Philadelphia University Faculty of Engineering Department of Computer Engineering		Date:- 13/11/2013 Allowed time:- 60 minutes
Advanced Computer Architecture First Exam Student Name: - ……..... ID: - ……		

Q1). Define the following Terms:

Temporal Locality:- (Locality in Time): If an item is referenced, it will tend to be referenced again soon (e.g. loops, reuse)

Spatial Locality:- (Locality in Space): If an item is referenced, items whose addresses are close by tend to be referenced soon (e.g., straight-line code, array access)

Structural hazards: Hardware cannot support a combination of instructions.

Q2). List and explain the three types of Data hazards in pipelined processors.

1- Read After Write (RAW). Occur when an Instruction tries to read an operand before previous Instruction writes it.
2- Write After Read (WAR). Occur when Instruction tries to writes an operand before previous Instruction reads it
3- Write After Read (WAR). Occur when an Instruction tries to writes an operand before previous Instruction writes it

---

Q3). Given a wafer with diameter 250mm, die side 1 cm, defects per unit area=0.4 and α=4. Calculate the followings:

1- Dies per wafer.

$$Dies\ per\ Wafer = \frac{\pi\times(\frac{Diameter}{2})^2}{Die\ area} - \frac{\pi\times Diameter}{\sqrt{2\times Die\ area}}\ ,\quad Dies\ per\ Wafer = \frac{\pi\times(\frac{25}{2})^2}{1} - \frac{\pi\times 25}{\sqrt{2}}$$

$$Dies\ per\ Wafer = 490 - 55.5\ ,\quad Dies\ per\ Wafer = 434$$

2- Die yield.

$$Die\ Yield = Wafer\ Yield \times (1 + \frac{Defects\ per\ unit\ area\ \times Die\ area}{a})^{-a}$$

$$Die\ Yield = 100\%\ \times (1 + \frac{0.4\times 1}{4})^{-4}\ ,\quad Die\ Yield = 0.68$$

Q4). Assume you have a server, which spends 50% of its time on I/O operation and the remaining time on arithmetic and logic operations, and assume the FP operations are 60% of the Arithmetic and logic operations. If you want to use a new system, which enhance the FP operation by factor of 5 (5X) what is the overall speedup of the new system.

$$fraction_{enhanced} = 50\% \times 60\% = 30\%$$

$$overall\ speedup = \frac{1}{(1 - fraction_{enhanced}) + \frac{fraction_{enhanced}}{speedup_{enhanced}}}$$

$$overall\ speedup = \frac{1}{(1 - 0.3) + \frac{0.3}{5}} = \frac{1}{0.7 + 0.06} = \frac{1}{0.76} = 1.32$$

Q5). In 5 stage pipeline, if your program have the following branches frequency

Unconditional branch	8%
conditional branch - taken	6%
conditional branch – not taken	6%

And the penalties of stalling the branches are:

Unconditional branch	conditional branch - taken	conditional branch – not taken
2	5	2

Calculate the overall pipeline speedup.

$$pipeline\ speedup = \frac{pipeline\ depth}{1 + \sum_{i=1}^{n} branch_i \times branch_i\ frequency}$$

$$pipeline\ speedup = \frac{5}{1+0.08\times2+0.06\times3+0.06\times2}$$

$$pipeline\ speedup = \frac{5}{1+0.16+.018+0.12}$$

$$pipeline\ speedup = \frac{5}{1.46} = 3.42$$