

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2016
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) What is Object Oriented Programming (OOP)? Encapsulated classes are easier to change. (09)
Give an example with necessary code.
b) How can you access static variable of a class without creating any object? (05)
c) Write a template function which returns the average of all the elements of an array of any (10)
built in data type. Extend your program for a user defined data type.
d) How does C++ handle different signals? Write the general syntax of signal() function. (06)
e) How does a function return another function with the help of a function pointer? (05)
2. a) How does internal shared ownership counter work while working with shared pointer? (06)
Explain with necessary code.
b) Suppose you enter 5 elements in a vector. Use Lambda expression and find_if algorithm to (08)
search a particular element in that vector.
c) How can you make the member function of a class friend of another class? Explain with (08)
necessary code.
d) Write a class to represent a vector (a series of float values). Include member functions to (13)
perform the following tasks:
i) To create the vector
ii) To modify the value of a given element
iii) To multiply by a scalar value
iv) To display the vector in the form (10, 20, ...)
3. a) What are the differences between if-else block and try-catch block for exception handling? (13)
Write a program to handle divide by zero exception using appropriate try-catch block.
b) Give an example of overloading const and Non-const function with appropriate code. (08)
c) How can you initialize a class using initialization list when all the member variables are (05)
public?
d) What is an inline function? When an inline function does not work? Explain with example. (09)
4. a) What is bit field? How is bit field used to utilize the memory space in a better way? Give an (10)
example.
b) Consider the following program- (15)

```
Class Person
{
    public:
    string name;
    int id;
    .....
    .....
}
```

Use STL map to map an integer to a set of person. So the key value pair would be:

⟨key, value⟩ ≡ ⟨int, set⟨person⟩⟩

Now write necessary C++ code to –

- i) insert data into the map
 - ii) traverse the entire map
- c) How can you change the default order of entering data into priority Queue? Use custom sort (10)
object and overload “()” operator.

SECTION B

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

5. a) Discuss the possible ways of overloading Double Subscript operator "[[]]" in C++. (10)
b) How does C++ compiler differentiate between overloaded postfix and prefix decrement operators? Explain with appropriate example(s). (05)
c) While overloading an operator using non-member function, is it mandatory to make that function a friend function? If so, explain why. (05)
d) Consider the input.txt file shown below. Write a C++ program which reads two complex numbers from each line of input.txt file and performs the specified mathematical operation (+, -) on those numbers. For working with these numbers create a ComplexNumber class with appropriate member attributes and functions. Specified mathematical operation must be performed using overloaded + and - operators. The program must generate a file named output.txt as shown below. For printing complex numbers use overloaded << operator. (15)

Perform following operations:

$3+2i + 5+3i$

$5+3i - 3+2i$

input.txt

$3+2i + 5+3i = 8+5i$

$5+3i - 3+2i = 2+1i$

output.txt

6. a) Create an array container class with bound-checking and dynamic resizing (when elements are added or removed) capability. (15)
b) What is memory leak? Explain with suitable example(s) how memory leaks occur in a C++ program. (08)
c) What is the problem associated with shallow copy? Explain how the problem can be solved using deep copy (consider both copy constructor and assignment operator). (12)
7. a) Differentiate among composition, aggregation and inheritance with appropriate example. (15)
b) Briefly explain the roles of different access specifiers used in inheritance in context of C++ language. Also discuss how granting access works for both member variables and member functions. (08)
c) What is the problem associated with multiple inheritance? Discuss all possible ways of solving the problem. (07)
d) "Child's pointer can point to parent's object but parent's pointer cannot point to child's object" – Justify this statement. (05)
8. a) Discuss the benefits of using "Namespace" in C++ with suitable example(s). (06)
b) Write a C++ program to show the use of Run-Time Type Identification (RTTI) and Dynamic cast. (08)
c) Describe the necessity of virtual destructor with an example. (05)
d) Explain the necessity of pure virtual function with appropriate example(s). What is an Abstract class? (10)
e) "Virtual functions are hierarchical" – justify this statement through suitable example. (06)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2016
Department of Computer Science and Engineering
CSE 2105

Data Structures and Algorithms

TIME: 3 hours

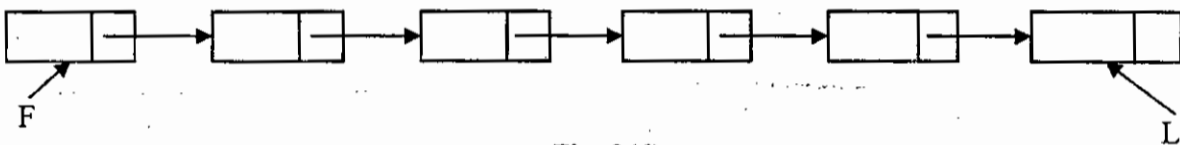
FULL MARKS: 210

- 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 type, abstract Data type and Data Structure with example(s). _____ (09)
b) Suppose A is a three dimensional array declared in C language. The location of A[0][0][0] is (13)
∞ and the declaration is A[5][6][7].
(i) Where is the location of A[1][2][3] if the row major representation is used?
(ii) Where is the location of A[4][5][6] if the column major representation is used?
c) Write an algorithm, modifying the binary search algorithm, to insert an item into a sorted (07)
linear array.
d) How do you access and store the elements of array? (06)
2. a) What are the differences between a heap and BST? When to use a heap and when to use a (07)
BST?
b) If you are using C language to implement the heterogeneous link list, what pointer type will (06)
you use?
c) Write a function to reverse a linked list. (09)
d) Consider a singly linked list of the form in Fig. 2(d) where F is a pointer to the first element in (13)
the linked list and L is a pointer to the last element in the list.



Write the functions/programs separately to perform the following operations.

- (i) Delete the last element of the list.
 - (ii) Delete the first element of the list.
 - (iii) Add an element after the last element of the list.
 - (iv) Add an element before the first element of the list.
 - (v) Interchange the first two elements of the list.
3. a) The Pre-order and In-order of T yield the following sequences of nodes. (11)
Pre-order: 30, 20, 10, 12, 40, 37, 45
In-order : 10, 12, 20, 30, 37, 40, 45
Draw the diagram of the tree T.
b) You have learned that singly linked list are trees. Are circularly linked list also trees? Why or (05)
why not.
c) What is Sparse Matrix and Multiway linked list? How to represent the Sparse Matrix by (09)
Multiway linked list?
d) Show how Insertion sort sorts the list of integers below by writing out the vector at each step (10)
of the following data set:
15, 20, 3, 9, 25, 30, 2, 5
Also derive its run time complexity.
 4. a) Consider the following binary tree in Fig. 4(a) representation of a max heap. (12)
(i) Give the array representation of the heap.
(ii) Delete the Maximum key. Give the resulting heap, circling any entries from (i) that
changed.
(iii) Insert the key Q into the original binary heap. Circling any entries from (i) that
changed.

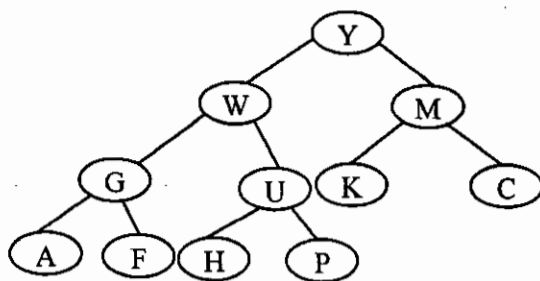


Fig. 4(a)

- b) Consider the binary search tree T in Fig. 4(b). Show stepwise, the In-order traversal result of (10) T after the key 17 is deleted.

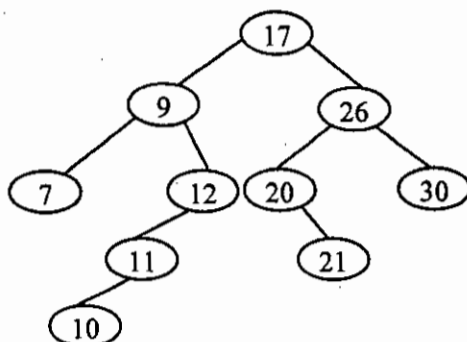


Fig. 4(b)

- c) Use Merge sort to find the largest integer on 38, 27, 43, 3, 9, 82, 10. Show your work step by (09) step and also draw the recursion tree.
 d) Why is not binary search algorithm applicable for sorted linked list? (04)

SECTION B

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

5. a) Define and discuss advantages of Polish notation. (06)
 b) Consider an infix expression consists of operands A, B, C, D, E, F, G, H and operators +, -, *, (15) /, ↑. Transform it into equivalent postfix notation while showing the contents of stack. Finally evaluate the postfix expression while showing the stack contents.
 c) Quicksort is an application of stacks. Using 12 unsorted data, explain quicksort while showing (14) the stacks' contents. Also discuss the complexity of quicksort.
6. a) Define and discuss the criteria of recursion. Solve 'Towers of Hanoi' problem recursively. (14) Also discuss the merits and demerits of recursion.
 b) Define hashing and hash function. Discuss at least three hash function techniques with (15) example(s). What is meant by hash collision?
 c) Explain the procedure of deleting an element from a linear array. (06)
7. a) Define queue and dequeue. Discuss the procedure of element insertion into a queue with (15) depiction. Differentiate between input-restricted and output-restricted dequeue.
 b) Discuss how elements are processed within a priority queue. Consider a priority queue where (15) various elements are categorized into five different priority levels. Then represent it using linked list and array.
 c) Write the procedure of garbage collection. (05)
8. a) Define the terms: directed graph, complete graph and connected graph. Discuss the steps (15) needed to follow to insert a node into a graph. Explain with example.
 b) A directed graph G consists of 9 nodes. Applying the appropriate graph traversing technique, (10) find and print all nodes reachable from a specific node.
 c) Using Warshall's algorithm, find the path matrix of the following graph (Fig. 8(c)). (10)

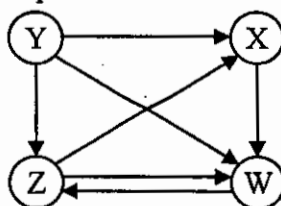


Fig. 8(c)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2016
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) Explain the terms: (i) computer architecture and (ii) computer organization with suitable examples. (08)
b) Define structure and function. Draw the structure of a control unit. (07)
c) How has the evolution of computer been characterized? Explain the operation of IAS machine with proper diagram. (11)
d) Explain Von Neumann architecture with proper diagram. (09)
2. a) Write down the principle concerns for computer arithmetic. What are the advantages of 2's complement representation over 1's complement and sign magnitude representation? Explain. (08)
b) Define overflow. Design an overflow detector circuit. (10)
c) Write an algorithm to multiply two unsigned binary numbers and verify your algorithm using a suitable example. (07)
d) Describe Booth's algorithm for 2's complement multiplication. (10)
3. a) What is memory hierarchy? Draw and explain pyramid structure of memory hierarchy. (07)
b) What is register? Explain user visible registers and status registers with examples. (08)
c) What is instruction? Explain instruction state diagram. (10)
d) Compare the superscalar and super pipelined approaches using examples. (10)
4. a) What is addressing modes? Discuss common addressing techniques with their principle advantages and disadvantages. (10)
b) What is instruction pipelining? Define branch penalty in a pipeline. How does instruction pipeline improve the performance of the system? Explain. (08)
c) Differentiate between RISC and CISC. (08)
d) What is instruction level parallelism? How does it differ from machine level parallelism? (09)

SECTION B

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

5. a) Define the terms: (i) memory access time and (ii) memory cycle time. (06)
b) What is cache-coherence problem? (06)
c) How do you ensure stale data will not exist in the cache? (05)
d) In a computer system, main memory and cache memory ratio is 64:4 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 8 words per block.
e) Consider a small memory consisting of 64K (65536) words of 8 bits each. How do you organize this memory using 16K×1 static memory chips? Explain with appropriate figure. (08)
6. a) Explain instruction cycle with interrupt. (07)
b) Suppose three interrupt handlers A, B and C (having priority level $A > B > C$) with Interrupt Service Routine (ISR) 10, 30 and 20 respectively. Graphically show the transfer of control for interrupt sequence of C, A and B at time $t = 10, 25$ and 45 respectively. (08)

- c) What is strip and stripe in RAID? How are data mapped in RAID level 0 array? (08)
- d) A 6-bit data 101010 is passed and written. After that when reading we use Hamming (12) correction and before correcting we get 101110. How do you detect and correct this one bit error?
7. a) Discuss briefly the elements of bus design. (09)
- 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 5 and 3 are stored in memory locations 940 and 941 respectively. Explain program execution with figure to store sum of the two values in the memory location 940. Consider Program Counter (PC), Accumulator (AC) and Instruction (IR) for the operation.
- c) Describe the functions of I/O module: (i) control and timing and (ii) processor (08) communication.
- d) Consider disk with an advertised seek time of 4ms, rotation speed 15000 rpm and 512 byte (10) sectors with 500 sectors per track. We wish to read a file consisting of 2500 sectors for a total of 1.28 Mbytes. Find total average access time for (i) sequential access and (ii) random access.
8. a) What are the basic tasks of control unit? (05)
- b) Draw the flowchart which defines the complete sequence of micro-operation for instruction (08) cycles.
- c) How is the concept of micro-programming used to implement a control unit? (10)
- d) Describe micro-operation. How can the following instruction cycle be described as a (12) sequence of micro-operation?
- i) Fetch.
 - ii) Execute.
 - iii) Interrupt.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 1st Term Examination, 2016
 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) Draw the circuit diagram of Tri-state TTL (TSL) logic circuit and explain its operation. (12)
 b) Define following terms with proper examples: (12)
 - (i) Fan-in and loading factor.
 - (ii) Noise immunity.
 - (iii) Power dissipation.
 - (iv) Noise margin.
- c) Draw the NAND and NOR gate using CMOS logic. Also, mention some applications of CMOS devices. (11)

2. a) Describe the operation of IIL inverter. (12)
 b) Draw the circuit diagram of a TTL gate with totem pole output and explain how the circuit works. (13)
 c) Draw the circuit diagram of a DTL NAND gate and explain its operation. (10)

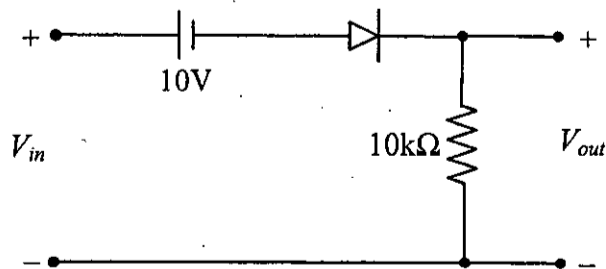
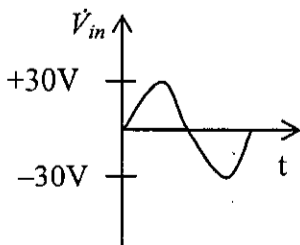
3. a) What do you mean by A/D, D/A converter? Why are they needed? What are the steps of A/D conversion? (11)
 b) What is PLA? Describe the working principle of PLA. (09)
 c) Write short notes on (i) Flip-flops (ii) Counters and (iii) Registers. (12)
 d) Mention some examples of PLD. (03)

4. a) What do you mean by memory unit? What are the basic properties of memory unit? (08)
 b) Define the terms: resolution, linearity and settling time. (05)
 c) Design excess-3 to BCD converter using PLA. (10)
 d) Describe the Read/Write operation of RAM in brief. (12)

SECTION B

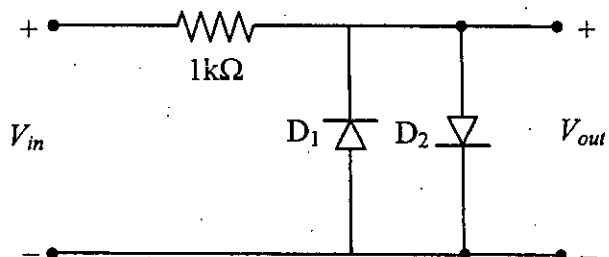
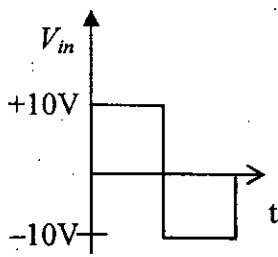
(Answer **ANY THREE** questions from this section in Script B)

5. a) Define linear waveshaping and non-linear waveshaping circuits. Also draw the following waveforms: (13)
 - (i) Step waveform
 - (ii) Pulse waveform
 - (iii) Square waveform
 - (iv) Ramp waveform
- b) Differentiate between clipping and clamping circuit. Draw the output waveforms of the circuits shown in Fig. 5(b)- (i), (ii), (iii). (12)

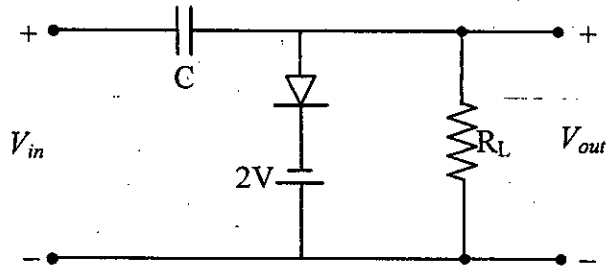
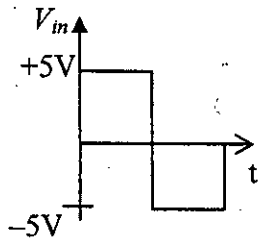


(i)

Fig. 5(b)



(ii)



(iii)

Fig. 5(b)

- c) What do you mean by sweep circuit? Draw the circuit of a constant current ramp generator (10) with input output waveform.
6. a) Derive the response of a RC high pass filter for step input. (12)
- b) An input symmetric square waveform of pulse repetitive frequency of 25 Hz is given to a (15) RC high pass filter shown in Fig. 6(b). Sketch the output waveform to scale by determining the corner voltages. Make use of the following two values of its lower 3dB frequency.
- (i) 0.2 Hz
- (ii) 20 Hz

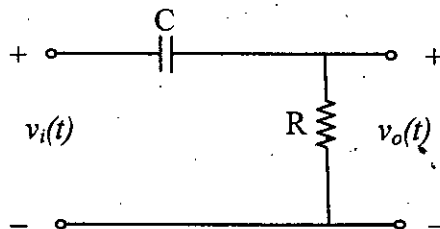


Fig. 6(b): RC high pass filter circuit

- c) Define blocking oscillator. Why is it named so? Mention its some applications. (08)
7. a) Define multivibrator. Classify it. Briefly explain the working principle of bistable (13) multivibrator.
- b) What do mean by triggering of a multivibrator? Draw a symmetrical and asymmetrical (12) triggering circuit for bistable multivibrator.
- c) What is Schmitt trigger? Draw a typical circuit and explain the working principle with typical (10) waveforms.
8. a) Define 555 timer IC. Draw its functional block diagram. Also describe the operation of an (14) astable multivibrator using 555 timer.
- b) What are DMM and VTVM? Explain their working principles shortly. (10)
- c) Define comparator circuit. Draw a break away diode comparator circuit and explain how it (11) works.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 1st Term Examination, 2016
 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 the following matrices with examples: (10)
 (i) Upper triangular matrix, (ii) Row matrix, (iii) Null matrix, (iv) Unit matrix and
 (v) Real matrix
 b) What is meant by a field? (10)
 c) Verify that B is the inverse of A by showing $AB = BA = I$, where $A = \begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ and (05)

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

- d) 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. (10)

2. a) What is meant by symmetric and skew-symmetric matrices? Find the symmetric and skew- (13)

symmetric parts of the matrix $E = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix}$.

- b) What is meant by equivalent matrix? Find the rank of $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ by the elementary row (10)
 transformation.

- c) Reduce $A = \begin{bmatrix} 6 & 3 & -4 \\ -4 & 1 & -6 \\ 1 & 2 & -5 \end{bmatrix}$ to echelon form and then to its row canonical form. Also find the (12)
 rank of A.

3. a) Apply rank test to solve the following system of linear equations: (12)

$$2x_1 + 3x_2 + x_3 = 9$$

$$x_1 + 2x_2 + 3x_3 = 6$$

$$3x_1 + x_2 + 2x_3 = 8$$

If consistent, then find its solutions.

- b) Let $M = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$. Find all eigen values of M and the corresponding eigen vectors. Also (13)
 determine an invertible matrix P such that $P^{-1}MP$ is diagonal.

- c) Test whether the following matrix P is invertible or not. If invertible, then find P^{-1} , where (10)

$$P = \begin{bmatrix} 4 & 1 & -1 \\ 0 & 3 & 2 \\ 3 & 0 & 7 \end{bmatrix}$$

4. a) Determine whether or not the vector $v = (3, 9, -4, -2)$ is a linear combination of vectors (08)
 $e_1 = (1, -2, 0, 3)$, $e_2 = (2, 3, 0, -1)$ and $e_3 = (2, -1, 2, 1)$.
- b) Let W be the subspace of \mathbb{R}^4 generated by the vectors $(1, -2, 5, -3)$, $(2, 3, 1, -4)$ and (10)
 $(3, 8, -3, -5)$. Find a basis and dimension of W .
- c) What is meant by orthogonal vectors? Examine whether the vectors $(1, -2, 3, -4)$ and (06)
 $(5, -4, 5, 7)$ are orthogonal or not.
- d) Define inner product of a vector space and orthogonal of a vector space. If $X_1 = [1, 2, 3]'$ and (11)
 $X_2 = [2, -3, 4]'$ find their inner product and length of each.

SECTION B

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

5. a) Write down the assumptions for the validity of Fourier series expansion. Obtain Fourier series (22)
for the expansion of $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, hence deduce that
- $$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \dots$$
- b) If $f(t) = t^2$, $0 \leq t \leq 1$. Find half range cosine series. (13)
6. a) Write down Parseval's identity of the Fourier series. Use parseval's identity to the function (20)
 $f(x) = \sin x$, $0 < x < \pi$ and show that $\frac{1}{1^2.3^2} + \frac{1}{3^2.5^2} + \frac{1}{5^2.7^2} + \dots = \frac{\pi^2 - 8}{16}$.
- b) Find the Fourier cosine transform of $f(x) = \frac{1}{1+x^2}$ and hence find Fourier sine transform of (15)
- $$\phi(x) = \frac{x}{1+x^2}$$
7. a) A sinusoidal voltage $E \sin \omega t$, where t is time, is passed through a half-wave rectifier that (18)
clips the negative portion of the wave. Find the Fourier series of the resulting periodic
- $$\text{function } u(t) = \begin{cases} 0 & , \text{ if } -\frac{\pi}{\omega} < t \leq 0 \\ E \sin \omega t, & \text{ if } 0 < t < \frac{\pi}{\omega} \end{cases}$$
- b) Find the Fourier integral of the function $f(x) = 0$, $\frac{1}{2}$ or e^{-x} for $x < 0$, $x = 0$ or $x > 0$ (17)
respectively.
8. 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) Find the Z-transform of the signal given and discuss its properties: (15)
- $$f(k) = \begin{cases} C^k, & k = 0, 1, 2, \dots \\ 0, & k = -1, -2, \dots \end{cases}$$
- Where the constant C takes the following values (i) $0 < C < 1$, and (ii) $C > 1$.
- c) Find the inverse Z-transform of $X(Z) = \frac{Z}{(Z-1)(Z^2+1)}$ by using Residue method. (10)