Assignment-1

Name → Md. Farhan Haseen Prantor

ID → 21301536

Section → 12

Ans no: 1

"Dependability via Redundancy" in terms of computer architecture indicates keeping extra components for specific functionality which acts as a backup if the functionality fails because of its failure in component.

Our computers need to be fast, but they also need to be dependable. It is common in any physical device that they will experience failure. So, including extra or redundant components can make the system dependable by taking over the system when a failure occurs and also detecting the failure. So, redundancy in components to overcome system failure and ensuring ~~syst~~ system dependability is known as 'Dependability via Redundancy'.

Ans no: 2

(A) Here,

wafer radius, r_w = silicon ingot radius

$\Rightarrow r_w = 7$ cm

die area, $A_D = 1.55$ cm^2

So,

wafer area, $A_W = \pi r_w^2 \Rightarrow A_W = \pi \times 7^2$

$\Rightarrow A_W = 153.938$ cm^2 (Ans.)

And,

number of dies, $Dies_W = \frac{A_W}{A_D}$

$\Rightarrow Dies_W = \frac{153.938}{1.55}$

$\Rightarrow Dies_W = 99.315$

$\Rightarrow Dies_W \approx 99$

$\therefore$ They can make 99 dies per wafer.

(Ans.)

(b) Here,

defects per area, $A_{Def} = 0.035$ defects/cm^2

die area, $A_D = 1.55$ cm^2

Now,

$$\text{yield, } Y = \frac{1}{\left(1 + A_{Def} \times \frac{A_D}{2}\right)^2}$$

$$\Rightarrow Y = \frac{1}{\left(1 + 0.035 \times \frac{1.55}{2}\right)^2}$$

$$\Rightarrow Y = 0.94788$$

(Ans.)

$$\cancel{\Rightarrow Y = 94.788\,\%}$$

Here,

$Y = 0.94788 \Rightarrow Y = 94.788\,\%$

yield is the proportion of working dies per wafer. Here, the value of yield 0.94788 or 94.788% means that, in a wafer, 94.788 or 94 dies are working dies per 100 dies produced from the wafer. The rest of the dies are defective.

(c) Here,

cost per wafer, $C_W = 13$ units

number of dies per wafer, $Dies_W = 99$

yield, $Y = 0.94788$

Now,

cost per die, $C_D = \dfrac{C_W}{Dies_W \times Y}$

$\Rightarrow C_D = \dfrac{13}{99 \times 0.94788}$

$\Rightarrow C_D = 0.1385$ units

So,

cost of making 9900 dies $= 9900 \times C_D$

$= 9900 \times 0.1385$

$= 1371.15$ units

Here,

working dies per wafer, $Dies_E = Dies_W \times Y$

$\Rightarrow Dies_E = 99 \times 0.94788$

$\Rightarrow Dies_E = 93.84$

$\Rightarrow Dies_E \approx 93$

Also,

total wafers, Wafers $= 10 \times 10 = 100$

$\therefore$ Working dies $= 100 \times Dies_E$

$= 100 \times 93$

$= 9300$

(Ans.)

(D) They can not fulfill their order. They have an order of 9900 IC chips. But they can only produce 9300 IC chips with the given resources. They lack $(9900 - 9300) = 600$ chips to produce. So, they can not fulfill their order as they produce 600 less chips.

Ans no: 3

(a) Amdahl's law states that the enhancement in performance is possible with a given improvement factor, but it is limited by the amount of used improved feature.

(b) Amdahl's law relates with the design principle "Make the common case faster".

Making the common case ~~fas~~ faster tends to enhance performance ~~of rare cases~~ rather than optimizing the rare cases. This is because the common cases are simpler to understand and enhance rather than the rare cases. As an example, if a program contains 10 common cases and 2 rare cases where rare cases take twice more time than the common cases. Then the common cases would take 10 units of time and the rare cases would take (2x2) or 4 unit of time. For 2 times overall improvement, Amdahl's law would suggest improving common cases as the common cases take more execution time. Amdahl's law ⇒

$$\frac{10+4}{2} = \frac{10}{n_1} + (10+4-10) \Rightarrow n_1 = 3.333$$

If Amdahl's law supported rare cases ⇒

$$\frac{10+4}{2} = \frac{4}{n_2} + (10+4-4) \rightarrow n_2 = -1.333$$ which

is impossible.

Amdahl's law thus focuses on making common cases faster because common cases have the most unit of instructions and the most total execution time and Amdahl's law predicts how to optimize it.

Ans no: 4

To calculate the benchmark of a system, we take the geometric mean instead of only taking the average of the individual spec ratios. This is because using the geometric gives the same relative result no matter what ~~is~~ ~~computer is used~~ system is used to normalize the results. If we had taken the average of the individual spec ratios, the results would vary depending on the system we choose as reference.

Ans no: 5

(a) The total number of instructions in the above program is 18.

Here, 8 add instructions, 5 sub instructions, 3 mul instructions, 2 addi instructions.

$\therefore$ Total instructions $= (8+5+3+2) = 18$

(Ans.)

(b) Here,

Instruction count, $IC = (8+5+3+2) = 18$

Average Cycles per Instruction, $CPI = \dfrac{8\times2+5\times3+3\times4+2\times5}{8+5+3+2}$

$\Rightarrow CPI = 2.944$

Clock cycle duration, $CP = 3s$

So,

execution time, CPU time $= IC \times CPI \times CP$

$\Rightarrow$ CPU time $= 18 \times 2.944 \times 3$

$\Rightarrow$ CPU time $= 158.976s$

(Ans.)

(c) Here,

duration of clock cycle, $CP = 3s$

So,

Clock Rate, $CR = \frac{1}{CP} \Rightarrow CR = \frac{1}{3}$

$\Rightarrow CR = 0.333$ Hz (Ans.)

(d) Here,

add instruction $\Rightarrow 8 \times 2 = 16$ cycles

sub instruction $\Rightarrow 5 \times 3 = 15$ cycles

mul instruction $\Rightarrow 3 \times 4 = 12$ cycles

addi instruction $\Rightarrow 2 \times 5 = 10$ cycles

As,

add instruction has the most cycles or the most execution time needed, I would choose add instruction for making system faster by speeding up.

(e) Here,

program execution time, CPU time = 158.976s

for add instruction execution ⇒ $T_{aff} = (8 \times 2 \times 3)s$

⇒ $T_{aff} = 48s$

~~unaffected executions~~ ⇒ $\cancel{T_{un}} = \cancel{(158.976 - 48)s}$

for reducing to 1.2 times ⇒

$$\frac{158.976}{1.2} = \frac{48}{n} + (158.976 - 48)$$

$$\Rightarrow n = 2.2321$$

So, required improvement factor = 2.2321

(Ans.)