1. (**25 pts**) ROM Design–1: Arithmetic component

   Design a digital logic circuit as a Read Only Memory (ROM) [Decoder plus OR gates]. A ROM accepts a three–bit number and generates an output binary number equal to four times the input number.

   (a) What is the size (number of bits) of the initial (unsimplified) ROM ?

   (b) What is the size (number of bits) of the final (simplified) ROM ?

   (c) Show in detail the final memory layout.

   - **At the end CLEARLY state the results**

2. (**25 pts**) ROM Design–2: RGB LED's

   Design a digital logic circuit as a Read Only Memory (ROM) [Decoder plus OR gates]: Three light–emitting diodes (LEDs) [one Red, one Green, one Blue] turn on when a number 0–7 is passed through. Red turns on with even numbers, green turns on with odd numbers, blue turns on with multiples of 3. Zero means they are all off, seven means they are all on.

   (a) What is the size (number of bits) of the initial (unsimplified) ROM ?

   (b) What is the size (number of bits) of the final (simplified/smallest size) ROM ?

   (c) Show in detail the final memory layout.

   - **At the end CLEARLY state the results**

3. (**25 pts**) ALU Design

   Design (step–by–step) and implement (using *LogiSim*) a 1–bit Arithmetic Logic Unit (ALU) that will perform the following logical (a) and arithmetic (b) operations:

   (a) Logical operations
   - `NOT` b
   - a `AND` b
   - a `OR` b
   - a `NAND` b
   - a `NOR` b
   - a `XOR` b
   - a `XNOR` b

   (b) Arithmetic operations
   - a + b
   - a `-` b

   Only **one** adder should be used for both `Add` (+) and `Sub` (–) operations.

   (a) Test the final design with one set of data. (The *LogiSim* circuit should be active)

4. (**25 pts**) RAM Design

   Design a $8K \times 8$ RAM (memory) system, **using** $1K \times 8$ RAM chips.

   (a) Number of Data Bus lines?

   (b) Number of Address Bus lines?

   (c) Draw and briefly explain the overall memory architecture layout.

   - **At the end CLEARLY state the results**

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IMPORTANT NOTICE; We allow absolutely no copying and pasting of homework solutions from other students, internet sites or "student discord servers". In all cases an automatic zero will be given for the specific homework.

- How can I submit my assignment?

  The homework–report should **ALL** be written ... using only a word processor (Microsoft WORD, ..., or TEX/LATEX). **Absolutely no handwriting/handgraphing and photographing**. Writing the report follow the sample homework given in CANVAS (Modules)

  ... Upload the report in PDF to CANVAS