

SULIT



Second Semester Examination
2022/2023 Academic Session

July/August 2023

EEE379 – Computer Systems and Multimedia

Duration : 2 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material including appendix before you begin the examination.

Instructions : This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

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1. As an employee of a robotics company, you and another colleague are assigned a project on designing JR-22, a nanny robot for children of ages 4 to 8 years old. Basically, JR-22 has a microphone, speakers, a camera and a display screen. You work in a computer department, responsible for designing suitable computer components for JR-22. Among JR-22's functions are:
- capture and send real-time video images showing what a child under care is doing when requested by parents,
 - call parents in an emergency situation (for example, when an unrecognized person is identified in the house),
 - note the time to wake-up the child under care every morning, and
 - read bed-time stories from a pendrive, CD or DVD when initiated to do so.

Answer the following questions regarding JR-22's computer system:

- a) State **ALL** the main components that are required in the design of JR-22's computer system to successfully accomplish the described tasks.
- (4 marks)
- b) For each of the components you answered in 1.a), separately describe an example of scenario to explain the component's function specifically in relation to JR-22's task requirements.
- (8 marks)
- c) In your opinion, does JR-22's computer system require a cache memory? Provide **ONE** justification to your answer by relating to JR-22's task requirements.
- (3 marks)
- d) Sketch a diagram of the components you answered in 1.a) and 1.c), to illustrate their organizational structure. Clearly label the components.
- (8 marks)
- e) To facilitate user's communication with the computer, what do you suggest should be integrated or implemented into the system so that users can efficiently and conveniently use the computer?
Based on your answer, briefly describe its function.
- (2 marks)

2. As an intern of a manufacturer of Hard Disk Drive (HDD) systems, you are tasked to improve the performance of a new magnetic disk for laptop applications. The company provides you with a diagram that represents the timing of the disk I/O transfer as shown in Figure 2. The design parameters of the disk are specified in Table 2.

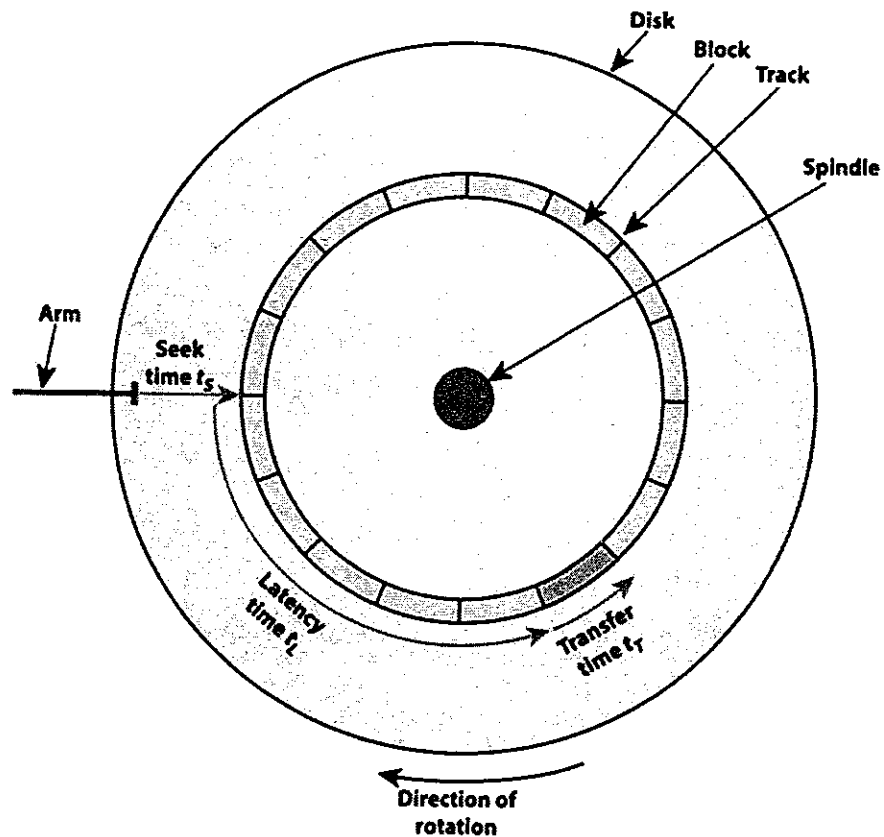


Figure 2. Timing of the Disk I/O Transfer

Table 2. The HDD design parameters

Design Parameters	Specifications
Capacity	500 GB
Spindle Speed	5,400 rpm
Interface Types	SATA
Form Factor	2.5in x 7mm
Sector Size	512 Bytes
Number of Sectors per Track	500 sectors
Number of Track	5 tracks
Average Seek Time	4 ms
Access Organization	Random Access
Disk I/O operation type	Programmed I/O

- a) By outlining the steps involved in the disk I/O operation for reading a file stored on the disk, explain how this operation causes time delay in terms of the seek time, t_s , the latency time, t_L and the transfer time, t_T .

(6 marks)

- b) Estimate the theoretical performance of the disk by calculating the access time for reading a file of 1.28 Mbytes size that has been stored randomly across 2500 sectors.

Your calculation should be informed by the design parameters specified in Table 2. You must communicate your estimation work well by showing the details of your calculation and by stating all the assumptions.

(6 marks)

- c) Performance comparison between the measured and the estimated values of the access time reveals that the actual delay is much longer than the estimated delay. Explain this revelation by drawing a flow chart that represents how the programmed I/O operation technique contributes to more delay.

(6 marks)

- d) To improve the performance, you have been asked to recommend design changes to any **TWO** of the design parameters specified in Table 2. Communicate your recommendation by:

- (i). describing the changes that you choose to make in terms of the names of the two design parameters and their new values or configurations.

(3 marks)

- (ii). explaining how the changes may help reduce the delay in file-reading operation.

(4 marks)

3. a) An original non-pipelined processor has average cycles per instruction (CPI) of 8 and operates at a clock rate of 2.8GHz. This processor is modified by introducing a eight-stage pipeline. Unfortunately, due to internal pipeline delays, such as latch delay, the clock rate of the processor is reduced to 1.6GHz.

(i). What is the Million Instructions Per Second (MIPS) rate for the original non-pipelined processor?

(5 marks)

(ii). What is the MIPS rate for the new pipelined processor?

(5 marks)

(iii). What is the speedup achieved for a program with 500000 instructions?

(5 marks)

b) A computer program has eight symbolic registers, indicated as Register A, Register B, Register C, Register D, Register E, Register F, Register G and Register H. Figure 3 shows the time sequence of active use of these symbolic registers. This program will be executed by a reduced instruction set computer (RISC) that has four actual registers (Register R1, Register R2, Register R3 and Register R4). By using the graph colouring method, suggest one possible mapping between the symbolic registers with the actual registers. A register interference graph should be provided.

(10 marks)

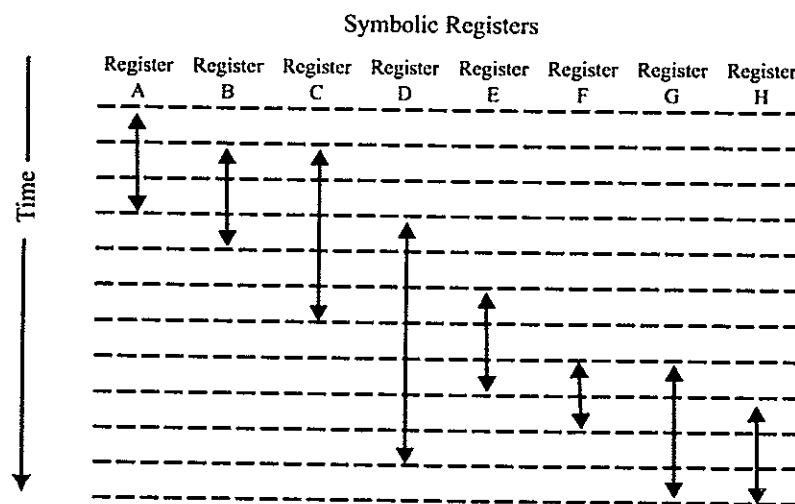


Figure 3: Time sequence of active use of registers

4. a) Data compression aims to reduce the size of storage needed and make the transfer via internet faster. Generally, there are two types of data compression schemes: lossy and lossless compression. Provide a table to compare between lossy with lossless compression.

(8 marks)

b) Propose **ONE** compression scheme that can be used to compress and decompress digital audio. Is this scheme a lossy compression, or a lossless compression? Justify it with one simple example.

(10 marks)

c) You are involved in a project to detect and identify the car number plate. Which digital image type that you will use for this application: 1-bit binary image, 8-bit grayscale image, 8-bit colour image, or 24-bit color image? Justify your selection.

(7 marks)

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APPENDIX

Question	Course Outcome (CO)	Programme Outcome (PO)
1	CO4	PO3
2	CO2	PO10
3	CO4	PO3
4	CO3	PO3