University of Waterloo
Department of Electrical and Computer Engineering
ECE 223 Digital Circuits and Systems

Midterm Examination Instructor: M. Sachdev Date Feb 16, 2000

Total Marks = 100

Name:..... Student id:.....								
1.		2.	3.	4.		5.		Total:

Attempt all problems. If information appears to be missing make a reasonable assumption, state it and proceed. Calculators are not needed and are not allowed

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Problem 1

(A): Convert following number from one radix to another [**12**]

(i) $(212.785)_{10}$ to radix 7

(ii) $(0110\ 1111)_2$ to radix 8

Name:..... Student id:.....

(B): How many different ways signed numbers can be represented in computers? Name them. Explain why in modern computers signed binary numbers are represented in "2's complement" format? [**8**]

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Problem 2

Given the following Boolean function, F = xy'z + x'y'z + w'xy + wx'y + wxy

(i) Draw a corresponding Karnaugh map of the function

(ii) Give minterm and maxterm expressions

(iii) Simplify the function and implement it by NAND gates only [**20**]

Name:..... Student id:.....

Problem 3

Given the function F (w, x, y, z) = Σ (0, 2, 3, 5, 7, 8, 10, 11, 14) [**20**]

(i) Find all prime implicants

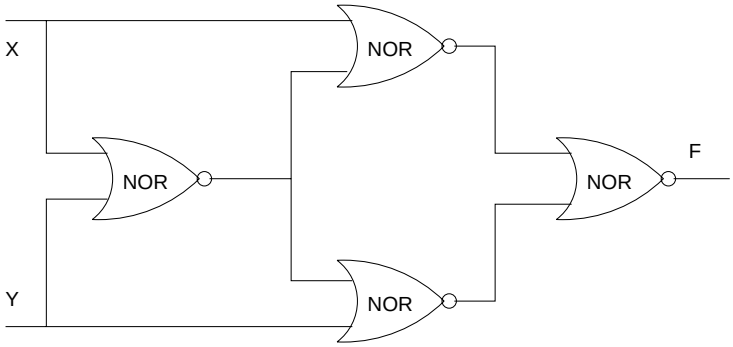
(ii) Find all essential prime implicants

(iii) Represent the function in the simplest “sum of products” form

Name:..... Student id:.....

Problem 4

(A): Verify algebraically that the circuit shown below generates the "exclusive-NOR" function **[10]**



(B): A "full subtractor" performs [(x-y) - z] operation. [**10**]

(i) Generate the truth table of the full subtractor

(ii) Implement the function with logic gates

Name:..... Student id:.....

Problem 5

(A): Draw a gate level diagram of a 2-to-4 decoder **[8]**

(B): Redefine the carry propagate and carry generate as follows: **[12]**

$$P_i = A_i + B_i \quad \text{and} \quad G_i = A_i.B_i$$

Show that the output carry and output sum of a full adder becomes

$$C_{i+1} = (C_i'G_i' + P_i')' = G_i + P_i.C_i$$

$$S_i = (P_iG'_i) \oplus C_i$$