```
    return false;
}
```

(b) (i) F D J B A E H G C I

(ii) Parent of B = A Parent of G = E

(iii) Leaves of Right sub-tree are H , I

[Short Sample Papers of Approximately 1 hour for sets I to IX]

SET I

Answer the following by showing your working and analysis wherever applicable.

Question 1

(a) State the two Idempotent laws of Boolean Algebra. Verify any one of them using truth table.

(b) Write the expression of XOR and XNOR and draw their gates.

(c) Find the complement of F75 = x ′ . (x + y ′)

(d) Simplify using Boolean Laws (state the law used) : F34 = (a + b ′) . (b + a ′. c)′

(e) Write the canonical form of F43 = (p + q′) . (q + r′)

Question 2.

(a) Write the dual of F62, given that F62 = X . Y. Z ′ + X ′.Y ′. Z + X . Y ′ . Z ′

(b) Write the Prefix notation of :- P / (E * N) + C * (I – L)

(c) Verify whether the given expression is a tautology or not using Truth Table
F27 = x . y . z + x ′. y ′ + y ′. z ′ + y + z

(d) A 2D array defined as ZA[3..6, –2..2] requires 2 bytes of storage space for each element. If the array is stored in Row Major order, determine the address of ZA[4, 2], given the base address as 1200.

(e) What is the complexity of Bubble Sort on an array of size n?

Question 3.

I. Given the following method : (do not copy the code)

```
void fnTimor (int leste, int p)
{
    System.out.print (leste + "  :  ");
    if ( p %2 != 0 )
    {
        if ( p > 1)
        {
            fnTimor ( leste + 2 , p–2 ) ;
        }
            System.out.print (" ## " );
    }
    System.out.print (" & " + leste );
}
```

(a) What will be the output of method fnTimor if leste = 5, p = 5 ?

(b) What will be the output of method fnTimor if leste = 10, p = 4 ?

II. The given code fills an array with non-duplicate elements. Fill in the **?n?** marked blanks. (do not copy the code)

```
double[ ] fnArrayFill ( int s )
{
    double WED[ ] = ?1?;
    double tmp = 0; int j = 0;
    while ( j<=s-1 )
    {
        tmp = Math.random();
        boolean present  = ?2?;
        for( int k = 0; k<j; k++)
        {
            if(WED[j] == WED[k])
            {   System.out.println( tmp + " already present");
                ?3?
                break;
            }
        }
        if(present == ?4? )
        {   WED[j] = tmp;
            ?5?
        }
    }
    return ?6? ;
}
```

Question 4.

A class **BUSH** is designed to calculate the sum of the following series :

$S = (1^2 * 2^3) + (3^2 * 4^3) + (5^2 * 6^3) + \ldots$ upto n terms

Some of the members of the class **BUSH** are given below :

Class name	BUSH
Data members or instance variables	int n – the number of terms long s – to store the result
Member functions/methods –	
Constructor	Initialize member data to null
void fnShow (void)	To print the series upto n terms and the result of the series
void fnCalculate (void)	To calculate the series and store the sum in s
void fnInput (void)	To input value of member data n

Specify the class **BUSH** giving detail of the given functions. You need not write the main().

SET II

Question 1.

(a) What is the function of :– (i) Decoder (ii) Multiplexer

(b) Design an Octal to Binary Encoder. Explain the circuit with the one example.

(c) Verify using Boolean Laws a.b'.c XOR a'.b.c' = a.b'.c + a'.b.c'

Question 2.

An airlines company had certain reservations on allotting window seat in long journey. A window seat was allotted to a passenger if :

- the passenger's age is between 3 to 7 years and the passenger is accompanied by an adult.
- the passenger is a lady and is not accompanied by an adult.
- the passenger's age is not between 3 to 7 years and the passenger is travelling for the first time.
- the passenger is a lady and is traveling for the first time.

Inputs are :

G - the passenger's age is between 3 to 7 years

A - the passenger is accompanied by an adult

L - the passenger is a lady

F - the passenger is traveling for the first time

Output is :

W - the passenger gets window seat [1 indicates Yes, 0 indicates No]

(a) Draw the truth table for the inputs and outputs given above. Write the Sum Of Product expression for **W(G, A, L, F).**

(b) Reduce **W(G, A, L, F)** using Karnaugh's map. Draw the logic gate diagram for the reduced expression for **W(G, A, L, F)** using elementary gates. You may use gates with two or more inputs.

Question 3.

Create a class named **COMPLEX** whose details are as follows :

Class Name	COMPLEX
Member Data	int A, int B
Member Methods –	
COMPLEX ( )	Constructor to initialize member data to null
void fnInput ( )	to input values for member data
void fnShow ( )	to print member data as Complex Number [(A + B i)]
void fnAd Complex (COMPLEX c1, COMPLEX c2)	Add the two complex numbers c1 and c2 sent as parameters to the method. The function prints the three complex numbers.

Question 4.

In a bank, the account holders were offered two kinds of interest scheme, Simple and Compound, both depending on Principal (P), Rate (R) and Time (T).

The formula for calculating Simple Interest is given as SI = (PxRxT)/100.

And to calculate Compound Interest, formula used is $CI = Px(1 + R/100)^T - P$.

The bank manager wishes to implement a program whose structure is given below :

Class Name	ACCOUNT
Member Data	
P	double, to store the Principal
R	double, to store the Rate
T	int, to store the time
Member Function	
ACCOUNT (...)	Parameterized Constructor to initiate member data
void display ()	to display the member data

Class **SIMPLE,** that is inherited from class **ACCOUNT,** the details of whose are given below :

Class Name	SIMPLE
Member Data	
si	double, to store the value of simple interest
Member Function	
SIMPLE (...)	Parameterized Constructor to initiate member data of both this class and its base class (3member data of base class, member of this class to get initialized to 0)
void Interest ()	to calculate simple interest.
void display ()	to display the amount payable and also the values of P, R and T.

SET III

Question 1.

(a) What is the function of a Half Adder? Draw its Logic Gate diagram. Explain its working.

(b) Draw the Logic Gate Diagram using Universal NAND gates F4 = (a.c' + b'.c)

Question 2.

(a) Given F (P, Q, R, S) = Σ(0, 1, 3, 4, 6, 11, 12, 13, 14, 15)

Use Karnaugh's Map to reduce function F(P, Q, R, S) using the given SOP form. Draw the logic gate diagram for the reduced SOP expression using NOT, AND, OR gates. You may use gates with more than two inputs.

(b) Given G (C, D, E, F) = $\prod$ (0, 1, 5, 6, 8, 9, 10, 11, 13, 14, 15)

Use Karnaugh's map to reduce this function G (C, D, E, F) the given POS form. Draw the logic gate diagram for the reduced POS expression using NOT, AND, OR gates. You may use gates with more than two inputs.

Question 3.

Declare a Two Dimensional Array of order M x N and type integer. Fill it with variables except the last row and the last column. Fill the cells of the last row with the sum of the elements of the corresponding column. Fill the cells of the last column with the largest element of the corresponding row. The cell in last row and last column remains empty.

Example :

Source Array: Enter Order : M = 4 N = 7

99	77	44	60	20	22
66	50	30	11	55	80
40	33	88	70	90	10

Final Array:

99	77	44	60	20	22	99
66	50	30	11	55	80	80
40	33	88	70	90	10	90
205	160	162	141	165	112	

Question 4.

A class **STEM** is made to perform certain operations using **recursive functions**. The detail of the class is given below :

Class name	STEM
Data members	int r1, r2
Member functions/methods	
STEM (int v1, int v2)	Parameterized Constructor
void RC1(int one)	Prints the digits of the argument, one.
int RC2(int t1, int t2)	Returns the LCM of arguments t1, t2

Specify the class **STEM** and give details of the mentioned functions (you may make necessary assumptions). You need not write the main().

SET IV

Question 1.

(a) State the two Associative laws of Boolean Algebra. Verify any one of them using truth table.

(b) What is an Universal Gate? Generate the elementary gates using universal NAND Gates.

(c) Find the complement of F5 = x. y '. z + x '. z ' + y

(d) Simplify using Boolean Laws (state the law used) : F4 = A' + A'.B ' + A.B '.C

(e) Plot in Truth Table F3 = A.B '.C ' + A '.B.C ' + A.B.C + A '.B '.C

Question 2.

I. Given the following method : (do not copy the code)

```
void fnTorsa (String thu, int p)
{
    System.out.print (thu.charAt(p) + " ... ");
    if ( p > 0 )
    {
        fnTorsa ( String thu, p–1);
    }
    System.out.print (" ... " + thu.charAt(p) );
}
```

(a) What will be the output of the method if thu = "WEDNESDAY", p = 2 ?

(b) What will be the output of the method if thu = "THURSDAY", p = 3 ?

II. The given code performs circular right shift on an array. Write the **?n?** marked blanks.

(do not copy the code)

```
int [ ] fnCircle ( int FRI[ ] )
{
    int s = ? 1 ?
    int ? 2 ? = FRI [s–1];
    for ( int j = ? 3 ? ; j ? 4 ? : ? 5 ? )
    {
        FRI [ j ] = FRI [ j–1] ;
    }
    FRI [ ? 6 ? ] = tmp ;
    return FRI ;
}
```

Question 3.

Input a Date (three integers, dd, mm, yy). If the Date is a valid date, then input an integer (say td) representing total number of days. Print the new date that will appear after adding **td** number of days to the entered Date.

Example	Input	Date:	25 5 2012
			It is a valid date.
	Input	Total Days	10
	The New Date		4 6 2012
Example	Input	Date:	31 2 2015
			It is NOT a valid date.

Question 4.

In Computer Science, the memory is measured in Bytes. The higher unit is Kilobyte, where

1 KB = 1024 Bytes

A class **Memory** is designed, some of whose functions/methods are shown below :

Class name	Memory
Data members or instance variables	int kb, b
Member functions/methods –	
Memory (int k1, int b1)	Parameterized Constructor
void fnPrint (void)	Print the member data
Memory fnSum (Memory m1, Memory m2)	Calculate the sum of two objects of class Memory
void main ( )	Create two objects of class Memory, store their sum in another object and print all the three objects

Specify the class **Memory** giving detail of the mentioned functions.

SET V

Question 1.

(a) Given that F2 = X . Y. Z '. W ' + X '.Y '. Z . W + X . Y ' . Z ' . W + X ' . Y . Z . W'
What will be the result of F2 if

(i) X = 1 , Y = 1, Z = 0 , W = 0

(ii) X = 1 , Y = 0, Z = 1 , W = 1

(b) Write the postfix notation of :

D * (A + (R+K) / (S * (U – N)))

(c) Verify using Truth Table

A.C ' + A'.C = A.C + A'.C '

(d) A 2D array defined as FEB[4..10, –4..2] requires 5 bytes of storage space for each element. If the array is stored in **Row Major order**, determine the address of FEB[6 , 0], given the base address as 1000.

(e) What is the complexity of Linear Search on an array of size n.

Question 2.

(a) Write in postfix form: F5 = s – u + p * (e / (r * b))

(b) Using Universal NAND Gate draw F4 = P.Q + P'.Q'

(c) Explain the working of Binary to Octal Decoder.

Question 3.

A Stack is made using Nodes. Define a class **Node**, some of whose members are given below :

Class name	Node
Data members/instance variables	int data – to store the data Node next – to store the address of a node
Member functions/methods –	
Constructor	To initialize members to null
void fnPushNode (Node st, int val)	To add val in the beginning of the list starting with Node st..
int fnPopNode (Node st)	To pop the first element of the list starting with Node st.
void fnShow (Node st)	To print all the elements of the list starting with Node st.

Specify the class **Node** and give details of the mentioned functions. You need not write the main().

Question 4.

A class **GRASS** is made to perform certain operations using **recursive functions**. The detail of the class is given below:

Class name	GRASS
Data members	int r1, r2
Member functions/methods	
GRASS (int v1, int v2)	Parameterized Constructor
void funR1(int ra , int f)	Print the factors of the first argument, ra. [you may assume any suitable value of f]
int funR2(int p , int q)	Returns the sum of all integers from p to q

Specify the class **GRASS** and give details of the mentioned functions (you may make necessary assumptions). You need not write the main().

SET VI

Question 1.

(a) Given the expression F9 = P.Q.R′ + P.Q′.R + P′.Q.R + P.Q.R
What will be the value of F9 if
(i) P = 1 Q = 1 R = 1 (ii) P = 0 Q = 0 R = 1

(a) Simplify using Boolean Laws F8 = P′.Q′.R′ + P.Q′.R′ + Q

(b) Draw the truth table of F7 = P.Q.R′ + P.Q.R + P′.Q′.R′ + P′.Q.R′

(c) Reduce the expression of F7 using Karnaugh's Map

(d) Write the complement of F6 = P′.Q′ + P.Q

Question 2.

I. Answer the following in context to Java:
(a) Draw a binary search tree of height two.
(b) What is the function of the keyword super?
(c) What is a wrapper class?

II. Given the following method, answer the questions given below showing the dry run:

```
int RunWin( int x, int y, int f)
{
    if(x%f ==0 && y%f == 0)
      return f;
    return (RunWin ( x, y, f–1));
}
```

(a) What will be the final return if x = 12, y = 8, f = 8?

(b) What will be the final return if x = 7, y = 3, f = 7?

(c) What is the aim of the function RunWin ()?

Question 3.

A. Write a recursive function to calculate the product of two integers p,q using repetitive addition, given the function prototype int fnProduct(int p, int q)

B. Given the structure of a node as

```
class node
{
    int value;  node next;
    ..... // other methods of the class
}
```

Write the algorithm OR the code to print all the odd elements of a singly linked list of nodes void fnPrint (node begin)

C. Explain the following terms used in the program application of Inheritance in Java. Also give the program syntax code, need not write the complete program.

(i) extends (ii) super

Question 4. Program in Java

Class **clWorld** has been designed that has the following structure :

Class Name	–	clWorld
Member Data	–	Cup[ ][ ] – int array to store 10 x 10 elements av – integer
Member Methods	–	
(i) Constructor	–	to initialize member data to null
(ii) void fnData ( )	–	to fill member array with random integers
(iii) void fnAverage ( )	–	calculate and print the average of the array elements (using av)

Declare the class **clWorld** and write the detail of the given members.

SET VII

Question 1.

(a) Given the expression F4 = p.q.r' + p.q'.r + p'.q'.r + p'.q.r

What will be the value of F4 if

(i) p = 0 q = 1 r = 1

(ii) p = 1 q = 1 r = 1

(b) Simplify using Boolean Laws F5 = p'.q'.r' + r + p.q'.r'

(c) Draw the truth table of G6 = $\prod$ (0, 1, 2, 6) and write its canonical form.

(d) Write in prefix form: F5 = (w – a) / n + d % e * r

(e) A matrix B[10][7] is stored in the memory with each element requiring 2 bytes of storage. If the base address at B [x] [1] is 1012 and the address at B [7][3] is 1060, determine the value of 'x' where the matrix is stored in Column Major wise.

Question 2.

In a car rally, prizes were given in various categories. A SHIELD was given to a car if –

- The car did not finish before time but it was environment friendly.
- The car was not more than 30 min late but it did not finish before time and it was not environment friendly.
- Although the car finished before time, it was environment friendly.
- The car was not more than 30 min late and it attended 6 check points and it finished before time.

Input :

L : The car was not more than 30 min late.

A : The car attended less than 2 check points.

T : The car finished before time.

E : The car was not environment friendly.

Output S : The car got a SHIELD.

(a) Draw the truth table for the inputs and outputs given above.

(b) Write the cardinal Sum-Of-Product expression for **S(L, A, T, E).**

(c) Reduce **S(L, A, T, E).** using Karnaugh's map and write the reduced SOP Expression.

(d) Draw the logic gate diagram for the reduced expression for **S(L, A, T, E)** using elementary gates. You may use gates with two or more inputs.

Question 3.

Write a recursive function to print the digits of a number, given the function prototype

void fnDigits (int b)

A. Given the code –

```
class SIMPLE extends ACCOUNT
{
    double si;
    public SIMPLE (double sP, double sR, double sT)
    {
        super(sP, sR, sT);
        si = 0;
        System.out.print("\n\n From constructor of SIMPLE  si = " + si);
    }
    public void Interest()
    {
        si = (P * R * T)/100;
    }
    public void display ()
    {
        super.display();
        Interest();
        System.out.print("\n\n From display() of SIMPLE  si = " + si);
    }
}
```

Answer the following :

(a) Name the base class and the derived class.

(b) Write the prototype of the constructor of the base class.

(c) Write the keyword that is connecting the two classes.

(d) Name the variables of the base class that has been used here.

(e) What is the use of *super.display()* ? What will happen without keyword *super* here?

B. Given below is a code with marked blanks. Write the detail of the numbered blanks and also write the **Aim of the code.**

```
void fnSort ( int ra[ ] )
{
    int n = _____(1)_____
    for ( int p = 1 ; p<=n–1 ; p++ )
    {
        int s = 0 ;
        while ( _____(2)_____ )
        {
        s++;
        }
        int tmp = ra[p] ;
        for ( int k = p–1 ; k>=s ; k-- )
        {
            _____(3)_____
        }
            _____(4)_____
}
System.out.println ( " \n The elements in DESCENDING order after Sort ... " ) ;
for( int r = 0 ; r <= n–1 ; r++)
        System.out.print ( ra [r] + "   " ) ;
}
```

Question 4.

Class **clApp** has been designed that has the following structure :

Class Name	–	clApp
Member Data	–	T[ ][ ] – int array to store 10 x 10 elements
Member Methods	–	
(i) Constructor		to initialize member data to null
(ii) void fnData ( )		to fill the member array with random positive integers with value less than 100.
(iii) void fnShow ( )		print the array elements

Declare the class **clApp** and write the detail of the given members.

SET VIII

Question 1.

I. Explain the following terms in context to Java:

(a) static (b) wrapper class (c) return (d) break (e) super

II. Given the following method, answer the questions given below showing the dry run

```
void fnStDg4(String b)
{
    if ( b.length() == 0)
      return ;
    if( b.charAt(0) >= 48 && b.charAt(0) <= 57 )
      System.out.print ( b.charAt(0) + " " ) ;
    fnStDg4(b.substring(1) );
}
```

(a) What will be the output if b = "123abcd456" ?

(b) What will be the output if b = "KRTZ – 233 – WW – 6445 – 9" ?

Question 2.

(a) Which keyword is significant in executing a parameterized constructor of the base class from the derived class and how.

(b) Write the prefix notation of :

P * A * R – A + (M + E / T) – E / R

(c) Write the postfix notation of :

S * T * A – (T – E + M) / E – N / T

(d) A 2D array defined as P[4..7, –1..3] requires 3 bytes of storage space for each element. If the array is stored in column major order, determine the address of P[6, 2], given the base address as 3500.

(e) What is the complexity of a non-optimized bubble sort algorithm? Justify your answer.

Question 3.

(a) How are logic gates useful? What is the function of a Half Adder? Draw its Logic Gate diagram. Explain its working.

(b) What is a Full Adder? Draw its Logic Gate Diagram by using Half Adder block. Explain its working.

Question 4.

A class clPoint is designed, some of whose functions/methods are shown below :

Class name	ClPoint
Data members/instance variables	int x, int y
Member functions/methods – ClPoint()	Constructor
void fnInput (void)	To input values for the member data.
void fnShowPoint (void)	To display the member data in Point form and the quadrant in which it is located.
clPoint fnMidPoint(clPoint PK, clPoint PD)	To return the mid-point of the two points given to it as arguments.
int fnQuadrant ()	To return the quadrant (1, 2, 3 or 4) in which this point is. In quadrant 1, x + and y is +. In quadrant 2, x – and y is +. In quadrant 3, x – and y is –. In quadrant 4, x + and y is –.

Specify the class clPoint giving detail of the mentioned functions. You need not write the main().

SET IX

Question 1.

A. Draw the expression tree of a * b + c / (d + e) * f

B. Draw the Logic Gate Diagram to Encode decimal values 3, 5, 8 to Binary.

C. How many select lines will a 4x1 Multiplexer need and why ?

D. Which Logic Gates are used by a Decoder?

Question 2.

A. Simplify using K Map and write the reduced expression.

(i) F6 = $\sum$ (1, 2, 4, 5, 6, 8, 9, 10)

(ii) F5 = π (2, 3, 4, 5, 9, 10, 11, 13)

B. (i) Using Universal NOR gates generate a NAND gate.

(ii) Using Universal NAND gates generate a NOR gate.

C. Write the expression of XOR and XNOR gates and draw the gates using Universal Nand gates.

Question 3.

Write a program to input a string **S**. For each character which is an alphabet in either upper case or lower case, add the alphabet's numeric value to give a numeric result **R**. Ignore non-alphabets.

E.g. **S** – "Work Hard" R = 23 + 15 + 18 + 11 + 8 + 1 + 18 + 4 = 98

where A, a = 1 Z, z = 26

Question 4.

Write a program to input a number N (larger than 100). Create a double linked list which contains the prime factors of N in the data part.