



**Uva Wellassa University of Sri Lanka**  
**Faculty of Science and Technology**  
**Department of Computer Science and Technology**  
**300 level 2<sup>nd</sup> Semester Examination – Dec. 2018/Jan. 2019**  
**CST363-2 Computer Systems Architecture**



**Instructions to candidates**

**Duration:** Two (02) hours

**Mark allocation:** 100

**Number of questions:** Five (05)

**Answer any four (04) questions only.**

- 1.
- a. Explain the two (02) mechanisms, which are available to write data into the cache. (6 mark)
  - b. Briefly explain the term “temporal locality”. (4 mark)
  - c. If there are 64 blocks in the cache and the block size is 16 bytes, what is the block number for mapping the address 1200? (3 mark)
  - d. Describe the following page replacement algorithms using tables. Assume the page frame size is four (04) and the page fault for the string is **0 1 2 3 0 1 4 0 1 2 3 4**.
    - i. First In First Out (FIFO) (6 mark)
    - ii. Least Recently Used (LRU) (6 mark)
- 2.
- a. List and describe the three (03) different types of instruction formats available in MIPS. (9 mark)
  - b. What are the decimal and binary representations of **add \$t0,\$s1,\$s2** in MIPS fields? (6 mark)
  - c. Briefly explain the memory hierarchy of a computer using a suitable diagram and list two (02) characteristics of the main levels. (6 mark)
  - d. List four (04) advantages of having memory hierarchy in a computer. (4 mark)
- 3.
- a. Briefly explain each line of code of the following assembly program.

```
li $t1, 1
add $t0, $t1, 2
```

(4 mark)
  - b. Briefly describe the functions of systems calls. (6 mark)
  - c. A system which comprise of ten (10) compressors had 2 failures. Normally a single compressor operating time is 800 hours. Calculate the Mean Time Between Failures (MTBF) for the above system. (4 mark)
  - d. A system is having 10 sensors and each and every sensor runs for 500 hours. Calculate the Mean Time To Failure (MTTF) for a sensor. (3 mark)

e. Write an assembly program to read two (02) numbers through the keyboard, add them together and display the result. (8 mark)

4.

- a. Draw the logic circuit and derive the truth table for the half adder. (4 mark)
- b. Draw the logic circuit and derive the truth table for the full adder. (5 mark)
- c. What is the decimal value of the hexadecimal number 'A0'? (2 mark)
- d. In a particular digital device, integers are represented in 8-bits two's complement form. However, the results of computations are display in decimal.
  - i. Give the representation of  $(-13)_{10}$  in the above device. (4 mark)

ii. Explain how the computation of  $28_{10} - 13_{10}$  done by the device. All the steps that you have used should be shown in the answer. (6 mark)

e. With the aid of a suitable example in arithmetic addition of binary number system, briefly explain the situation of "overflow". (4 mark)

5.

- a. Briefly explain the term "System bus". Name and describe the three (03) functional groups that the system bus can be classified. (8 mark)
- b. Name two (02) ways to improve the CPU Time/Performance. (2 mark)
- c. Following description is about a hard disk.

The advertised average seek time is 4 ms, the transfer rate is 100 MB/sec, and the controller overhead is 0.2 ms. Assume that the disk is idle so that there is no waiting time. The hard disk is rotating at a speed of 15,000 RPM.

What is the average time to read/ write a 512-byte sector from/ to hard disk?

(5 mark)

d. Calculate the clock rates of processor P3 and P4 on the following dataset.

	L1 Size	L1 Miss Rate	L1 Hit Rate
P3	2 KB	8.0 %	0.66 ns
P4	4 KB	6.0 %	0.90 ns

(5 mark)

e. A cache is a two-way set associative cache and it has four (04) blocks. Determine the block number for the memory access sequence 0, 2, 4, 8, 10, 12, 14, 16, 0. (5 mark)

### Annex

Average Disk Access Time = Average Seek Time + Average Rotational Delay + Transfer Time  
+ Controller Overhead.

Total number of bits in a direct-mapped cache =  $2^n * (\text{Block size} + \text{Tag size} + \text{Valid field size})$

CPU time = (CPU execution clock cycles + Memory-stall clock cycles)  $\times$  Clock cycle time

CPU Clock Cycles = Instructions for a Program  $\times$  Average clock cycles per instruction

CPU Time = Instruction count  $\times$  CPI  $\times$  Clock cycle time

CPU Time = (Instruction Count  $\times$  CPI) / Clock Rate

CPU Execution Time = CPU Clock Cycles for a Program  $\times$  Clock Cycle Time

CPU Execution Time = CPU Clock Cycles for a Program / Clock Rate

Memory-stall clock cycles = Read-stall cycles + Write-stall cycles

Performance = 1 / Execution Time

Average Memory Access Time (AMAT) = Hit time + Miss rate  $\times$  Miss penalty

Register number 17 = \$s1, Register number 18 = \$s2 .....

Register number 8 = \$t0, Register number 9 = \$t1, .....

For addition the opcode value is 0 and the function code value is 32.

