http://www.makaut.com

Name : ....
Roll No. : ....
Invigilator's Signature : ....

CS/M.TECH (VLSI)/SEM-1/PGMVD-104/2010-11

2010-11

MICROELECTRONICS TECHNOLOGY & VLSI DESIGN

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Justify any *ten* of the following statements : 10 × 2 = 20

   i) Reactive Ion Etching blends both of directionality and selectivity.

   ii) Hydrofluoric acid is usually buffered with NH_4F to remone SiO_2.

   iii) 'Si' is the material of choice for CMOS VLSI technology.

   iv) Sheet resistance is expressed in ohm/□.

   v) 'Al' has been the preferred material for contact.

   vi) Introduction of halogen species during oxidation stabilizes threshold voltage.

   vii) Proximity printing is better option over contact printing.

viii) Growing oxide layer in CMOS VLSI technoloty the actual sequence involves dry/wet/dry.

ix) Lift-off technique is extensively used for pattern transfering.

x) For MOSFET Fabrication p-type <100> orientation Si water is preferred over <111> orientation.

xi) Dry etching is preferred for small feature size.

GROUP – B

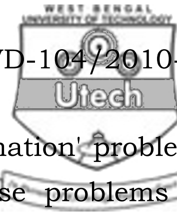
(Short Answer Type Questions)

Answer any *four* of the following. $4 \times 5 = 20$

2. What is "Piranha cleaning" ? Why is this cleaning procedure required for device fabrication ? Write down the chemical composition of "standard clean" processes ? 2 + 1 + 2

3. What are the different kind of dry etch techniques ? Which parameter is to be controlled to select the particular etching mode ? Point out the important characteristics of dry etch technique ? 2 + 1 + 2

4. Why is local oxidation (LOCOS) required in CMOS VLSI technology ? Give reasons for using pad oxide in case of LOCOS. How does Bird's beak appear in LOCOS ? 1 + 2 + 2



5. What are 'Junction spiking' and 'Electromignation' problems related to Al metallization ? How can these problems be minimized ? 2 + 2 + 1

6. Write down the important properties of a good photoresist. Compare positive and negative photoresist in terms of image transfer to the water. 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *two* of the following. $2 \times 15 = 30$

7. What issues are to be considerd in etching process ?

   0·6μm of SiO_2 is to be etched ; rate is 0·2 μm/min. If etch selectivity of oxide relative to mask is 24 : 1 and to slightly over-etch you expose for 3·6 min, how thick should mask be ? How thick is 0·035 μm mask after etch ? How do you conclude that Si water is completely free from oxide film ? What etching technique do you use to make a "V" groove in Si ? 6 + 3 + 2 + 2 + 2

8. What are the different techniques for the formation of oxide layer over any substrate ? Write down the different functions of oxide layer in CMOS VLSI technology ? Starting with oxide growth kinetics develop the growth rate equation. Find the linear and parabolic rate constants from the equation. What factors affect oxidation process ? Comment on the factors. 2 + 3 + 5 + 3 + 2

9. What kind of material is required for multilevel interconnect network ? Why do we need damascene process ? Explain with suitable diagrams. the steps of a dual damascene process ? What benefit can be achieved by the dual damascene process ?

   If we replace 'Al' with 'Cu' wire associated with some low-K dielectric (K = 2·6) instead of SiO_2 layer, what percentage of reduction of RC time constant will be achieved ?

   (ρ_{Al} = 2·7 μΩ-cm & ρ_{cu} = 1·7 μΩ cm) 2 + 2 + 6 + 2 + 3