# 2014

# VLSI

## Paper : EC 602

*Full Marks : 100*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

## *Section - A*

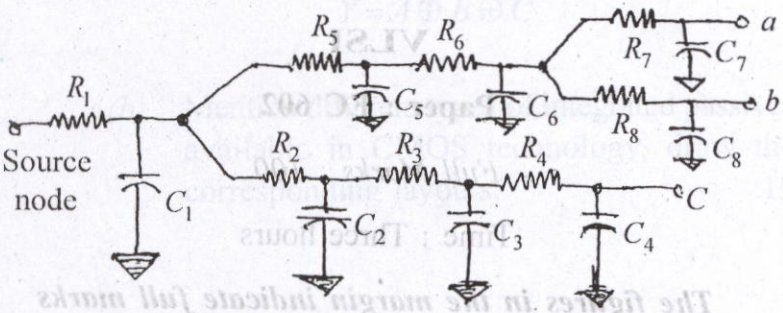
*Answer **any two** questions from question **2, 3, 4** and question **1** is **compulsory**.*

1. *(a)* What do you mean by fringe-capacitance ? How does it effect the delay in a circuit ? 2+2

   *(b)* Derive the expression for drain current ($I_D$) in an n-MOS Transistor operating in Triode region. 6

2. *(a)* Describe the operation of CMOS inverter, draw the transfer characteristics. 10

(b) Calculate the Elmore's delay for the RC-tree shown below at nodes *a, b, c.* 10




3. (a) Write VHDL code for a full Adder using two Half Adders in structural model. 10

(b) Describe the operation of BiCMOS inverter. 10

4. (a) Classify different types of memory and describe the operation of SRAM cell (6 Transistor). 2+8

(b) Write short notes on photolithography and oxidation. 5+5

## *Section - B*

*Answer* ***any two*** *from question* ***5, 6, 8*** *&* ***question 7 is compulsory.***

5. *(a)* Describe channel length modulation for an n-MOS Transistor. Derive the expression of transition frequency ($w_T$) for an n-MOS transistor in saturation. 4+6

*(b)* Draw the layout for a CMOS inverter with proper substrate contacts. 6

*(c)* Describe how n-MOS and p-MOS transistors can be used as pass transistors. 4

6. *(a)* Write down the fabrication steps for an n-well CMOS process with proper sketch. 10

*(b)* Mention the basic blocks of an FPGA, draw the diagram of a typical FPGA Architecture. Discuss SRAM based FPGA in brief. 2+2+6

7. Why scaling is important in IC Design ? Mention the types of scaling. Describe the effect of scaling on $I_{DS}$, $V_{TH}$, $C_{OX}$. 2+2+6

8. *(a)* Draw the schematic diagram for the following boolean expression : 10

$$Y = \overline{A \oplus B \oplus C}$$

*(b)* Mention different types of integrated passives available in CMOS technology, draw the corresponding layouts. 10

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