POST-GRADUATE DEGREE PROGRAMME

Term End Examination — December, 2024

MATHEMATICS

Paper-4B : COMPUTER PROGRAMMING & ITS APPLICATION TO NUMERICAL ANALYSIS

Time : 2 hours] [Full Marks : 50

Weightage of Marks : 80%

Special credit will be given for accuracy and relevance in the answer. Marks will be deducted for incorrect spelling, untidy work and illegible handwriting. The marks for each question has been indicated in the margin.

Use of scientific calculator is strictly prohibited.

Answer Question No. **1** and any *four* from the rest :

1. Answer any *five* questions : $2 \times 5 = 10$

   a) What happens if you initialize an integer with fewer elements than declared ?

   b) Give an example of infinite loop in C.

   c) What is file pointer in C.

   d) How many times will this loop execute ?

```
for (inti=1;i<=10;i=i+2) {
        //body
   }
```

   e) Consider the following C program.

```
#include<stdio.h>
void print(int n) {
       if(n= =0)
           return;
       printf("%d",n);
       print(n-1);
}
int main()
{   print(3);
    return 0;
}
```

   What is the output of this program ?

f) Which of the following is not a valid condition in an if statement in C ? Explain the reason.

(i) `x = = 5` (ii) `x > 5` (iii) `x` (iv) `x = 5`

g) Assume that in your C environment an int occupies 4 bytes, a double occupies 8 bytes, and a char occupies 1 byte.

Given the following union :

```
Union sample {
     int a;
     double b;
     char c;
} ;
```

Determine the total size of the union.

h) Mention the behaviour of `"r+"` file opening mode when using the `fopen()` function in C.

2. a) Consider the following declaration in C:

```
int a[8] = {12,8,9,9,11,10,2,5};
int *p;
```

Assuming the starting address of the array *a* is 100 and each integer occupies 4 bytes of memory, answer the following :

i) Determine the values of the following expressions :

`p, &a[4]- &a[1], *(++p)`

where & → address operator, * → indirection operator,

++ → prefix increment operator.

ii) Justify why the expressions `a[5]`, `*(a+5)`, and `*&a[5]` all yield the same value 10. 3 + 3

b) Write a function in C that accepts *n* as an integer argument and returns the factorial of *n*. 4

3. a) Modify the following code so that

- 'continue' skips even numbers, and
- 'break' exits the loop when the running sum exceeds 20.

```
int sum=0;

for(int i=1; i<=10; i++) {

      // Modify the code here

}
```

5

b) Write a program to find the sum of following series, correct up to 4 significant digits.

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \text{ (for any } x \text{)}$$

Your program should take value of x from the user and display the value of e^x in the terminal. 5

4. a) Define the Big-O notation (O) and the little-o notation (o) in the context of asymptotic analysis of algorithms. 4

b) Prove that $2n^2 = O(n^2)$ but $2n^2 \neq o(n^2)$. 4

c) What is wrong in the following lines in C ? 2

(i)
```
int x=10;

printf("%f", x);
```

(ii)
```
printf("Enter the value of x:");

scanf("%d", x);
```

5. a) Write a C program to implement the fixed Point Iteration method to solve the equation $x = \cos(x)$ with an initial guess x = 0·05 for 5 iterations. 6

b) Provide examples (only) of the following :

(i) Nested if statement in C.

(ii) Statement in C using the conditional (ternary) operator. 4

6. a) Three integer variables are given as a = 5, b = 3 and c = 2. You are required to trace the following three expressions in C, executed in order :

```
a = b++ +c*a;
b = a> 10 <c;
c = a = = b || c + 1;
```

Show then step-by-step evaluation of each expression and update values of a, b and c after each line. You can refer the precedence and order information given below: 6

Precedence		Operators	Associativity
High	1	++ (Postfix)	L(left) to R(Right)
↓	2	Multiplication(*)	L to R
	3	Addition (+)	L to R
	4	Relational (>)	L to R
	5	Equality (= =)	L to R
Low	6	Assignment (=)	R to L

b) Design a flowchart that reads a positive integer n and calculate the sum of its digits. 4

7. a) Given an expression containing only round brackets "(" and ")", write a pseudocode algorithm using a stack to check whether the expression is balanced. An expression is balanced if every opening parenthesis "(" has a matching closing parenthesis ")" and they are properly nested.

For example:

Expr	Balanced
$(a+b)+(c+(d-(e+f)))+g$	Yes
$(a+b)+e)$	No

You can assume a character string expr containing the expression is given to you. An empty stack S of size n with a pointer top, initially set to 0, indicating the next available position. You can use following procedure to write the pseudocode.

- push (x, s) : Inserts element x into the stack S.

  pop(s) : Removes and return the top element from stack S.
  empty (s): Returns 1 if stack S is empty (i.e., if top = = 0). 7

b) Explain how switch statement works with an example. 3