# Reg. No. :

# **Question Paper Code : 82438**

## M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

**First Semester** 

## VLSI Design

# VL 9213/VL 913/10244 VL 105 – SOLID STATE DEVICE MODELING AND SIMULATION

(Regulation 2009/2010)

Time : Three hours

Maximum : 100 marks

(8)

Answer ALL questions.

PART A —  $(10 \times 2 = 20 \text{ marks})$ 

- 1. Write the expression for flat-band voltage.
- 2. Draw the five resistor network.
- 3. Write the theory mechanism of flicker noise.
- 4. Define harmonic distortion.
- 5. Define narrow width effect.

6. What is rgatemod?

- 7. What are the features of EKV model?
- 8. List out the main characteristics of MM9 model.

9. Define LPVM.

10. Differentiate interdie and intradie process variation.

PART B —  $(5 \times 16 = 80 \text{ marks})$ 

11. (a) (i) Derive the expression for threshold voltage of the MOSFET.

(ii) Calculate the oxide capacitance the flat-band capacitance and the high frequency capacitance in inversion of a silicon nMOS capacitor with a substrate doping  $N_a = 10^{17} \text{ cm}^{-3}$ , a 20 nm thick oxide  $(\varepsilon_{0x} = 3.9\varepsilon_0)$  and an aluminium gate  $(\Phi_m = 4.1 \text{ V})$ . (8)

### Or

(b) (i) Explain the equivalent circuit representation of MOS transistors.(8)

(ii) Describe in detail about the Unified MOSFET C - V model. (8)

- (a) (i) Derive the expression for noise figure in a two port network and in a two port network device the noise power is 500mW, noise bandwidth is 300Hz in the temperature of about 273K. Find the minimum noise figure of the network device Also calculate the expected noise figure obtained for an equivalent noise resistance of 330 ohms admittance of 34+j22 and an optimum source admittance of 27+j32.
  - (ii) Derive the expressions for non-linear conductance and multidimensional transconductance. (8)

#### Or

- (b) (i) Draw the two port network and derive the expression for the noise parameters Given  $R_{va} = 400$  ohms,  $G_{in} = 23$ ,  $B_c = 0.06$ ,  $G_c = 230$ , find the values of noise parameters. (8)
  - (ii) Draw the small signal model for noise parameters and derive the expression for induced gate noise and its correlation to the drain noise.
    (8)
- 13. (a) Describe the BSIM 4 capacitance models in detail.

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## Or

- (b) Explain the BSIM 4 channel charge model and mobility model with suitable equations.
- 14. (a) Explain in detail about the modeling of second order effects of the drain current with respect to EKV model.

### Or

(b)	(i)	Explain in detail MOSA1 model.	(8)
	(ii)	Derive the noise model of MM9.	. (8)
(a)	Wri	te short notes on	
	(i)	Mismatch model in resistors and capacitors.	(8)
	(ii)	Mismatching models of MOSFETs.	(8)
		Or	
(b)	Disc	cuss in detail about	

(i)	Leakage current	(5)
(ii)	Transfer characteristics in weak and moderate inversion region	(6)
(iii)	Gate Leakage current.	(5)