Full Mark: 35   Duration: 2 hours

Answer **Four** questions taking any **Two** from each section

Section -A

1. a) What is business?   2
    b) Discuss the various types of businesses.   6.75

2. a) Define industry.   1.75
    b) Discuss, in brief, the different categories of secondary industry.   3
    c) How commerce can help to eliminate the barriers for conducting a business perfectly in   4
        Bangladesh?

3. a) Describe the functions of management process.   6
    b) Discuss the roles of a manager.   2.75

Section -B

4. On June 1, 2020 Mr. Monir Hossain formed the Hi-Speed Riding Stable. The following transactions occurred during June:

    June 1,   The owner invested Tk.10,000 cash in the business.

    June 5,   A horse stable and riding equipment were rented (and paid for) for the month at a cost of Tk.1,200.

    June 8,   Horse feed for the month was purchased on credit Tk. 800.

    June 15, Miscellaneous expenses of Tk.600 for June were paid (to the supplier of various items and services).

    June 20, The owner withdrew Tk. 500 cash.

    June 22, Land was purchased for use in the business by borrowing Tk. 40,000 from a relative by signing a note. The note is due to be repaid in five years with no interest.

    June 25 Salaries of Tk. 700 for the month were paid.

    June 30 Riding and lesson fees were billed in the amount of Tk. 2,400 to a riding club, whose members used the stable facilities (This bill due on July 10).

    June 30 Fees of Tk. 3,000 for the month were billed to the riding club, whose members were boarding their horses at the stable (The amount is due on July 12).

    Required:
    a) Prepare a summary of the above transactions by using the columns headed Cash, Accounts   4.75
        Receivable, Land, Accounts Payable, Notes Payable and Monir Hossain's Capital. Determine
        balances after each transaction to determine that the basic accounting equation is in balance.
    b) Prepare an income statement for the month of June, 2020.   2
    c) Prepare a balance sheet as of June 30, 2020.   2

5. On September 1, 2020 Mr. Aziz established an IT company. The following transactions were completed during the month.

Sep 1,   Invested cash to start the company Tk. 50,000;

Sep 3,   Paid cash for office rent Tk. 6000;

Sep 8,   Purchased office equipment for Tk. 20,000 cash and Tk. 5000 on account;

Sep 15,   Paid cash for office supplies Tk. 3000;

Sep 20,   Service performed for cash Tk. 28,000 and on account Tk. 7000;

Sep 27,   Received Tk. 7000 for service performed on account;

Sep 30   :Paid salary Tk. 8000.

Required:

a) Prepare journal entries to record the above transaction.   3

b) Post the journal entries to the accounts in the ledger (Use T account)   -3.75

c) Prepare Trial Balance.   2

6. a) What is break-even point?   1

b) Padma Company Limited produces a product selling at Tk. 30 per unit. Variable cost per unit is   7.75 Tk. 18. Annual fixed cost is Tk. 1,50,000. Estimated sales for the period are 20,000 units.

Required:

     i. The break-even point in units and taka;

    ii. The contribution margin and contribution margin ratio;

   iii. The margin of safety;

   iv. The estimated profit for the period;

    v. The sales volume in units, if the company wants to earn profit of Tk. 1,20,000.

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. (Engg) Part-II Odd Semester Examination 2021
Course: STAT-2111 (Theory of Statistics)
Full Marks: 35   Duration: 2(Two) Hours
Answer 04(Four) questions taking any 02(Two) questions from each part

Part-A

1. a) Define with example (i) Population and Sample, (ii) Parameter and Statistic. **1.75**
   b) Define Chi-square sampling distribution. Mention some important properties and uses of Chi-square distribution. **3**
   c) Find MGF and CGF of Chi-square distribution. Hence find mean variance, β_1 and β_2. **4**

2. a) Define with examples (i) Unbiased estimate, (ii) Consistent estimate. **2.75**
   b) What do you mean by sufficient estimator? What is Factorization theorem? **2**
   c) Let $x_1, x_2,..., x_n$ be a random sample from $N(\mu, \sigma^2)$ population. Find sufficient estimator for μ and σ^2. **4**

3. a) What is point estimation? What are the properties of a good estimator? **2**
   b) Mention some properties of maximum likelihood function. **2.75**
   c) Suppose $x_1, x_2,..., x_n$ be a random sample of size n from poisson distribution with parameter θ. Obtain the MLE of θ and show that the estimator is unbiased. **3+1**

Part-B

4. a) What do you mean by contingency table? What are the uses of such table? **2**
   b) For a 2x2 contingency table prove that Chi-square test of independence gives **3**
   $$\chi^2 = \frac{N(ad-bc)^2}{(a+c)(a+b)(c+d)(b+d)}, \quad N = a + b + c + d.$$
   c) In an experiment on immunization of cattle from tuberculosis, the following results are obtained **3.75**

	Affected	Not affected
Inoculated	10	35
Not inoculated	13	6

   Examine whether vaccination control diseases using the critical value 3.29 at $\alpha = 0.05$.

5. a) Explain Type-I and Type-II errors. **1.75**
   b) What is power of a test? Explain the different steps to construct statistical test of hypothesis. **4**
   c) Jeffrey, as an eight-year old, established an average time of 16.43 seconds for swimming the 25-yard freestyle, with a standard deviation of 0.8 seconds. His dad, Frank, thought that Jeffrey could swim the 25-yard freestyle faster by using goggles. Frank bought Jeffrey a new pair of expensive goggles and timed Jeffrey for 15 25-yard freestyle swims. For the 15 swims, Jeffrey's average time was 16 seconds. Frank thought that the swim goggles helped Jeffrey to swim faster than the 16.43 seconds. Conduct a hypothesis test using a preset $\alpha = 0.05$. Assume that the swim times for the 25-yard freestyle are normal. **3**

6. a) What is Non-parametric test of hypothesis? How does it differ from parametric test. **1.75**
   b) Explain the advantages and disadvantages of Non-parametric test over parametric test. **3**
   c) Discuss about median test stating usual assumption. **4**

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. (Engg) Part-II Odd Semester Examination 2021
Course: CSE-2111 (Digital System Design)
Full Marks: 52.5   Duration: 3(Three) Hours
Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. a) Explain weighted, non-weighted, and unit-distance codes for representing decimal numbers with examples. **4.50**

   b) Given two 8-bit 2's complement binary number A = $(00101101)_2$ and B = $(11011010)_2$. Compute C=A-B and verify the result by converting A, B, and C into decimal. **3**

   c) How parity bit can be used for single-biterror detection? Explain with an example. **1.25**

2. a) Draw a circuit diagram to implement an Exclusive-OR gate using four NAND gates. **1.25**

   b) Design a circuit diagram for converting BCD code into 2-out-of-5 code. **3.50**

   c) Prove i) $y + x\bar{y}\bar{z} + xz = x + y$ and ii) $(\overline{x+y})z + x\bar{y} = \bar{y}(x + z)$ using Boolean algebra properties. **4**

3. a) i) Write down the truth table for a half adder. **3**
      ii) Derive the logic circuit from the truth table of a half adder.
      iii) Draw a full adder circuit by using two half adders.

   b) What is the basic difference between a parallel adder and a serial adder? Draw the timing diagram of a 4-bit parallel adder. **3**

   c) Implement a logic circuit for a 1-bit comparator and draw its truth tableState the truth table and circuit diagram of a 1-bit binary comparator. **2.75**

4. a) Design the circuit diagram of a BCD to 7-segment decoder. **5**

   b) Implement the following Boolean expressions using a 74LS138 3-to-8-line decoder. **2.75**
      $Y_1 = \bar{A}\bar{B} + AC + \bar{A}\bar{C}; Y_2 = \bar{A}C + A\bar{C}; Y_3 = \bar{B}C + B\bar{C};$

   c) Write some typical applications of multiplexer and demultiplexer. **1**

Part-B

5. a) Differentiate between i) combinational and sequential logic circuits, ii) synchronous and asynchronous logic circuits. **3**

   b) Define setup time and hold time with necessary diagram. **2**

   c) ExplainDflip-flop with asynchronous Preset and Clear input signals with block diagram, truth table, and timing diagram. **3.75**

6. a) Mention the different modes of operations of the shift register. Draw the block diagram of 4-bit serial input serial output shift register, discuss its operation, and draw the truth table and waveforms. Draw the circuit diagram of a 4-bit serial in/parallel out and parallel in/serial out shift registers. **4.75**

   b) Classify counters in shift registers. Explain the operation of Johnson Counter in brief. **4**

7. a) Draw the HDL design flow. **2.25**

   b) State the Verilog HDL supported levels of abstraction for designing digital circuits. **2.50**

   c) Write HDL code to implement a 4-to-2 line priority encoder. **4**

8. a) Explain the port connection rules of Verilog HDL. **2**

   b) Define rise, fall, and turn-off delays with necessary diagram. **2.25**

   c) Draw the timing diagram of the following simulate module. **4.50**

```
module comb_circuit(x, v);          module simulate;
input [3:0]v;                       reg [3:0]V; wire X;
output x;                           comb_circuitct(X, V);
nor #5 (n,v[3],v[2]);               initial
and #10 (a,v[1],v[0]);              begin
xor #5 (x,n,a);                        V = 4'b0000;
endmodule                           #25 V = 4'b0110;
                                    #25 V = 4'b0011;
                                    #25 V = 4'b1011;
                                    end
                                    endmodule
```

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. (Engg) Part-II Odd Semester Examination 2021
Course: MATH-2131 (Differential Equations and Optimization)
Full Marks: 52.5   Duration: 3(Three) Hours

Answer 06(Six) questions taking any 03(Three) questions from each part

Section-A

1. a) Define the order and degree of a differential equation with examples. Find the differential equation of all circles passing through the origin and having their centers on the x-axis.   2.75

    b) Form the differential equation of the family of parabolas with focus at the origin and axes along the x-axis.   3

    c) Solve $y = x^2 p^2 - px$ where $p \equiv \frac{dy}{dx}$.   3

2. a) Solve $\cos(x + y)\, dy = dx$.   3   2.75

    b) Solve $\frac{dy}{dx} = x^3 y^3 - xy$.

    c) Define Bernoulli differential equation. Solve $\frac{dy}{dx} + y = xy^3$.   3

3. a) Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = 2e^x - 10\cos x$ by using method of undetermined coefficients.   3

    b) Solve the differential equation $(D^2 - 4D + 4)y = 3x^2 e^{2x}\sin 2x$ by operator method.   2.75

    c) Solve $(D^2 + 4)y = \cos^2 x$.   3

4. a) Define regular singular point. Find the general solution $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 + 2)y = 0$ in power of x about $x_0 = 0$.   4

    b) Write Helmholtz's equation and solve it.   4.75

Section-B

5. a) What is an optimization problem? Describe unconstrained and constrained optimization problems.   3

    b) Define: linear programming problem, nonlinear programming problem, and convex optimization problem.   2.75

    c) What do you mean by minimizer of a function? Define local and global minimizer of a function f. Let $f: \mathbb{R} \to \mathbb{R}$ be a function defined by $f(x) = (x + 1)^2 + 3$ find the arg min $f(x)$.   3

    d)

6. a) Define feasible direction of a vector and directional derivative of a function f. Let $f: \mathbb{R}^2 \to \mathbb{R}$ be defined by $f(x) = x^T \begin{pmatrix} 1 & 2 \\ 4 & 7 \end{pmatrix} x + x^T \begin{pmatrix} 3 \\ 5 \end{pmatrix} + 6$. Find the directional derivative of f at $(1,1)^T$ with respect to a unit vector in the direction of maximal rate of increase.   3.75

    b) Define *gradient* and *Hessian matrix* of $f: \mathbb{R}^n \to \mathbb{R}$. State First-Order Necessary Condition. Suppose there are two basestation antennas, one for the primary basestation and another for the neighboring basestation. Both antennas are transmitting signals to the mobile user at equal power. However, the power of the received signal as measured by the mobile is the reciprocal of the squared distance from the associated antenna. Find the position of the mobile that maximizes the signal-to-interference ratio, which is the ratio of the received signal power from the primary basestation to the received signal power from the neighboring basestation.   3

    c) Let $f: \mathbb{R}^n \to \mathbb{R}$ be the continuously differentiable function and $\{x_k\}$ be a sequence generated by Steepest descent algorithm. Prove that, for each k, the vectors $x_{k+1} - x_k$ is orthogonal to the vector $x_{k+2} - x_{k+1}$.   2

7. a) Define the epigraph of a function and a convex function. Let $f: \Omega \subseteq \mathbb{R}^n \rightarrow \mathbb{R}$ be a convex function on Ω. Prove that Ω is a convex set.   **3.75**

   b) Let $f: \Omega \subseteq \mathbb{R}^n \rightarrow \mathbb{R}$ be a quadratic form which is given by $f(x) = x^T Q x, Q \in \mathbb{R}^{n \times n}, Q = Q^T$.   **3**
   Prove that f is convex on Ω if and only if $(x - y)^T Q(x - y) \geq 0$, for all $x, y \in \Omega$.

   c) Let $f: \Omega \subseteq \mathbb{R}^n \rightarrow \mathbb{R}$ be a function defined by $f(x) = x_1 x_2$. Is f convex on   **2**
   $\Omega = \{x: x_1 \geq 0, x_2 \geq 0\}$?

8. a) Define a unimodal function. Use Golden section search method to find the value of x that   **3**
   minimizes $f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the range $[0,2]$. Locate this value of x to within a
   range of 0.3.

   b) Define Lagrangian function. Prove that the Lagrange condition for a local minimizer x^* can be   **3.75**
   represented using the Lagrangian function as $Dl(x^*, \lambda^*) = 0^T$ for some λ^*, where the derivative
   operation D is with respect to the entire argument $(x^T, \lambda^T)^T$.

   c) What is a sequential quadratic programming (SQP)? Construct SQP for the nonlinear optimization   **2**
   problem.

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part 2 Odd Semester, Examination-2021
Course: CSE-2121 (Data Structure)

Full Marks: 52.5 Duration: 3Hours

[Answer six questions taking any three from each section]

Section A

1. (a) What is the benefit of binary search over linear search? 2
   (b) Maze (1:6, -4:1, 5:10) is a 3D array with base=100, w=4, calculate Maze [3, -2, 8] address in a row major order and column major order. 3.75
   (c) We often store sparse matrix in a 1D array to save spaces. What is the memory saving if we store a sparse matrix in a 1D array rather than a 2D array? 3

2. (a) What is a linked list? Explain the main differences between the linked list and linear array? 2.75
   (b) Briefly discuss the terms garbage collection, overflow and underflow. 3
   (c) One of the advantages of linked list is the ability to insert data into the list easily. Explain with your own words and figures how to insert data at the beginning, after a given node, at the end and to a sorted list. 3

3. (a) Define stack. Explain the usage of stack in recursive algorithm implementation. 3
   (b) Simulate the infix to postfix transformation algorithm for
   Q: A + (B * C - (D / E ↑ F) * G) * H by showing the stack's contents as each element is scanned. 3.25
   (c) Write down a routine to insert an element onto a queue. 2.5

4. (a) What is a hash function? 2
   (b) The keys 14, 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and plus 3 probing. What is the resultant hash table? 3
   (c) A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. 3.75

0	1	2	3	4	5	6	7	8	9
		42	23	34	52	46	33		

Which one of the following choices gives a possible order in which the key values could have been inserted in the table?
(A) 46, 42, 34, 52, 23, 33
(B) 34, 42, 23, 52, 33, 46
(C) 46, 34, 42, 23, 52, 33
(D) 42, 46, 33, 23, 34, 52

Section B

5. (a) Define the terms (i) siblings, (ii) ancestor, and (iii) depth of a binary tree.　　　3
   (b) Tree traversal (also known as walking the tree) refers to the process of visiting each node　　5.75
   exactly once. Simulate the preorder traversal algorithm for the following tree.
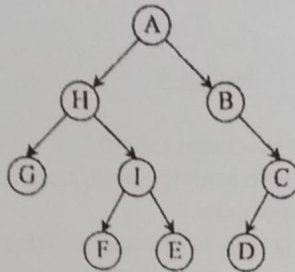
6. (a) What is adjacency matrix? How is it formed?　　　2.75
   (b) Define the terms (i) Isolated node, (ii) Simple Path and (iii) Weighted Graph.　　　3
   (c) How can you search '5' in the following binary search tree? However if '5' is not in the　　3
   tree just insert to its appropriate place and show the resultant tree.
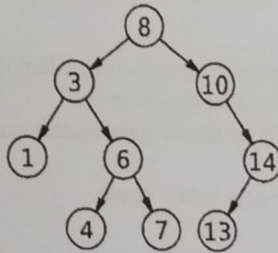
7. (a) What is meant strongly and weakly connected in a graph?　　　2
   (b) Prove that the maximum number of edges that a graph with n vertices is $n*(n-1)/2$.　　　2.75
   (c) Explain Breadth First search algorithm with example.　　　4

8. (a) Suppose we want to encode a message constructed from the symbols A, B, C, D, E, F and　　2
   G using a fixed-length code. How many bits are required to encode the message
   FDEGAACAAGAAFABA?
   (b) Build the Huffman coding tree for the message 'science engineering'.　　　3.75
   (c) Suppose you are to insert a node 'X' as the right child of node 'P'. Discuss the inserting　　3
   mechanisms with figures.
   　i. When the right subtree of 'P' is empty.
   　ii. When the right subtree of 'P' is not empty.

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. (Engg) Part-II Odd Semester Examination 2021
Course: CSE-2131 (Discrete Mathematics)
Full Marks: 52.5   Duration: 3(Three) Hours
**Answer 06(Six) questions taking any 03(Three) questions from each part**

Section-A

1.(a) Define contradiction, tautology, and contingency with example.   2.75

(b) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent.   2

(c) Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives. Let the domain consist of all people.   4

     (i) Someone in your class can speak Hindi.
     (ii) Everyone in your class is friendly.
     (iii) There is a person in your class who was not born in Rajshahi.
     (iv) No student in your class has taken a course in logic programming.

2.(a) Define the following with example   3
     (i) Existential quantifier (ii) Universal quantifier

(b) Show that $\neg \forall x\, (P(x) \to Q(x))$ and $\exists x\, (P(x) \wedge \neg Q(x))$ are logically equivalent.   1.75

(c) Translate the statement "The sum of two positive integers is always positive" into a logical expression.   2

(d) Translate the following statement into English, where C(x) is "x has a computer," F(x, y) is "x and y are friends," and the domain for both x and y consists of all students in your school.   2
$$\forall x(C(x) \vee \exists y(C(y) \wedge F(x, y)))$$

3.(a) *'Fallacy of denying the hypothesis'* is a type of wrong reasoning. Explain with example.   2.75

(b) Show that the premises "A student in this class has not read the book," and "Everyone in this class passed the first exam" imply the conclusion "Someone who passed the first exam has not read the book."   3

(c) Prove the theorem "*Prove that if n is an integer and n^2 is odd, then n is odd.*" by using appropriate method.   3

4.(a) The bit strings for the sets {1,2,3,4,5} and {1,3,5,7,9} are 1111100000 and 1010101010, respectively. Use bit strings to find the *union* and *intersection* of these sets.   3

(b) Proof the following statements using set laws: i) $A - (B \cup C) = (A - B) \cap (A - C)$ ii) $(A - B') \cup (A - C') = A \cap (B \cup C)$.   3

(c) Write down the properties of *binary* relations.   2.75

Section-B

5.(a) Use Warshall's Algorithm to find the transitive closures of the relation 　　4
$R = \{(2, 1), (2,3), (3,1), (3,4), (4,1), (4, 3)\}$ on $\{1,2,3,4\}$

(b) Define 'poset' and 'lattice'.　　2

(c) Determine whether the posets represented by each of the Hasse diagrams (E and F) in the　　2.75
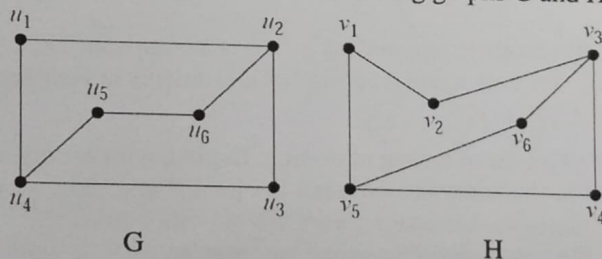following

are lattices.

          E   F
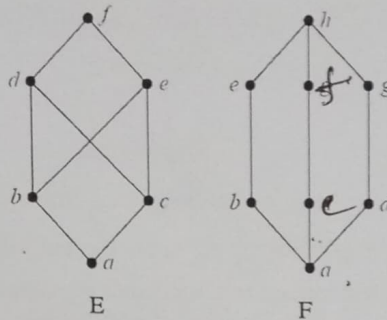
6.(a) How many edges are there in a graph with 10 vertices each of degree six?　　1

(b) Define n-Cube graph with example. Draw the Q3 graph with example.　　1.75

(c) How is adjacency matrix used to represent a graph? Discuss with example. Draw a graph　　3
with the following adjacency matrix

$$\begin{bmatrix} 0 & 2 & 3 & 0 \\ 1 & 2 & 2 & 1 \\ 2 & 1 & 1 & 0 \\ 1 & 0 & 0 & 2 \end{bmatrix}$$

(d) Give the reasons whether the following graphs G and H are isomorphic or not.　　3

          G   H

7.(a) What is planar graph? Is Q_3 planar? Justify your answer with figure.　　2.75

(b) Define Hamilton circuit and Euler circuit. How do they differ from each other?　　3

(c) How many paths of length four are there from a to d in the following simple graph?　　3
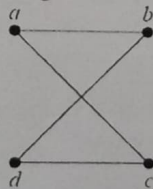
8.(a) What is the prefix form for $\big((x + y) \uparrow 2\big) + \big((x - 4)/3\big)$? What is the value of the postfix　　4
expression $7\ 2\ 3\ * -4\ \uparrow 9\ 3\ /\ +$?

(b) What are the differences between *graph* and *tree*? Prove that a tree with n vertices has　　2.75
$(n - 1)$ edges.

(c) Draw a binary tree to represent the following mathematical expression:　　2
$(a - b) / (c * (d - e))$.