

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd year 1st term Examination, 2018
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) Distinguish between the following terms: (08)
 - i) Objects and classes,
 - ii) Data abstraction and data encapsulation.
- b) "The speed benefits of inline function diminish as the function grows in size." -- justify the statement. (07)
- c) Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a C++ program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object. The output should be in the format of feet and inches or meters and centimeters. Assume 1 centimeter is equal to 0.39 inch. (12)
- d) Give an example of overloading constant and Non-constant function with appropriate examples. (08)
2. a) What is inline function? When an inline function does not work? Explain with example. (08)
- b) Is it possible to call constructor and destructor explicitly? Explain with suitable example. (08)
Also explain the output.
- c) Write a C++ program to create a class "DoubleArray". It will be used to store double data in an array member variable. The data will be stored in heap. At first create an object and store N double data. Later, find the average of the data and copy the average and data into another object during initialization of that object using deep copy method. (12)
- d) "Static member function has no this pointer." – Is it true? Explain your answer with example. (07)
3. a) What are the advantages of using this pointer? Explain with suitable example(s). (09)
- b) Write a C++ program to add two 2x2 Matrix of complex numbers. Write the declaration of complex number class into ComplexNumber.h file and definition into ComplexNumber.cpp file. Then create a template class MATRIX to perform matrix addition. (14)
- c) What is STL? Briefly describe the components of STL. Also, give a C++ coding example. (12)
4. a) Explain the uses of functor with appropriate example(s). What are the advantages of functor over function pointer? (09)
- b) Define Lambda expressions. Explain the syntax of Lambda expression with suitable example(s) (08)
- c) Compare the performance characteristics of lists, vectors and maps with proper example. (11)
- d) Define reference. What are the typical uses of reference? (07)

SECTION B

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

5. a) What do you mean by containership? How does it differ from inheritance? (08)
- b) Briefly describe the multiple and hierarchical inheritance with examples. (08)
- c) Where does the diamond problem occur in inheritance? How does it can be solved? Give example. (13)

d) Explain the output of the following program.

(06)

```
#include<iostream>
using namespace std;
class A{
public:
    A(int a){
        cout<<"Base A \n";
    }
};
class B{
public:
    B(int a){
        cout<<"Base B \n";
    }
};
class C: protected A, private B{
public:
    C(int a):B(a),A(a){
        cout<<"Derived C \n";
    }
};
int main(){
    C c(10);
    B a(5);
}
```

6. a) Define polymorphism, static binding and dynamic binding.

(06)

b) Consider the following code segment.

(08)

```
class M{
public:
    int a, b;
private:
    double d;
public:
    void set(int a)
    {
        //...
    }
};
int main()
{
    M obj1;
    M obj2;
}
```

Discuss the amount of memory allocated by obj1 and obj2.

c) Why is pure virtual function necessary? Explain with proper example.

(10)

d) How do we achieve runtime polymorphism? Explain with proper example.

(11)

7. a) How does exception differ from error?

(05)

b) Describe the exception handling mechanism using block diagram.

(10)

c) How does rethrowing of exception work? Give an example.

(10)

d) How does C++ handle different signals? What is the general syntax of signal() function? Explain.

(10)

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

(05)

b) What are the design principle of Object Oriented Programming?

(08)

c) Explain Dynamic Cast using an example base class and derived class.

(10)

d) Briefly describe the different membership function of type_info class for RTTI.

(12)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2018
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. Distinguish between data type and abstract data type. (08)
b) How do you calculate the element address in two dimensional array? Consider the linear array AA[20:70] and BB[-10:70] (14)
 i) Find the number of elements in each array
 ii) Suppose, Base(AA) = 500 and $w = 6$ words per memory cell for AA. Find the address of AA[65] and A[69].
c) 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
d) Discuss how stacks can be used for checking balancing of symbols. (05)
2. a) Consider an infix expression consists of operands A, B, C, D, E, F, G, H and operators +, -, *, /, \uparrow . Transform it into equivalent postfix notation while showing the content of stack. Finally evaluate the postfix expression while showing the stack contents. (13)
b) Explain the procedure of inserting and deleting an element from a linear array. (08)
c) Define and discuss the criteria of Recursion. Solve Fibonacci Sequence recursively. (09)
d) Can we apply binary search algorithm for sorted Linked List? Justify your opinion. (05)
3. a) What is Hash function? Write down the desirable properties of Hash function. (06)
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 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 $h(k) = 5 - (k \bmod 5)$.
c) Consider the deque of characters where DEQUE is a circular array which allocates seven memory cells: Left = 3, right = 5, DEQUE = ..., ..., A, B, C, ..., Describe the deque after following operations take place: (08)
 i) D is added to left of the queue.
 ii) Two letters on the right are deleted.
 iii) F, G, H are added to the left of the deque.
 iv) S is added to the right of the queue.
d) Discuss how elements are processed within a priority queue. Consider a priority queue where various elements are categorized into five different priority levels. Then represent it using linked list and array. (09)
4. a) What are the moves allowed by the solution of Tower of Hanoi Problem when $n = 4$ disks? (10)
b) Consider the elements: 348, 43, 6, 23, 128, 54, 36. Now sort them using Radix Sort algorithm. Also calculate the complexity of Radix Sort algorithm. (10)
c) What are limitations of binary search algorithm? Distinguish between linear search and binary search algorithms. (10)
d) Write down the technique for minimizing the external fragmentation problem of memory management. (05)

SECTION B

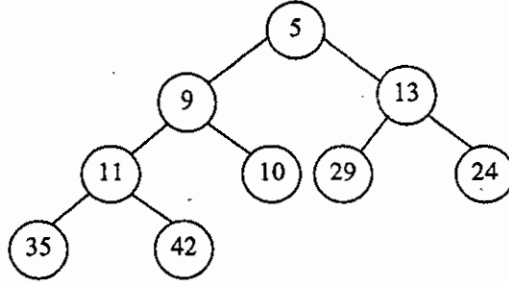
(Answer **ANY THREE** questions from this section in Script B)

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) 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? Explain your answer. (10)
c) What is Sparse Matrix and Multiway Linked List? How to represent Sparse Matrix by Multiway Linked List? (10)

6. a) The Pre-order and In-order traversal of a tree T yield the following sequence of nodes: (12)
 Pre-order: 30, 20, 10, 12, 40, 37, 45
 In-order: 10, 12, 20, 30, 37, 40, 45

Draw the diagram of the T.

- b) Define the terms: directed graph, complete graph and connected graph. Discuss the steps (13) needed to follow to insert a node into a graph. Explain with example.
 c) Given the following Heap, draw the max heap step by step that would result after deleting the (10) maximum element.



7. a) What is the difference between a heap and Binary Search Tree (BST)? When to use a heap (08) and when to use a BST?
 b) How a node deletion occurs in a BST? Explain each case with proper example. (12)
 c) Write a function to split a linked list into two lists at a specific point for the given example: (10)
 inList = (10 20 30 40 50), loc = 3, outList1 = (10 20 30), outList2 = (40 50)
 d) Write down the procedure of garbage collection. (05)
8. a) Consider a directed graph h having 9 nodes. Apply BFS to find the minimum path P from a (10) source node to a destination node with h .
 b) The keys of value $N, N - 1, N - 2, \dots, 4, 3, 2, 1$ are inserted in this order in a splay tree. What (15) is the configuration at each step of the tree? What is cost in Big-O notation of each inserted operation?
 c) What is postponed decisions? Write down the shortest path algorithm for graph. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2018
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) What is meant by computer architecture and computer organization? Explain with example. (10)
Why do we need to study computer architecture and computer organization? — (07)
b) Differentiate between structure and function. (07)
c) How has the evolution of computer been characterized? Explain. (10)
d) State and explain Von Neumann architecture. (08)
2. a) Explain the speed up factors of a computer system. (10)
b) What are the main concerns of computer arithmetic? "2's complement is better than sign magnitude and 1's complement"-explain with example. (07)
c) Define overflow. Design an overflow detector circuit by discussing underlying theory. (10)
d) Write an algorithm for unsigned binary multiplication. Using an example, show how your algorithm works. (08)
3. a) Explain data flow in fetch, indirect and interrupt cycle with proper diagram. (09)
b) What is memory hierarchy? Explain. (06)
c) Explain user visible and status register with example. (10)
d) Define instruction. Discuss about instruction cycle state diagram. (10)
4. a) Calculate $Z = \frac{A+B-C}{D+(E \times F)}$, using one, two and three address representation. (08)
b) What is addressing modes? Describe different type of addressing modes with figures. (12)
c) Differentiate between RISC and CISC. (08)
d) What is meant by instruction pipeline? Explain with appropriate diagram. (07)

SECTION B

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

5. a) How next address decision is made in micro-program control unit. (06)
b) How does the control of program execution transfer when multiple interrupt occur? Explain with proper figure. (10)
c) Draw and briefly explain the flow chart of programmed I/O technique. (09)
d) In a computer system, main memory and cache memory ratio is 64:16 and 20 bits is for the addressing. Find: (10)
i) TAG, BLOCK and WORD bits in direct mapping when block size is 16 words.
ii) TAG, SET and WORD bits for set-associative mapping for 8 blocks per set and 4 words per block.
6. a) Why peripheral does not connect directly to the system bus? (06)
b) "RAID 4 involves a write penalty when I/O write request of small size is performed"-justify the statement. (08)
c) A 7 bit data 1010101 is passed and written. After that when reading, we use Hamming corrector and before correcting we get 1010001 (bit position b_3 is changed). How do you detect and correct this one bit error? (12)
d) What are the differences among direct mapping, associative mapping, and set-associative mapping? (09)
7. a) Explain briefly serpentine recording. (07)
b) Suppose two values are stored in two different locations in the memory. The length of instruction is 16 bit and opcode is 4 bit. Explain program execution with figure to store sum of the two values in one of the locations. Consider program counter (PC), accumulator (AC) (08)

and instruction register (IR) for the operation.

- c) Look at the following algorithm that normalizes the elements of an array (A) of 10 numbers (12) with respect to the average value using a cache having 8 blocks. Each block consists of only one 16-bit word and memory is word addressable with 16-bit address.

```
SUM: = 0
for j:=0 to 9 do
    SUM: = SUM + A(2,j)
end
AVG: = SUM/10
for i: = 9 down to 0 do
    A(2,i): = A(2,i)/AVG
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 = 0 to 9).
- d) Explain data reconstruction procedure in RAID 3 in the event of a drive failure. (08)
8. a) What are the basic tasks performed by a micro-program control unit? Briefly explain with figure. (10)
- b) What is locality of reference? Describe its classification. (05)
- c) Write down the sequence of micro-operations for the execution of (i) Fetch cycle and (ii) Interrupt cycle. (08)
- d) A computer system takes 10 clock cycles for each read access from RAM when no cache is available. Suppose the system has a cache that holds 8-word blocks and 15 cycles are needed to load a block into the cache. Assume that 40% of the instructions in a typical program perform a read or a write operation. Let us further assume that the hit rates in the cache are 0.9 for instruction and 0.8 for data, and 1 cycle is for cache read or write. (12)
- i) Estimate the improvement in performance for the cache in terms of time required ratio without and with cache.
- ii) Find performance improvement for ideal cache when hit rate is 1.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 1st Term Examination, 2018
 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

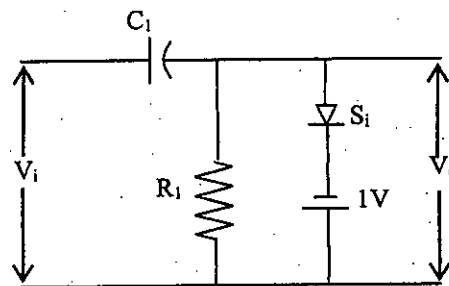
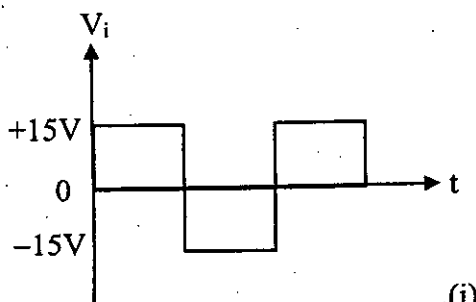
(Answer ANY THREE questions from this section in Script A)

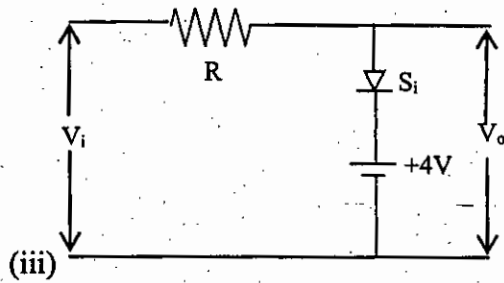
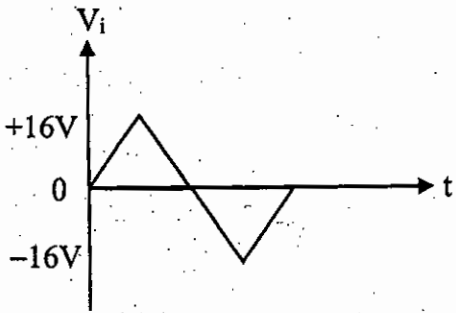
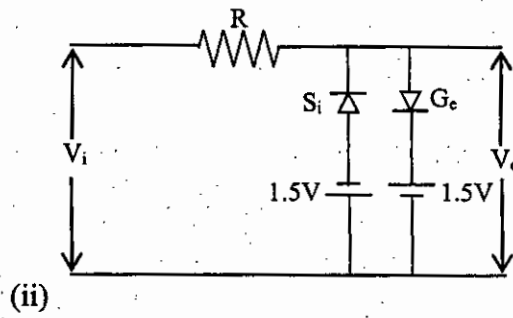
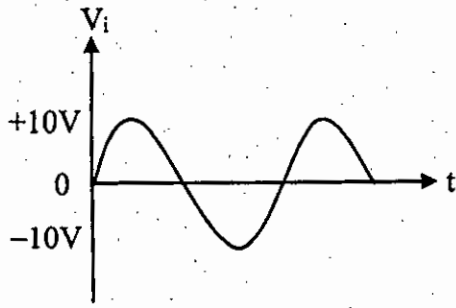
1. a) Define logic families. What are the different identical characteristics of a logic family? Briefly explain (i) Propagation Delay, (ii) Noise margin with proper schematic diagram. (10)
 - b) Construct AND gate and OR gate using diode. Why are many inputs AND and OR gate not possible to construct using gates? (09)
 - c) Write down the advantages and limitations of RTL and DTL logic families. Implement (i) NAND, (ii) NOR gates with RTL and DTL logic families. (09)
 - d) What is Fan-out? Draw the circuit diagram for finding loading factor of DTL logic family. (07)
2. a) Write down the name of different TTL Logic subfamilies. What do you mean by MC74HC04N? (05)
 - b) Classify TTL logic families on the basis of its output configurations. Discuss TTL with open collector output gate with circuit diagram and also writes its applications. (14)
 - c) Draw the 3-input NAND and NOR gate using CMOS logic. Why ECL is faster than TTL? (12)
 - d) Write down some differences between I²L and RTL Logic families with proper schematic diagram. (04)
3. a) What are the functions of Sample and Hold circuit? How an Analog Signal is converted into a Digital signal. Explain briefly with block diagram. (06)
 - b) Draw the block diagram of a dual slope A/D converter and explain its operation. (12)
 - c) Write down some differences between static and dynamic FF's. Also draw the NMOS based circuit diagram for a Set-Reset FF's. (08)
 - d) What is PLA? Explain PLA based JK Flip-Flops with truth table, characteristics equation and logic diagram. (09)
4. a) Classify the computer memory system. What are the difference between ROM and RAM? Also differentiate PROM, EPROM and EEPROM. (12)
 - b) Draw the circuit of a Six transistor based static Random Access Memory (RAM) cell. Also draw the diagram of 4x4 RAM. (12)
 - c) Explain PLD. Mention the advantages of using PLDs in the design of digital systems. (06)
 - d) Describe the principle of operation of LED oscillator. (05)

SECTION B

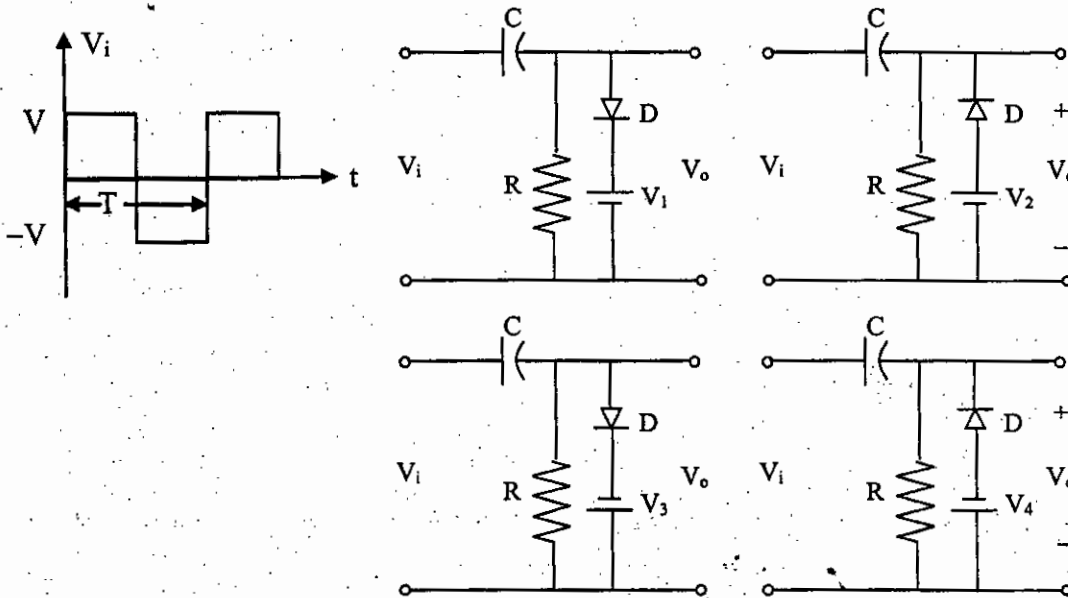
(Answer ANY THREE questions from this section in Script B)

5. a) Describe pulse waveform. Classify the pulse generating circuit. Mention some applications of pulse waveforms. (10)
- b) Derive the response of an RC high pass filter for an exponential input $v_i = V(1 - e^{-\frac{t}{\tau_1}})$, where τ_1 is the time constant. (12)
- c) Differentiate between clipping circuit and clamping circuit. Draw the output waveform of the following circuits for their respective given input. (13)

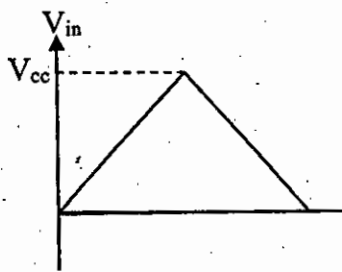




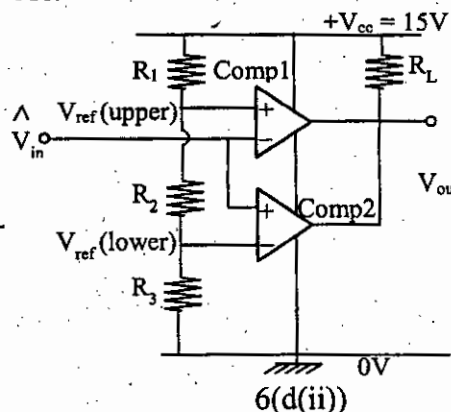
6. a) What are the requirements for constructing a clamping circuit? (06)
 b) What do you mean by UTP and LTP? Draw the input/output characteristics of schmitt trigger circuit. (11)
 c) Draw the output waveform for the following clamping circuits. (09)



- d) For the window comparator circuit of Fig. 6(d(ii)), find the output waveform of the input of Fig. 6(d(i)). Here $R_1 = 3\Omega$, $R_2 = 4\Omega$, $R_3 = 5\Omega$. (09)



6(d(i))



6(d(ii))

7. a) Define a multivibrator. Classify different types of multivibrator circuits. Draw the input and output waveform (ideal) of different types of multivibrator. (08)
 b) Derive the expression of frequency and duty cycle of an astable multivibrator for 50% duty cycle. (15)
 c) Consider a linear ramp generator circuit using 555 timer. In this configuration, $V_{cc} = 12V$, $C = 50\mu F$, $R_1 = 10k$, $R_2 = 5k$, $R_E = 100\Omega$, $V_{be} = 0.6V$. Determine the expression of ramp signal and time period, T. (12)
8. a) Draw and explain the operation of a bistable multivibrator. Mention its applications. (10)
 b) What is a pulse transformer? Describe the working principle of a pulse transformer. Draw the equivalent circuit of a pulse transformer. Transform the equivalent circuit to a T network and derive necessary equations. (12)
 c) Write short notes on (i) DMM, (ii) VTPM, and (iii) Q-meter. (13)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2018
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 z-transform. Find the z-transform of $f(n)$ where, (10)
- $$f(n) = \begin{cases} 5^n, & n < 0 \\ 3^n, & n \geq 0 \end{cases}$$
- b) What do you mean by Region of Convergence (ROC) of z-transform? Write down the (13)
important properties of the ROC for z-transform.
- c) By applying the time shifting property, determine the signal of $X(z) = \frac{z^{-1}}{1-3z^{-1}}$. (12)
2. a) Determine the z-transform of the signal $x(n) = a^n u(n) - b^n u(-n-1)$ ($a, b < 1, b > a$) and plot the (11)
ROC.
- b) Write convolution theorem. Find the inverse z-transform of $X(z) = \frac{1}{1 - \frac{1}{6}z^{-1} - \frac{1}{3}z^{-2}}$ using (12)
convolution method.
- c) Find the inverse z-transform of $X(z) = \frac{z}{(z-1)(z-2)(z-3)}$ using partial fraction method for (12)
ROC $3 > |z| > 2$.
3. a) Write down the assumption for the validity of Fourier Series expansion. Obtain the Fourier (22)
Series for the expansion of $f(x) = x \sin x$ in the interval $-\pi < x < \pi$ hence deduce the
following:

$$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \dots$$

- b) Find the Fourier integral of the function $f(x) = e^{-kx}$ when $x > 0$ and $f(-x) = -f(x)$ for $k > 0$ (13)
and hence prove that $\int_0^{\infty} \frac{u \sin ux}{k^2 + u^2} du = \frac{\pi}{2} e^{-kx}, k > 0$.
4. a) Write parsevals identity corresponding to the Fourier Series of the following function: (18)
- $$f(x) = \begin{cases} x, & 0 < x < 2 \\ -x, & -2 < x < 0 \end{cases}$$
- b) Find the Fourier cosine transform of $f(x) = \frac{1}{1+x^2}$ and hence derive Fourier sine transform of (17)
 $\phi(x) = \frac{x}{1+x^2}$.

SECTION B

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

5. a) Define rank of a matrix. Find the rank for the matrix A where, (10)
- $$A = \begin{bmatrix} 0 & 1 & 0 & -1 \\ 1 & 0 & 1 & -1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

- b) Find the inverse of matrix A by elementary transformation where, (10)

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

- c) What is meant by consistent system of linear equations? Determine the relationship among the constants p, q and r under which the following system is consistent: (15)

$$x + 2y - 3z = p$$

$$3x - y + 2z = q$$

$$x - 5y + 8z = r$$

6. a) What is orthogonal matrix? Determine the value of α, β, γ of the orthogonal matrix A where (12)

$$A = \begin{bmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{bmatrix}$$

- b) What do you mean by basis of a vector space? Find a subset of the vectors: (13)
 $v_1 = (1, 0, 1, 1), v_2 = (-3, 3, 7, 1), v_3 = (-1, 3, 9, 3), v_4 = (-5, 3, 5, -1)$, that forms a basis for the space spanned by those vectors, and then express the vector that is not in the basis as a linear combination of the basis vectors.

- c) By partitioning find A^2 , where (10)

$$A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 1 & 2 & 0 \end{bmatrix}$$

7. a) Find basis of null space of A , where (08)

$$A = \begin{bmatrix} 1 & -1 & 3 \\ 5 & -4 & -4 \\ 7 & -6 & 2 \end{bmatrix}$$

- b) What is orthonormal set? Is $S = \{v_1, v_2, v_3\}$ an orthonormal basis for \mathcal{R}^3 with the Euclidean inner product? Express $u = (1, 2, 3)$ as a linear combination of v_1, v_2, v_3 where, (12)
 $v_1 = \left(-\frac{1}{2}, \frac{1}{2}, 0\right), v_2 = \left(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 0\right), v_3 = (0, 0, 1)$.

- c) Find the diagonal matrix P such that $P^{-1}AP$ is diagonal and has a diagonal elements of the characteristic roots of A , where (15)

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

8. a) Define subspace of a vector space. Let w be the subspace of \mathcal{R}^4 generated by the vectors (1, -2, 5, -3), (2, 3, 1, -4) and (3, 8, -3, 5), find a basis and dimension of w . (12)
- b) Define norm. Find the angle θ between the vectors $u = (1, 3, -1, 2, 0)$ and $v = (-1, 4, 5, -3, 2)$. (08)
- c) Consider the vector space \mathcal{R}^3 with Euclidean inner product. Apply the Gram Schmidt orthogonalization process to transform the basis vectors $v_1 = (1, 1, 1), v_2 = (0, 1, 1), v_3 = (0, 0, 1)$ into an orthogonal basis vectors to obtain an orthonormal basis $\{u_1, u_2, u_3\}$. (15)