

- N.B. i) Answer **ANY TWO** questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.

**SECTION A**

(Answer **ANY TWO** questions from this section in Script A)

1. a) Write the characteristics of member function. Show memory allocation of objects. (10)
- b) Define encapsulation. What are the special characteristics of static member variable? Give an example how static variable works. (10)
- c) Define the ways of passing an object as a function argument with proper example. Show the way of defining a member function to the outside of class definition. (10)
2. a) Differentiate between default constructor and default argument constructor. What are the special characteristics of constructor? (10)
- b) Is it possible to call constructor and destructor explicitly? Explain with suitable example. Also explain the output. Why should the copy constructor accept its parameter by reference in C++? (10)
- c) What are the advantages of this pointer? Explain the difference between references and pointer with example. (10)
3. a) Write a program to add two complex number. Also overload the '+' operator. Sample input and output are given below. (10)

input		object
real	img	
2	3	2+3i
4	5	4+5i

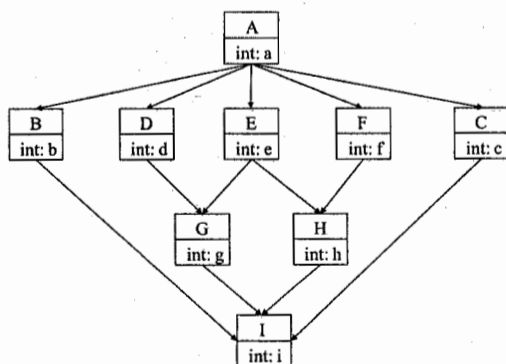
<b>Main Body:</b> complex c <sub>1</sub> (2, 3), c <sub>2</sub> (4, 5); complex c <sub>3</sub> = c <sub>1</sub> + c <sub>2</sub> ; complex c <sub>4</sub> = c <sub>3</sub> ++;
---

- b) Is it possible to overload IO operator using member function? Show how the overloading of input operator is done using friend function. (12)
- c) What is dynamic constructor? Write the special characteristics of destructor. (08)

**SECTION B**

(Answer **ANY TWO** questions from this section in Script B)

4. a) Consider the following diagram for inheritance. The arrow indicates the base class to derived class. The capital case letters represent the class name and others are public data numbers. Now, implement the inheritance into a C++ code using least number of "virtual" keyword so that the instructions in the given main() program works properly. (20)



<pre> #include&lt;iostream&gt; using namespace std; int main(){     I cc;     cc.a = 6;     cc.e = 9;     return 0; }                 </pre>
--

- b) Does the following code work correctly? If yes, then what will be the output? Or if not, then where are the abnormalities and how do you handle it? (10)

```

#include<iostream>
using namespace std;
int main(){
    int data[] = {10, 340, 200, 0, 50, 60};
    float sum = 0;
    for(int i = 0; i <= sizeof(data) / sizeof(int); i++)
        sum += 1 / data[i];
    cout << sum << endl;
    return 0;}
    
```

5. a) How does constructor in the derived class work? Explain with proper example. (10)  
 b) Discuss the properties of "type\_info" class for run time type identification. (10)  
 c) What type of reusability is implemented in the following code? Is there exist any problem? If yes, then how can you overcome it? Otherwise analyze the output. (10)

```
#include<iostream>
using namespace std;
class Base1{
    public:
        void display(){
            cout << "Base1\n";
        }
};
class Base2 : Base1{
    public:
        void display(){
            cout << "Base2\n";
        }
};
class Derived : public Base2{
    public:
        void displays (){
            cout << "Derived\n";
        }
};
int main(){
    Derived dd;
    dd.display();
    return 0;
}
```

6. a) Design a class containing attributes a and b where (a, b) denotes a 2D point and membership function cal\_dis\_distance(point1, point2) for calculating the distance between two 2D points and displaying the distance. Derive another class which contain a data member c and reuses the properties of 2D class. So, the object of derived class denotes a 3D point. Use constructor in both classes to initialize an object of the classes. Then declare and initialize two objects (2D points) of base class and two objects of 3D points of derived class and calculate the distances between the corresponding points. You must use the base class pointer of object for the calculations and displaying the distances. (18)  
 b) Show the different types of casting that are possible for the following program in main() section? Remember, you cannot create further object. (12)

```
#include<iostream>
using namespace std;
class Creature{
    public:
        virtual void eat(){
            cout << "All creature eats\n";
        }
};
class Human : public Creature{
    public:
        void eat(){
            cout << "All human eats\n";
        }
};
int main(){
    Creature *pp, oCr;
    Human *hum, oHum;
    //Write from here
    return 0;
}
```

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Term Examination, 2020  
Department of Computer Science and Engineering  
CSE 2105

Data Structures and Algorithms

TIME: 1.5 hours

FULL MARKS: 120

- N.B. i) Answer **ANY TWO** questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.

**SECTION A**

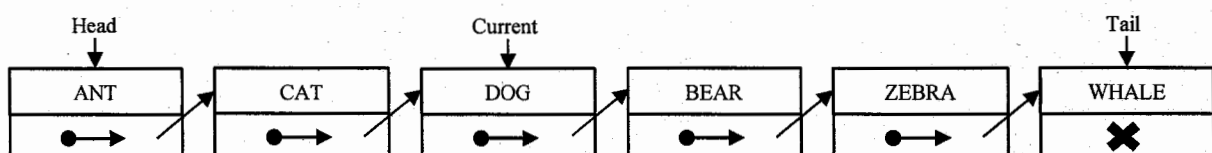
(Answer **ANY TWO** questions from this section in Script A)

1. a) How do you calculate the element address in two-dimensional array? Consider the linear array  $AA[25:75]$  and  $BB[-10:50]$  (15)  
i) Find the number of elements in each array.  
ii) Suppose  $Base(AA) = 300$  and  $\omega = 7$  words per memory cell for  $AA$ . Find the address  $AA[65]$  and  $AA[70]$ .  
b) How do you access and store the elements of array? (07)  
c) Is recursion a better solution technique than iteration? Justify your answer. (08)
2. a) Suppose queue is stored in a circular array with  $N = 10$  memory cells. (10)  
i) Find the member of elements in a queue when  $FRONT = 2$ ,  $REAR = 6$ .  
ii) When will the array be filled?  
b) What are the relative advantages and disadvantages of array and one-way list representation of a priority queue? (08)  
c) What are the moves allowed by the solution of Towers of Hanoi problem when  $n = 4$  disks? (12)
3. a) Translate the infix expression  $((A*(B+D)/E) - F*(G+H/K))$  to its equivalent postfix expression. Which data structure is needed for this task? (14)  
b) Construct a Min-heap  $H$  from the following list of numbers: (16)  
34, 30, 40, 22, 50, 2, 55, 77, 55, last digit of your roll number.  
and  
i) Insert another item 70 into the constructed heap.  
ii) Then delete the number 22 for reheaping it. What are the correct steps in both cases? Explain.

**SECTION B**

(Answer **ANY TWO** questions from this section in Script B)

4. a) Given a singly linked list which represents a number where each node contains only one digit [0-9]. Write a sample program to add 1 to the number represented by the given linked list and print the new linked list. (10)  
Example:  
Input:  $1 \rightarrow 2 \rightarrow 9 \rightarrow 9$   
Output:  $1 \rightarrow 3 \rightarrow 0 \rightarrow 0$   
Input:  $1 \rightarrow 9 \rightarrow 9 \rightarrow 9$   
Output:  $2 \rightarrow 0 \rightarrow 0 \rightarrow 0$   
Input:  $9 \rightarrow 9 \rightarrow 9 \rightarrow 9$   
Output:  $1 \rightarrow 0 \rightarrow 0 \rightarrow 0 \rightarrow 0$   
b) The diagram below depicts a linked list of strings that has been partially sorted by a version of the insertion sort algorithm. The algorithm has been adapted for working with the linked lists. Like the array-based version of the algorithm, it considered the elements of the list from left to right and we insert each element in the correct position with respect to the elements that come before it in the list. However, as we are dealing with the linked list, the algorithm cannot perform backward pass to determine the appropriate location for a given element. Rather, it performs a forward pass to find the point of insertion. (20)



Assume the following declarations have been made:

```
class Node
{
    Public:
        string id;
        Node *next;
};
Node *head;
Node *tail;
Node *temp;
Node *current;
```

Head refers to the first element of the list, tail to the last element, and current to the last element in the portion of the list that is known to be correctly ordered.

- i) Show on the diagram above how references will be modified after the node with the id "BEAR" has been moved by the algorithm to its appropriate position in the list. Also, write sample code for the operation.
- ii) When insertion sort is used for sorting a large array of  $n$  elements, both the number of data moves and the number of comparisons are proportional to  $n \times n$ . For sorting a linked list, one aspect of this behaviour is better. State which, and briefly explain why.

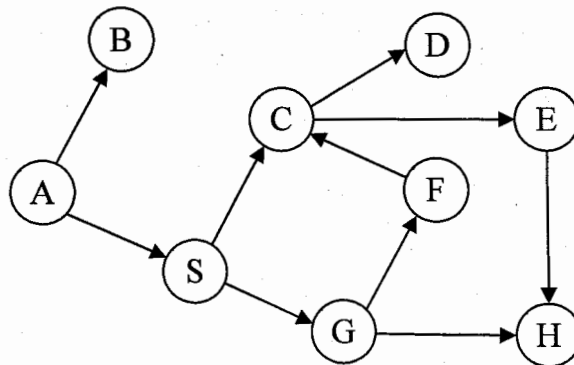
5. a) Consider each digit of your roll number as a single numeral and store them in an array. Sort them either using selection or insertion sort. Then, apply binary search algorithm to find a number from that sorted array. (15)

Example: Roll '1807562'.

Array A:	1	8	0	7	5	6	2
Sorted Array A':	0	1	2	5	6	7	8

Now, if we want to find '5' as search item, it will return '3' as '5' is in the 4<sup>th</sup> position of the array A'. Show step by step simulation. Also, write a sample code for this.

- b) Define the terms: complete graph, directed graph and degree of node in a graph. Consider the following graph  $G$ . Now, run a Breadth-First Search (BFS) algorithm on  $G$  to find the minimum path  $P$  from A to H. Show the queue status after each iteration. (15)



6. a) What is the Big-O time complexity of traversing, inserting a node at the front, deleting a node at the end of a circular linked list and two-way linked list? Explain your answer with proper illustrations. (12)
- b) Consider a hash table of size 7 with hash function  $h(k) = k \bmod 7$ . Draw the table that results after inserting in the given order, the values 20, 27, 14, 52, 26 for each of the scenarios below: (13)
  - i) When collision is handled by linear probing.
  - ii) When collision is handled by double hashing using a second hash function  $h'(k) = 5 - (k \bmod 5)$ .
- c) What is the purpose of the partition procedure in Quicksort? (05)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 B.Sc. Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Term Examination, 2020  
 Department of Computer Science and Engineering  
 MATH 2107

Fourier Analysis and Linear Algebra

TIME: 1.5 hours

FULL MARKS: 120

- N.B. i) Answer **ANY TWO** questions from each section in separate scripts.  
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**SECTION A**

(Answer **ANY TWO** questions from this section in Script A)

1. a) Define causal and noncausal system with example. Check the following function (10)  
 (i)  $y(t) = x(t^2)$ , (ii)  $y(t) = x^2(t)$  are causal or not.  
 b) Write down the important property of the ROC for z-transform. Find the inverse z-transform (20)  
 of  $X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$ , using long division method for ROC  $|z| > 1$ .
2. a) Define z-transform. Determine the z-transform of the signal  $x(n) = a^n u(n) - b^n u(-n-1)$  (10)  
 ( $a$  and  $b$ )  $< 1$ ,  $b > a$  and plot the ROC.  
 b) Write down the dirichlet's condition for Fourier series. Obtain Fourier series expansion of (20)  
 $f(x) = x \sin x$  in the interval  $-\pi < x < \pi$  hence deduce that,  $\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} \dots$
3. a) Define integral transform and hence find the kernel of Fourier transform. Find the Fourier (18)  
 transform of  $f(x) = \begin{cases} 1 - x^2, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases}$  hence evaluate,  $\int_0^{\infty} \frac{x \cos x - \sin x}{x^2} \cos^{x/2} dx$   
 b) Find the Fourier integral of the function  ~~$K > 0$~~  when  $x > 0$  and  $f(-x) = f(x)$  for  $K > 0$  hence (12)  
 prove that  $\int_0^{\infty} \frac{\cos ux}{K^2 + u^2} du = \frac{\pi}{2K} e^{-Ku}$ .  $\int(x) = e^{-Kx}$

**SECTION B**

(Answer **ANY TWO** questions from this section in Script B)

4. a) Define rank of a matrix. Reduce the matrix A to its echelon form then to its canonical form (18)  
 and hence find its rank where  $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$   
 b) If exists, find the inverse of the matrix A by applying elementary transformations where, (12)  
 $A = \begin{bmatrix} 1 & -1 & 1 \\ 4 & 1 & 0 \\ 8 & 1 & 1 \end{bmatrix}$
5. a) Find the basis for the row space and column space of the matrix (15)  
 $A = \begin{bmatrix} 1 & -2 & 5 & 0 & 3 \\ -2 & 5 & -7 & 0 & -6 \\ -1 & 3 & -2 & 1 & -3 \\ -3 & 8 & -9 & 1 & -9 \end{bmatrix}$   
 b) Consider the vector space  $\mathbb{R}^3$  with Euclidian inner product. Use the Gram-Schmidt (15)  
 orthogonalization process to transform the basis vectors  $u_1 = (1, 1, 1)$ ,  $u_2 = (-1, 1, 0)$ ,  
 $u_3 = (1, 2, 1)$  into an orthogonal basis vectors to obtain an orthonormal basis  $\{v_1, v_2, v_3\}$ .

6. a) Test the consistency of the following system of equation  $x + y + z = 9$ ;  $2x + 5y + 7z = 52$ ;  $2x + y - z = 0$ . If the system is consistent then solve it. (14)

b) Find the eigen values and one of the corresponding eigen vector of the matrix  $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$  (16)

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Department of Computer Science and Engineering  
CSE 2113  
Computer Architecture

TIME: 1.5 hours

FULL MARKS: 120

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**SECTION A**

(Answer **ANY TWO** questions from this section in Script A)

1. a) Draw the block diagram of a general purpose computer and explain it in the light of Von-Neuman architecture. (11)  
b) What problems are solved using memory hierarchy? (07)  
c) How performance mismatch can be solved in computer architecture? Explain in brief. (06)  
d) Draw the structure of control unit. (06)
2. a) Draw and explain the flowchart for unsigned binary multiplication. Also, use proper example(s) in the explanation section. (10)  
b) Explain Booth's algorithm with proper example(s). (10)  
c) Calculate  $X = (A+B) * (C+D)$ , using zero, one, two and three address representation. (10)
3. a) What is meant by branch in instruction pipelining? Explain with proper illustrations(s). Also, briefly discuss the available approaches to deal with the branches in pipeline. (15)  
b) Draw and explain the instruction cycle state diagram with proper example(s). (10)  
c) Differentiate between RISC and CISC. (05)

**SECTION B**

(Answer **ANY TWO** questions from this section in Script B)

4. a) Consider a computer system requires (10)
  - i) 10 clock cycles for each memory read access when cache memory does not exist.
  - ii) 17 clock cycles to load a block into cache when cache exists and single clock cycle to access cache. Suppose a typical program in which 20% of its instructions program a read or write operation.Calculate improvement of the performance for using cache if the hit in the cache are 0.9 for instructions and 0.8 for data.  
b) Consider a small memory consisting of 64K words of 8 bits each. How do you organize this memory using 16K × 1 static memory chips? Explain with proper figure. (09)  
c) Explain the operating principle of static and dynamic RAM with appropriate figures. Which one is more energy efficient and why? (11)
5. a) A 7 bit data 1010101 is passed and written. After that when reading we use Hamming corrector and before correcting, we get 1010100 (bit position b1 is changed). How do you detect and correct this one bit error? (10)  
b) The hypothetical machine has the following instructions: (08)  
0001 = Load AC from memory  
0010 = Store AC to memory  
0101 = Add AC from memory  
Suppose the value 2 and 3 are stored in memory 940 and 941 respectively. Explain program execution with figure to store sum of two values in the memory location 940. Consider Program Counter (PC), Accumulator (AC) and Instruction Register (IR) for operation.  
c) "RAID4 involves a write penalty when I/O write request of small size is performed" – Justify the statement. (06)  
d) How do you ensure state data will not exist in the cache? (06)
6. a) Suppose three interrupt handles  $A$ ,  $B$  and  $C$  (having priority level  $A > B > C$ ) with Interrupt Service Routine (ISR) 10, 30, 20 respectively. Graphically show the transfer of control for interrupt sequence of  $C$ ,  $A$  and,  $B$  at time  $t = 10, 25, 45$  respectively. (08)

- b) In a computer system, main memory and cache ratio is 32:1 and 20 bits is for the addressing. (09)  
Find
- i) TAG, BLOCK and WORD bits in direct mapping when block size is 8 words.
  - ii) TAG and WORD bits in associative mapping for 16 word block size.
  - iii) TAG, BLOCK and WORDS bits for set-associative mapping for 4 blocks per set and 8 words block size.
- c) “The cache bridges the speed gap between the processor and the main memory. The virtual memory mechanism bridges the size and the speed gaps between main memory and secondary storage” – Justify the statement. (08)
- d) What is cache-coherence problem? (05)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Term Examination, 2020  
Department of Computer Science and Engineering  
EEE 2113  
Digital Electronics

TIME: 1.5 hours

FULL MARKS: 120

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**SECTION A**

(Answer **ANY TWO** questions from this section in Script A)

1. a) What is meant by digital logic families? Design the following functions using CMOS logic (10)  
(i)  $F_1 = (A+B+C) \cdot D$  (ii)  $F_2 = (A+BC+DEF)$   
You can use CMOS NAND or CMOS NOR logic to design these functions.  
b) Write down the classification of different TTL sub-families. Also, show the meaning of "MC74HC86N" (10)  
c) What is Fan-out? Draw the circuit diagram for finding loading factor of DTL logic family. (10)
2. a) Classify different types of A/D and D/A converters. Draw and write the steps for conversion of 7.1V into digital signal using successive approximation A/D converter. (12)  
b) Why dual slope A/D converter is preferable than single slope converter? Explain with circuits and equations. (10)  
c) Draw the circuit of six transistor based static RAM cell. (08)
3. a) What is PLD? Classify PLD. Draw the block diagram of CPLD's and FPGA's. (10)  
b) Classify the computer memory system. Write short notes on i) ROM, ii) RAM, iii) EPROM, iv) EEPROM v) PROM. (10)  
c) Draw the circuit diagram for R-2R and binary weighted D/A converter with their output equations. (10)

**SECTION B**

(Answer **ANY TWO** questions from this section in Script B)

4. a) Describe pulse waveform. Classify the pulse generating circuit. Mention some applications of pulse waveforms. (10)  
b) Draw the circuit diagram of a Bistable and monostable multivibrator. Also write their applications. (10)  
c) Explain clamping and clipping circuit using circuit diagram and input-output waveform. (10)
5. a) What is meant by UTP and LTP? Draw the input/output characteristics of Schmitt trigger circuit. (10)  
b) Draw the circuit diagram of a RC-phase shift oscillator. Also write its applications and expression for frequency. (10)  
c) How a transistor can be used as a switch? Explain with the concept of operating mode of transistor. (10)
6. a) Write short notes on (i) hysteresis voltage, (ii) DMM, (iii) VTVM (10)  
b) Draw and design an 555 oscillator to produce an square wave at 40KHz. Consider  $C > 470\text{pF}$ . (10)  
c) What is sweep time and restoration time? Design a constant voltage sweep circuit with input and output waveforms. (10)