

Open Book Exam: Signed Number Arithmetic

Open Book Examination

Subject: Computer Organization

Topic: Signed Number Arithmetic Using Complements

Full Marks: 40

Time: 1 Hour

Section A — Conceptual Questions (5 x 2 = 10 marks)

Answer all.

1. Why is 2's complement preferred over 1's complement in computer arithmetic units?
2. What is the significance of the most significant bit (MSB) in signed number representation?
3. Can two negative numbers produce a positive result in 2's complement addition? Justify with reasoning or an example.
4. Explain what is meant by overflow in the context of signed binary arithmetic. When does it occur?
5. Why do we need complement-based subtraction when we can just add and subtract decimal numbers directly?

Section B — Application & Reasoning (3 x 5 = 15 marks)

Answer any 3.

6. Two 8-bit numbers $A = 01101010$ and $B = 11010110$ are added.
 - a) Identify the decimal values of A and B.
 - b) Perform the addition in binary.
 - c) Is there an overflow? Explain why or why not.
7. Suppose a student claims that the 1's complement of -7 is 11111000. Is the student correct? Justify your answer.
8. Explain with steps how 2's complement simplifies hardware implementation of

subtraction.

9. Compare and contrast the handling of zero in 1's complement and 2's complement systems. Why is one preferred over the other?

10. You are given a system that uses 1's complement for arithmetic. What specific challenges will you face while implementing a signed adder?

Section C — Analytical Problem (1 * 10 = 10 marks)

Answer any 1.

11.

a) Describe the full process of performing subtraction $A - B$ using 2's complement (with binary steps).

b) Use your explanation to solve $25 - 50$ using 8-bit 2's complement. Comment on the result.

12.

A signed 8-bit computer system uses 2's complement arithmetic. The addition of two numbers results in the binary value:

$$01111111 + 00000001 = 10000000$$

a) What are the decimal equivalents of the operands and result?

b) Why does this operation result in overflow?

c) Explain how this kind of overflow can be detected using logic gates in hardware.