Machine Level Programming (CS2253) Assignment

Instructions:

- Answer all questions.
- Show all necessary calculations and explanations.
- Submit your assignment in PDF format.
- Ensure MIPS assembly code is properly commented.
- Late submissions will incur a penalty unless prior arrangements are made.

Question 1: MIPS Instruction Analysis (20 Marks)
Explain the difference between **R-type**, **I-type**, and **J-type** instructions in MIPS architecture. Provide an example of each type and describe the format and purpose of the fields involved.

Question 2: Assembly Code Conversion (20 Marks)
Convert the following high-level C code into MIPS assembly code:

```
int x = 10, y = 20, z;

if (x < y) {

  z = x * 2;

} else {

  z = y * 2;

}
```

- Assume x, y, and z are stored in registers $t0, $t1, and $t2 respectively.
- Comment on the branching logic used.

Question 3: Complex Loop Implementation (20 Marks)
Write MIPS assembly code to implement the following nested loop:

```
int sum = 0;
```

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= 3; j++) {
    sum += i * j;
  }
}
```

- Store sum in register $s0, i in $s1, and j in $s2.
- Explain how nested loops are handled in MIPS, focusing on loop control instructions and register usage.

Question 4: Memory Addressing (20 Marks)
Consider an array A of integers. Write MIPS assembly code to compute the sum of the first five elements of the array.

- Assume the base address of A is stored in $s3, and each element is 4 bytes.
- Store the result in $s0.
- Explain the memory addressing techniques used.

Question 5: Advanced Logical Operations in MIPS (20 Marks)
Write MIPS assembly code to perform the following operations:

1. Perform a bitwise AND between the values in $t0 and $t1, then shift the result left by 3 bits and store it in $t2.
2. Perform a bitwise OR between $t2 and $t3, followed by an XOR operation with $t4, and store the final result in $t5.
3. Check if the result in $t5 is zero. If it is, set $t6 to 1; otherwise, set $t6 to 0.

Provide comments explaining each operation, including the use of shift and conditional logic to manipulate data.

Submission Deadline: [2025-05-23]
Total Marks: 100