

**University of Puerto Rico – Mayagüez
School of Engineering**

INEL 4206 – Microprocessors

Problem Set 1 – Due February 15, 2002

1. Consider the problem of determining if a Turing Machine ever writes a specific symbol from its alphabet into its tape.
 - a. Argue that this problem is undecidable.
 - b. Try to generalize this result to other problems concerning the algorithmic determination of properties of Turing Machines.

2. Consider an ALU with two n-bit inputs (A and B) and with the following operation table:

Operation	Selection code	Ouput
PASS A	0 0 0	A
ADD	0 0 1	A+B+ Ci
NOP	0 1 0	Don't Care
SUB	0 1 1	A – B - Ci
AND	1 0 0	A and B
XOR	1 0 1	A xor B
OR	1 1 0	A or B
COMPARE	1 1 1	Not (A xor B)

- a. Using the bit-slice design technique provide a schematic diagram of a 1 bit ALU segment including its internal gate-level logic.
 - b. Show how the different ALU segments can be combined to form an n-bit ALU.

3. Consider the design of the Easy I Architecture discussed in class:
 - a. Add a NAND instruction that computes the bitwise logical NAND operation as described by the following RTL expression:

AC <- AC NAND MEM[X]

Include diagrams illustrating the necessary changes to the Easy I flowcharts and control unit design.

- b. Discuss the tradeoffs between providing a special instruction to compute this logic operation versus relying on other basic instructions with which NAND can be computed in “software”. What kind of information you think is necessary in order to make an intelligent choice?