ICS 2104: COMPUTER ORGANIZATION AND ARCHITECTURE CAT 2 – GROUP B

TIME: 1 HOUR

Answer ALL the Questions

a) A pedestrian crossing traffic light controller has two inputs:
   - ✓ P = Pedestrian button pressed (1 if pressed)
   - ✓ T = Timer signal (1 if timer has elapsed)

The output G (green light for pedestrians) should be ON if the pedestrian button is pressed, and the timer signal is ON, or the timer signal is ON and the button is not pressed (to allow crossing if timer expired regardless)

   i.   Formulate the Boolean expression for output G.   [3 Marks]

   G = (P AND T) OR (NOT P AND T)

   G=(P·T)+(P'·T)

   G= T. (P·+(P'

   Since P+P' =1, then:

   G=T·1=T

   ii. Create a truth table for inputs P and T and output G.   [2 Marks]

b) Briefly describe the three categories to classify external devices.   [3 Marks]

   i.   Human readable: To communicate with the computer user.
   ii. Machine readable: To communicate with equipment.
   iii. Communication: To communicate with remote devices.

c) Convert the following C++ code snippet into equivalent assembly instructions. Assume all variables are unsigned 32-bit integers stored in memory.   [4 Marks]

   Result = (X + Y) * (Z - W);

   mov eax, [X]   ; Load X into eax
   add eax, [Y]   ; Add Y to eax
   mov ebx, [Z]   ; Load Z into ebx
   sub ebx, [W]   ; Subtract W from ebx
   ; Multiply eax by ebx

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mul ebx                 ; edx:eax = eax * ebx
mov [Result], eax       ; Store lower 32 bits of product in Result
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d) List and briefly explain two key factors that affect the speed of reading and writing data on a magnetic disk. [2 Marks]

    i. Seek Time: The time taken for the read/write head to move to the correct track on the disk.

    ii. Rotational Latency: The time waiting for the disk to rotate so the correct sector is under the read/write head.

e) Double-Data-Rate DRAM provides several features that dramatically increase the data rate. List the three ways that lead to achieving these high data rates. [3 Marks]

    i. The data transfer is synchronized to both the rising and falling edge of the clock, rather than just the rising edge. This doubles the data rate, hence the term double data rate.

    ii. DDR uses a higher clock rate on the bus to increase the transfer rate.

    iii. A buffering scheme is used.

f) Machine instructions are made up of four key elements. State and briefly explain these elements. [4 Marks]

    i. Operation code: Specifies the operation to be performed (e.g., ADD, I/O). The operation is specified by a binary code, known as the operation code, or opcode.

    ii. Source operand reference: The operation may involve one or more source operands, that is, operands that are inputs for the operation.

    iii. Result operand reference: The operation may produce a result.

    iv. Next instruction reference: This tells the processor where to fetch the next instruction after the execution of this instruction is complete.

g) The basic element of a semiconductor memory is the memory cell. List the properties shared by all semiconductor memory cells. [3 Marks]

    i. They exhibit two stable (or semistable) states, which can be used to represent binary 1 and 0.

    ii. They are capable of being written into (at least once), to set the state.

    iii. They are capable of being ready to sense the state.

h) State the key elements shared by most RISC architecture designs. [3 Marks]

i) A variety of technologies are used to implement memory systems. List the relationships that hold across this spectrum of technologies.   [3 Marks]

    i.   Faster access time, greater cost per bit.

    ii.   Greater capacity, smaller cost per bit.

    iii.   Greater capacity, slower access time.