improve accessibility in education.
  - iv. AI is responsible for designing school curriculums from start to finish.
  - v. There are concerns about the privacy of student data when using AI-powered systems.
- (b) **Based on your reading of the passage choose the correct option from a b c and d.** 05
1. How does AI personalize learning experiences for students?
    - a) By offering one-size-fits-all lesson plans
    - b) By adjusting the curriculum based on individual progress
    - c) By removing all teachers from the classroom
    - d) By providing group-based learning for all students
  2. What role does AI play in improving accessibility for students?
    - a) It only helps students with high grades
    - b) It provides tools like speech recognition and real-time translation
    - c) It replaces all textbooks with digital content
    - d) It creates personalized content for each student
  3. How does AI assist teachers in managing administrative tasks?
    - a) By grading exams and tracking student progress
    - b) By teaching classes
    - c) By eliminating the need for lesson plans
    - d) By replacing teachers in classrooms

4. What is a concern regarding AI in education?
  - a) It helps students learn faster
  - b) It may reduce the human element in teaching
  - c) It improves teacher-student interaction
  - d) It is only useful for managing administrative tasks
5. What is one advantage of AI in education?
  - a) It reduces the need for teachers
  - b) It helps create more inclusive learning environments
  - c) It only works for students with disabilities
  - d) It limits access to learning resources

OR

- (a) **Choose ONE WORD AND/OR A NUMBER from the passage for each answer** 5×2
- a) \_\_\_\_\_ motivation comes from within an individual and is driven by personal satisfaction or curiosity.
  - b) Extrinsic motivation is often influenced by external factors such as rewards or \_\_\_\_\_.
  - c) Self-determination theory highlights the importance of three psychological needs: autonomy, competence, and \_\_\_\_\_.
  - d) A student who studies to earn high grades is motivated by \_\_\_\_\_ motivation.
  - e) Successful individuals often find purpose in the process of striving towards their \_\_\_\_\_.

(b) Write down the summary of the passage. 05

2. (a) **Fill in the blanks with appropriate verbs:** 10×1

- I. Ten miles (be) --- a long distance
- II. If I were rich, I (establish) --- a hospital for the poor.
- III. Hardly he--(hear) the news when he burst into tears.
- IV. While (take) --- dinner, he received the phone.
- V. Had I possessed vast property, I--- (establish) a college.
- VI. If she \_\_\_\_ (study) harder, she would have passed the exam.
- VII. By the time I arrive, they \_\_\_\_ (finish) their work.
- VIII. I wish I \_\_\_\_ (know) the answer to that question.
- IX. He said he \_\_\_\_ (help) us with the project tomorrow.
- X. As soon as she \_\_\_\_ (leave), I will start the meeting.

(b) **Change the sentences as directed** 5×1

- (i) His behaviour surprised me. (Passive)
- (ii) Despite being rich, he leads a poor life. (Compound)
- (iii) Work hard and you will succeed. (Simple)
- (iv) He said to me, "Let me come in" (indirect)
- (v) My mother said, "May God bless you." (Indirect)

### Part B

3. (a) Suppose you are a reporter of a national daily. Write a report for the newspaper on the cultural week in your university. 10

(b) What are the differences between Report and Essay? 05

OR

(a) Many people believe that social media platforms have a negative impact on the mental health of young people. Others argue that these platforms can provide valuable connections and learning opportunities. Discuss both views and give your opinion. Write at least 250 words. 15

4. (a) Discuss Anita Desai's treatment of child psychology in her short story "Games at Twilight".

(b) Write a short note on 'Hide and Seek Game' described in the story "Games at Twilight". 05

**Sylhet Engineering College, Sylhet**  
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**Department of Computer Science & Engineering**

**Final Examination, 2023**

**Course No: SS 101**

**Time: 02 (Three) hours**

**1<sup>st</sup> Year 2<sup>nd</sup> Semester**

**Course Title: Managerial Economics**

**Full Marks: 60**

N.B. : (i) Use separate answer scripts for each PART

(ii) Marks allotted are indicated in the margin

(iii) Special Instruction (if any)-----N/A---

**PART-A**

1. (a) Explain the concept of **managerial economics** and discuss how it helps in answering the basic economic questions of **what, how, and for whom to produce**. Provide an example to illustrate how a country might approach these questions when dealing with scarce resources. 09
- (b) A company is considering two strategies: one focuses solely on **profit maximization**, while the other emphasizes **shareholder wealth maximization**. Analyze the key differences between these two approaches in the context of a company's economic objectives. 06
- OR
- (a) State and explain the law of demand with its exceptions. 05
- (b) The equation for a demand curve has been estimated to be  $Q = 100 - 10P + 0.5Y$ , where Q is quantity, P is price, and Y is income. Assume  $P = 7$  and  $Y = 50$ . 07
- i. Interpret the equation.
- ii. At a price of 7, what is price elasticity?
- iii. At an income level of 50, what is income elasticity?
- iv. Now assume income is 70. What is the price elasticity at  $P = 8$ ?
- (c) Differentiate between short run and long run market equilibrium 03
2. (a) Describe and show in graphs on the following short run market equilibrium conditions 08
- i. A decrease in demand causes equilibrium price and quantity to fall.
- ii. An increase in supply causes equilibrium price to fall and quantity to rise.
- (b) Distinguish between GNP and GDP. Discuss the causes and control measures of the inflation. 07

**PART-B**

3. (a) Define supply chain management with its flowchart. 06
- (b) Identify and explain both the short run and long run changes in the market. 07
- (c) Differentiate between fiscal year and accounting year. 02
- OR
- (a) "Apply the principles of fiscal policy to evaluate how changes in government spending and taxation can impact a country's economy during a period of recession or inflation." 07
- (b) Create a comprehensive framework for addressing the challenges faced by developing countries in preparing their national budgets, considering factors such as political instability, resource constraints, and external influence 08
4. (a) Define economics of scale. Identify the reasons for economics and diseconomies of scale. 06
- (b) Define Long-Run Average and Marginal Cost and show and explain why long run average cost curve intersect on the lowest point of long run marginal cost curve. 09

**Sylhet Engineering College, Sylhet**  
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Final Examination, 2023

Course No: CSE 141

Time: 02 (Two) hours

1<sup>st</sup> Year 2<sup>nd</sup> Semester

Course Title: Theory of Computation

Full Marks: 60

N.B. : (i) Answer all the questions from each PART  
 (iii) Marks allotted are indicated in the margin

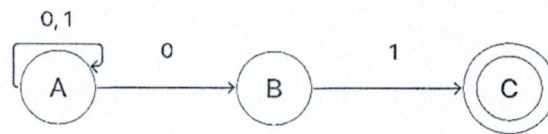
(ii) Use separate answer scripts for each PART  
 (iv) Special Instruction (if any)-----N/A-----

**Part A**

1. (a) What is the theory of computation? 03
- (b) What do you understand by the term automaton? 05
- (c) Design a DFA where language is  $L = \{\text{String has an odd number of 1's and ends with '0'}\}$  and the alphabets are  $\{0,1\}$ . 07
2. (a) Create a context-free grammar (CFG) for a language  $L = \{0^n 1^n \mid n \geq 1\}$ . Check whether the 000111 string is accepted or not. 04
- (b) Using Regular Expression Construct a DFA where  $\Sigma = \{a, b\}$ ,  $L = \{\text{String has an odd number of a's and ends with 'b'}\}$ . 05
- (c) Check whether the Constructed DFA of question (2. (a)) can be minimized. If possible, minimize the DFA; otherwise, Explain why? 06

**OR**

- (a) State the Union Theorem. 02
- (b) Can a DFA recognize a context-free language? Provide reasoning. 04
- (c) Evaluate whether the string 010001 is acceptable by the given Nondeterministic Finite Automaton (NFA). 04



- (d) Construct a mDFA where  $\Sigma = \{0, 1\}$ ,  $L = \{\text{Binary number divisible by 4}\}$ . Analyze all its properties. 05

**Part B**

3. (a) What is time complexity of an algorithm? 02
- (b) What fundamental concepts and principles can be understood from the theory of Turing Machines? 04
- (c) Construct a NFA for the following Regular expressions (using 6 cases of RE) - 09
  - i.  $(a * \epsilon) \cup (b * \epsilon) \cup (c * \epsilon)$
  - ii.  $(a * \cup b *) *$
  - iii.  $(s \cup b) * \circ (s \cup b)$
4. (a) Explain the difference between P and NP complexity classes. 03
- (b) Evaluate the ambiguity of the CFG for arithmetic expressions and suggest modifications to resolve it. 03

- (c) Design a Context-Free Grammar (CFG) for the language  $L = \{\text{all strings over the alphabet } \{a, b\}\}$ . 04
- (d) Provide a parsing tree to demonstrate that the string "abba" can be generated by the designed CFG of question (4.(c)). 05

OR

- (a) Name four space complexity classes. 02
- (b) What is Halting Problem and its implications for computability? 03
- (c) Analyze the Space Hierarchy Theorem and its importance in complexity theory. 05
- (d) Transform the following context-free grammar (CFG) into Greibach Normal Form (GNF) 07

$S \rightarrow AB \mid a$

$A \rightarrow bA \mid \epsilon$

$B \rightarrow c$

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**Final Examination, 2023**

**Course No: MAT 111**

**Time: 03 (Three) Hours**

**1<sup>st</sup> Year 2<sup>nd</sup> Semester**

**Course Title: Calculus**

**Full Marks: 60**

N.B. : (i) Use separate answer scripts for each PART

(ii) Marks allotted are indicated in the margin

(iii) Special Instruction (if any)-----N/A---

**PART-A**

1. (a) Sketch the graph and find the domain and range of the functions 04  
 (i)  $y = e^x$  (ii)  $y = \cos x$
- (b) Write down the conditions of a function to be continuous. Create a function and test the continuity at a point. 06
2. (a) State Rolle's Theorem. Verify Mean value theorem for the function 06  
 $f(x) = x(x-1)(x-2)$  in the interval  $\left[0, \frac{1}{2}\right]$ .
- (b) Define Beta and Gamma function. Evaluate  $\int_0^{\infty} x^5 e^{-4x} dx$  04
3. (a) If  $y = \sin(m \sin^{-1} x)$  then show that 05  
 $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$
- (b) Examine the function for maxima and minima  $y = 2x^3 - 21x^2 + 36x - 20$  05

OR

- (a) Define Curvature and find the radius of curvature of a function. 04
- (b) If  $U = \log(x^3 + y^3 + z^3 - 3xyz)$  then show that  $\frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} + \frac{\partial U}{\partial z} = \frac{3}{x+y+z}$  06

**PART-B**

4. (a) Define ordinary and partial differential equations. Form a differential equation for the curve  $y = ax + bx^2$  05
- (b) Solve the differential equation  $ydx - xdy = xydx$  05
5. (a) Solve the differential equation 05  
 $(x-y-2)dx - (2x-2y-3)dy = 0$
- (b) Define Homogeneous differential equation. Solve the differential equation 05  
 $y(x-y)dx = x(x+y)dy$
6. (a) Define order and degree of a differential equation with example. 02
- (b) Form a differential equation of the family of curves  $y = e^x(A\cos x + B\sin x)$ . 03
- (c) How you identify if a differential equation is exact and solve this 1st order differential equation :  $(y^2+4x^3y+3x)dy+(x^4+4xy^3+y+1)dx=0$  05

OR

- (a) Integrate with respect to x for (i)  $\int \frac{x}{\sqrt{a^2+x^4}} dx$  (ii)  $\int \frac{\sqrt{a+x}}{\sqrt{a-x}} dx$  04
- (b) Evaluate  $\int_0^{\frac{\pi}{2}} \frac{(\cos x - \sin x)dx}{1 + \sin x \cos x}$  03
- (c) Find the area bounded by the circle  $x^2 + y^2 = 4$  03

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**Sylhet Engineering College, Sylhet**  
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**Final Examination, 2023**

**Course No: CSE 137**

**Time: 03 (Three) hours**

**1<sup>st</sup> year 2<sup>nd</sup> semester**

**Course Title: Data Structures**

**Full Marks: 60**

N.B. : (i) Use separate answer scripts for each PART

(ii) Marks allotted are indicated in the margin

(iii) Special Instruction (if any)-----N/A---

**PART-A**

1. (a) Find (a)  $[7.5]$ ,  $[-7.5]$ ,  $[-18]$ ,  $[\sqrt{30}]$  (b)  $[7.5]$ ,  $[-7.5]$ ,  $[-18]$ ,  $[\sqrt{30}]$  1.5X2
- (b) Suppose Module A requires M units of time to be executed, where M is a constant. Find the complexity  $C(n)$  of following algorithm, where n is the size of the input data and b is a positive integer greater than 1. 03
- Algorithm:**
1. Repeat for I=1 to N:
  2.     Repeat for J=1 to N:
  3.         Repeat for K=1 to N:
  4.             Module A.
  - [End of Step 3 loop.]
  - [End of Step 2 loop.]
  - [End of Step 1 loop.]
  5. Exit.
- (c) Write a procedure FIND (DATA, N, LOC1, LOC2) which finds the location LOC1 of the largest elements and the location LOC2 of the second largest elements in an array DATA with  $n>1$  elements. 04

**OR**

1. (a) Let S1 and S2 be the string "Success is simple." and "Do what's right, at the rightful time." respectively. Now perform the following operations sequentially (the result of each step will affect the next) and write the output (the starting index is 1 for S1, S2 and other resulting strings): 05
- i) LENGTH(S1 // □ // S2) ii) REPLACE(S1, 'simple', 'straightforward')
- iii) INSERT (S2, 16, "the right way") iv) INDEX('right') v) DELETE (S2, 45, 3)
- (b) Consider the pattern P= aaabb. Construct the table and the corresponding labeled directed graph used the 'fast' or second pattern matching algorithm. 05
2. (a) Suppose a 10-element array A contains the values  $a_1, a_2, \dots, a_{10}$ . Find the values in A after each loop. 2+2
- (a) Repeat for K=1 to 9:  
    Set  $A[K+1]:=A[K]$   
    [End of loop.]
  - (b) Repeat for K=9 to 1 by -1:  
    Set  $A[K+1]:=A[K]$   
    [End of loop.]
- (b) Implement the Bubble Sort algorithm to sort an array of integers in ascending order. Given the array [64, 25, 12, 22, 11], apply Bubble Sort and show the array after each pass through the array. Explain how the algorithm works in each step. 03
- (c) Ackermann Function. 03
- (i) If  $m=0$ , then  $A(m,n)=n+1$ .
  - (ii) If  $m \neq 0$  but  $n=0$ , then  $A(m,n)=A(m-1,1)$
  - (iii) If  $m \neq 0$  and  $n \neq 0$ , then  $A(m,n)=A(m-1,A(m,n-1))$
- Use the definition of Ackermann function find the value of  $A(1,2)$ .

3. (a) What is linked list? Write the advantages and disadvantages of linked list over array. 1+2
- (b) Explain and show graphically the Insert and Delete node after a given node. 1.5X2
- (c) Figure-1 pictures a linked list in memory. 1X4

|   | INFO | LINK |
|---|------|------|
| 1 | A    | 2    |
| 2 | B    | 8    |
| 3 |      | 6    |
| 4 | C    | 7    |
| 5 | D    | 0    |
| 6 |      | 0    |
| 7 | E    | 1    |
| 8 | F    | 5    |

Figure-1

Here START=4 and AVAIL =3

- i. Find the sequence of characters in the list.
- ii. Suppose F and then C are deleted from the list and then G is inserted at the beginning of the list. Find the final structure.
- iii. Suppose C and then F are deleted from the list and then G is inserted at the beginning of the list. Find the final structure.
- iv. Suppose G is inserted at the beginning of the list and then F and then C are deleted from the list. Find the final structure.

### PART-B

4. (a) Solve the Tower of Hanoi problem for 3 disks. There are three rods: A (source), B (auxiliary), and C (destination). The objective is to move all disks from rod A to rod C, following these rules: 03
1. Only one disk can be moved at a time.
  2. A disk can only be placed on top of a larger disk or an empty rod.
- Explain each step of the solution and determine the minimum number of moves required.
- (b) Translate the infix expression to its equivalent postfix expression using stack. Show the steps using a table. 04
- $$(A - 2 * (B + C) \uparrow 3 / D * E) + F \uparrow G$$
- (c) Consider the following arithmetic expression P, written in postfix notation: 2+1
- P: 12, 7, 3, -, /, 2, 1, 5, +, \*, +
- i. Translate P, by inspection and hand, into its equivalent infix expression
  - ii. Evaluate the infix expression
5. (a) Consider the algebraic expression  $E = (2x+y)(5a-b)^3$ . 1X3
- i. Draw the tree T which corresponds to the expression E.
  - ii. Find the scope of the exponential operator; i.e., find the subtree rooted at the exponential operator.
  - iii. Find the prefix Polish expression P which is equivalent to E, and find the preorder of T.

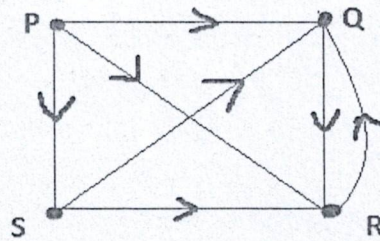
- (b) Suppose the following eight numbers are inserted in order into an empty binary search tree T: 2+1  
 50, 33, 44, 22, 77, 35, 60, 40  
 i. Find the final tree T and  
 ii. Find the inorder traversal of T.
- (c) Use **Huffman coding** to encode the following symbols with the frequencies listed: A: 18, B: 4, C: 8, D: 5, E: 20, F: 15. What is the average number of bits used to encode a character? 04

OR

5. (a) Consider the following **Incidence Matrix**. Find **Edge List** and **Vertices List**. 05

$$\begin{bmatrix} 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix}$$

- (b) Consider the directed graph **G** in the following figure. Suppose the nodes stored in an array as follows: P, Q, R, S. 05



- i) Find the adjacency matrix A    ii) Is G strongly connected?

6. (a) You are given a sorted list of integers representing the ages of employees in a company: 02  
 ages = [22, 25, 29, 32, 35, 38, 42, 45, 50, 54, 58, 63, 67, 71, 75]  
 Write a function that performs a binary search to find whether an employee of a given age exists in the list. If the age exists, return True; if it doesn't, return False.
- (b) Translate selection sort into a subprogram **SELECTSORT(A, N)** which sorts the array with N elements. Test the program using: 2+2  
 i. 44, 33, 11, 55, 77, 90, 40, 60, 99, 22, 88, 66  
 ii. D, A, T, A, S, T, R, U, C, T, U, R, E, S
- (c) Consider the following 4-digit employee numbers: 1X4  
 9614, 5882, 6713, 4409, 1825  
 Find the 2-digit hash address of each number using (i) the division method, with m=97; (ii) the midsquare method; (iii) the folding method without reversing; and (iv) the folding method with reversing.

**Sylhet Engineering College, Sylhet**  
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**Department of Computer Science & Engineering**

Final Examination, 2023

Course No: CHEM 101

Time: 02 (Three) hours

1<sup>st</sup> year 2<sup>nd</sup> semester

Course Title: Chemistry

Full Marks: 60

N.B. : (i) Use separate answer scripts for each PART

(ii) Marks allotted are indicated in the margin

(iii) Special Instruction (if any)-----N/A---

**PART-A**

- |    |  |                   |
|----|--|-------------------|
| 1. | (a) Define quantum numbers. How are the electrons distributed in various sub-shells for $n=3$ ?  | 2+3               |
|    | (b) How does Bohr's theory explain the emission spectrum of hydrogen atom?   | 04                |
|    | (c) State and explain Pauli's exclusion principle.   | 03                |
|    | (d) Find the wavelength in $\text{\AA}$ of the line in the Paschen series that is associated with the drop of the electron from the fifth orbit. The value of the Rydberg constant is $109,676 \text{ cm}^{-1}$ .                    | 03                |
| 2. | (a) Explain law of mass action and equilibrium constant.   | <del>01</del> 06. |
|    | (b) Derive the relation between $K_p$ and $K_c$ .  | <del>4</del> 05   |
|    | (c) The concentration equilibrium constant, $K_c$ for the reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ at $400^\circ\text{C}$ is 0.5. Find the value of $K_p$ . [ $R = 0.0821 \text{ L.atm.k}^{-1}\text{mol}^{-1}$ ] | <del>1</del> 5 00 |

Or

- |     |   |     |
|-----|---|-----|
| (a) | Define electromotive force (emf) of a cell.   | 01  |
| (b) | State and derive Raoult's law of relative lowering of vapour pressure. 5g of NaCl is dissolved in 1000g of water. If the density of the resulting solution is 0.997g per ml, calculate the molality and molarity assuming volume of the solution is equal to that of solvent. | 4+4 |
| (c) | What is solubility curve? State and explain Hess's law of constant heat summation.  | 1+5 |

**PART-B**

- |    |   |     |
|----|---|-----|
| 3. | (a) What is pH? Derive Henderson-Hasselbalch equation for acid solution.  | 2+5 |
|    | (b) What are conjugate acid-base pair? Give two examples.   | 04  |
|    | (c) The buffer solution of $\text{pH}=5$ is to be prepared by using acetic acid and sodium acetate. Calculate the ratio $[\text{Salt}] : [\text{Acid}]$ that must be used. [ $K_a = 1.8 \times 10^{-5}$ ] | 04  |
| 4. | (a) Define phase rule. Draw and explain the phase diagram of a mono-component system showing triple point of water.   | 2+5 |
|    | (b) What are noble gases? Why are they chemically inert?  | 1+2 |
|    | (c) What is an ionic bond? What are the factors favouring an ionic bond formation?  | 1+4 |

Or

- |     |  |     |
|-----|--|-----|
| (a) | What do you mean by pseudo-order reaction? Show that half-life for a first order reaction is independent of the initial concentration of the reactant. | 2+2 |
| (b) | Define exothermic and endothermic reaction. Prove that $\Delta H = \Delta E + \Delta nRT$ where symbols have their usual meaning.                      | 2+3 |
| (c) | Write down the mechanism of the following reactions:   | 3+3 |

i) Reimer-Tiemann Reaction

ii) Cannizaro Reaction