

Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj
Department of Computer Science & Engineering
2nd Year 1st Semester B.Sc. (Engg.) Final Examination-2020

Course No.: CSE201

Full Marks: 60

N.B.:

- i. Answer **SIX** questions, taking any **THREE** from each section.
- ii. All questions are of equal values

Course Title: Data Structure

Times: 3 Hours

Section A

1. a) Define Data Structure. Why do we need to know about different types data structures in the computer engineering field? 1+3
- b) What do you mean by garbage collection? Define Overflow and Underflow. 1+2
- c) What do you mean by the complexity of an algorithm? Discuss briefly the time-space tradeoff of algorithms. 1+2
2. a) What are the limitations of linear search algorithm? 2
- b) Apply binary search technique to the following sorted array, when search item is 40. 4
 Array: 11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99
- c) Let's consider an array with values: 5, 1, 6, 2, 4, 3. Sort this array using the Bubble Sort algorithm. Show the first step's (pass 1) comparisons in detail. 4
3. Consider the following link list.

START
4

AVAIL
3

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

- a) Find the sequence of characters in the list. 1
- b) 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. 2
- c) 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. 2
- d) Suppose G is inserted at the beginning of the list and then F and then C are deleted from the structure. Find the final structure. 2
- e) What is two-way list? Write down the advantages and disadvantages of it. 3
4. a) Consider the following stack, where STACK is allocated N = 6 memory cells: 3
 STACK: AAA, DDD, EEE, FFF, GGG, _____
 Describe the stack as the following operations take place:
 (i) PUSH(STACK, KKK), (ii) POP(STACK, ITEM), (iii) PUSH(STACK, LLL),
 (iv) PUSH(STACK, SSS), (v) POP(STACK, ITEM) and (vi) PUSH(STACK, TTT).
- (b) Consider the following arithmetic expression P, written in postfix notation: 3
 P: 12, 7, 3, -, /, 2, 1, 5, +, *, +

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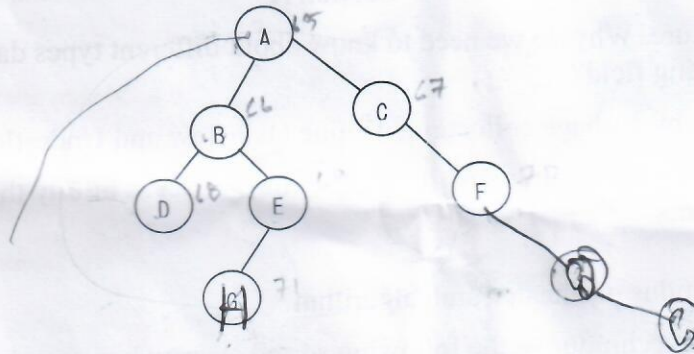
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		6
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- b) Consider the following arithmetic expression P, written in postfix notation: 3
 P: 12, 7, 3, -, /, 2, 1, 5, +, *, +
 (i) Translate P, by inspection and hand, into its equivalent infix expression.
 (ii) Evaluate the infix expression.
- c) Define priority queue. Consider the following queue of characters, where QUEUE is a 4 circular array which is allocated six memory cells:
 FRONT = 2, REAR = 4, QUEUE: _, A, C, D, _, _
 (For notational convenience, we use “_” to denote an empty memory cell). Describe the queue as the following operations take place:
 (i) F is added to the queue (ii) K, L, and M are added to the queue
 (iii) R is added to the queue (iv) S is added to the queue

Section B

8. a) What is heap? State max-heap and min-heap property. 1+2
- b) Write the Huffman's Algorithm. Suppose A, B, C, D, E, F, G and H are 8 items and suppose they are assigned Weights as follows: 4
- | | | | | | | | | | |
|-----------|---|----|---|----|----|---|----|----|---|
| Data Item | : | A | B | C | D | E | F | G | H |
| Weight | : | 22 | 5 | 11 | 19 | 2 | 11 | 25 | 5 |
- Construct a tree using Huffman's algorithm.
- c) Deduce the preorder, in order, and post order sequences for the following binary tree: 3



- a) Consider the following list of letters is inserted into an empty binary search tree: 4+3
 J, R, D, G, T, E, M, H, P, A, F, Q
 i. Find the final tree T (show each step separately) and
 ii. Describe the tree after the node R is deleted
- b) Suppose inorder and preorder traversals of a binary tree are as follows: 3
 Inorder: D B H E A I F J C G
 Preorder: A B D E H C F I J G
 Draw the binary tree.

7. a) Consider the following directed graph G. 4
 (i) Find the indegree and outdegree of each node. (ii) Find the number of simple paths from v_1 to v_4 . (iii) Are there any sources or sinks?



- b) Suppose the graph G (Figure 7) represents the daily flights between cities of some airline. 6
 Now find the minimum path from the city A to city E using BFS, where the each edge has length 1.

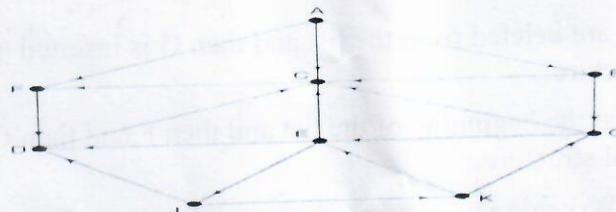


Figure 7: A directional graph G

8. a) Suppose an array A contains 6 elements as follows: 99 2 34 18 76 14 3
 Insertion sort algorithm is applied on array A to sort its elements. Depict the state of the array after each pass of the algorithm.
- b) Suppose S is the following list of 14 alphabetic characters: 4
 DATA STRUCTURES



6. a) Consider the following list of letters is inserted into an empty binary search tree:
J, R, D, G, T, E, M, H, P, A, F, Q
i. Find the final tree T (show each step separately) and
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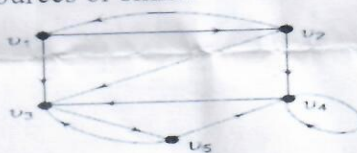
4+3

- b) Suppose inorder and preorder traversals of a binary tree are as follows:
Inorder: D B H E A I F J C G
Preorder: A B D E H C F I J G
Draw the binary tree.

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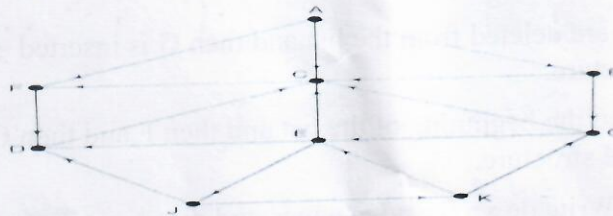


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Insertion sort algorithm is applied on array A to sort its elements. Depict the state of the array after each pass of the algorithm.

3

- b) Suppose S is the following list of 14 alphabetic characters:
D A T A S T R U C T U R E S S
Suppose The characters in S are to be sorted alphabetically. Use the quicksort algorithm to find the final position of the first character D.

4

- c) Suppose 9 cards are punched as follows: 348, 143, 361, 423, 538, 128, 321, 543, 366.
Sort the numbers using Radix sort.

3

Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science & Engineering

2nd Year 1st Semester B.Sc. Engineering Examination-2020

Course Code: **CSE205**

Course Title: **Java Technology**

Full Marks: **60**

Time: 3 hours

Answer Three questions from each section

Section A

- Q.1 (a) Why is object oriented design used for large scale software projects such as java? 3
(b) Explain about Public, Private and protected access specifiers with proper example. 3
(c) What is interface, why do we need interface? justify your answer with a proper example. 4
- Q.2 (a) Why java is Object-oriented, Platform independent and Multi-threaded? 3
(b) Briefly describe Encapsulation, Polymorphism and Inheritance with real life example. 5
(c) Write down the difference between constructor and method in java. 2
- Q.3 (a) What are the functions of class constructors? 3
(b) Explain function overriding and function overloading with proper examples. 4
(c) Why bytecodes are important in java. What are the functions of JVM? 3
- Q.4 (a) Explain the use of the final keyword in variable, method and class. 3
(b) Explain class and objects in java? 3
(c) Translate the following algorithm into Java Code: 4
 Step1: Declare a double variable named **miles** with initial value 100
 Step2: Declare a double constant named **KILOMETERS_PER_MILE** with value 1.609
 Step3: Declare a double variable named **kilometers**, multiply **miles** and **KILOMETERS_PER_MILE**, and assign the result to **kilometers**.
 Step4: Display **kilometers** to the console.

Section B

- Q.5 (a) What is a Thread? How many ways a thread can be created, answer it with proper examples? 3
(b) Explain Thread life cycle. 4
(c) How does an exception propagate in the code? give example. 3
- Q.6 (a) What do you mean by class variable? What do you understand by an instance variable and a local variable? 4
(b) What are the advantages of Packages in Java? Give examples. 3
(c) Multiple inheritance is not allowed in java but Multilevel is allowed; justify it. 3
- Q.7 (a) What do you mean by data encapsulation, JDK, JVM, JRE? 4
 Write output of the following code: 3

```
public class InterviewBit{
    final static int a=10;
    public static void main(String[] args)
    {
        a++;
        System.out.println(a);
    }
}
```


(b) 3
(c) Use relevant properties to highlight the differences between interfaces and abstract classes. 3
- Q.8 (a) Do final, finally and finalize keywords have the same function? 3
(b) When can you use super keyword? 2
(c) What are the differences between C++ and Java? Can the static methods be overloaded? Can the static methods be overridden? 4

Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science and Engineering

2nd Year 1st Semester B.Sc. Engineering Examination-2020

Course Code: CSE203

Course Title: Digital Logic Design

Total Marks: 60

Time: 3 (Three) Hours

N.B. i) Answer any **SIX** questions taking **THREE** from each section.

SECTION-A

1. a) Find out the 11's and 10's complement of $(5192.19)_{11}$. 3
b) Implement the function $F = \Pi(1, 2, 3, 4, 5, 7)$ with only NAND gates. 3✓
c) Simplify the function $F = \Sigma(2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$ by using the tabulation method. 4✓
2. a) Design a logic circuit that converts a BCD number into a Gray code number. 4
b) Design a 4-input priority encoder with the priority $2 < 1 < 0 < 3$. 3
c) Design a full subtractor with a decoder and basic logic gates. 3
3. a) Implement the function $F = \Sigma(1, 3, 4, 5, 7, 8, 9, 13, 15)$ with only one 4X1 MUX. 4✓
b) Design a combinational circuit that compares two 4-bit numbers A and B to check whether B is 2's complement of A. 4
c) Design a 4X1 MUX using two 2X1 MUXs. 2✓
4. a) Design a sequential circuit that performs the following operations on a 4-bit binary number using necessary MUXs with selectors S_1 and S_0 . 8

S_1	S_0	Operation
0	0	Set
0	1	Reset
1	0	Shift left
1	1	1's complement

- b) What is carry propagation? Why is it used? 2

SECTION-B

5. a) What do you mean by multiplexers? Implement a 8-to-1 multiplexer using two 4-to-1 and one 2-to-1 multiplexer. 6
b) Make a 2-to-1 multiplexer using NAND gate. 4
6. a) A sequential circuit has following equations- 3
 $A(t+1) = (CD' + C'D)x + (CD + C'D')x'$;
 $B(t+1) = A$;
 $C(t+1) = B$;
 $D(t+1) = C$
Obtain the sequence of states when $x = 1$, starting from state $ABCD = 0001$.
b) What is self-correcting counter? Design a synchronous counter with T flip-flop for the following sequence. $000 \rightarrow 001 \rightarrow 011 \rightarrow 100 \rightarrow 110 \rightarrow 111$. If state 010 is encountered, it moves to valid state 011 and for state 101, it moves to state 110. 5
c) What are the conditions for state reduction? 2
7. a) There are 4 states as 00, 01, 10, 11 for a machine. It moves from a state to another which 6
1's complement of the previous state when input $x = 0$ and 2's complement of the previous state when input $x = 1$. Design the sequential circuit with JK flip-flop.

- b) Implement the function $F = \Pi(1, 2, 3, 4, 5, 7)$ with only NAND gates. 3✓
- c) Simplify the function $F = \Sigma(2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$ by using the tabulation method. 4✓
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- b) Convert a D flip-flop to T flip-flop. Use necessary gates. 2
- c) Derive the characteristic table and the characteristic equation for a JK flip-flop. 2
8. a) Explain the memory unit and its operating principles with block diagram. 4
- b) Design a 4-bit Johnson Counter. What is the disadvantage of Johnson Counter? What is the difference between Johnson Counter and Ring Counter? 4
- c) Write the difference between ROM and PLA. 2

Bangabandhu Sheikh Mujibur Rahman of Science and Technology University
Department of Computer Science and Engineering
2nd Year 1st Semester B.Sc. (Engg.) Final Examination-2020
Course Code: STA205, Course Title: Applied Statistics and Queuing Theory

Full Marks: 60

Time: 3 Hour

Section A

[Answer any **three** of following questions]

1. a) Define the following terms with example: Statistics, Variable, Data 3
- b) Distinguish among the following: Qualitative and quantitative variable, Bar diagram and histogram, Mean and median. 3
- c) Classify the following variables as nominal, ordinal, interval or ratio: 4
Number of patients seen, Social Status, Quality of manufacturing product, Occupation, Country, Running Speed of an athletic.

2. a) Show that $\sum_{i=1}^n (x_i - \bar{x}) = 0$ 2
- b) Prove that arithmetic mean is dependent on both origin and scale of measurement. 3
- c) The following table shows the age distribution of 50 workers of a pharmaceutical company 5

Age in years	25-29	30-34	35-39	40-44	45-49	50-54
Number of workers	3	9	15	12	6	5

Calculate mean and median.

3. a) What do you mean by dispersion? State the name of some measures of dispersion. 2
- b) The following table gives the marks of 30 students in physics in an examination 5

Marks	30-34	35-39	40-44	45-49	50-54
Number of students	8	12	6	2	2

Calculate variance and hence standard deviation.

- c) Show that the variance is independent on the origin but dependent on the scale of measurement. 3
4. a) Define and illustrate with example: Probability, Sample space, Event, Experiment 4
- b) Distinguish between: Deterministic experiment and Random experiment. 2
- c) A newly married couple is planning to have two children and suppose that each child is equally likely to be a boy or a girl. Construct a sample space and find the probability that the couple will have i) two boys ii) one boy and one girl iii) at least one girl. 4

Section B

[Answer any **three** of the followings]

5. a) What is regression analysis? Mention some properties of correlation coefficient. 4
What are the differences between regression and correlation analysis?

- b) A departmental store has the following statistic on sales (y) for a period of last one year of 10 salesmen, who have varying years of sales experience (x). 6

Salesperson	1	2	3	4	5	6	7	8	9	10
Years of experience (x)	1	3	4	4	6	8	10	10	11	13
Sales (y)	80	97	92	102	103	111	119	123	117	136

- Find the regression of y on x.
- Predict the annual sales volume of persons who have 12 and 15 years of sales experience.

6. a) Define: Joint probability, Conditional probability. 2
- b) Examination results of 150 students showed that 95 students passed mathematics, 75 students passed economics and 135 students passed at least one of the above subjects. A student is selected at random. What is the probability that the student
- Passed both mathematics and economics?
 - Failed both the subjects?
 - Passed mathematics but failed economics?
- c) What is independence of events? A fire brigade has two fire engines operating independently. The probability that a specific fire engine is available when needed is 0.99 4
- What is the probability that an engine is available when needed?
 - What is the probability that none is available when needed?

7. a) Define probability distribution. What conditions to be satisfied for a probability mass function? An unbiased coin is tossed three times. Let X be the number of heads obtained as a result of the outcomes of this experiment. Find the probability distribution of X. 6
- b) A continuous random variable X has the following density function: 4

$$f(x) = \frac{2(x+1)}{27}, 2 < x < 5$$

$$= 0, \text{ elsewhere}$$

Find (i) $P(X < 4)$ and (ii) $P(3 < X < 4)$

8. a) What is the differences between Bernoulli and Binomial distribution? State the important properties of Binomial distribution. 3
- b) Find mean and variances of Binomial distribution. 4
- c) A traffic control officer reports that 75% of the trucks passing through a check post are from within Dhaka city. What is the probability that at least three of the next five cars are from outside of Dhaka city? 3

28
22
2
24
2

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science & Engineering
2nd Year 1st Semester B.Sc. Engineering Examination, 2020
Course Code: MAT205, Course Title: Vector, Matrix and Fourier Analysis

Time: 3 hours

Full Marks: 60

- N.B. i) Answer **SIX** questions, taking any **THREE** from each section.
 ii) All questions are of equal values.

SECTION-A (30 Marks)

- Q.1 (a) Define unit vector. Find a unit vector parallel to the resultant of vectors $r_1 = 2i + 4j - 5k$ and $r_2 = i + 2j + 3k$ 5
- (b) Find the unit tangent vector to any point on the curve $x = t^2 + 1$, $y = 4t - 3$, $z = 2t^2 - 6t$. Also determine the unit tangent at the point where $t = 2$. 5
- Q.2 (a) Define gradient, divergence and curl. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at $(1, -2, -1)$ in the direction $2i - j - 2k$. 6
- (b) Prove that: $\nabla \times (\phi A) = (\nabla \phi) \times A + \phi(\nabla \times A)$ 4
- Q.3 (a) Define line integrals, surface integrals and volume integrals. Find the total work done in moving a particle in a force field given by $F = 3xyi - 5zj + 10xk$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$. 6
- (b) Evaluate $\iint_S A \cdot n \, dS$, where $A = zi + xj - 3y^2zk$ and S is the surface of the cylinder $x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$. 4
- Q.4 (a) State and prove Green's theorem in the plane. 6
- (b) Verify Green's theorem in the plane for $\oint_C (xy + y^2)dx + x^2dy$ where C is the closed curve of the region bounded by $y = x$ and $y = x^2$. 4

SECTION-B (30 Marks)

- Q.5 (a) Define symmetric matrix, hermitian matrix and orthogonal matrix with example. Show that $A = \begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$ is a idempotent matrix. 6
- (b) Show that, every square matrix can be uniquely expressed as the sum of a symmetric matrix and a skew-symmetric matrix. 4

Q.6 (a) Using row canonical form, find the inverse of the following matrix:

$$A = \begin{bmatrix} 3 & 4 & -1 \\ 1 & 0 & 3 \\ 2 & 5 & -4 \end{bmatrix}$$

(b) Define rank of a matrix.

Find the rank of the matrix $A = \begin{bmatrix} 1 & 3 & 1 & -2 & -3 \\ 1 & 4 & 3 & -1 & -4 \\ 2 & 3 & -4 & -7 & -3 \\ 3 & 8 & 1 & -7 & -8 \end{bmatrix}$.

Q.7 (a) Define Fourier series.

Find the Fourier series of the function $f(x) = \begin{cases} 0, & -\pi \leq x \leq 0 \\ 1, & 0 \leq x \leq \pi \end{cases}$.

(b) Find the Fourier integral of the function $f(x) = e^{-kx}$ when $x > 0$ and $f(-x) = f(x)$ for

$k > 0$, and hence prove that $\int_0^{\infty} \frac{\cos ux}{k^2 + u^2} du = \frac{\pi}{2k} e^{-kx}$.

Q.8 (a) Find the Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$.

(b) Use finite Fourier transforms to solve

$$\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2}; \quad U(0, t) = 0; U(\pi, t) = 0; U(x, 0) = 2x \quad \text{where } 0 < x < \pi, t > 0.$$

$$\iiint_V A \cdot n \, dV = \iint_R A \cdot n \frac{dx \, dy \, dz}{|n \cdot \hat{j}|}$$

$$\nabla \cdot (x^2 + y^2) = 2x + 2y$$

$$R_1 = \frac{R_1}{3}$$

$$R_2 = R_2 - R_1$$

$$R_3 = R_3 - 2R_1$$

$$R_2 = -\frac{3}{4}R_2$$

$$R_1 = R_1 - \frac{1}{3}R_2$$

$$R_3 = R_3 - \frac{7}{3}R_2$$

$$R_3 = \frac{2}{5}R_3$$

$$R_1 = R_1 - 3R_3$$

$$R_2 = R_2 + \frac{5}{2}R_3$$

10107 What is the Median?

Median plays an important role in the world of statistics. By definition, it is a value which divides an array into two equal parts. In this problem you are to determine the current median of some long integers. Suppose, we have five numbers $\{1, 3, 6, 2, 7\}$. In this case, 3 is the median as it has exactly two numbers on its each side. $\{1, 2\}$ and $\{6, 7\}$. If there are even number of values like $\{1, 3, 6, 2, 7, 8\}$, only one value cannot split this array into equal two parts, so we consider the average of the middle values $\{3, 6\}$. Thus, the median will be $(3+6)/2 = 4.5$. In this problem, you have to print only the integer part, not the fractional. As a result, according to this problem, the median will be 4!

Input

The input file consists of series of integers X ($0 \leq X < 2^{31}$) and total number of integers N is less than 10000. The numbers may have leading or trailing spaces.

Output

For each input print the current value of the median.

Sample Input

```
1
3
4
60
70
50
2
```

Sample Output

```
1
2
3
3
4
27
4
```