[This question paper contains 16 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1197 **F**

Unique Paper Code : 2342011201

Name of the Paper : Object-Oriented Programming with C++ (DSC04)

Name of the Course : **B.Sc. (H) Computer Science**

Semester : II

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory (Question **1**).
3. Attempt **any 4** questions from **Section B** (Questions **2** to **6**).

Section A

(Compulsory Question)

1. (a) What are inline functions? Rewrite the following code using the inline function. (3)

```
#include<iostream>
using namespace std;
float mul (int x, int y)
{
    return (x*y);
}
int main()
{
    int a = 2, b = 5;
    cout << mul(a, b) << "\n";
    return 0;
}
```

(b) What will be the output of the following program :

(i) (3)

```
#include<iostream>
using namespace std;
class construct
{
int p, q;
```

```
public:
  construct(int x, int y)
  {
     p = x;
     q = y;
  }
  void Display()
  {
     cout<<p<<"\n"<<q<<"\n";
  }
};
int main()
{
  construct item1(10, 20), item2 =
construct(30, 40);
  item1.Display();
  item2.Display();
  return 0;
}
```

(ii) (3)

```
#include<iostream>
using namespace std;
void square(int* snum)
{
   cout<<"Square of 10 is ";
   *snum *= *snum;
}
int main()
{
   int num = 10;
   square (&num);
   cout << num << end1;
}
```

(iii) (3)

```
#include<iostream>
using namespace std;
void Myclass()
{
   try
   {
      throw “y”;
```

```
    }
        catch (const char*)
    {
        cout<<"Exception inside Myclass\n";
        throw;
    }
}
int main()
{
    cout<<"Now main starts\n";
    try
    {
        Myclass();
    }
    catch (const char*)
    {
        cout<<"Exception inside main\n" ;
    }
    cout<<"Now main ends\n";
    return 0;
}
```

(c) Write a program that takes a character from the keyboard and displays its corresponding ASCII value on the screen. (3)

(d) How do the properties of the following two derived classes A and B differ?

(i) class A: private C{//...};

(ii) class B: public C{//...}; (3)

(e) Write a function to swap two numbers using pointer datatype parameters. (3)

(f) Identify the error(s) in the following program :

(i) (3)

```
#include<iostream>
using namespace std;
class four_seater
{
    public:
        void Property()
    {
```

```
        cout<<"It has space for four
        persons"<<endl;
    }
};
class four_wheeler
{
    public:
        void Property()
        {
            cout<<"It runs on four tyres"<<endl;
        }
};
class Car: public four_seater, public four_wheeler
{ };
int main ()
{
    Car C1;
    C1.four_seater;
    C2.four_wheeler;
    return 0;
}
```

(ii) #include<iostream> (3)

```
using namespace std;
Template<class T1, class T2>
class Person
{
    T1 m_t1;
    T2 m_t2;
public:
    Person (T1 t1, T2 t2)
    {
        m_t1=t1;
        m_t2=t2;
        cout<<m_t1<<" "<<m_t2<<end1;
    }
    Person (T3 t2, T4 t1)
    {
        m_t2=t2;
        m_t1=t1;
        cout<<m_t1<<" "<<m_t2<<end1;
    }
};
```

```
void main()
{
    Person <int, float> obj1(1, 2.34);
    Person <float, char> obj2(2.13, 'r');
}
```

(iii)

```
# include <iostream>
#include <fstream>
using namespace std;
int main()
{
    const int size = 100;
    char buffer[size];
    ifstream in ("p1.cpp");
    ofstream out("p2.cpp");
    while(in.get(buffer))
    {
        in.get();
        cout<<buffer<<endl;
        cout<<buffer<<endl;
    }
    in.close();
    out.close();
}
```

(3)

SECTION B

2. (a) Write a program that reads a text file and creates an output file, named "out. dat". The output file is identical to the text file except that every sequence of consecutive blank spaces is replaced by a single space. (5)

(b) What is the sequence of constructors and destructors being called in the following multilevel inheritance : (5)

```
class X

{...};

class Y: public X;

{...};

class Z: public Y;

{...};
```

(c) Write the output of the following code. Also, mention the call by value and call by reference parameters in the following code. (5)

```
#include<iostream>
using namespace std;
int func(int a, int* b, int& c)
{
    int temp = a + *b + c;
    a += 10;
    *b += 20;
    c += 30;
    return temp;
}
int main()
{
    int x = 1, y = 2, z = 3;
    cout << x << ", " << y << ", " << z << "\n";
    cout << func(x, &y, z);
    cout << "\n" << x << ", " << y << ", " << z;
    return 0;
}
```

3. (a) Create a class ThreeDim which contains x, y and z coordinates as integers. Define the following for the class :

(i) default constructor to initialize data members to zero

(ii) parametrized constructor to initialize data members to values passed

(iii) function out() to display the coordinates of the class. (9)

(b) What will be the change in the output if a virtual keyword is removed from the print () function of the class basel? Write the output for the following code with the virtual keyword and without it. (6)

```
#include<iostream.h>
using namespace std;
class basel
{  public:
    virtual void print()
    {
```

```
        cout<<"print version of base class"<<end1;
    }
    void show()
    {
        cout<<"Show version of base class"<<end1;
    }
};
class der: public basel
{
    public:
        void print()
        {
            cout << "print version of derived class " <<
end1;
        }
        void show()
        {
            cout << "Show version of derived class" <<
end1;
        }
```

```
};
int main()
{
        basel *ptr;
        der x;
        ptr = &x;
        ptr->print();
        ptr->show();
}
```

4. (a) Write a program to print the following output : (6)

```
1
12
123
1234
12345
.....
```

(b) Write a program to print the area of a square and circle using function overloading. (9)

5. (a) Write a program to define a class, Complex, with the following features : (10)

   (i) data members hidden from outside the class

   (ii) a default and parametrised constructor

   (iii) a member function to add another complex number to it main() function to show the implementation of the class

   (b) Write a function that compares the two given arrays arr1 and arr2 of the same size (passed as parameters) for equality, and returns true or false. (5)

6. (a) What is a pure virtual function? Define an abstract class Polygon, with a data member area that stores the area of the Polygon, and a pure virtual function that calculates the area of the Polygon. Inherit a Rectangle class from the Polygon. Complete the program to show the use of the abstract class and polymorphism. (10)

(c) Write a function UpperTriangle() that accepts a square matrix A and its order n as input arguments. The function should convert matrix A to an upper triangular matrix by assigning 0 to all elements below the diagonal (diagonal left to right from top). (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1216

F

Unique Paper Code : 2342011202

Name of the Paper : Discrete Mathematical Structures

Name of the Course : **B.Sc. (Hons.) Computer Science (NEP-UGCF-2022)**

Semester : II

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1 (Section–A)** is compulsory.
3. Attempt any **four** questions from **Section–B**.
4. Parts of a question should be attempted together.
5. Use of simple calculator is allowed.

P.T.O.

SECTION A

1. (a) Determine whether the following function is one-to-one and onto from $\mathbb{R}^+$ to $\mathbb{R}^+$

$$f(x) = -3x^2 + 7$$

Also, check whether it is invertible. If invertible, find its inverse. Justify your answer in each case. (5)

(b) Show that $\neg(p \vee (\neg p \wedge q)$ and $(\neg p \wedge \neg q)$ are logically equivalent by developing a series of logical equivalences. (5)

(c) Evaluate 7^{644} mod 645 using Fast Modular exponentiation algorithm. (5)

(d) Prove that if any 14 numbers from 1 to 25 are chosen then one of them will be the multiple of another. (5)

(e) State whether the K_5 graph is/has a

(i) Tree

(ii) Euler Path

(iii) Euler circuit

Justify your answer. (5)

(f) Let a be a numeric function such that (5)

$$a_r = \begin{cases} 2 & 0 \le r \le 3 \\ 2^{-r} + 5 & r \ge 4 \end{cases}$$

(i) Determine S^2a.

(ii) Determine ∇a.

SECTION B

2. (a) Prove that the relation "congruence modulo m" over the set of positive integers is an equivalence relation. (7)

(b) If no three diagonals of a convex decagon meet at the same point inside the decagon, into how many line segments are the diagonals divided by their intersections? (8)

3. (a) Prove the following statement using the Direct Proof method :

If m and n both are perfect squares, then m * n is also a perfect square. (7)

(b) Using the principle of mathematical induction, prove that

$1.2.3 + 2.3.4 + \cdots + n.(n+1).(n+2) = n(n+1)(n+2)/3$ (8)

4. (a) Using the Euclidean algorithm, find the GCD of 1529 and 14039. (7)

(b) The interest for money deposited in a saving bank account is paid at a rate of 0.5% per month, with interest compounded monthly. $50 is deposited in the saving account each month for a period of 3 years, followed by $20 each month for next 2 years. What is the total amount in the account

(i) 4 years after the first deposit?

(ii) 20 years after the first deposit?

Formulate the numeric functions for each. (8)

5. (a) Prove that a tree with n vertices has n – 1 edges. (7)

(b) For the following numeric functions : (8)

$$a_r = 2^r \text{ for all } r$$

$$b_r = \begin{cases} 0 & 0 \le r \le 2 \\ 2^r & r \ge 3 \end{cases}$$

Determine a * b in either sketch or closed form expression.

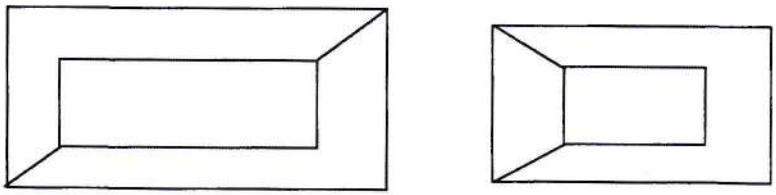
6. (a) In how many ways can a cricket team of eleven be chosen out of a batch of 14 players? How many of them will:

(i) include a particular player?

(ii) exclude a particular player? (7)

(b) Define graph isomorphism. Check whether the

following pair of graphs are isomorphic. Give justification in support of your answer. (8)



7. (a) Is Q_3 a planar graph? If planar, draw it in such a form. Verily your result using Euler formula also. (7)

(b) Draw Hasse Diagram for the relation R on $A = \{1, 2, 3, 4, 5\}$, whose relation matrix is given below

$$\begin{pmatrix} 1 & 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Is it a totally ordered set? Justify your answer.

(8)

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1235 **F**

Unique Paper Code : 2342011203

Name of the Paper : Probability for Computing

Name of the Course : **B.Sc. (H) Computer Science**

Semester / Type : II / DSC

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **First** question is compulsory and attempt any **four** questions from remaining.
3. Part of the questions to be attempted together.
4. Attempt all questions from **Section A**.
5. Attempt any four questions from **Section B**.
6. Use of non-programmable scientific calculator is allowed.

P.T.O.

SECTION A

1. (a) State the Central Limit Theorem. (2)

(b) A box contains six red, four orange, and two blue balls. Two balls are randomly selected. What is the sample space of this experiment? Let X represent the number of orange balls selected. What are the possible values of X? Calculate $P\{X = 0\}$. (5)

(c) (i) For any two random variables X and Y, prove that :

$$Cov(X, Y) = E[XY] - E[X]E[Y]$$

(ii) Calculate the expected sum obtained when three fair dice are rolled. (4+3)

(d) Coming home from work, Neha always encounters traffic signal. The probability that she makes it through a traffic signal is 0.2. How many traffic

signals can she expect to hit before making it through one? What is the probability of the third traffic light being the first one that is green? (5)

(e) Assume that each child who is born is equally likely to be a boy or a girl. If a family has two children, what is the probability that both are girls given that :

(i) the eldest is a girl?

(ii) at least one is a girl? (2+2)

(f) (i) When are two states of a Markov chain said to communicate with each other?

(ii) For the given transition probability matrix of a four-state Markov chain with states 0,1,2, and 3, answer the following :

$$P=\begin{Vmatrix} \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & 0 & 0 & 1 \end{Vmatrix}$$

(a) Which state is an absorbing state?

(b) Do states 0 and 2 communicate?

(c) Do states 0 and 1 communicate? (2+3)

(g) Name and define one technique to generate pseudorandom numbers. (2)

SECTION B

2. (a) Suppose the joint density of two random variables X and Y is given by :

$$f(x,y) = \begin{cases} 6xy(2 - x - y), & 0 < x < 1, 0 < y < 1 \\ 0, & otherwise \end{cases}$$

Compute the conditional expectation E[X| Y = y], where $0 < y < 1$. (7)

(b) Calculate E[X] for a Poisson distribution with parameter λ. (3)

(c) Consider two bags. The first contains two white and seven black balls, and the second contains five white and six black balls. We flip a fair coin and then draw a ball from the first bag or the second bag depending on whether the outcome was heads or tails. What is the conditional probability that the outcome of the toss was heads given that a white ball was selected? (5)

3. (a) Prove that for all discrete random variables X and Y: E[X] = E[E[X|Y]]. (5)

P.T.O.

(b) Suppose that we toss two coins. What is the sample space for this experiment? What is the probability that either the first or the second coin falls heads? (3)

(c) Derive the expectation of a uniform random variable with interval [a,b]. (3)

(d) A manufacturer produces medicine bottles out of which 0.1% are defective. Bottles are contained in a box containing 500 bottles. A drug company buys 100 boxes. Using Poisson distribution, find out how many boxes will contain no defective bottles. (4)

4. (a) Explain the n-step transition probabilities of a Markov chain using Chapman Kolmogorov equations. (6)

(b) A company pays dividends on a monthly basis when it is earning profits, and suspends the dividend payments in unprofitable times. Suppose that after a dividend has been paid in the current month, the dividend is paid in the next month with probability 0.9, while after a dividend is suspended the next one will be suspended with probability 0.6.

(i) What is the one-step transitional probability matrix for the above problem?

(ii) What will be the probability that dividend is paid in March 2023, given dividend is suspended in January 2023? (4+5)

5. (a) Let X denote the number of hours you spend in lab doing programming during a randomly selected college day. The probability that X can take on x values has the following form, where k is some unknown constant :

$$P(X=x) = \begin{cases} 0.1, & if\ x = 0 \\ kx, & if\ x = 1\ or\ x = 2 \\ k(5-x), & if\ x = 3\ or\ x = 4 \\ 0, & otherwise \end{cases}$$

(i) Find value of k.

(ii) What is the probability that you spend time on programming in lab for at least 3 hours?

(3+2)

(b) Let c be a constant. For a continuous random variable X, show the following :

(i) $Var(cX) = c^2Var(X)$

(ii) $Var(c + X) = Var(X)$ (3+3)

(c) Ram and Shyam go target shooting together. Both shoot at a target at the same time. Suppose Ram hits the target with probability 0.7, whereas