※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. The format of IEEE single-precision floating-point standard representation requires 23 fraction bits, 8 exponent bits, and 1 sign bit, with a total of 32 bits for each word. Convert the following binary number in the IEEE single-precision format to its decimal format. (10%)

1	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2. For the logic statement as follows:

```
F = 1 if ((A is 1 AND B is 1) OR (B is 1 AND C is NOT 1))
```

   a) Draw the logic circuit. (5%)
   b) Show the truth table for the given logic statement. (5%)

3. The seven stages in a von Neumann fetch-execute cycle are shown in the table below. Put each stage in the correct sequence by writing the numbers 1 to 7 in the right hand column. (10%)

Stage	Sequence number
The instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	
The instruction is decoded and then executed	
The PC (program counter) contains the address of the next instruction to be fetched	
The entire instruction is copied from the MDR (memory data register) and placed in the CIR (current instruction register)	
The address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	
The address part of the instruction, if any, is placed in the MAR (memory address register)	
The value in the PC (program counter) is incremented so that it points to the next instruction to be fetched	

4. There are various methods used to detect errors that can occur during data transmission and storage. Describe each of the following error detection methods and explain each with an example.
   a) Parity check (3%)
   b) Checksum (4%)
   c) Automatic Repeat reQuest (ARQ) (3%)

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5. Construct the NFA (nondeterministic finite automaton) transition diagram given the following transition table. (6%)
   Convert the NFA to a DFA (deterministic finite automaton) using the subset construction. (4%)

	0	1
→ p	{ p, q }	{ p }
q	{ r }	{ r }
r	{ s }	∅
* s	{ s }	{ s }

6. Construct a derivation tree for $w = abbbaabbaba$ using the grammar below. (10%)

$$S \rightarrow abB,$$
$$A \rightarrow aaBb,$$
$$B \rightarrow bbAa,$$
$$A \rightarrow \lambda.$$

7. Given the symbols and their corresponding probability in the following table:

Code	*a*	*b*	*c*	*d*	*e*
Probability	0.35	0.20	0.18	0.15	0.12

   a) Construct the Huffman coding tree. (5%)
   b) Show the Huffman code of the string "*cbbcbaeda*". (5%)

8. Suppose you run the following assembly program on a computer. The computer consists of 8 memory registers (`M[1]` to `M[8]`), 2 input registers (`I[A]` and `I[B]`), and one output register (`OUT`). Consider the operations and controls for the assembly.

```
21 MOV I[A] M[1]
22 MOV I[B] M[2]
23 ADD I[A] I[B]
24 MOV I[A] OUT
25 MOV I[B] M[3]
26 SUB I[A] I[B]
27 MOV M[4] OUT
28 HALT
```

OPERATIONS AND CONTROLS
1: MOVE X Y: X = Y
2: ADD X Y: OUT = X + Y
3: SUB X Y: OUT = X - Y
4: HALT: halt

   If the initial contents of the registers are: `M[1]` = 0010; `M[2]` = 0011; `M[3]` = 0010; `M[4]` = 0001. Answer the questions below. Write your answers in the format of 4-digit decimal numbers.
   a) What is the value of `OUT` after the instruction at location 24 completes? (4%)
   b) What is the value of `OUT` when the program halts? (3%)
   c) What is the value of `M[4]` when the program halts? (3%)

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9. What is the output of the following C program? (10%)

```
#include <stdio.h>
int func(int n);

int main()
{
   int test = 5;
   int result = 0;
   result = func(test);
   printf("The result is: %d", result);
   return 0;
}

int func(int n)
{
   int a;
   if (n == 1) return 1;
   a = n * (n - 1);
   printf("n = %d, a = %d\n", n, a);
   return a * func(n - 1);
}
```

10. Design a function that calculates the greatest common divisor (GCD) of two positive integers. Use a main function to call this function. The main function needs to ask the user to input the two integers repeatedly and display the calculation result until the user responses to end the program. You may use any computer programming language for this problem. (10%)

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