University of Windsor
Faculty of Science
School of Computer Science

COMP-2650
Computer Architecture I: Digital Design
Winter 2022

Title	Date	Time	Duration	Grade Release Date
Midterm Exam	March. 01, 2022	10:00 AM	90 minutes	March 07, 2022

	Elliott 405	Raspberry Pi Zero
Year	1957	2015
Price	£85,000 (1957)	$5
Memory	16 KB	512 MB
Weight	3-6 tons	9 g
Size	21 cabinets, each 2m x 77cm x 77cm	65mm x 30mm x 5.4mm

Sourse: https://www.spinellis.gr/blog/20151129/

Questions

You must show your work and all steps for every question!

Q1: [10 marks: 5 marks each] Explain the following terms in two or three sentences.

a) Quantization
b) Digital System

Q2: [20 marks: 5 marks each] Assuming an *un*signed number system, show the maximum number and the smallest unit of increment given 3 integer and 2 fraction positions in the *hexadecimal* number system and their equal decimal values.

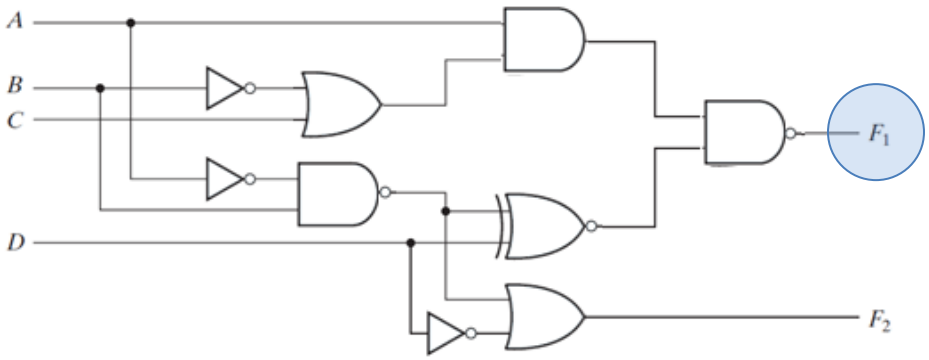
a) $(\text{Max } ?)_{16} = (?)_{10}$
b) $(\text{Smallest Unit } ?)_{16} = (?)_{10}$

Q3: [15 marks] Show the minimum possible error when converting $(16.42)_{10}$ to base-9 if only 5 positions are given in total for both integer and fraction parts. Report the error in base-10.

Q4: [15 marks] Perform (+14) – (–1) in base-2 in (a) signed-magnitude and (b) singed-2's-complement. Use the least number of bits and check whether an overflow happens.

Q5: [15 marks] Analyze the logic circuit shown below *only for F1*:

a) Show the truth table.
b) F1 = ∏ (?)



Q6: [25 marks] Design a 3-bit INCrementor, that is, the circuit generates the next number after the input number (e.g., 011 → 100. Also, 111 → 000):

a) Show the truth table.
b) Show the Boolean expressions for the outputs in PoS.
c) Design an *efficient* circuit using NOR gates only.