

ECE 733
Final Spring 2008

Name:

Student ID:

This test is open book, open notes. Computers are NOT allowed (calculators are). You have 100 minutes. Turn in answers in the space provided.

Question 1

Consider a transmission line that is 1 m long. Its cross section is 10 μm thick and 25 μm wide. For the calculations below, please use the following parameters:

- Dielectric constant = 4.3. Loss tangent $\tan \delta = 0.03$.
- Copper resistivity = $1.7\text{E-}8$ Ohm.m
- Magnetic permeability = $4\pi \text{E-}7$
- Speed of light in a vacuum = $3\text{E}8$ m/s
- $Z_0=50 \Omega$

Please answer the following questions:

(a) What is the DC resistance per unit length of the transmission line? [2 points]

$$R_{DC} = \rho / wt = 1.7\text{E-}8 / (10\text{e-}6 \cdot 25\text{e-}6) = 68 \text{ Ohm/m}$$

(b) At what frequency is the skin depth half of the thickness? [2 points]

$$f_s = \rho / \pi \mu (t/2)^2 = 1.7\text{E-}8 / (\pi \cdot 4\pi \text{e-}7 \cdot (10\text{e-}6)^2) = 43 \text{ MHz}$$

(c) At what frequency does the dielectric loss exceed the skin effect loss? [2 points]

$$a_{se} = R_{dc} / (2Z_0) \sqrt{f/f_s} = 68 / (2 \cdot 50) \sqrt{f / 43\text{E}6} = 1.04\text{E-}4 \sqrt{f}$$

$$a_{dl} = \pi f \sqrt{\epsilon_r} \tan \delta / c = \pi f \sqrt{4.3} \cdot 0.03 / (3 \text{e-}8) = 6.51\text{e-}10 f$$

$$\text{equal when } \sqrt{f} = 1.04\text{E-}4 / 6.51\text{E-}10 = 25 \text{ GHz}$$

Question 2

(a) Consider an eye diagram analysis. What factors determine the probability of a Bit Error due to horizontal eye closure? [4 points]

Signal Jitter + $t_{su} + t_{hold}$ + clock jitter. The jitters are probabilistic.

Question 3

Consider the differential current mode latch.

(a) What transistors are on when $Ck=0$ and $IN=1$? [2 points]



