

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

**INEL 4206 – Microprocessors**

Problem Set 1

Due: Thursday September 5, 2002

1. Design a combinational logic circuit that complies with the following specifications:

| Input |       |       |       | Output |       |       |       |
|-------|-------|-------|-------|--------|-------|-------|-------|
| $I_0$ | $I_1$ | $I_2$ | $I_3$ | $O_0$  | $O_1$ | $O_2$ | $O_3$ |
| 0     | 0     | 0     | 0     | 0      | 0     | 0     | 1     |
| 0     | 0     | 0     | 1     | 0      | 0     | 1     | 0     |
| 0     | 0     | 1     | 0     | 0      | 0     | 1     | 1     |
| 0     | 0     | 1     | 1     | 0      | 1     | 0     | 0     |
| 0     | 1     | 0     | 0     | 0      | 1     | 0     | 1     |
| 0     | 1     | 0     | 1     | 1      | 1     | 0     | 0     |
| 1     | 1     | 0     | 0     | 1      | 0     | 1     | 1     |
| 1     | 0     | 1     | 1     | 1      | 0     | 1     | 0     |
| 1     | 0     | 1     | 0     | 0      | 0     | 0     | 1     |

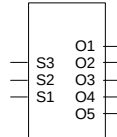
(This is a 0↗1 then 1↘5, 5↘1 loop )

- a) Provide a Karnaugh Map (K-Map) and Boolean equation for each of the outputs ( $O_n$ ).
- b) Make the design in Logic Works, use a “Hex Keyboard wo/STB” as input, with the pins arranged as follows:  
display the output of the circuit.

|   |   |   |   |       |       |
|---|---|---|---|-------|-------|
| 1 | 2 | 3 | — | $I_0$ |       |
| 4 | 5 | 6 | 7 | —     | $I_1$ |
| 8 | 9 | A | B | —     | $I_2$ |
| C | D | E | F | —     | $I_3$ |

use Binary Probes to

2. Design a combinational circuit that works as a decoder, it will receive the binary equivalents for 1 through 5, and set high the output corresponding to that number. *(The circuit must have exactly 5 outputs; you may NOT use the available decoders in Logic Works)*
- Provide the schematics for the decoder.
  - Make a new device symbol and package the circuit you designed above, so that it can be used as an “IC”. It should look something like this:



- Design a five LED scanner (sequence of LED's that light up from side to side in a loop). Use the two circuits you have designed in problems 1 and 2 as part of the sequential circuit that will make up the scanner.

#### Problem Set Submission:

Your solution will consist of four (4) Logic Works files.

- Solution for problem 1
- Solution for problem 2
- Library file with the packaged IC from problem 2
- Solution for problem 3

Send these 4 files in an e-mail attachment to: [inel4205-submit@ece.uprm.edu](mailto:inel4205-submit@ece.uprm.edu)

The subject of the e-mail should be PS1:<<student #>>

K-maps and Boolean Equations from problem 1a will be handed in to the professor on Sept 5.

#### Correction criterias:

| Criteria    | Weight(%) |
|-------------|-----------|
| Correctness | 60%       |
| Design      | 20%       |
| Efficiency  | 10%       |
| Style       | 10%       |

Remember the policy on late submission stated on the “Course Information Sheet”.