CEN263 Digital Design Final Exam
January 19, 2021

- Read all directions carefully.
- This exam must be completed individually. Copying answers is unacceptable and will result in a fail on the course.
- You should write your answers on paper. You can use more than one paper if you need it. Please do not forget to write your name and student id every paper you used.
- You should scan your papers into a single .pdf file before submission. It is recommended that you use an App on your phone for ease of use with on-device camera for creating electronic submissions. Select an App that is able to convert images into .pdf files. It is beneficial to have the functionality to detect the edges, correct the orientation, and remove/cleanup the background.
- You must show all your work to receive full credit. Messy or unreadable submissions will receive no credit.
- You will use a **"key"** to solve the problems in this exam. The key is the number formed by the last two digits of your student id. If your key is less than 20, add 20 to it. So for example, if your student id was 2019555047 your key would be "47"; if your student id was 2019555008 your key would be "28".
- We will assume that the key is 47 while explaining the problems. **You should replace it with your own key.**
- You have 60 minutes to complete this exam. Good luck.

1. (1 point) Write down your id and key.
   Student Id: .... Key: ....

2. (4 points) m = key * 10. **(Example: m=47*10=470)**.
   Find your m and convert m to hexadecimal and then from hexadecimal to binary.

3. (15 points) m = key mod 15; if $m < 7$ then add 7 to m.
   (Example: m=47 mod 15=2; add 7, then m=9).
   What is the smallest (most negative) m bit binary number that can be represented with

   a unsigned numbers?

   b two's complement numbers?

   c sign/magnitude numbers?

   Please explain.

4. (20 points) Use m,n,p,x,y, and z
m = key mod 3 (**Example: m=2**). Write down your m. m = . . . x = m+7 = . . (**Example: x=9**)
n = key mod 5 (**Example: n=2**). Write down your n. n = . . . y = n+4 = . . (**Example: y=6**)
p = key mod 8 (**Example: p=7**). Write down your p. p = . . . z = p+5 = . . (**Example: z=12**)
Find your F. $F(A, B, C, D) = \sum(m, n, p, x, y, z)$ **(Example:** $\mathbf{F} = \sum(\mathbf{2, 2, 7, 9, 6, 12}) = \sum(\mathbf{2, 6, 7, 9, 12})$**)**.
Using the K-map method, simplify F and draw its circuit.

5. (30 points) Using m,n and p
m = key mod 3 ((**Example: m=47 mod 3=2**). Find your m. m = ... mod 3 = ...
n = key mod 5 ((**Example: n=47 mod 5=2**). Find your n. n = ... mod 5 = ...
p = key mod 8 ((**Example: p=47 mod 8=7**). Find your p. p = ... mod 8 = ...
Find your F. $F(A, B, C) = \sum(m, n, p)$ **(Example:** $\mathbf{F} = \sum(\mathbf{2, 2, 7}) = \sum(\mathbf{2, 7})$**)**.

   a Implement F using an 8x1 Multiplexer.

   b Implement F using a 4x1 Multiplexer.

6. (30 points) Describe in words what the state machine in the figure below does. Using binary state encodings, complete a state transition table and output table for the FSM. Write Boolean equations for the next state and output and sketch a schematic of the FSM.