



## End Semester Examination – Nov/Dec – 2016

**Code : 14EC3023**  
**Sub. Name : Solid State Device Modeling and Simulation**

**Semester : 2016-17 ODD**  
**Duration : 3hrs**  
**Max. marks : 100**

### ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	Discuss the work function and flat band voltage of MOS capacitor when no external voltage is applied.	CO1	20
<b>(OR)</b>				
2.	a.	An n-channel silicon MOSFET (NMOS) has the following construction: The p-type substrate doping is $N_A = 5 \times 10^{16} \text{ 1/cm}^3$ . The n-type polysilicon gate is doped at $N_D = 10^{19} \text{ 1/cm}^3$ . The gate length is $0.5 \text{ }\mu\text{m}$ . The oxide thickness $t_{ox} = 20 \text{ nm}$ . The device width is $20 \text{ }\mu\text{m}$ . The source and drain are doped degenerately (very highly) at $N_D = 10^{20} \text{ 1/cm}^3$ . The source and drain regions are each $1 \text{ }\mu\text{m}$ wide and $0.25 \text{ }\mu\text{m}$ deep. The p-type bulk (substrate) is $100 \text{ }\mu\text{m}$ deep. Silicon dioxide and silicon permittivity are $\epsilon_{ox} = 3.9 \times 8.9 \times 10^{-14} \text{ F/cm}$ and $\epsilon_{si} = 11.7 \times 8.9 \times 10^{-14} \text{ F/cm}$ . $n_i = 1.45 \times 10^{10} \text{ 1/cm}^3$ , $\mu_n = 500 \text{ cm}^2/\text{V. sec}$ . Assume room temperature, so that $KT/q = 0.026 \text{ V}$ . Draw the band diagram with no bias applied to the substrate. Then calculate the threshold voltage $V_{th}$ under that condition.	CO2	15
	b.	Derive an expression for transconductance of a MOSFET.	CO1	5
3.	a.	Derive an expression for threshold voltage for a non-uniformly doped substrate MOSFET.	CO1	20
<b>(OR)</b>				
4.	a.	Discuss the Velocity Saturation Model and Capacitance Models of a MOSFET.	CO1	20
5.	a.	Explain the modeling of the Intrinsic and extrinsic Components of high-frequency applications.	CO2	20
<b>(OR)</b>				
6.	a.	With an equivalent circuit name the noise sources in a MOSFET.	CO1	5
	b.	How will you extract parameters using Y-parameter analysis.	CO1	15
7.	a.	Discuss the threshold voltage model for Nonuniform Lateral Doping due to Pocket (Halo) Implant and improved threshold voltage model for Short-channel Effects.	CO2	20
<b>(OR)</b>				
8.	a.	Discuss mobility model and source/drain resistance model of a MOSFET.	CO2	20
<b>Compulsory:</b>				
9.	a.	Discuss the noise Model of a MOSFET in detail.	CO2	20