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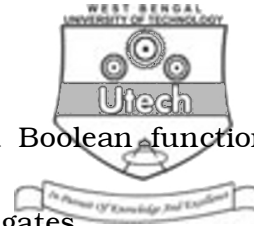
CS/B.TECH(ECE)/SEM-6 /EC-604/2012
2012
VLSI CIRCUITS AND SYSTEMS

Time Allotted : 3 Hours Full Marks : 70

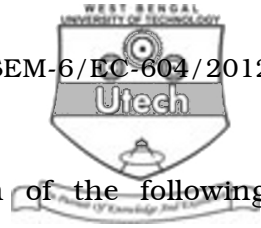
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10
- i) The noise margin for high signal levels (NM_H) is
 - a) $V_{IL} - V_{OL}$ b) $V_{OH} - V_{IH}$
 - c) $V_{OH} - V_{OL}$ d) none of these.
 - ii) The switching threshold voltage of CMOS inverter is obtained when
 - a) $V_{in} = V_{out}$ b) $V_{T,n} = -V_{T,p}$
 - c) $V_{in} = 2V_{out}$ d) none of these.
 - iii) In CMOS static logic design, total number of transistors required for the Boolean function $F = A + (B + CD)$ is
 - a) 10 b) 8
 - c) 5 d) none of these.



- iv) The sum-of-product expression of a Boolean function can be realized by
 - a) AOI gates
 - b) OAI gates
 - c) both (a) and (b)
 - d) none of these.
- v) Dynamic logic circuit is
 - a) faster than static design
 - b) slower than static design
 - c) bigger than static design
 - d) none of these.
- vi) VHDL is used for
 - a) Timing analysis
 - b) layout diagram
 - c) logic design
 - d) RTL coding.
- vii) Active resistor is used for
 - a) less fabrication area
 - b) load resistor
 - c) constant current source
 - d) all of these.
- viii) For depletion type NMOS
 - a) the threshold voltage is + ve
 - b) the threshold voltage is - ve
 - c) the threshold voltage is - ve and + ve
 - d) all of these.
- ix) BiCMOS means
 - a) two BJT circuits
 - b) two CMOS circuits
 - c) both BJT and CMOS circuits
 - d) none of these.
- x) For a symmetrical CMOS inverter the relation between aspect ratio of NMOS and PMOS is
 - a) $(W/L)_p = (W/L)_n$
 - b) $(W/L)_p = 2 \cdot 5 (W/L)_n$
 - c) $(W/L)_n = 2 \cdot 5 (W/L)_p$
 - d) $(W/L)_p = 5 (W/L)_n$.



- xi) Pseudo n MOS logic provides which of the following advantages ?
- Static power dissipation is less compared to CMOS logic
 - It is faster compared to other logics
 - It requires less no. of transistors compared to CMOS logic
 - It is more noise immune.
- xii) Configurable logic blocks are used in
- gate array design style
 - standard cell based design
 - field programmable gate array layout
 - full custom design.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- What is current source and current sink in VLSI circuit ? Design a current sink using $V_{DD} = -V_{SS} = 2.5V$ to sink a current of $10\mu A$. Estimate the minimum voltage across the current source and the output resistance. Assume $K_p = 50\mu A/V^2$, $L = 5\mu m$, $V_{THN} = 0.83V$, $\lambda = 0.06$. $2 + 3$
- Draw and explain the operation of MOS Switched Capacitor Integrator and also find the expression for output voltage.
- Compare between static logic and dynamic logic. Explain the operation of Domino-logic to design any CMOS circuit. $2 + 3$
- What is Transmission Gate (TG) ? Explain the operation of Edge Triggered D Flip-Flop using CMOS TG gates. Implement the expression using CMOS TG logic. $Z = XY' + X'Y$. (X' = complement of X) $1 + 2 + 2$
- Draw the circuit of a CMOS full adder circuit and explain its operation.



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain the fabrication process steps for an NMOS transistor with necessary diagrams.
b) Write down the difference between twin-tub process and *P*-well process.
c) Draw the layout of the following :
(i) $F = AB + CD$ (ii) $F = A + BC$ $7 + 3 + 5$
8. a) Explain how CMOS can be used for inverter logic. Draw the voltage transfer characteristics of CMOS inverter and clearly define operating regions of NMOS and PMOS.
b) Show that for a symmetric CMOS inverter the two noise margins are same and are equal to V_{IL} . Also show that for ideal CMOS inverter $(W/L)_p = 2 \cdot 5 (W/L)_n$.
 $3 + 3 + 3 + 3 + 3$
9. a) What is CMRR ?
b) Explain with a circuit diagram, operation of a differential amplifier.
c) Explain briefly different stages of an OP-AMP with the help of a block diagram. $2 + 7 + 6$
10. a) What do you mean by current sink and current source ?
b) Explain how combination of switches and capacitors can be used to emulate a resistor.
c) What is phase locked loop ? Explain its operation. Mention two uses of phase locked loop.
 $2 + 5 + 2 + 5 + 1$
11. Write short notes on any *three* of the following : 3×5
a) Constant voltage scaling
b) CMOS NORA logic
c) ASIC
d) DCVSL and pseudo *n*-MOS inverter.
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