KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2019
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) Discuss about Data Hiding with necessary figure. What are the limitations of C structure?   (10)
   b) What are the special characteristics of a static member variable? How can you access static   (10)
      variable and functions of a class without creating any object? Explain with example code.
   c) Define friend function. Write the special characteristics of friend function.   (10)
   d) Explain the difference between references and pointer with example.   (05)

2. a) "When default argument constructor is called with no argument, it becomes a default   (10)
      constructor."-justify the statement with proper example.
   b) Is it possible to call constructor and destructor explicitly? Explain with suitable example. Also   (10)
      explain the output.
   c) How constructors are different from a normal member functions? What are the advantages of   (10)
      this pointer?
   d) Why should the copy constructor accept its parameter by reference in C++?   (05)

3. a) How does C++ compiler differentiate between overloaded postfix and prefix decrement   (10)
      operators? Explain with appropriate examples.
   b) Write a C++ program to add two 2X2 Matrix of complex numbers. Write the declaration of   (12)
      complex number class into ComplexNumber.h file and definition into ComplexNumber.cpp
      file. Then create a template class Matrix to perform matrix addition.
   c) Is it possible to overload "<<" operator using member function? Explain with example.   (08)
   d) Discuss memory allocation of objects in Object-oriented Programming (OOP).   (05)

4. a) What is STL? Discuss about the types of STL containers. Give an example how does stack   (12)
      and priority queue work?
   b) Write a program to add two numbers and store the result using file. Sample input and output   (10)
      are given below.

10 20	30
30 40	70
50 10	60

input.txt   output.txt

   c) Why do we use template? Predict and explain the output of the following code: (08)

```
template <class T>
void fun(const T &x)
{
    static int count = 0;
    cout << "x = " << x << " count = "<< count++ <<endl;
    return;
}
int main()
{
    fun<int> (1);
    fun<int> (2);
    fun<double> (1.1);
    return 0;
}
```

   d) How can you initialize a class using initialization list when all the member variables are   (05)
      public?

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

5. a) Write down the differences between Structured Programming Language and Object-oriented Programming Language. (10)

   b) What is the problem arise in the multiple inheritance? How can you overcome ti? (09)

   c) Why do we need "protected" access modifier? (06)

   d) Explain the output of the following program: (10)

```
#include <iostream>
using namespace std;
class A {
    public:
        A(){cout<<"_1 ";}
        A(A & obj){ cout<<" 2 ";}
};
class B: virtual A{
    public:
        B(){cout<<" 3 ";}
        B(B & obj){ cout<<" 4 ";}
};
```

```
class C: virtual A{
    public:
        C(){cout<<" 5 ";}
        C(C & obj){ cout<<" 6 ";}
};
class D: B, C{
    public:
        D(){cout<<" 7 ";}
        D(D & obj){ cout<<" 8 ";}
};
int main(){
    D d1;
    D d (d1);
}
```

6. a) "Every interface is abstract class but every abstract class is not interface"-justify the statement with examples. (10)

   b) Why is pure virtual function necessary? Explain with proper example. (10)

   c) Explain the compile time polymorphism and run time polymorphism in details with examples. (15)

7. a) Why is Run Time Type Identification (RTTI) a necessary feature of C++? (05)

   b) Design a class containing attributes x and y where (x,y) denotes a 2D point. Derive another class which contains a value z and reuse the values x and y. So, the objects of derived class denotes a 3D point. Use constructor in both classes to initialize an object of derived class. Then declare and initialize two objects (3D points) of derived class and calculate the distance between these points. Use membership functions as you like. Write the entire code in C++. (15)

   c) Explain Dynamic cast using an example of base class and derived class. (10)

   d) How does exception differ from error? (05)

8. a) Why do we need to handle exceptions in program? (05)

   b) What do you mean by Is-A relation and Has-A relation? Discuss with examples. (10)

   c) Is there exist any abnormality in the following code? If yes then how can it be handled? (10)

```
#include <iostream>
using namespace std;
int main(){
    int array[10] = {10};
    for (int i = 0; i <= 10; i++)
        cout << array[i] << endl;
}
```

   d) How can we restrict a function to throw certain exception? (10)

TIME: 3 hours   FULL MARKS: 210

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

1. a) What do you mean by data structure? What are the basic operations of data structure? (06)
   b) How to calculate the element address in two dimensional array? Consider the linear array (14)
      AA[30:80] and BB[-20:80].
      i)   Find the number of elements in each array.
      ii) Suppose Base(AA) = 500 and w = 8 words per memory cell for $\overline{AA}$. Find the
           address AA[65] and AA[69].
   c) "Is bubble sort is Divide and Conquer type"? Explain your answer if you say 'yes' or give a (08)
      counter example if you say 'no'.
   d) Explain the procedure of inserting and deleting an element from a linear array. (07)

2. a) Suppose a data set S contains n elements. Compare the time complexity T[1] of linear search (09)
      algorithm with the time complexity T[2] of the binary search algorithm when (i) $n = 1000$ and
      (ii) $n = 10000$.
   b) Translate the infix expression "$((A+B)*C-(D-E)\uparrow(F+G))$" to its equivalent postfix (09)
      expression. Which data structure is needed for this task?
   c) What are the moves allowed by the solution of Towers of Hanoi problem when $n = 4$ disks. (10)
   d) Define priority queue. How do you write priority queue in a linear array and one-way list. (07)

3. a) What is stack? Consider the following deque of characters where deque is a circular array (10)
      which is allocated 8 memory cells: LEFT = 7, RIGHT = 2.

yy	zz					ww	xx

   Describe the deque while the following operations take place.
      i)   FF is added to the right of the deque.
      ii)   KK and LL are added to the left of the deque.
      iii) One letter on the left is deleted.
   b) The Pre-order and In-order of T yield the following sequence of nodes. (09)
                Pre-order : G, B, Q, A, C, K, F, P, D, E, R, H
                In-order : Q, B, K, C, F, A, G, P, E, D, H, R
   Draw the diagram of the tree T.
   c) Define recursive procedure. Devise a recursive algorithm for the celebrated Fibonacci (07)
      sequence.
   d) Suppose queue is stored in a circular array with N = 10 memory cells. (09)
      i)   Find the number of elements in a queue when FRONT = 2, REAR = 6.
      ii)   When will the array be filled?

4. a) What do you mean by heap and heap property? (06)
   b) Construct a down-heap H from the following list of numbers: (14)
                20, 25, 35, 38, 50, 2, 55, 77, 82, 22
      i)   Insert another item 70 into constructed heap.
      ii)   Then delete the number 22 for replacing it.
   What are the correct steps in both cases?
   c) What is B-tree? How B-tree is constructed? Explain with example(s). (08)
   d) "All stacks are lists, but all list are not stacks" – Explain this statement with examples. (07)

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

5. a) What are the advantages and disadvantages of linked list over array? (08)
   b) Write a simple procedure which deletes a node in the linked list at a given position. Example: (10)
      Input : Position = 2, linked list = 8→2→3→1→7
      Output : linked list = 8→2→1→7
   c) What is hash function? Write down the desirable properties of a hash function. (07)

d) Briefly explain the procedure of inserting a node into a sorted linked list with appropriate (10) figure(s). Also, write an algorithm for it.

6. a) Consider a hash table of size 8 with hash function $h(k) = k \bmod 8$. Draw the table that results (12) after inserting in the given order, the values 20, 27, 14, 49, 18 for each of the scenarios below:
   i) When collision is handled by separate chaining.
   ii) When collision is handled by linear problem.
   iii) When collision is handled by double hashing using a second hash function $h'(k) = 5 - (k \bmod 5)$.

   b) What is Big-O time complexity of traversing, inserting a node at the front, inserting a node at (10) the end of a linked list, circular linked list? Explain your answer.

   c) Suppose AAA and BBB are sorted linked lists with distinct elements, both maintain INFO and (13) LINK. Write a procedure which combines the lists into a single sorted linked list CCC without changing any values in INFO. Also, write advantages, if any, of a two-way list over one-way for the following operations:
   i) Traversing the list to process each node.
   ii) Searching an unsorted list for given element ITEM.
   iii) Inserting a node after the node a given location LOC.

7. a) Consider the items: 77, 33, 44, 11, 88, 22, 66, and 55. Now, sort them using Insertion Sort (10) algorithm. Also, calculate the complexity of Insertion Sort algorithm.
   b) Write the procedure of Garbage Collection. (05)
   c) Consider the 12 elements: 18, 9, 25, 34, 70, 52, 47, 50, 33, 28, 77, and 11. Sort the first six (15) elements using Shell Sort and the last six elements using Bucket Sort. After applying these two sorting algorithms, the first six elements will be sorted and so the last six elements will be sorted, but as a whole the list will be unsorted. Now, apply Quick Sort algorithm over the resultant list got after applying Shell Sort and Bucket Sort so the final list will be sorted. Also, calculate the complexity of the whole process.
   d) Write down the algorithm to delete an edge from a graph G. (05)

8. a) Consider the following graph G. (15)

   Now,
   i) Find the adjacency matrix A of the graph G.
   ii) Find the path matrix P of G using powers of the adjacency matrix A.
   iii) Find the path matrix P of G using Warshall's algorithm.
   iv) Is G strongly connected?

   b) Consider the following graph G. (10)

   Suppose, G represents the daily flights between cities of some air lines. Now, calculate the minimum path P from node A to J using Breadth-First Search (BFS).

   c) Define the terms: compete graph, directed graph and degree of a node in a graph. Consider the (10) weighted graph G in the following figure.

   Calculate the sorted path cost matrix Q from the graph G using Shortest Path algorithm.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2019.
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. Why (10)
   do we need to study computer architecture and computer organization? —
   b) Explain the speed up factors of a computer system. (08)
   c) State and explain Von Neumann architecture. (07)
   d) Explain the operation of IAS machine with block diagram. (10)

2. a) State and explain Moore's law with figure. (07)
   b) What are the main concerns of computer arithmetic? Make a comparison among sign (08)
   magnitude, sign 1's complement and sign 2's complement.
   c) Explain Booth's algorithm with proper example. (10)
   d) Define overflow. Design an overflow detector circuit. (10)

3. a) Calculate $Z = \dfrac{(A \times B) + C}{D + (E - F)}$, using one, two and three address representation. (07)
   b) Explain different type of registers with example. (08)
   c) Discuss data flow in fetch and indirect cycle. (08)
   d) What is meant by instruction set? Discuss instruction set design issues. (12)

4. a) What are the advantages of variable length instruction format? (07)
   b) Define addressing modes. Discuss different type of addressing modes with their principal (12)
   advantages and disadvantages.
   c) Differentiate between CISC and RISC. (06)
   d) What is meant by instruction level parallelism? How does a super scalar processor take the (10)
   advantage of it? Explain.

SECTION B

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

5. a) What is bus? Explain merits and demerits of separate data and address buses. (08)
   b) Suppose three interrupt handlers a, b, and c, and their priority are 5, 10, and 15 respectively. (12)
   Graphically, show the transfer of control for interrupt sequence (i) a, b, c (ii) b, a, c
   (iii) b, c, a.
   c) Describe the merits and demerits of write through protocol and copy back protocol of cache (08)
   memory.
   d) What is TLB? Describe virtual-memory address translation technique having TLB. (07)

6. a) What common characteristics are shared by all RAID levels? (06)
   b) Explain data reconstruction procedure in RAID 4 in the event of a drive failure. (08)
   c) Define the terms: (i) seek time, (ii) rotational delay and (iii) transfer time. (06)
   d) In a computer system, main memory and cache memory ratio is 64:16 and 20 bits are for the (08)
   addressing. Find
      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 8
            words per block.
   e) Consider a magnetic disk with an advertised average seek time of 4 ms, rotational speed of (07)
   12000 rpm and 512 byte sectors with 500 sectors per track. Suppose a file consisting of 2500
   sectors for a total of 1.28 Mbytes is stored in 5 adjacent tracks. Find total time to read the file
   if sectors are distributed randomly over the disk.

7. a) How does a rewritable CD (CD-RW) work? (07)

b) An 8 bit data 10010101 is passed and written. After that when reading, we use Hamming (12) corrector and before correcting we get 11010101 (bit position b_7 is changed). How do you detect and correct this one bit error?

c) Explain operating principle of a dynamic RAM with appropriate figure. (08)

d) Consider a simple processor with single accumulator: (08)
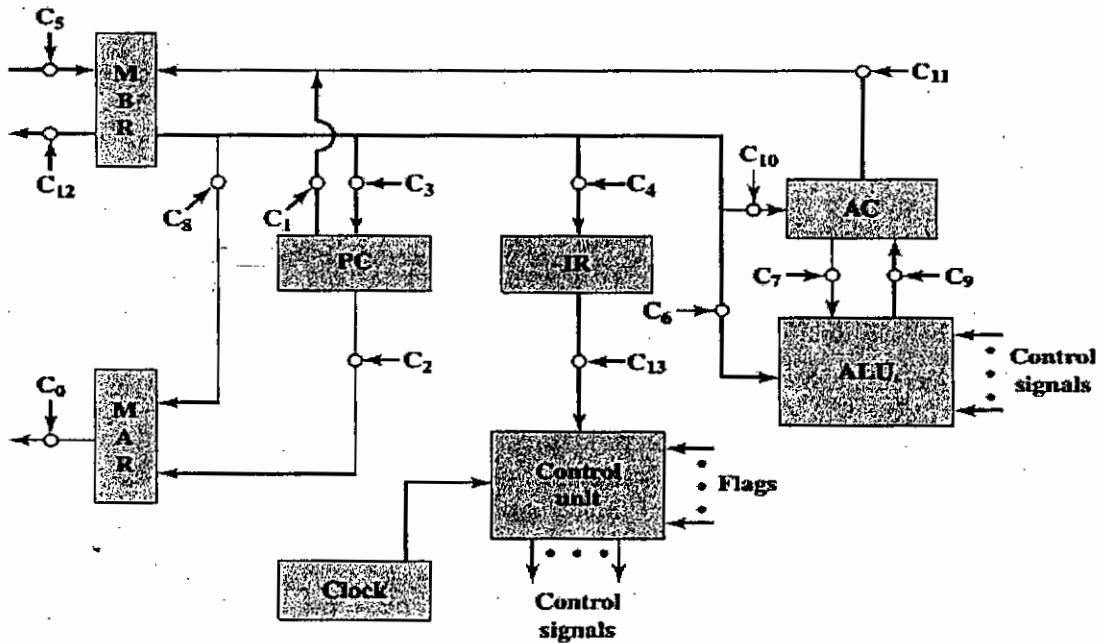
Write down the micro-operations and control signals for the following instruction cycle operations:

    i)   Fetch

    ii)   Interrupt

8. a) Consider a small memory consisting of *32K* words of *16* bits each. How do you organize (08) $8K \times 2$ static memory chips? Explain with appropriate figure.

b) Briefly explain following functions of an I/O module: (10)
    i)   Control and timing
    ii)   Processor communication.

c) Draw and explain the flowchart that defines the complete sequence of micro-operations. (10)

d) How can you use the concept of micro-programming to implement a control unit? (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2019
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) What is meant by digital logic families? (06)
   b) Define and explain the following terms: (14)
      (i) Noise margin, (ii) Figure of merit, (iii) Fan in and loading factor, and (iv) Propagation delay time.
   c) Write down the classification of different TTL subfamilies. Also, show the meaning of (07) "MC74HC86N".
   d) "I^2L is preferable than RTL logic family"-justify this statement. Also, draw the basic I^2L gate (08) and RTL gate with proper circuits.

2. a) What are the advantages of CMOS over MOS circuit? Draw the 3-input NAND and AND gate (15) using CMOS logic.
   b) Draw the circuit diagram of a TTL gate with totem-pole output and explain its operation. (10)
   c) Classify TTL logic family based on its output configuration. Show that "open collector gates (10) can be tied-together to form a common bus".

3. a) Classify different types of A/D and D/A converters. Draw the circuit diagram of successive (12) approximation A/D converter and also write the steps for conversion of 9.1V into digital signal.
   b) Why dual slope A/D converter is preferable than single slope converter? Explain with circuits (12) and equations.
   c) Draw the circuit diagram for R-2R and binary weighted D/A converter with their output (11) equations.

4. a) What is meant by PLD? Classify PLDs. Also, draw the block diagrams of CPLD's and FPGA's (12) with their advantages.
   b) What is meant by static and dynamic FF's? Draw the transistor based circuit for static and (11) dynamic FF's. Also, write their advantages and disadvantages.
   c) Classify memory systems. Write short notes on (i) ROM, (ii) RAM, (iii)EPROM, and (iv) (12) EEPROM.

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

5. a) Define duty cycle and wave shaping. A rectangular waveform has a positive pulse width of (06) 20 ms and a duty cycle of 15%, calculate its frequency.
   b) Write down the difference between linear and non-linear wave shaping. Show that a high pass (10) filter can act as a differentiator.
   c) A 10 Hz symmetrical square wave whose peak to peak amplitude is 2V and is imposed upon (10) high pass RC circuit as shown in the following figure, whose lower 3-dB frequency is 5 Hz. Calculate and sketch the output waveform.
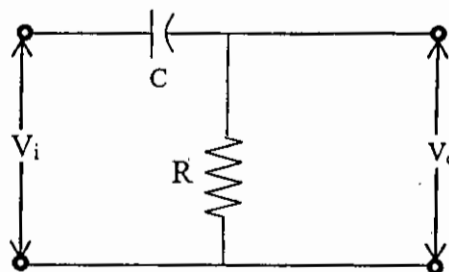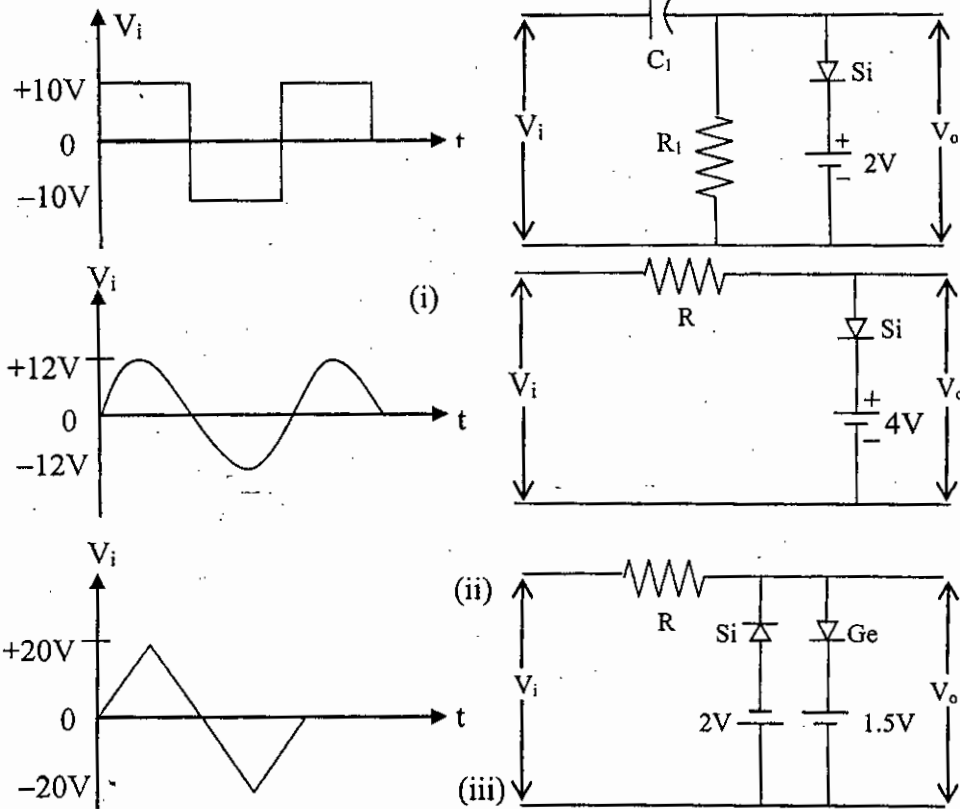

   d) Design the appropriate circuit diagram for the following output waveform as shown in the (09) following figure.
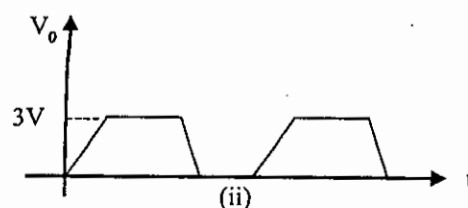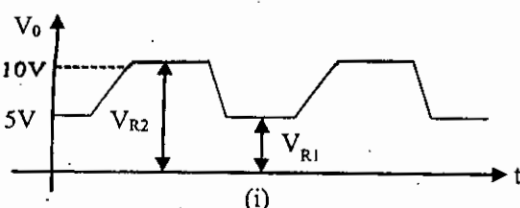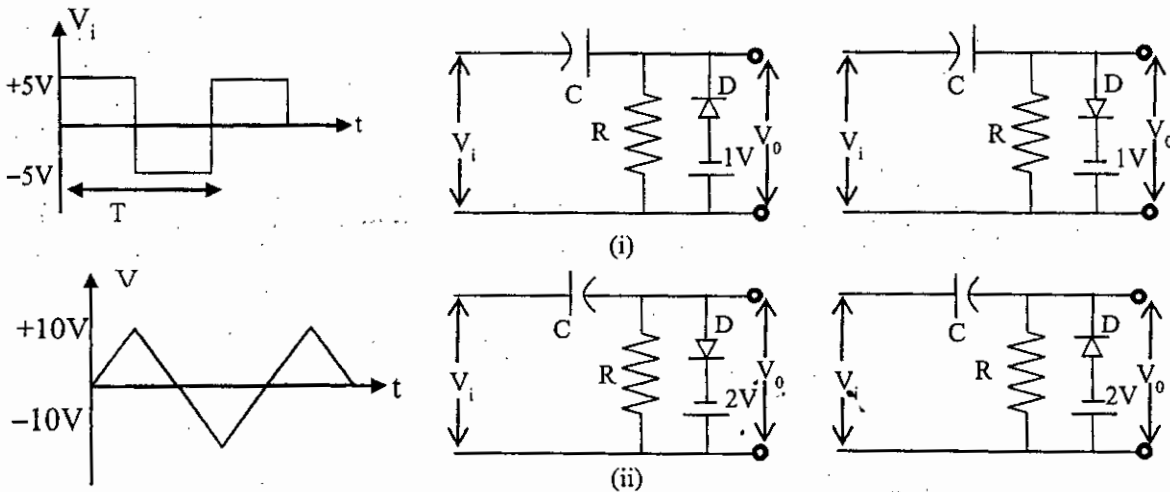

Consider V_i is sinusoidal voltage. Assume diodes are ideal.

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6. a) Draw the output waveform of the following circuits for their respective given input: (12)

(i)

(ii)

(iii)

b) What is meant by trigger on and trigger off voltage? Draw the input/output characteristics of (11) Schmitt trigger circuit.

c) Draw the output waveform for the following clamping circuit: (12)

(i)

(ii)

7. a) How can a transistor act as a switch? Draw the neat sketch for on-off condition. (06)

b) Why 555 timer IC is named so? Draw a transistor based astable multivibrator for 25% duty (12) cycle and explain its operation.

c) Draw and design a 555 oscillator to produce an approximate square wave at 40 KHz. Consider (09) $C > 470pF$.

d) Define hysteresis voltage. Also, draw the transfer characteristic curve of inverting and non- (08) inverting Schmitt trigger.

8. a) What is pulse transformer? Draw the transformer equivalent circuit of it. Also mention its (12) advantages and application.

b) Define sweep time and restoration time. Design a constant voltage sweep circuit with input and (11) output waveforms.

c) Write short notes on (i) DMM, (ii) Q-meter, and (iii) VTVM. (12)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2019
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 periodic function and its period with an example.   (05)
   b) Write down the sufficient conditions for the convergence of a Fourier series.   (08)
   c) Find a series of sines and co-sines of multiple of x which represent $x + x^2$ in the interval   (14)
      $-\pi < x < \pi$.
   d) Expand $f(x) = x, 0 < x < 2$, in half range Fourier sine series.   (08)

2. a) Evaluate the Fourier integral of the function $f(x)$, where   (13)

   $$f(x) = \begin{cases} 0, & \text{when } x < 0 \\ \frac{1}{2}, & \text{when } x = 0 \\ e^{-x}, & \text{when } x > 0 \end{cases}$$

   b) If $F(x) = \begin{cases} x, & |x| < a \\ 0, & |x| > a \end{cases}$ and $f(u) = \dfrac{2\sin au}{u}$, $u \neq 0$ then using the Parseval's identity for   (12)

   Fourier transform, evaluate $\displaystyle\int_{0}^{\infty} \frac{\sin^2 ax}{x^2} dx$.

   c) Find the Fourier cosine transform of the function $F(x) = 2x, \ 0 < x < 4$.   (10)

3. a) Use the Fourier transform, solve the following boundary value problem   (20)

   $\dfrac{\delta u}{\delta t} = 3\dfrac{\delta^2 u}{\delta x^2}$, where $u(0,t) = u(2,t) = 0, t > 0$ and $u(x,0) = x, 0 < x < 2$.

   b) Find the inverse z-transform of $X(z) = \dfrac{z}{(z-1)(z^2+1)}$ using residue method.   (15)

4. a) Define integral transform and hence find the kernel of this transform. Also find the kernel of   (08)
      Fourier sine transform.
   b) Define causal and non-causal of a system of equation with example. Test whether the   (15)
      following system of equations are causal or not.
      i) $y(t) = tx(t)$
      ii) $y(n) = x(n) - x(n-1)$
      iii) $y(t) = x(t^2)$.
   c) What do you mean by Region of Convergence (ROC) of z-transform? Write down the   (12)
      important properties of the ROC for z transform.

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

5. a) Define with example: (i) Harmitian matrix, (ii) Elementary matrix, (iii) Symmetric matrix and (12)
   (iv) Diagonal matrix.

   b) Using row operation find A^{-1}, where $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$. (12)

   c) If $A = \begin{bmatrix} 2 & 1 & 0 \\ 3 & 2 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 & 1 & 0 \\ 2 & 1 & 1 & 0 \\ 2 & 3 & 1 & 2 \end{bmatrix}$ then find AB by partitioning. (11)

6. a) Find the rank of the following matrix (10)

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

   b) Define homogeneous and non-homogeneous system of linear equations. Find trivial and non- (13)
   trivial solution of the following system of equations (if exist)
$$2x - y - 3z = 0$$
$$-x + 2y - 3z = 0$$
$$x + y + 4z = 0$$

   c) For which values of 'a' will the following system have no solution? Exactly one solution? (12)
   Infinitely many solutions?
$$x + 2y - 3z = 4$$
$$3x - y + 5z = 2$$
$$4x + y + (a^2 - 14)z = a + 2$$

7. a) Examine the consistency of the following system of equations (10)
$$x + 2y - 3z = -1$$
$$3x - y + 2z = 7$$
$$5x + 3y - 4z = 2$$

   b) Define vector space with an example. (07)

   c) Find a basis for the row space, column space and null space of the following matrix (18)

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

8. a) Find all the eigen values and the eigen vector corresponding to largest eigen value of the (12)
   following matrix

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

   b) Define inner product. Use the Gram-Schmidt orthogonalization process to transform the basis (13)
   $\{u_1, u_2, u_3\}$ into an orthonormal basis where $u_1 = (1,1,1)$ and $u_2 = (1,1,0)$ and $u_3 = (1,0,0)$.

   c) Using Cayley-Hamilton theorem find A^{-1}, where (10)

$$A = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$$