EE 330 F12

HW 1 -solutions

Due 8/24/2012

1

$$A_{die} = (32nm \times 32nm) \times 10 \times 10000 = 1.024 \times 10^{-10} m^2$$

$$A_{wafer} = \pi \times \left(6in \times \frac{2.54 cm}{1in} \times \frac{1m}{100cm}\right)^2 = 0.0729\ m^2$$

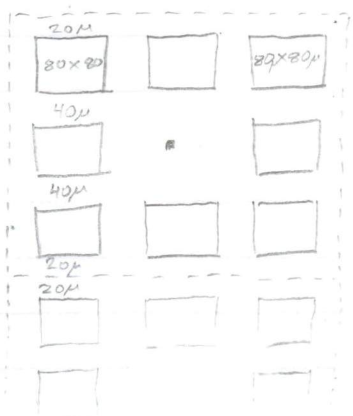
$$n_{die} = \frac{A_{wafer}}{A_{die}} = \boxed{7.12 \times 10^8 \text{ die}}$$

2

$$\frac{cost}{die} = \frac{C_{wafer}}{n_{die}} = \frac{\$6000}{7.12 \times 10^8 \text{ die}} \approx \boxed{\$8.42 \times 10^{-6} / die}$$

3

#1



$$A_{die+pads} = (3 \cdot 80\mu + 2 \cdot 40\mu + 2 \cdot 20\mu)^2 = (360\mu)^2$$

$$= 1.296 \times 10^{-7} m^2$$

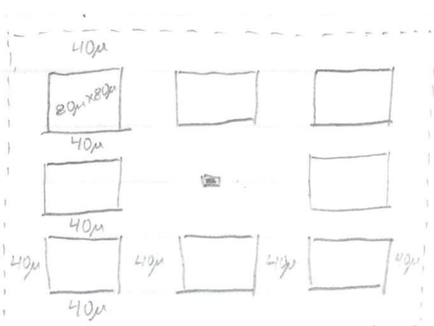
$$A_{wafer} = \pi \times \left(6in \times \frac{2.54 cm/in}{100 cm/m}\right)^2$$

$$= 0.0729 m^2$$

$$n_{die} = \frac{A_{wafer}}{A_{die+pads}} = \frac{0.0729\ m^2}{1.296 \times 10^{-7} m^2} \qquad \boxed{n_{die} = 5.63 \times 10^5 \text{ die}}$$

$$C_{die} = \frac{\$6000}{n_{die}} \qquad \boxed{C_{die} = \$0.01066}$$

#2



$$A_{die+pads} = (3 \cdot 80\mu + 4 \cdot 40\mu)^2 = (400\mu)^2$$

$$= 1.6 \times 10^{-7} m^2$$

$$A_{wafer} = 0.0729 m^2$$

$$n_{die} = \frac{A_{wafer}}{A_{die+pads}} = \frac{0.0729 m^2}{1.6 \times 10^{-7} m^2} \qquad \boxed{n_{die} = 4.56 \times 10^5 \text{ die}}$$

$$C_{die} = \frac{\$6000}{n_{die}} \qquad \boxed{C_{die} = \$0.01316}$$

4

$$\frac{\text{feature size}}{\text{diameter si}} = \frac{20nm}{0.222nm} = \boxed{90.090}$$

* d_{si} found on wikipedia

5 Allows processors to turn off when not actively doing computations.

6 Intel core i7, i5, i3, Pentium Desktop/Mobile, Celeron Desktop/Mobile, Xeon

$\boxed{0.7B - 2.6B \text{ transistors}}$

7 Core i7 $V_{ss} = 1.2V$

power consumption $\underset{(idle)}{20W} - \underset{(peak)}{350W}$ (depends on i7 version)

$$V_{drop} = I \times R = \frac{P}{V} \times R$$

$$R = \rho \cdot L = 1.16 \frac{\Omega}{in} \cdot 0.5in = 0.58\Omega$$

$$V_{drop_1} = \frac{20W}{1.2V} \cdot 0.58\Omega = 9.667V$$

$$V_{drop_2} = \frac{350W}{1.2V} \cdot 0.58\Omega = 169.167V$$

$$\boxed{V_{drop} = 9.667 - 169.167V}$$

$$P_{line} = \frac{V^2}{R} \qquad P_{line_1} = \frac{9.667^2}{0.58} = 161.122W$$

$$P_{line_2} = \frac{169.167^2}{0.58} = 49340.47W$$

$$\boxed{P_{line} = 160 - 4.93E4 \ W}$$

$$n = \frac{I_{i7}}{I_{fuse} \times 0.10} \qquad I_{fuse} = 0.6 - 0.7 \ A$$

$$I_{i7} = \frac{P}{V}$$

$$n_1 = \frac{\left(\frac{20W}{1.2V}\right)}{0.7A \cdot 0.1} = 238$$

$$n_2 = \frac{\left(\frac{350W}{1.2V}\right)}{0.6A \cdot 0.1} = 4861$$

$\boxed{n = 238 - 4861 \text{ parallel gold wires}}$

8-9

Type	~Bit/cm^2	~cost/bit
CD	1~9 e7	$ 1~9e-11
DVD	1~9 e8	$ 1~9e-12
BR DVD	1~9 e9	$ 1~9e-12
Hard Disk	1~9 e10	$ 1~9e-12
SRAM	1~9 e7	$ 1~9e-6
DRAM	1~9 e9	$ 1~9e-9
Flash	1~9 e10	$ 1~9e-10

$\boxed{\text{lowest cost} = \text{DVD, BR DVD, Hard disk}}$

$\boxed{\text{Ratio in } \frac{\text{cost}}{\text{bit}} = 1\times10^{6}}$

10

$$\text{Cell Revenue} = 1.4\times10^{9}\text{ units} * \frac{\$100}{\text{unit}} = \$140\times10^{9}$$

$$n_{engineers} = \frac{(\$140\times10^{9})\times 0.10}{\$6.0\times10^{4}} = \boxed{2.33\times10^{5}\text{ engineers}}$$