B.TECH/ECE/5TH SEM/ECEN 3103(BACKLOG)/2021

MICROELECTRONICS & ANALOG VLSI DESIGN
(ECEN 3103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The low frequency MOS series capacitance in the strong inversion region is
(a) depletion layer capacitance and the insulator capacitance in series
(b) depletion layer capacitance
(c) insulator capacitance
(d) depletion layer capacitance and the insulator capacitance in parallel.

(ii) According to Moore's law, the dimensions of a MOS device are reduced with every technology node roughly by
(a) 20% (b) 50% (c) 70% (d) 80%.

(iii) The threshold voltage in short channel MOSFETs _____
(a) shifts towards the higher voltage (b) shifts towards the lower voltage
(c) remains same (d) none of the above.

(iv) Value of 'lambda' in 180nm technology node is
(a) 360nm (b)180nm (c) 90nm (d) 45nm.

(v) Sputtering is a _____ process
(a) physical (b) chemical
(c) mechanical (d) none of the above.

(vi) The performance of a current source/sink may be improved by
(a) reducing V_{min} and output resistance
(b) increasing V_{min} and output resistance
(c) reducing V_{min} and increasing output resistance
(d) increasing V_{min} and reducing output resistance.

(vii) Photo resist is a _____ compound
(a) radiation sensitive (b) radiation insensitive
(c) radiative (d) non-radiative.

(viii) The performance of a current mirror circuit depends on
(a) channel length modulation (b) aspect ratio
(c) V_{th} (d) all of the above.

(ix) Switched capacitor circuit realizes
(a) resistance (b) capacitance
(c) inductance (d) current source.

(x) CMRR for a perfectly matched Differential Amplifier circuit
(a) one (b) zero (c) infinite (d) ten.

Group – B

2. (a) Define the threshold voltage of a MOSFET. [(CO1)(Remember/LOCQ)]
(b) Explain with the help of band diagram the condition of inversion in an n-channel MOSFET. [(CO2)(Understand/LOCQ)]
(c) Show with appropriate diagram how the capacitance of a MOS structure changes with the applied gate voltage. [(CO2)(Analyze/IOCQ)]

2 + 5 + 5 = 12

3. (a) Show the impact of channel length modulation on the drain current characteristics of enhancement type MOSFET. [(CO1)(Apply/IOCQ)]
(b) What are short channel effects in MOSFETs? [(CO1)(Remember/LOCQ)]
(c) Discuss any one short channel effect in a MOSFET. [(CO1)(Analyse/IOCQ)]

5 + 2 + 5 = 12

Group – C

4. (a) Illustrate with a flow diagram, the steps of fabrication of an nMOS. [(CO2) (Remember/LOCQ)]
(b) Differentiate between dry and wet oxidation. [(CO2) (Understand/LOCQ)]

6 + 6 = 12

5. (a) What is photolithography? [(CO2)(Remember/LOCQ)]
(b) Differentiate between positive and negative photoresist. [(CO2)(Understand/LOCQ)]
(c) Show the steps of pattern transfer using a positive photoresist. [(CO2)(Apply/IOCQ)]

2 + 4 + 6 = 12

Group – D

6. (a) Draw the small signal equivalent circuit model of an nmos at low frequency. [(CO3) (Apply/IOCQ)]
(b) Mention the advantage of using a CMOS switch over a single MOS switch. [(CO3) (Understand/LOCQ)]
(c) Show how a MOS may be used as a diode. [(CO3)(Apply/IOCQ)]

4 + 2 + 6 = 12

7. (a) Draw a current mirror circuit using pmos. [(CO3)(Apply/IOCQ)]
   (b) Derive an expression for the output current neglecting the channel length modulation phenomenon. [(CO3) (Create /HOCQ)]
   (c) Discuss about the non-idealities that may affect the output current. [(CO3)(Analyze/IOCQ)]

4 + 5 + 3 = 12

Group – E

8. (a) Obtain the small signal equivalent circuit model of an active pmos load inverter. [(CO4)(Apply/IOCQ)]
   (b) Find out its voltage gain and the output resistance. [(CO4)(Create/HOCQ)]

6 + 6 = 12

9. (a) Consider a MOS differential amplifier with a differential input signal applied in a complementary manner. Show that the gain of the amplifier is doubled when the output is taken differentially and not in a single-ended fashion. [(CO4)(Create/HOCQ)]
   (b) Define CMRR. What is its ideal value? [(CO4) (Remember/LOCQ)]

9 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33%	45.83%	20.83%

Course Outcome (CO):

After the completion of the course students will be able to

1. Basics of microelectronics and VLSI design
2. Types of MOS, IC manufacturing Process - the steps
3. Analog VLSI circuits – the intricacies
4. Important Circuits like OP AMP and their analysis

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
ECE - BACKLOG	https://classroom.google.com/c/NDY1NzMyNTU0NTk5?cjc=ynin37y