Indian Institute of Technology Kharagpur

Computer Science and Engineering

CS 31007 COMPUTER ORGANIZATION AND ARCHITECTURE Autumn 2020

Date: 17.09.2020 **Maximum points = 32** Credit: 20%

Online Test-1 **Time:** 8:00 AM - 9:00 AM

Instructions:

This is an **OPEN-BOOK**, **OPEN-NOTES**, **MCQ** test. For each question, please choose one answer from the given choices. Each correct answer will fetch 4 points, incorrect answer will contribute 0 point, and no answer leads to 1 point. You may use calculators if required.

Submission of answers: Please create a text file including your name, roll-number, and your choice of option against each question (no details of calculation or explanation required), and submit it to the CSE Moodle Page by 9:20 AM.

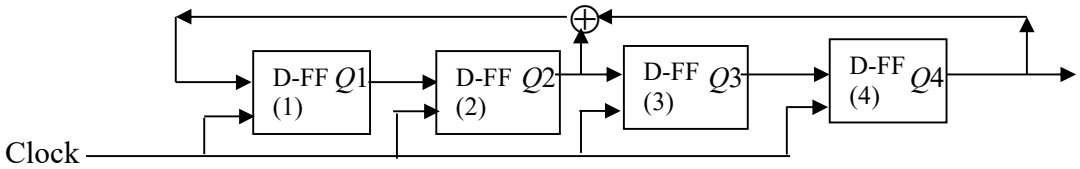
1. Consider the following Boolean function F of three variables A, B, C:

$$F(A, B, C) = \overline{(AB + BC + CA)} \oplus AB \oplus BC \oplus CA,$$

where $\oplus$ denotes Exclusive-OR (XOR) operation and "bar" denotes complementation.
F is equivalent to (choose one):

(i) ABC, (ii) $\overline{ABC}$, (iii) 0, (iv) 1, (v) none of these

2. In the following circuit, four D flip-flops (D-FF) are connected serially to form a 4-bit register as shown. All the flip-flops are leading–edge clock triggered. The present state of the register ($Q1$ $Q2$ $Q3$ $Q4$) is 0 1 0 1. The symbol $\oplus$ denotes exclusive-OR operation.



Just after the arrival of the two clock pulses, the state ($Q1$ $Q2$ $Q3$ $Q4$) of the register will be (choose one):

(i) 1 0 1 0 (ii) 0 1 0 1 (iii) 0 0 1 1 (iv) 0 0 0 1 (vi) none of these

3. In a machine language program *P*, 10% of instructions should be executed serially whereas the remaining 90% can be parallelized when multiple cores are available. The maximum speed-up achievable on a 10-core multi-processor system is approximately (choose one):

A. (i) 9.1 (ii) 6.2 (iii) 5.3 (iv) 4.8 (v) none of these, by Amdahl's Law;

B. (i) 9.1 (ii) 6.2 (iii) 5.3 (iv) 4.8 (v) none of these, by Gustavson-Barsis Law.

4. You are given a circular silicon wafer of diameter $(20\sqrt{2})cm$ on which processor chips with die size $(1cm \times 1cm)$ each, have been fabricated. The approximate number of square dies that can be sliced out from the wafer after discarding mutilated peripheral dies, is closest to (choose one):

(i) 2387 (ii) 2212 (iii) 1991 (iv) 1809 (v) 2578 (vi) none of these

5. In Question 4 above, assume die yield is 90%, defect density is 1.0 per cm^2, and the value of α that reflects masking complexity used in the fabrication process is 3. The estimated number of good chips is closest to (choose one):

(i) 1595 (ii) 906 (iii) 1236 (iv) 827 (v) 1765 (vi) none of these

6. For a given program to be executed, a RISC machine will offer you the following features compared with a CISC machine (choose one). Assume the same value of cock cycle time (CCT) for both machines.

(i) More instruction count, higher CPI, lower chip yield, better performance;
(ii) Lesser instruction count, higher CPI, higher chip yield, better performance;
(iii) More instruction count, less CPI, lower chip yield, worse performance;
(iv) More instruction count, less CPI, higher chip yield, better performance;
(v) None of the above.

7. The program counter (PC) of a machine has the following attributes (choose one).

(i) It is a register in the CPU that helps to discriminate between instructions and data while retrieving memory contents;
(ii) It is a register in the CPU that contains the address of the memory location where the next instruction is located;
(iii) It is a register in the CPU that contains the address of the memory location where the next instruction or data is located;
(iv) It is a register in the CPU that can be used for general purpose of storing memory addresses as well as variables for computation;
(v) None of the above.

8. A program *P* consisting of 1000 instructions, is run on a machine *M* operating at 1 *GHz* clock frequency. The fraction of floating point (FP) instructions is 25%. The average CPI for FP operations is 4.0, and that for all other instructions is 1.0. The execution time needed by *P* in *M* in seconds is approximately (choose one):

(i) 1.75×10^{-6} (ii) 2.25×10^{-6} (iii) 2.65×10^{-6} (iv) 3.65×10^{-5} (v) none of these