

THE UNIVERSITY OF BRITISH COLUMBIA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEC 379 : Microcomputer System Design
1998/99 Winter Session Term 2

MID-TERM EXAMINATION
8:30 – 9:20 AM
February 25, 1999

This exam has two (2) questions. The marks for each question are as indicated. There are a total of 25 marks. Answer all questions. Write your answers in the exam book provided. Show your work. You may answer the questions in any order. Books, notes and calculators are allowed. You may keep this exam paper.

Question 1 (15 marks)

(a) Design a decade counter. Write the entity and architecture for this device assuming it is called decade, has an the following inputs and outputs:

- a counter-enable input, *en*
- a clock input, *clk*
- a four-bit binary count output, *q*
- a one-bit “terminal count” output, *tc*

The counter is incremented if *en* is asserted. The counter counts from 0 to 9 and then returns to 0. *tc* is asserted when the count is 9. The counter output changes on the rising edge of *clk*.

(b) Assume a package called *counters* exists in the *work* library and that it includes the decade counter as a component. Write the entity and architecture of a two-digit decade counter that has the following inputs and outputs:

- a clock input, *clk*
- two four-bit outputs: *a* and *b* (where *a* is the least-significant digit).

For both parts (a) and (b) write an entity and architecture that is synthesizable by Max-Plus+II. All signals are *std_logic* or *std_logic_vector* and are active-high. Use type conversion functions as necessary. Any process in your VHDL code must contain exactly one *if* statement and one signal assignment statement. Do not include comments. Include any library and use statements required.

Hint: the tc output of the LS digit counter is used to enable the MS digit counter.

Question 2 (10 marks)

Write a subroutine, `toupper:`, in 8086 assembly language that converts a string to upper-case. Lower-case characters have ASCII codes between 61H and 7AH. A lower-case character can be converted to upper-case by subtracting 20H. The BX register will contain the offset and DS will contain the segment of the string when the subroutine is called. The end of the string is marked by a null character (ASCII code 00H). Your function must save and restore any registers it modifies. It must return control to the calling function with a RET instruction. You must declare storage for any temporary variables you use, but you need not include comments or assembler directives such as `segment`, `assume` or `org`.