



SCHOOL OF COMPUTING AND ENGINEERING SCIENCES

Bachelor of Science in Computer Networks and Security

CNS2202: Computer Organization and Architecture

Date: 13th December 2022

Time: 2 Hours

Instructions:

1. This examination consists of **FIVE** Questions.
2. Answer **Question 1 (Compulsory)** and any other **TWO** Questions.

Question #1: (Compulsory):

- (a) Explain any three *cache replacement algorithms* for memory blocks of data brought to the caches that supports the processor? Explain your choice of a most effective algorithm often used. [5 Marks]
- (b) Differentiate between *write-through policy* and *write-back policy*, giving the advantages and disadvantages of each policy. [5 Marks]
- (c) The increase in block sizes, increases the hit ratio too because of the *principle of locality*. Explain why the hit ratio subsequently increases and the related limitations to this increase to this principle of locality. [5 Marks]
- (d) Semiconductor Memory is subject to various storage and access errors and these can be categorized either as *hard failures* or *soft errors*. Briefly differentiate between the two categories of storage and access errors. [5 Marks]

Question #2:

- (a) Describe the construction of a *combinational circuit*, giving the different ways used to define combinational circuits [3 Marks].
- (b) Describe the construction of the *Read Only Memory (ROM)*. Why is it referred to as Read Only Memory [3 Marks]

- (c) Consider three variables P, Q and R where the concatenation forms binary number related to a function F from 000 through to 111 (i.e., Octal). The values for the next three columns are obtained by dividing the decimal number of the concatenation of P, Q and R bits by 2, 3 and 7 respectively and the function F is the XOR of the values in the division columns per row.
- (i) Create a Truth Table for the function, F obtained from variables P, Q and R. (*Hint: Need columns for P, Q, R, Decimal Value of the Concatenation, Div. by 2, Div. by 3, Div. by 7 and F. A number say, 010 = 2 in decimal number and hence divisible by 2 etc.*). [6 Marks]
- (ii) Draw a Boolean Implementation of an F using basic logic gates for rows 4 and 7 only [3 Marks]

Question 3:

- (a) Determine the Decimal Value (Base 10) of IEEE-754 32-bit floating-point representation for the following numbers. *Hint: From the floating-point representation, do identify the sign bit, the biased exponent and the trailing significand /mantissa. Show your working for each one of them.*
- (i) 0 01111111 110 0000 0000 0000 0000 0000 [2.5 Marks]
- (ii) 1 01111100 010 0000 0000 0000 0000 0000 [2.5 Marks]
- (b) Compare the four locations of *source and results operands* for the use by the processor for a Computer. [6 Marks]
- (c) Explain the *contents or elements* of the Instruction format. Further, what determines the instruction length? [4 Marks]

Question #4:

- (a) Differentiate memory management by *fixed partitioning* and *dynamic partitioning*. Why the two techniques are considered inefficient? [3 Marks]
- (b) Describe the technique Memory Management referred as *paging*. Why is this an efficient technique of memory management? [4 Marks]
- (c) A variety of addressing techniques have been employed in the design of the Computer and involve some *trade-off* between address range and/or addressing flexibility, on one hand, and the number of memory references in the instruction and/or the complexity of address calculation. Differentiate between the *Register Addressing* and *Displacement Addressing* of operands. [5 Marks]

- (d) Computer processor provides opportunity for variable instruction lengths. What are the problems resulting from these variable instruction lengths? [3 Marks]

Question #5:

- (a) Within the processor there is a set of registers that function as a level of memory above cache and main memory in the hierarchy, namely the *user-visible registers* and *control/status registers*. Briefly explain with examples the roles of each of these two kinds of registers. [4 Marks]
- (b) When the disk drive is operating, the disk is rotating at constant speed. Explain any two *disk performance parameters*. [4 Marks]
- (c) Using an illustrative diagram, differentiate between the *random* and *sequential access* as implemented in Computer Memory. [3 Marks]
- (d) Using an illustrative diagram, explain the difference in capacity for storage between a CD and a DVD, with a DVD holding more information.[4 Marks]