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SABARAGAMUWA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

DEPARTMENT OF COMPUTING & INFORMATION SYSTEMS
BSc DEGREE PROGRAMME IN COMPUTING AND INFORMATION SYSTEMS

IS 2019/2020 SEMESTER I EXAMINATION SEPT/OCT 2022

IS1105- Computer System Organization

Time allowed: **Three (03) Hours**

INSTRUCTIONS TO CANDIDATES:

This paper consists of 05 questions. Answer ALL questions.

The marks given in brackets are indicative of the weight given to each part of the question.
Write your Index No clearly in all places where appropriate.
Write clearly in English and use blue or black ink.
Non-programmable calculators are ALLOWED in this examination.
No clarifications will be provided on the given questions.
Strike a line through all unused pages in the answer booklet/sheets.
Cross out all scratch paper and hand in at the time of collection.

01. a) Explain the organization and architecture of a computer system *[20 Marks]*

b) Describe the Flynn's Classification of a computer architecture *[20 Marks]*

c) The table shows a segment of the primary memory from a Von Neumann model computer

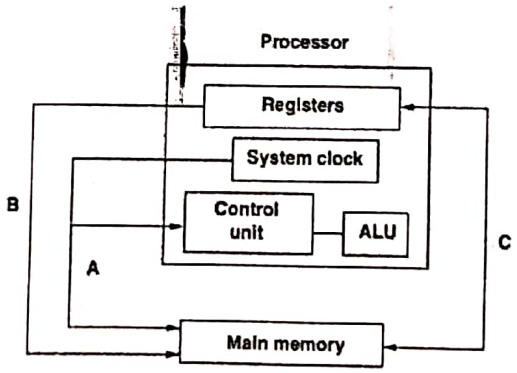
Address	Contents
10001	11001101
10010	11110001
10011	10101111
10100	10000110
10101	00011001
10110	10101100

The program counter contains the data 10010

i. State the data that will be placed in the Memory Address Register (MAR) *[10 Marks]*

ii. State the data that will be placed in the Memory Data Register (MDR) *[10 Marks]*

d) The diagram below shows a simplified form of the processor architecture. Name the three buses labeled as A, B and C. *[10 Marks]*



e) State the role of each of the following special purpose registers used in a typical processor. *[30 Marks]*

b. Program Counter
c. Memory Data Register
d. Current Instruction Register
e. Memory Address Registe

02 a) i. Give three (03) reasons why Solid state drives (SSDs) are replacing hard disc drives (HDDs) in some computers. *[20 Marks]*

ii. Explain why many webservers still use hard disc drive (HDD) technology. *[20 Marks]*

b) What is meant by Seek time, Rotational latency, and Transfer rate in the case of a disk drive. *[30 Marks]*

c) Consider a hard disk with:

4 surfaces

64 tracks/surface

128 sectors/track

256 bytes/sector

i. What is the capacity of the hard disk? *[10 Marks]*

ii. The disk is rotating at 3600 RPM, what is the data transfer rate? *[10 Marks]*

iii. The disk is rotating at 3600 RPM, what is the average access time? *[10 Marks]*

03) a) Define the following terms *[40 Marks]*

a) Response time
b) Throughput
c) CPU execution time
d) Million instructions per second (MIPS)

b) A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count: *[30 Marks]*

Instruction Type	Instruction Count	Clock cycle ~~Cycles per Instruction~~
Integer arithmetic	45000	1
Data transfer	32000	2
Floating point	15000	2
Control transfer	8000	2

Calculate the effective **CPI (Cycles Per Instruction) and MIPS rate** for this application.

c) Processor A runs at 200 MHz and executes a 40 million instruction program at a sustained 50 MIPS • Processor B runs at 400 MHz and executes the same program (w/ a different compiler) which yields a count of 60 million instructions and a CPI of 6

i. What is the CPI of the program on Processor A? *[10 Marks]*

ii. Which processor executes the program faster and by what factor? *[10 Marks]*

iii. What is the MIPS rate of Processor B? *[10 Marks]*

04 a) i. Describe the computer system's memory hierarchy. *[20 Marks]*

ii. What is the reason for not having a large enough main memory to store the totality of information in a computer system? *[20 Marks]*

b) A computer system uses 16-bit memory addresses. It has a 2K-byte cache organized in a direct-mapped manner with 64 bytes per cache block. Assume that the size of each memory word is 1 byte.

i. Calculate the number of bits in each of the Tag, Block, and Word fields of the memory address. *[20 Marks]*

ii. When a program is executed, the processor reads data sequentially from the following word addresses: *[20 Marks]*
128, 144.
All the above addresses are shown in decimal values. Assume that the cache is initially empty. For each of the above addresses, indicate whether the cache access will result in a hit or a miss.

iii. Explain **Two (02)** advantages and **Two (02)** disadvantages of using a direct mapped cache instead of an set associative cache. *[20 Marks]*

05 You are employed by XYZ Computers as a Computer Systems Technician. The XYZ Computers has just started offering computer apprenticeships to 15 to 19 year old school leavers and are preparing resources to be used for teaching on the apprenticeships. As an experienced technician, your manager has offered you the opportunity to be a part of the team responsible mentoring and training the school leavers. However, to be a part of the team, every candidate member is supposed to demonstrate their understanding of Computer Systems Architecture by carrying out a number of tasks.

i. Describe the techniques used to improve the CPU performance of Compare Reduced Instruction Set Computer (RISC) chips and Complex Instruction Set Computer (CISC) chips. *[20 Marks]*

ii. Produce a design specification of a performance PC system. The design must include your choices of: *[80 Marks]*

- The bit size of the CPU (32 or 64)
- The memory type
- The bus speed
- The address and data bus widths
- Any techniques you will use (e.g., DMA or memory mapping).

Describe the choices you make and how they impact the overall performance and complexity of the system.