



**Universidad de Puerto Rico  
Recinto Universitario de Mayagüez  
Departamento de Ingeniería Eléctrica y Computadoras**

**ICOM 4036 – Programming Languages  
Otoño 2007**

**Ejercicios de práctica  
Examen Parcial II**

- 1) Design low-level computer to perform the following computations in the languages indicated:
  - a) Compute the exclusive-or function (CMOS, NAND gates)
  - b) Compute if two 2-bit numbers are equal (CMOS, NAND gates)
  - c) Compute if an n-bit number has two or more consecutive zeros (CMOS, NAND gates)
  
- 2) Add a STACK pointer register to the Easy I Data Path. The register points to a memory cell that represents the next empty element in a stack. After a Reset Cycle the value of the stack pointer is the address of highest memory cell ( $2^{16}-1$ ). For each of the following instructions show the changes to the DataPath, flowchart and control unit necessary to implement the following new Easy I instructions.
  - a) Add an instruction to PUSH the value of the accumulator into the stack. PUSH stores the value of the accumulator at the memory cell pointed to by the stack pointer and then decrements the pointer.
  - b) Add an instruction to POP the element at the top of the stack into the accumulator. The instruction must first decrement the stack pointer and then move the contents of the memory cell at the top into the accumulator.
  
- 3) Write easy I assembly language programs to compute the following:
  - a) The product of two numbers X and Y where Y is a power of 2
  - b) The quotient of two numbers X by Y where Y is a power of 2
  - c) The product of two numbers X and Y
  - d) The remainder of two numbers X and Y
  - e) The remainder of two numbers X and Y
  - f) The greatest common divisor of two numbers X and Y (Use remainder as subroutine)
  - g) N factorial (use product as subroutine)
  - h) Determine if a number N is prime in  $O(\sqrt{N})$  time
  
- 4) Translate the solutions in (3) to easy I machine code.
- 5) Translate the solutions in (3) to MIPS assembly Language