Name	Symbol	Value	Units
Boltzmann's constant	k	1.38×10^{-23}	$J/^{\circ}K$
Dielectric constant of vacuum	ε_o	8.854×10^{-14}	F/cm
Dielectric constant of Silicon	ε_{si}	$11.7\varepsilon_o$	F/cm
Dielectric constant of SiO_2	ε_{ox}	$3.97\varepsilon_o$	F/cm
Intrinsic carrier concentration	n_i	1.45×10^{10}	cm^{-3} (at 27 °C)

Que 1:- Solve any four of the following. (4 x 5 = 20 marks).

(a) Realize EXOR gate using NMOS pass transistors.

(b) Discuss advantages of transmition gates in VLSI.

(c) For N channel MOSFET having threshold voltage 1.75 Volt, when V_{gs} = 5 V and V_{ds} = 2.0V is applied, the drain current is 120 μA. Find the mode of operation and W/L ratio of the device. (Assume oxide capacitance = 51.72×10^{-9} F/cm^2).

(d) Write short notes on Photolithography .

(e) Explain input protection in CMOS.

Que 2:- (a)Calculate the zero-bias threshold voltage for an NMOS Silicon- gate transistor that has well doping $N_A = 3 \times 10^{17}\ cm^{-3}$,gate doping $N_D = 10^{20}\ cm^{-3}$, gate- oxide thickness t_{ox} = 200 A° , and $2 \times 10^{10}\ cm^{-2}$ singly charged positive ions per unit area at the oxide-Silicon interface. Also calculate the ion- implant doses needed to achieve a threshold voltage of 1.1 V. (7+3 marks)

(b) Explain Euler's method with suitable example and discuss its advantages. (10 marks)

Que3:- Draw a circuit diagram, stick diagram of 2 input CMOS NOR gate and its mask layout considering lambda based design rules. (20 marks)

Que4:-(a) Compare NMOS logic family with enhancement mode and Depletion mode pull up. (10 marks)

(b) Explain latch-up in CMOS. (10 marks)

Que5:- (a) Explain self registered buried contacts in NMOS circuits. (10 marks)

(b) Explain Importance of full scaling in VLSI. (10 marks)

Que6:- (a) Explain lambda based design rules for (I) polysilicon crossing diffusion to have MOSFET and (II) metal pattern over via. Discuss the faults created, if the rules are not followed. (10 marks)

(b) Draw static RAM cell and explain its working. (10 marks)

Que 7:- (a) Draw circuit diagram and stick diagram of 4:1 multiplexer using enhancement mode and depletion mode devices and explain its operation. (10 marks)

(b) Write short notes on Ion implantation. (10 marks)