May 29, 2003

COMPUTER ENGINEERING DEPARTMENT

COE 545

Digital System Testing

Major Exam II

Second Semester 2003 (022)

Time: 3:30-5:30 PM

Student Name : ____

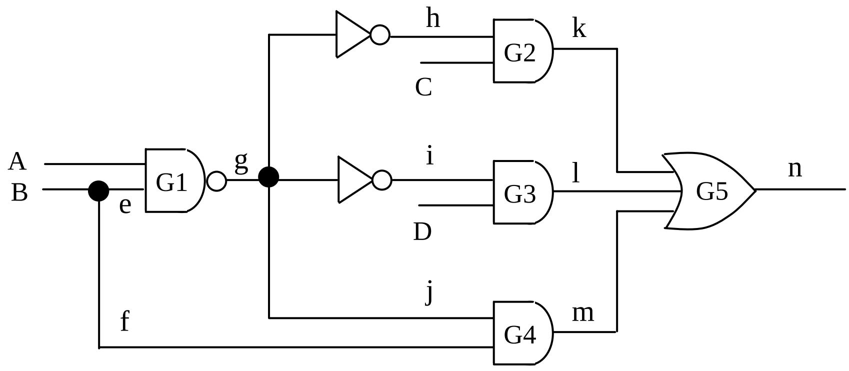
Student ID. : ____

Question	Max Points	Score
I	30	
II	30	
III	20	
IV	20	
Total	100	

Dr. Aiman El-Maleh

[30 Points]

(I) Consider the circuit shown below:



a. Compute the controllability and observability costs for every line in the circuit using the generalized formulas (6.1) to (6.4).

b. Determine a lower bound on the detection probability of the stuck-at 0 fault on the stem B based on fault propagation across the path {G4, G5}.

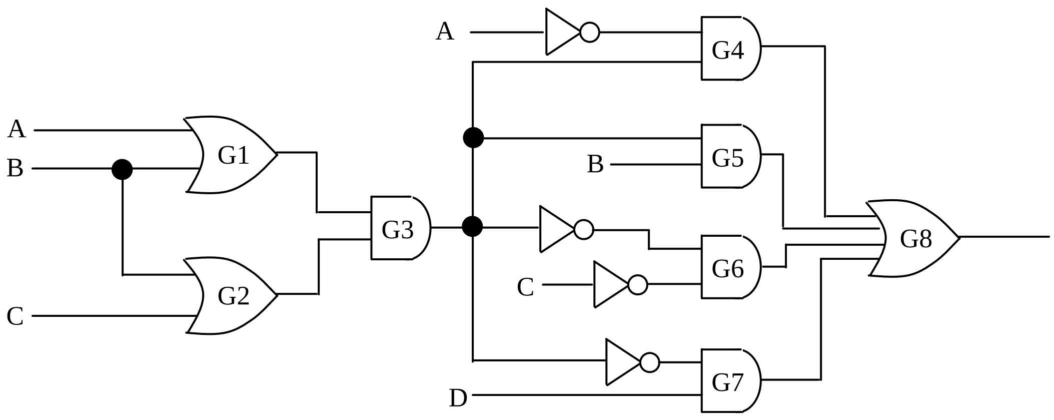
c. What is the exact detection probability of the fault?

d. Based on the exact fault detection probability obtained in (c), compute the escape probability of the fault assuming that 10 random vectors are applied.

e. What is the length of random test patterns required such that the escape probability of any fault in the circuit is less than or equal to 10^{-2}? Hint: consider the faults on node g.

[30 points]

(II) Consider the circuit shown below:



Generate a test vector to detect the stuck-at-1 fault on the output of G3 using the following algorithms:

1. D-Algorithm.

2. PODEM.

Show the detailed steps done by each of the algorithms including the decision tree. Assume that the observability cost of G7<G6<G5<G4. Furthermore, assume that the controllability costs of A<B<C<D<G1<G2<G3<G4<G5<G6<G7.

[20 points]

(III) Determine the following:

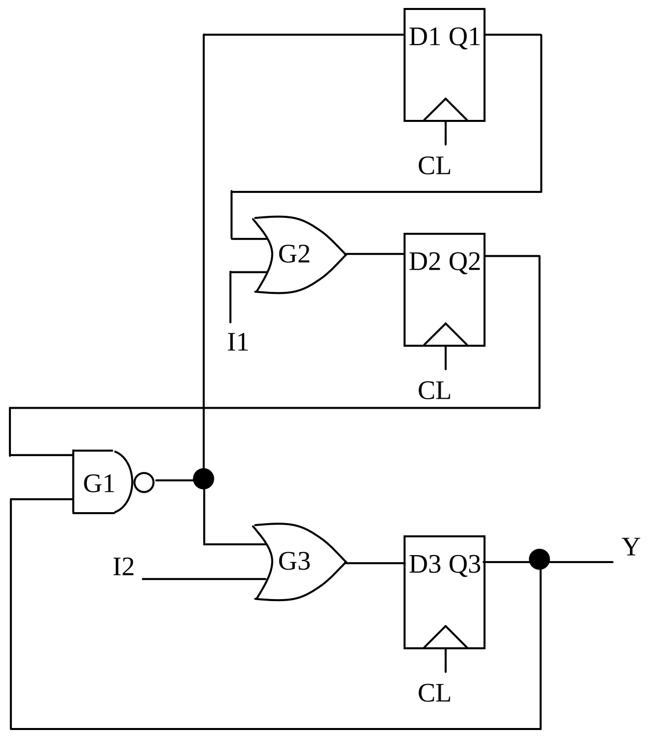
a. The signal probability $\mathbf{P_Z}$ of a 3-input OR gate Z=A+B+C as a function of its input signal probabilities, P_A, P_B, and P_C. Assume that the inputs are independent.

b. The signal probability $\mathbf{P_Z}$ of a 2-input XOR gate Z=A XOR B as a function of its input signal probabilities, P_A and P_B. Assume that the inputs are independent.

c. The primitive cubes and the propagation D-cubes of a gate G implementing the function G = A B + A C.

[20 points]

(IV) Consider the sequential circuit shown below, where the sequential elements are D-FFs, I1 and I2 are primary inputs and Y is a primary output:



a. Generate a minimal-length test sequence for detecting the single fault G2 stuck-at-1 assuming the reset state 000.

b. Generate a minimal-length self-initializing test sequence for detecting the single fault G2 stuck-at-1.