



‘समानो मन्त्रः समितिः समानी’

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 3rd Semester Examination, 2022

SEC1-P1-MATHEMATICS

Time Allotted: 2 Hours

Full Marks: 60

The figures in the margin indicate full marks.

The question paper contains SEC1A and SEC1B. Candidates are required to answer any *one* from the *two* SEC1 courses and they should mention it clearly on the Answer Book.

SEC1A

LOGIC AND SETS

GROUP-A

1. Answer any **four** questions: 3×4 = 12
 - (a) If a is an odd integer, establish that $a^2 + (a+2)^2 + (a+4)^2 + 1$ is divisible by 12.
 - (b) Describe the method of contradiction to prove an argument. 3
 - (c) Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology. 3
 - (d) Determine all solutions in integer of $24x + 138y = 18$. 3
 - (e) If $p \geq 5$ is a prime number, show that $p^2 + 2$ is composite. 3
 - (f) Let $A_i = \{1, 2, 3, \dots, i\}$ for $i = 1, 2, \dots$ then find $\bigcup_{i=1}^{\infty} A_i$ and $\bigcap_{i=1}^{\infty} A_i$. 3

GROUP-B

2. Answer any **four** questions: 6×4 = 24
 - (a) State Fermat's theorem. Using induction prove that if p is a prime, then $a^p = a \pmod{p}$ for any integer a . 6
 - (b) For three sets A, B, C show that $A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C)$. 6
 - (c) Find the number of non-negative integer solutions of the inequality $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 < 10$ where $x_i > 0, i = 1, 2, \dots, 6$. 6

- (d) Find the H.C.F and L.C.M of the numbers 12, 20 and 140 using set theory. 6
- (e) Show that each integer divisor $e > 1$ of $a^2 + b^2$ is a product of Gaussian prime divisors $q + ir$ of $a^2 + b^2$, unique up to unit factors. 6
- (f) (i) Find the negation of the following statement: 3
 $\forall x \exists y [\{p(x, y) \wedge q(x, y)\} \Rightarrow r(x, y)]$
- (ii) Establish the validity of the argument: 3
- $$\begin{array}{l} p \vee q \\ p \Rightarrow \sim q \\ p \Rightarrow r \\ \hline \therefore r \end{array}$$

GROUP-C

Answer any *two* questions

12×2 = 24

3. (a) How many relations are there on a set with n elements? How many of them are reflexive relations? 6
- (b) Define POSET. Show that the relation “ \geq ” is a partial ordering on \mathbb{Z} . 6
4. (a) If A and B be two equivalence relations on a set S then prove that $A \cap B$ is an equivalence relation. 6
- (b) Prove that if n is an integer then $n^2 \geq n$. 6
5. (a) Explain tautology and contingency. Construct truth tables to determine whether the following statements are tautology or contingency: 6
- (i) $\{p \Rightarrow (q \wedge r)\} \Rightarrow \sim (p \Rightarrow q)$
- (ii) $\sim (p \wedge \sim q) \Leftrightarrow \sim p \vee q$.
- (b) Prove that $A - \left(\bigcup_{i=1}^n B_i\right) = \bigcap_{i=1}^n (A - B_i)$. Show how this formula is the generalization of the De Morgan’s law. 6
6. (a) State and prove Euler’s criterion. 8
- (b) Verify that if p is an odd prime, then 4

$$\left(\frac{2}{p}\right) = \begin{cases} 1, & \text{if } p \equiv 1(\text{mod } 8) \text{ or } p \equiv 3(\text{mod } 8) \\ -1, & \text{if } p \equiv 5(\text{mod } 8) \text{ or } p \equiv 7(\text{mod } 8) \end{cases}$$

SEC1B**C++****GROUP-A**

1. Answer any *four* questions:

3×4 = 12

(a) What will be the output of the following program?

```
# include <iostream>
void main( )
{
    int a, b, c = 50;
    float age;
    a = c;
    b = c + 50;
    age = 23;
    cout << "a = " << a << "\n";
    cout << "b = " << b << "\n";
    cout << "c = " << c << "\n";
    cout << "age = " << age;
}
```

(b) What is an inline function? Is it possible to ignore inlining?

(c) Write a C++ program to find the maximum of two input numbers.

(d) What are the most important differences between C and C++ ?

(e) Write a C++ program to find the absolute value of an integer.

(f) What is friend function? Describe its importance.

GROUP-B**Answer any four questions**

6×4 = 24

2. Suppose there are two '.txt' files named file1.txt and file2.txt. Write a C++ program that reads the data file1.txt and copy every alternative character to file2.txt.

3. Write a C++ program to alternate rows and columns of a 4×4 matrix.

4. Which header file requires to calculate the length of a string? Write a C++ program to calculate the length of a string.

5. Write a C++ program that will give the following output:

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

6. What is inheritance? What are base and derived classes? Give a suitable example for inheritance. 2+2+2
7. What is demonstrated by the following program? 6
- ```
include < iostream >
using namespace std;
int main()
{ int exponent;
 float base, result = 1;
 cout << "Enter base and exponent:";
 cin >> base >> exponent;
 cout << base << "^" << exponent << "=";
 while (exponent != 0)
 {
 result *= base;
 -- exponent;
 }
 cout << result;
 return 0;
}
```

### GROUP-C

Answer any *two* questions

12×2 = 24

8. (a) Write a C++ program to detect and handle divide by zero errors. 7  
 (b) Write a C++ program to find the sum of first 15 even numbers and their squares sum. 5
9. (a) Write a C++ program to find the factorial of a positive integer. 4  
 (b) Write a C++ program for sorting names in alphabetical order. 8
- 10.(a) What are copy constructor? Explain their need. 4  
 (b) Write a program in C++ to illustrates the concept of overriding default operations performed by a user defined copy constructor. 8
- 11.(a) What is class? Describe the syntax for declaring a class with example. 5  
 (b) Write a program in C++ to declare a class employee, consisting of data members "employee no" and "employee name". Write the member functions "accept( )" to accept and "display( )" to display the data for five employees. 7

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