

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2nd Year 1st Term Examination, 2017  
Department of Computer Science and Engineering  
CSE 2101

Object Oriented Programming

TIME: 3 hours

FULL MARKS: 210

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

SECTION A

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

1. a) Write down minimum number of constructors to declare six objects of any user-defined class (08) using following parameters as a constructor parameter:  
i) ('A', 3, 3.2), ii) (2, 3.4), iii) ('B', 2), iv) (2, 3.3, 'A'), v) (2, 3.4, 2), vi) ('C').  
b) Create a STUDENT class that includes a student's first\_name (private), roll\_number (private) (12) and marks of three subjects (private). Now create a demo array of objects and copy the previously created objects into this demo one using copy constructor.  
c) How can we prevent class objects from being copied to other object? Explain with examples. (10)  
d) Explain the differences between references and pointer with example (05)
  
2. a) Define a class "String" that could work as a user defined string type. Include constructor that (15) will enable you to create an uninitialized string.  
String S1; //string with length 0.  
And also to initialize an object with a string constant at the time of creation like.  
String S2; ("object oriented");  
Now, overload '+' operator to add two strings making a third string <sup>and</sup> '=' operator to check whether the two strings are equal or not. (Do not use any string related built in function).  
b) Can we overload main() in C++? Explain your position with proper reasons. (05)  
c) Why overloading of operator '<<' must return by reference? Is it possible to overload '<<' (10) operator using member function? Explain with examples.  
d) Predict the output of the following program: (05)

```
#include <iostream>
using namespace std;
class Test{
    static int x;
public:
    static int y;
    void func(int x){
        cout<<"Value of Test :: x is" <<Test::x;
        cout<<"Value of x is" <<x;
    }
};
int Test::x = -1;
int Test::y = 2;
int main(){
    Test obj;
    int x = 3;
    obj.func(x);
    cout<<"\n Test::y = "<<Test::y;
    return 0;
}
```

3. a) What mistake prevents the following class declaration from functioning properly as an (08) abstract class?

```
class Shape{
public:
    virtual double print()const;
    double area()const{
        return base * height;}
};
private:
    double base;
    double height;
};
```

- b) From the following class definition find out the errors. Rewrite the program after removing errors and then predict the output of the modified program. NOTE: You cannot define any new constructor for any classes and the given constructor for each class must take only one integer value as a parameter except A1's default constructor. (15)

```
#include <iostream>
using namespace std;
class A1{
public:
    A1(int x){
        cout<<"A1 :: A1(int) called"<<endl;}
};
class A2 : public A1{
    A2(int x){
        cout<<"A2 :: A2(int) called"<<endl;}
};
class A3 : public A1{
    A3(int x){
        cout<<"A3 :: A3(int) called"<<endl;}
};
class A4 : virtual public A2{
public:
    A4(int x){
        cout<<"A4 : A4(int) called"<<endl;}
};
class A5 : virtual public A3{
public:
    A5(int x){
        cout<<"A5 : A5(int) called"<<endl;}
};
class A6 : public A4, public A5{
public:
    A6(int x){
        cout<<"A6 :: A6(int) called"<<endl;}
};
int main(){
    A6 A61(30);
    return 0;
}
```

- c) Define two classes Polar and Rectangle to represent in the Polar and Rectangle system. Use conversion routines to convert from one system to another. (12)
4. a) Design a class hierarchy for persons (class Person), students (class Student), and master students (class MasterStudent), such that a person has a name (of type string), a student is a person with an additional matric\_number (of type int), and a master student is a student with an additional subject (of type string). Provide suitable constructors for the classes and make sure that all data members are private. Write a virtual member function info that prints all information (i.e. the data members) about a person and override this function in the derived classes such that also the additional information about students and master students is printed. When overriding info, call the info function of the base class first and then print the additional information. (15)
- b) What do you mean by "this" pointer? Explain with example. (06)
- c) Why is the use of the '<<' and '>>' operators called "formatted" I/O and the use of the functions put(), get(), write(), read() etc. called "unformatted" I/O. (07)
- d) Why argument to a copy constructor must be passed as a reference? (07)

### SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) "A deep copy allocates memory for the copy and then copies the actual value, so that the copy lives in distinct memory from the source". Explain with appropriate code. (08)
- b) Is it possible to use template version of Lambda Expression? Justify your opinion briefly. (06)
- c) What is the difference between list's member function remove() and algorithm's remove()? (05)
- d) Traverse the map: map<string, list<map<string, vector<int>>>> (06)
- e) Write down the template version background code for the following code segment. (06)
- ```
for each(vect.begin(), vect.end(), print it);
```
- Where "vect" is a vector and "print\_it" is a function.
- f) What will be the output of the following code? (04)

```

class Lsb_less{
public:
    bool operator()(int x, int y){
        return (x%10)<(y%10);
    }
};
set <int,Lsb_less>s = {21,23,26,27};
set <int,Lsb_less> :: iterator itr1, itr2;
itr1 = find(s.begin(), s.end(),36); //output = ??
itr2 = s.find(36); //output = ??

```

6. a) (08)

```

int main()
{
    Auto_ptr <Resource> res (new Resource)
}
return 0;

```

Use smart pointer concept and append necessary code with the above code segment in such a way that "res" gets deallocated when it goes out of scope.

b) What would be the problem when you write the following code segment? (*Auto\_ptr* is a smart pointer). (05)

```

Auto_ptr <Resource> res1 (new Resource);
Auto_ptr <Resource> res2 (new res1);

```

c) <sup>Complete</sup> Compute the following two tables. (06)

| L-value reference       | Can be initialized with | Can modify |
|-------------------------|-------------------------|------------|
| Modifiable L-values     | ---                     | ---        |
| Non-Modifiable L-values | ---                     | ---        |
| R-values                | ---                     | ---        |

| R-value reference       | Can be initialized with | Can modify |
|-------------------------|-------------------------|------------|
| Modifiable L-values     | ---                     | ---        |
| Non-Modifiable L-values | ---                     | ---        |
| R-values                | ---                     | ---        |

d) (08)

```

class Dog{
public:
    void bark(){
        cout<<"I don't have a name."<<endl;
    }
};
class YellowDog : public Dog{
    string m_name;
public:
    YellowDog(string name):m_name(name){}
    void bark(){cout<<"My name is "<<m_name<<endl;}
};

```

Write necessary codes (use STL containers) to arise a scenario of "object slicing" and then resolve it.

e) (08)

|                                                                                                                                                                            |                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre> template &lt;class T&gt; class storage8{ private:     T m_array[8]; public:     void set(int index, const T &amp;value)         { m_array[index] = value;} }; </pre> | <pre> int main(){     storage8&lt;int&gt;intstorage;     for(int c = 0;c &lt; 8;c++)         intstorage.set(c,c);     storage8&lt;bool&gt;boolstorage;     for(int c = 0;c &lt; 8;c++)         boolstorage.set(c,c&amp;3);     return 0; } </pre> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*storage8<bool>* class in the above code segment contains 8 bools, which is 1 byte worth of useful information and 7 byte of wasted space. Now, using the concept of class template initialization, append necessary code with the above code segment so that the *array* of 8 bools can be replaced with a variable that is single byte in size.

7. a) Give two solutions for the problem in the following code segment (04)

```
try{
    Person *pJohn = new Person("John", 18);
    ProcessPerson(pJohn); //Exception occurs here
    delete pJohn;
}
catch(PersonException &CE)
{
    cerr<<"Fail: "<<&CE.what();
}
```

- b) Give an example of ~~stack~~<sup>stack</sup> unwinding via exception handling. (07)  
 c) "Exceptions should not be thrown in destructors". Why? (05)  
 d) What does it mean to delete memory and what is dangling pointer? (06)  
 e) What are the problems of writing pointers to disk? (07)  
 f) Identify the problem in each of the following codes. (06)

i) void doSomething()                      ii) int value = 5;  
 {                                              int \*ptr = new int;  
     int \*ptr = new int;                      ptr = &value;  
 }  
 iii) int \*ptr = new int;  
       ptr = new int;

8. a) Write necessary code to read the content from an input file (in.txt) and make an output file (06) that looks like out.txt. Use file pointer manipulator concept for this.

|                                                                      |                                      |
|----------------------------------------------------------------------|--------------------------------------|
| This is line 1<br>This is line 2<br>This is line 3<br>This is line 4 | is line 1<br>line 2<br>his is line 4 |
| in.txt                                                               | out.txt                              |

b) What are the errors in the following code segments? (if any) (04)

|                                                                                          |                                                                                    |
|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| vector<int>vec = {2,3,4,5};<br>int *p = &vec[3];<br>vec.push_back(6);<br>cout<<*p<<endl; | deque<int>deq = {2,3,4,5};<br>p = &deq[3];<br>deq.push_back(6);<br>cout<<*p<<endl; |
|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|

- c) Given a key, use Lambda Expression and find\_if algorithm to find the corresponding value in (08) an STL map?  
 d) What are the ways to insert a custom object in a set? Explain with appropriate code only. (08)  
 e) What is anonymous variable? Is it possible to hold the address of an anonymous object? (05) Justify your answer.  
 f) What is meant by each of the following code segments: (04)

i) char \*const ptr1 = "ABC";  
 ii) int const \*ptr2 = &m;  
 iii) const char\* const cp = "XYZ";  
 iv) const static int x = 42;

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 B.Sc. Engineering 2nd Year 1st Term Examination, 2017  
 Department of Computer Science and Engineering  
 CSE 2105

Data Structures and Algorithms

TIME: 3 hours

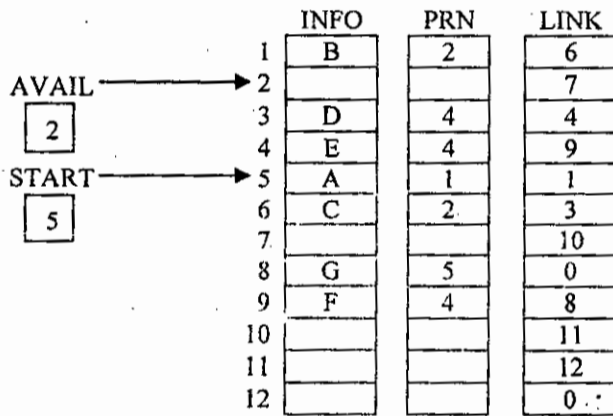
FULL MARKS: 210

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

**SECTION A**

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

1. a) Define data structure. Give some examples of linear and non-linear data structure. (06)
  - b) Suppose a five dimensional array A is declared using A(2:8, -4:1, 6:10, 3:7, -2:6). Consider the element A[3, -1, 8, 4, 2] in A. Find the effective indices E<sub>1</sub>, E<sub>2</sub>, E<sub>3</sub>, E<sub>4</sub>, E<sub>5</sub> and the address of the element in row-major order and column-major order, assuming Base(A) = 400 and there are w = 4 words per memory location. (12)
  - c) Why do we need postfix and prefix notation over infix notation? Translate the infix notation  $A*(B+D)/E - F*(G+H/K)$  to its equivalent postfix notation using stack. (10)
  - d) "The average number of comparison required to find the location of an item is approximately equal to half the number of elements in an array" – justify the statement. (07)
2. a) How can you minimize overflow in stack? Explain with example(s). (06)
  - b) Consider the priority queue in the following figure which is maintained as a one way list. (08)



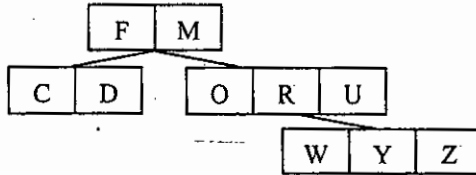
- i) Describe the structure after (X, 2), (Y, 3), (Z, 2) and (W, 1) are added to the queue.
  - ii) Describe the structure if, after the preceding insertions, 3 elements are deleted.
  - c) Write a recursive procedure to solve the 'Tower of Hanoi' problem. (08)
  - d) Show the steps if you apply merge sort algorithm for the following data in ascending order: (08)  
 66, 33, 40, 22, 53, 88, 60, 11, 80, and 20
  - e) Discuss how stacks can be used for checking balancing of symbols. (05)
3. a) Consider the following deque of characters where DEQUE is a circular array which allocates six memory cells: (10)  
 LEFT = 2, RIGHT = 4, DEQUE: -----, A, C, D, -----, -----  
 Describe the deque while the following operations take place:
    - i) F is added to the right of the deque.
    - ii) Two letters on the right are deleted.
    - iii) K, L, M are added to the left of the deque.
    - iv) One letter on the left is deleted.
    - v) R is added to the left of the deque.
  - b) Consider a hash table of size 7 with hash function  $h(k) = k \text{ mod } 7$ . Draw the table that results after inserting in the given order, the values, 19, 26, 13, 48, 17 for each of the scenarios below: (12)
    - i) When collisions are handled by separate chaining.
    - ii) When collisions are handled by linear probing.
    - iii) When collisions are handled by double hashing.
 Using a second hash function  $h'(k) = 5 - (k \text{ mod } 5)$ .
    - c) Why does a good hash function important? (05)
    - d) Using your own data, explain how binary search algorithm works. Also discuss the limitation of this algorithm. (08)

4. a) Compress the sentence "Happy hip hop" using Huffman coding scheme and also show the effectiveness of the compression. (12)
- b) Define garbage collection, overflow and underflow. (08)
- c) Sort the items using Quick Sort algorithm: 44, 33, 11, 55, 77, 44, 40, 90 and 60. (15)

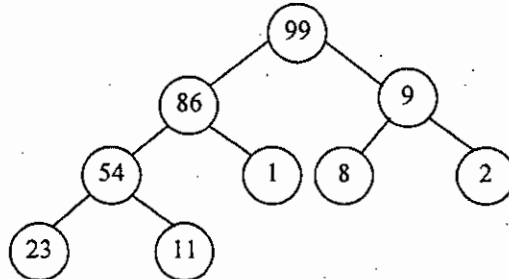
**SECTION B**

(Answer ANY THREE questions from this section in Script B)

5. a) Write a function that will merge two linked lists of integer, assuming that they are sorted in ascending order. The merged list should itself be sorted in ascending order. (15)
- b) The following figure is represented as a 4-way search tree. Draw the final tree after deletion of U and M. (06)

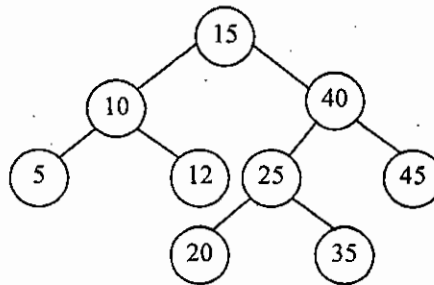


- c) What is the main advantage of splay tree over any kind of balanced trees? Explain with example. (06)
- d) What is Big-O time complexity of traversing, inserting a node at the front, inserting a node at the end of a linked list, circular linked list and doubly linked list? Explain your answer. (08)
6. a) What are the differences between heap and BST? When to use a heap and when to use a BST? (07)
- b) Consider the following heap: (20)



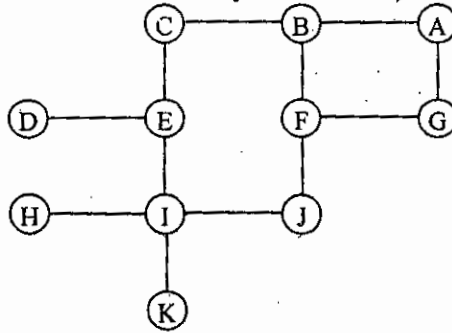
For each of the following questions use the original heap. Do not use the heap obtained after each answer.

- i) Represent the heap as an array indexed by 1 through 9.
- ii) Delete the element 99 from the heap shown in the above figure.
- iii) Delete the element 23 from the heap shown in the above figure.
- iv) Delete the element 8 from the heap shown in the above figure.
- v) Is it max heap or min heap? Sorting the elements in descending order by heap sort.
- c) Define full binary tree and complete binary tree. Convert the expression  $2*3/(2-1)+5*(4-1)$  into binary tree. Finally traverse the resulted tree by post order traversing technique. (08)
7. a) Consider the following AVL tree: (10)

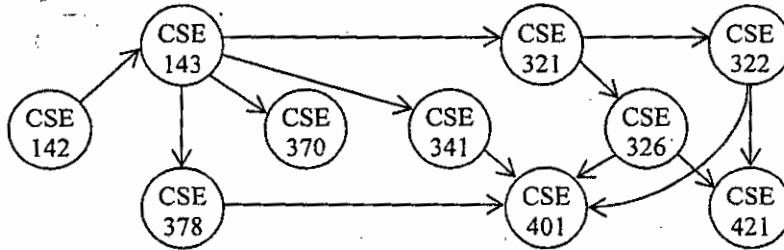


- i) Insert the key 30 into the tree and rebalance if needed. Draw the final and all intermediate trees that you need.
- ii) Remove the key 40 from the original tree and rebalance if needed. Draw the final tree and all intermediate trees that you need.
- b) The keys of value N, N-1, N-2, ..., 4, 3, 2, 1 are inserted in this order in a splay tree. What is the configuration at each step of the tree? What is cost in Big-O notation of each inserted operation? (10)
- c) Assign the keys 2, 3, 5, 7, 11, 13, 17 to the nodes of Red-Black tree so that they satisfy the binary search tree properly. Labeling each node with "red" or "black" and rebalancing if needed. Show the final tree and all intermediate trees that you need. (15)

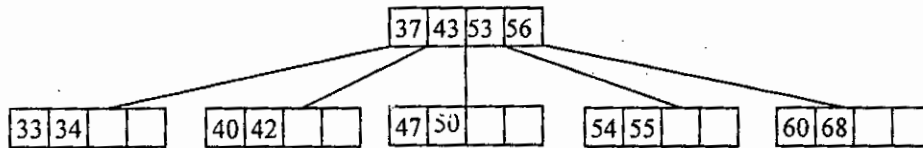
8. a) You find yourself in a maze, looking for exit. Which graph traversal techniques would you choose, depth-first or breadth-first? Why? Apply your choice in the following graph (Consider your position except D, H and K because they are for exit). (10)



- b) Find an order in which all these courses shown in the following figure can be taken using Topological Sort. (10)



- c) What is the most important advantage of  $B^+$  tree compared to B tree? (05)
- d) Is the tree given below a B tree or  $B^+$  tree or none? What is its degree? Show the new tree after insertion of the records with the key values 135, 200, 100 to the above tree if it's a proper tree structure. (10)







KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2nd Year 1st Term Examination, 2017  
Department of Computer Science and Engineering  
CSE 2113  
Computer Architecture

TIME: 3 hours

FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

SECTION A

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

1. a) Differentiate between computer architecture and computer organization with example(s). (08)  
b) How has the evolution of computer been characterized? Explain. (08)  
c) State and explain Von Neumann architecture with appropriate diagram. (07)  
d) Explain the operation of IAS machine with figure. (12)
  
2. a) What are principle concerns for computer arithmetic? "2's complement representation is better than 1's complement and sign magnitude representation"-justify. (10)  
b) Explain Booth's algorithm for two's complement multiplication. (08)  
c) Define overflow. Design an overflow detector circuit by discussing underlying theory. (10)  
d) What is instruction cycle? Explain instruction cycle state diagram with figure. (07)
  
3. a) Explain data flow in fetch, indirect and interrupt cycle. (09)  
b) What is instruction pipeline? How does it improve the performance of computer system? Explain with diagram. (08)  
c) What is meant by branch penalty? Discuss the various approaches for dealing with branches. (08)  
d) Calculate  $Z = \frac{A-B}{C+(D \times E)}$  using one, two and three address instructions. (10)
  
4. a) Define addressing modes. Discuss various type of addressing modes with their principal advantages and disadvantages. (12)  
b) What do you mean by instruction level parallelism? How does it differ from machine level parallelism? Explain. (08)  
c) What is RISC? State key features of RISC architecture. Differentiate between RISC and CISC with example(s). (07)  
d) Define superscalar processor. Differentiate it with 4-stage pipelining and super pipelined approaches. (08)

SECTION B

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

5. a) List and briefly define two approaches to deal with multiple interrupts. (08)  
b) Write the functions of the following registers: (08)  
i) PC  
ii) IR  
iii) MAR  
iv) MBR.  
c) A 4 bit data 1001 is passed and written. After that when reading we use Hamming corrector and before correcting we get 1101 (bit position  $b_3$  is changed). How do you detect and correct this one bit error? (10)  
d) "RAID 4 involves a write penalty when an I/O request of small size is performed"-justify this statement. (09)
  
6. a) What is DMA? Explain DMA data transfer procedure using appropriate figure. (12)  
b) In a computer system, main memory and cache memory ratio is 64:8 and 16 bits is for the addressing. Find (10)  
i) TAG, BLOCK and WORD bits in direct mapping when block size is 8 words.  
ii) TAG, SET and WORD bits for set-associative mapping for 4 blocks per set and 16 words per block.

- c) Look at the following algorithm that normalizes the elements of an array (A) of 10 numbers (13) with respect to the average value using a cache having 8 blocks. Each block consists of only one 16-bit word and the memory is word addressable with 16-bit address.

```

SUM: = 0
for j: = 0 to 9 do
    SUM: = SUM + A(1, j)
end
AVE: = SUM/10
for i: = 9 down to 0 do
    A(1, i): = A(1, i)/AVE
end

```

- i) Find contents of cache after each operation when followed associative mapping technique.
- ii) Again find the contents of cache for the second loop in reverse order (i.e., for  $i = 9$  to 0).

7. a) Explain operating principle of a static RAM with appropriate figure. (08)

- b) What is cache memory? How does it minimize gap between CPU and RAM? (07)

- c) 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 the cache when cache exists and
- iii) Single clock cycle to access cache.

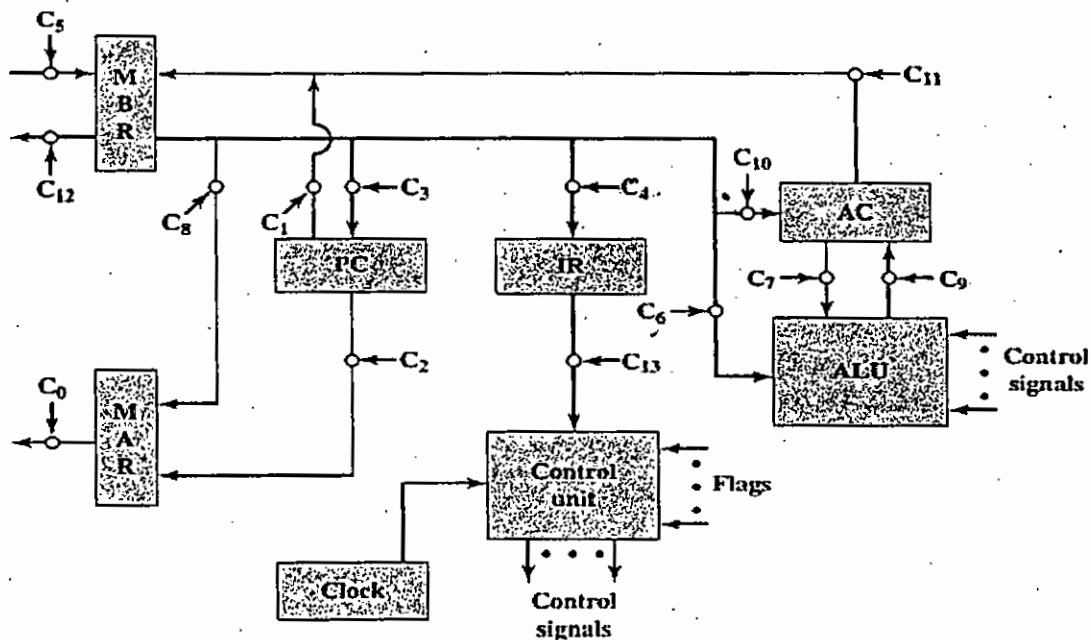
Calculate improvement of the performance for using cache for a typical program where 30% of the instructions perform a read or write operation and the hit rates in the cache are 0.95 for instructions and 0.9 for data.

- d) Consider disk with an advertised average seek time of 4 ms, rotation speed 12000 rpm and 512 byte sectors with 500 sectors per track. We wish to read a file consisting of 6 tracks. Find total average access time for: (i) sequential access and (ii) random access. (10)

8. a) How does a recordable CD (CD-R) work? (08)

- b) What are the basic tasks of control unit? (06)

- c) Consider a simple processor with single accumulator: (12)



Write down the micro-operations and control signals for the following instruction cycle operations:

- i) Fetch
- ii) Indirect
- iii) Interrupt.

- d) How is the concept of micro-programming used to implement a control unit? (09)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 B.Sc. Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Term Examination, 2017  
 Department of Computer Science and Engineering  
 EEE 2113  
 Digital Electronics

TIME: 3 hours

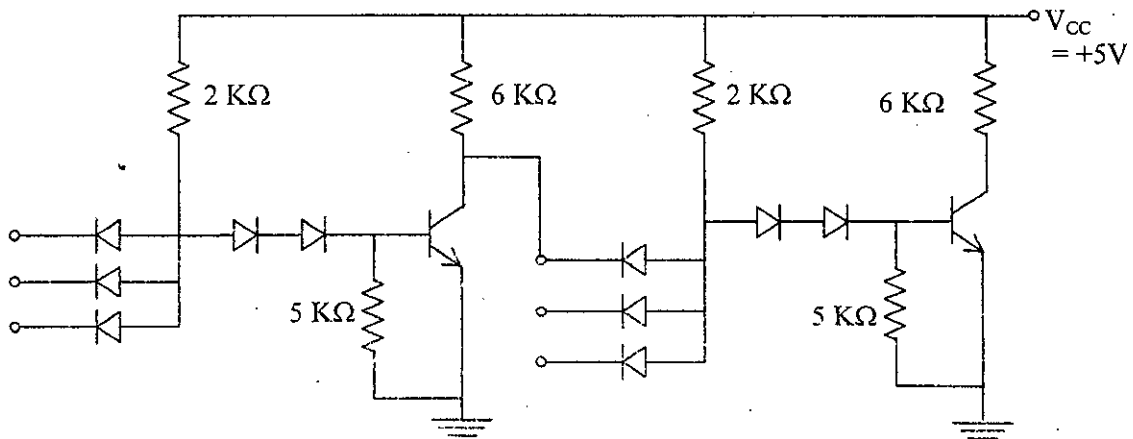
FULL MARKS: 210

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

**SECTION A**

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

1. a) Define and explain the terms: (i) Loading factor (ii) Figure of merit (iii) Storage time (10)  
 (iv) Noise immunity and (v) Propagation delay time.
- b) Determine the fan out for the DTL NAND gate shown in figure below. Assume that (13)  
 $h_{FE(min)} = 20$  and that all diodes and transistors are silicon made.



- c) Draw and explain the operation of the following circuits: (12)  
 (i) 3-terminal AND using diode, (ii) RTL NOR gate (iii) RTL NAND gate
2. a) Draw the circuit diagram of a TTL gate with totem-pole output and explain its operation. (11)  
 b) Mention the advantages of CMOS over MOS circuit. Also, draw NAND and NOR gate using CMOS logic. (12)  
 c) Why is BCL faster than TTL? Mention the drawbacks of BCL logic family. What is  $I^2L$ ? Why are they named so? (12)
3. a) Define the terms: (i) Resolution (ii) Linearity (iii) Settling time. (06)  
 b) Describe the conversion process in a successive approximation type A/D converter. (10)  
 c) Describe the method by which the drawbacks of weighted resistor D/A converter can be overcome. (12)  
 d) Find out the quantization error of a 8 bit A/D converter. (07)
4. a) What is programmable logic array? How does it differ from ROM? List the major differences between PAL and PLA. (08)  
 b) A Boolean function is defined by the truth table given below: (15)

| A | B | C | F <sub>1</sub> | F <sub>2</sub> |
|---|---|---|----------------|----------------|
| 0 | 0 | 0 | 0              | 0              |
| 0 | 0 | 1 | 0              | 0              |
| 0 | 1 | 0 | 0              | 0              |
| 0 | 1 | 1 | 0              | 1              |
| 1 | 0 | 0 | 1              | 0              |
| 1 | 0 | 1 | 1              | 1              |
| 1 | 1 | 0 | 0              | 0              |
| 1 | 1 | 1 | 1              | 1              |

Implement the circuit with a PLA having three inputs; three product terms and two outputs.

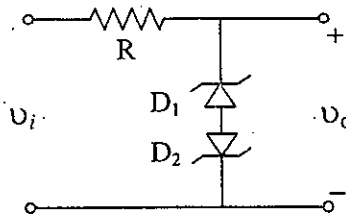
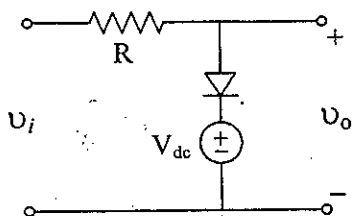
- c) What is a programmable logic device? What are the advantages of using PLDs in the design of digital systems? (08)
- d) Write short notes on LED oscillator. (04)

**SECTION B**

(Answer ANY THREE questions from this section in Script B)

5. a) Define pulse waveform. Classify pulse generation circuit with examples. (10)  
 b) A pulse of amplitude 10V and duration  $10\mu s$  is applied to a highpass RC circuit. Sketch the output waveform indicating the voltage levels for (i)  $RC = t_p$ , (ii)  $RC = 0.5t_p$ , (iii)  $RC = 2t_p$ , (iv)  $RC = 10t_p$  and (v)  $RC = 0.1t_p$ . (17)

- c) Draw the output waveforms for the following circuits, where  $v_i$  is a sinusoidal voltage. (08)  
 Assume the diodes are ideal.



6. a) What is a multivibrator? Draw the ideal waveform (input and output) of different types of multivibrators. (06)  
 b) Draw an IC 555 timer monostable multivibrator and explain its operation. (11)  
 c) Draw the astable multivibrator configuration for 50% duty cycle. (08)  
 d) How can you use a 555 timer as a bistable multivibrator? Explain with neat sketch. (10)
7. a) How can a transistor act as a switch? Draw the neat sketch for on-off condition. (08)  
 b) What is a pulse transformer? Explain the working principle of a pulse transformer. What are the applications of a pulse transformer? Draw the equivalent circuit of a pulse transformer and mention different components. (15)  
 c) Explain inverting and non-inverting comparator circuits with input and output waveforms. Draw and explain the window comparator circuit. (12)
8. a) Write short notes on (i) DMM (ii) VTVM and (iii) Q meter. (13)  
 b) What is meant by a sweep circuit? Draw a constant ramp generator and explain its operation. (10)  
 c) Briefly explain the following terms: (12)
- (i) Measurand
  - (ii) Measurement device
  - (iii) Measurement error
  - (iv) Accuracy
  - (v) Precision
  - (vi) Calibration

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2nd Year 1st Term Examination, 2017  
Department of Computer Science and Engineering  
MATH 2107

Fourier Analysis and Linear Algebra

TIME: 3 hours

FULL MARKS: 210

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

**SECTION A**

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

1. a) Define integral transform and kernel of the transform. (08)  
b) Define causal and non-causal system of equation with example. Test whether the following system of equations are causal or not. (17)  
(i)  $y(t) = tx(t)$ , (ii)  $y(n) = x(n) - x(n-1)$  and (iii)  $y(t) = x(t^2)$   
c) Write down the important properties of the ROC for z-transform. (10)
2. a) Define z-transform. Determine the z-transform of the signal  $x(n) = a^n u(n) - b^n u(-n-1)$  where  $(a \text{ and } b) < 1, a < b$  and plot the ROC. (12)  
b) Find  $x(n)$  by using convolution for  $X(z) = \frac{1}{(1 - \frac{1}{2}z^{-1})(1 + \frac{1}{4}z^{-1})}$ . (10)  
c) Find the inverse z-transform of  $X(z) = \frac{z+0.5}{(z+0.6)(z+0.8)}$ ,  $|z| > 0.8$  using residue method. (13)
3. a) Define periodic function with example. The function  $x^2$  is periodic with period  $2l$  on the interval  $[-l, l]$ . Find its Fourier series. (25)  
b) Find the Fourier sine transform of  $e^{-x}, x \geq 0$ . (10)
4. a) Write down the complex form of Fourier series. Write Parseval's identity corresponding to the Fourier series of the function (20)  
$$f(x) = \begin{cases} x, & 0 < x < 2 \\ -x, & -2 < x < 0 \end{cases}$$
  
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  $\int_0^{\infty} \frac{u \sin ux}{k^2 + u^2} du = \frac{\pi}{2} e^{-kx}, k > 0$ . (15)

**SECTION B**

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

5. a) Define with example: (i) Upper triangular matrix, (ii) Skew-symmetric matrix, (iii) Hermitian matrix and (iv) Orthogonal matrix. (12)  
b) Express the given matrix A as sum of a symmetric and skew-symmetric matrices: (12)  
$$A = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 2 & 1 \\ 4 & 3 & 2 \end{bmatrix}$$
  
c) Define inverse of a matrix. Find the inverse of  $\begin{bmatrix} 1 & -3 & 2 \\ -3 & 3 & -1 \\ 2 & -1 & 0 \end{bmatrix}$ . (11)

6. a) Let  $w$  be the subspace of  $\mathbb{R}^4$  spanned by the vectors  $u_1 = (1, -2, 5, -3)$ ,  $u_2 = (2, 3, 1, -4)$ ,  $u_3 = (3, 8, -3, -5)$ . Find a basis and dimension of  $w$ . (10)

b) Find the inverse of  $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$  using partitioning. (10)

- c) Reduce the matrix  $A$  to its echelon form then to its canonical form then to its normal form. (15)

Also find its rank where  $A = \begin{bmatrix} 2 & 1 & 5 & 1 & 5 \\ 1 & 1 & -3 & -4 & -1 \\ 3 & 6 & -2 & 1 & 8 \\ 2 & 2 & 2 & -3 & 2 \end{bmatrix}$ .

7. a) Test the following vectors are linearly dependent or independent. If the vectors are linearly dependent determine a maximum subset of linear independent vectors and express the other as a linear combination of these, where  $x_1 = [1, 2, 3, 2]$ ,  $x_2 = [2, 3, 5, 1]$ ,  $x_3 = [1, 3, 4, 5]$ . (12)

b) Reduce the matrix  $A = \begin{bmatrix} 1 & 2 & 3 & -2 \\ 2 & -2 & 1 & 3 \\ 3 & 0 & 4 & 1 \end{bmatrix}$  to normal form  $N$  and compute the matrices  $P$  and  $Q$  such that  $PAQ = N$ . (15)

c) For what value of  $x$ , the matrix  $A = \begin{bmatrix} 3-x & 2 & 2 \\ 2 & 4-x & 1 \\ -2 & -4 & -1-x \end{bmatrix}$  is singular? (08)

8. a) If  $A = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 2 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 2 \end{bmatrix}$  then find  $AB$  by partitioning. (10)

- b) Define inner product spaces. Apply the Gram-Schmidt orthogonalization process to find an orthogonal basis of  $\mathbb{R}^4$  as:  $v_1 = (1, 1, 1, 1)$ ,  $v_2 = (1, 2, 4, 5)$ ,  $v_3 = (1, 3, -4, -2)$ . (13)

- c) State Cayley Hamilton theorem. Find the characteristic equation and characteristic roots for (12)

the matrix  $A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$ .