EECS 243 – Advanced IC Processing and Layout

Fall 2000	**Office Hours**	**Prof. A. R. Neureuther,**
Tu, Th 3:30-5	**M, Tu,Th, (F) 11am**	**510 Cory Hall, 2-4590**
299 Cory	**W 10**	**neureuth@eecs**

Homework Assignment # 1, Due Th, Sept 7th, 00

Reading for Week#1: Chapter 2 "Modern CMOS Technology" from PDG00 (Loan copies available) and Chapter L1 "The Lithography Process and Basic Simulation Models" by ARN (copies will be distributed in class).

1.1 Simple Process Flow. Go to the SIMPLer web site for EECS 40 at **http://www-inst.eecs.berkeley.edu/~ee40/SIMPLer/index.html** and run one of the available non-custom examples. Move the process slider to see the time evolution of the profile. Select a different cut-line for the cross-section as well. The "help" link leads to the manual which explains how to draw masks and write a process flow. Choose a simple microstructure or part of a microstructure involving at least three masks and ten process steps. Use SIMPLer to sketch and label the masks, create the process flow and the time-evolution of the cross-sections along a cut-line. Print out one intermediate and the final cross-section for your process. Using the print command.

1.2 Berkeley Microlab CMOS Process. The process flow for the Berkeley CMOS baseline process is at **http://www-microlab.eecs.berkeley.edu:8080/baseline/index.html** Compare this process flow with that that described in Chapter 2 of PDG00. Categorize the isolation, the well formation process, and the device structure for the Berkeley baseline CMOS process in the terminology of PDG00. List the masks as they are used in sequence and a previous mask to which they likely align. Also describe any simple relationships between masks such as being complements or direct combination of well and select (well contact) masks.

1.3 LAVA Remote Simulation. Use the Explorer browswer to go to the Lithography Analysis through Virtual Access (LAVA) website at **http://cuervo.eecs.berkeley.edu/Volcano/** and select "Applications" and then the "Basic Projection Lithography." This applet allows the user to select the outer and inner radius of illumination and hence the partial coherence. Various one-dimensional patterns such as line, isolated space and line-space arrays can be selected. Their sizes are in normalized units of λ/NA where λ is the wavelength and NA is the numerical aperature. The submit button then simulates the selected parameters with SPLAT and plots the resulting intensity. For this problem assume a "Top Hat" illumination case (sigma = 0.5, sigma in = 0).

- **a)** Select Dense lines (for which line equal space = L) and simulate the images for a few normalized sizes from L = 1.4 down to 0.4. Report your observations on how the peak intensity, contrast [C=(max-min)/max+min)], and edge slope change with feature size.
- **b)** Simultaneously select Iso-Line, Iso-Space and Dense at their default sizes and compare their images. Repeat for a smaller feature size of say 0.4. (Be sure to hit return after you edit any number in a box). Report your observations on how the image characteristics depend on feature type and the extent to which this dependency increase with decreasing feature type.