

Ryerson University
Department of Electrical and Computer Engineering
COE 608–Computer Organization and Architecture

Final Exam APRIL 27, 2016

Name: _____ **Student Number:** _____ **Sec:**-----

Time limit: 2 hours 30 min

Examiners: N. Mekhiel

Notes:

- a) Closed book.
- b) No calculators.
- c) Answer all questions **in the space provided.**

Total Marks=80, each=20

Q1-1 Translate the following into C. Assume i is in register \$s2, \$s0 has base address of A[] array, \$s1 has base address of B[] array and register \$s9 has 1000.

```
    addi $s2, $0, $0
LOOP: sll $s3, $s2, 2
    add $s4, $s0, $s3
    add $s5, $s1, $s3
    lw $s6, 0($s4)
    lw $s7, 0($s5)
    add $s8, $s7, $s6
    sw $s8, 0($s4)
    addi $s2, $s2, 1
    beq $s2, $s9, EXIT
    j LOOP
EXIT:
```

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Q1-2 Find the effective CPI for the above code if arithmetic and logic operations take 1 cycle, data transfer instructions take 3 cycles, and conditional branches take 2 cycles, unconditional branches takes 1 cycle.

Q1-3 Calculate the performance of the above code if the MIPS processor runs at 1 GHz

Q1-4 Find performance of above code if MIPS uses on chip cache for data transfers that improves it by 3 times but it slows down processor speed to 800 MHz.

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Q2-1 Design a Register File that consists of 16 Registers, each has 16 bits. Register File must have two READ ports, and one WRITE port. Draw a detailed schematic diagram.

Q2-2 Explain how a READ operations from Register 7, and Register 9 can be performed at the same time

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Q2-3 Explain how a WRITE operation of 007E HEX to Register 2 is performed

Q3-1 Convert the following decimal to IEEE754 FP format:
-.5625

Q3-2 Draw a block diagram (hardware) to implement a multiplier system for 16 bits numbers

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Q3-3 Calculate how long it takes for a single multiplication operation in the above system assuming clock speed is = 1 GHz

Q4-1 For the Multicycle Data Path below, find the effective CPI running the code of Q1

Q4-2 Find the value of asserted control signals in each cycle when executing the following instruction:

```
sw $s8, 0($s4)
```

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Q4-3 Identify all types of Hazards in the code of Q1 if it runs in a pipeline data path

Q4-4 If the pipeline uses forwarding, identify hazard stalls in Q1 that could not be eliminated by forwarding, then suggest a solution to get rid of stalls

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