



United International University

Department of Computer Science and Engineering

CSE 3313: Computer Architecture

Midterm Examination: Spring 2025

Total Marks: 30 Time: 1 hour and 30 minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Answer all questions. Numbers to the right of the questions denote their marks.

1. Suppose there are three classes of instructions A, B, and C in a particular instruction set architecture with CPIs 2, 1.5, and 2.2 respectively. The number of instructions(IC) from each class in two separate programs is as follows:

Programs	A	B	C
P1(IC)	100	110	116
P2(IC)	112	100	40

Consider that both programs run on the same device with a clock frequency of 2 GHz. Both P1 and P2 require 450 ns to be completed.

- Find out the affected and unaffected times for both programs. [2]
 - Find the improvement factor for P1 and P2 if we get the total program completion time improved by 3x. [6]
 - If P2 now has the same execution time as P1 what should be the number of instructions (IC) for instruction class C? [2]
2. Consider the following C function and assign registers according to your requirements.

```
1 void calculate(int i, int k){  
2   int a, b=15;  
3   a = ((b%8)|i)&(~k);  
4 }
```

- Convert the code to the corresponding MIPS assembly instructions. [4]
- Convert the first 8 lines of MIPS assembly instructions to the corresponding machine code. No need to convert it into binary. [4]
- Can we write the below code in MIPS? Justify with proper explanation. [3]

```
1 sll $t0, $s1, 40
```

- Assume that processor X has 256 registers. The size of MIPS instruction is 32 bits and 6 bits are reserved for opcode. The structure for beq instruction is given in the table-1. Find out the maximum value of Y that can be written in the instruction below. [4]

opcode	rs	rt	address
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Table 1: Structure of beq instruction

```
1 beq $s5, $zero, Y
```

- Multiply two numbers A by B using the optimized multiplication algorithm, where A = 7 and B = 9. [4]
 - Using the optimized multiplication algorithm if we multiply two numbers of 5 bits, then what will the size of the product register? [1]

Instruction	Opcode	Function Code
add	0	32
sub	0	34
lw	35	-
sw	43	-
and	0	36
or	0	37
nor	0	39
andi	12	-
ori	13	-
sll	0	0
srl	0	2
beq	4	-
bne	5	-
slt	0	42
j	2	-
jr	0	8
jal	3	-
addi	8	-

(a) MIPS Machine Codes

Name	Register Number
\$zero	0
\$at	1
\$v0-\$v1	2-3
\$a0-\$a3	4-7
\$t0-\$t7	8-15
\$s0-\$s7	16-23
\$t8-\$t9	24-25
\$k0-\$k1	26-27
\$gp	28
\$sp	29
\$fp	30
\$ra	31

(b) MIPS Registers