



UNIVERSITY OF GHANA

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**BSc. COMPUTER SCIENCE/INFORMATION TECHNOLOGY, EXAMINATION
FOR FIRST SEMESTER: 2020/2021**

DCIT 207: COMPUTER ORGANIZATION AND ARCHITECTURE (3 CREDITS)

INSTRUCTION:

Please ensure that all your answers are brief and properly demonstrate your understanding of the concepts. Marks will be awarded for clarity of expression. Answer all questions in the answer booklet provided.

Answer Three (3) Questions out of the Four (4) Questions

TIME ALLOWED:

TWO (2) HOURS

ANSWER THREE (3) QUESTIONS IN ALL

1. a) Consider a hypothetical 32-bit microprocessor having 32-bit instructions composed of two fields: the first byte contains the opcode and the remainder the immediate operand or an operand address.
 - i. What is the maximum directly addressable memory capacity (in bytes)?
[1 mark]
 - ii. Discuss the impact on the system speed if the microprocessor bus has:
 - a. 32-bit local address bus and a 16-bit local data bus, or [2 marks]
 - b. 16-bit local address bus and a 16-bit local data bus. [2 marks]
 - iii. How many bits are needed for the program counter and the instruction register?
[Justify your answer] [4 marks]

b.

- i. What common characteristics are shared by all RAID levels? [2 marks]
- ii. Illustrate the Block Diagram for an External Device and explain how the various part functions. [9 marks]

TOTAL = [20 MARKS]

2.

- a. Consider two different machines, with two different instruction sets, both of which have a clock rate of 200 MHz. The following measurements are recorded on the two machines running a given set of benchmark programs:

Instruction Type	Instruction Count (millions)	Cycles per Instruction
Machine A		
Arithmetic and logic	8	1
Load and store	4	3
Branch	2	4
Others	4	3
Machine B		
Arithmetic and logic	10	1
Load and store	8	2
Branch	2	4
Others	4	3

- i. Determine the effective *CPI*, *MIPS rate*, and *Execution Time* for each machine. [8 marks]
- ii. Comment on the results. [2 marks]
- b) When large volumes of data are to be moved, a more efficient technique is required: direct memory access (DMA). Explain how DMA works touching on *cycle stealing*. Also explain how the processor interact with the DMA module. [10 Marks]

TOTAL = [20 MARKS]

3.

- a. Assume a stack-oriented processor that includes the stack operations PUSH and POP. Arithmetic operations automatically involve the top one or two stack elements. Begin with an empty stack. What stack elements remain after the following instructions are executed? [10 marks]

PUSH 4
PUSH 7
PUSH 8
ADD
PUSH 10
SUB
MUL

- b. Explain the functions of **condition codes** and provide four (4) advantages and four (4) disadvantage of condition codes. [6 marks]
- c. Explain the typical characteristics of a RISC instruction set architecture? [4 marks]

TOTAL = [20 MARKS]

4.

- a. A microprocessor provides an instruction capable of moving a string of bytes from one area of memory to another. The fetching and initial decoding of the instruction takes 10 clock cycles. Thereafter, it takes 15 clock cycles to transfer each byte. The microprocessor is clocked at a rate of 10 GHz.
- Determine the length of the instruction cycle for the case of a string of 64 bytes.
 - What is the worst-case delay for acknowledging an interrupt if the instruction is noninterruptible?
 - Repeat part (ii) assuming the instruction can be interrupted at the beginning of each byte transfer. [6 marks]
- b. Explain the difference between an arithmetic shift and a logical shift? [2 Marks]

- c. Explain the difference between big endian and little endian? [2 Marks]

- d. Compare zero-, one-, two-, and three-address machines by writing programs to compute

$$X = (A + B * C) / (D - E * F)$$

for each of the four machines. The instructions available for use are as follows:

0 Address	1 Address	2 Address	3 Address
PUSH M	LOAD M	MOVE ($X \leftarrow Y$)	MOVE ($X \leftarrow Y$)
POP M	STORE M	ADD ($X \leftarrow X + Y$)	ADD ($X \leftarrow Y + Z$)
ADD	ADD M	SUB ($X \leftarrow X - Y$)	SUB ($X \leftarrow Y - Z$)
SUB	SUB M	MUL ($X \leftarrow X \times Y$)	MUL ($X \leftarrow Y \times Z$)
MUL	MUL M	DIV ($X \leftarrow X/Y$)	DIV ($X \leftarrow Y/Z$)
DIV	DIV M		

[10 marks]

TOTAL = [20 MARKS]