Printed Page:-4 **Subject Code:- BECVL0301**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2025 - 2026)

Subject: VLSI Technology

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

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SECTION-A 20

1. Attempt all parts:-

1-a. How many particles per cubic meter are permitted in a Class 10 clean room? (CO1, K1) 1

(a) 100 particles/ft^3
(b) 10 particles/ft^3
(c) 1 particles/ft^3
(d) 1000 particles/ft^3

1-b. Which ISO standard is followed for present-day clean room classification? (CO1, K1) 1

(a) SEMI F21
(b) FED STD 209E
(c) ISO 14644
(d) IEEE 802.3

1-c. Anisotropy is higher in: (CO2, K1) 1

(a) Dry Etching
(b) Wet Etching
(c) Both equal
(d) None

1-d. What type of etching achieves high throughput? (CO2, K1) 1

(a) Depends on the chemical used
(b) Dry Etching
(c) Wet Etching
(d) Both equal

1-e. In optical lithography, how are circuit patterns transferred onto the wafer surface? (CO3, K1) — 1

(a) Electrons
(b) Light
(c) X-rays
(d) Plasma

1-f. The photosensitive layer used to define patterns during lithography is called what? (CO3, K1) — 1

(a) Metal film
(b) Polysilicon
(c) Oxide
(d) Photoresist

1-g. Atomic diffusion in solids is primarily described by which fundamental physical law? (CO4, K1) — 1

(a) Gauss' Law
(b) Fick's law
(c) Ohm's law
(d) Ampere's law

1-h. In limited-source diffusion, the total impurity dose inside the semiconductor remains how? (CO4, K1) — 1

(a) Constant
(b) Increasing with time
(c) Zero
(d) Infinite

1-i. The metallization stage in integrated circuit fabrication is mainly carried out for what purpose? (CO5, K1) — 1

(a) Electrical interconnection
(b) Oxide growth
(c) Diffusion barrier
(d) Junction formation

1-j. Which metal remains the most common choice for interconnects in VLSI circuits? (CO5, K1) — 1

(a) Gold
(b) Copper
(c) Tungsten
(d) Aluminum

2. Attempt all parts:-

2.a.	Differentiate between wet and dry etching. (CO1, K1)	2
2.b.	Define epitaxy. Differentiate between homoepitaxy and heteroepitaxy. (CO2, K1)	2
2.c.	What is the role of photoresist in lithography? (CO3, K1)	2
2.d.	State Fick's first law of diffusion. (CO4, K1)	2

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2.e.	State the purpose of metallization in IC fabrication. (CO5, K1)	2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	What is a diffusion profile? Compare constant source and limited source profiles. (CO1, K2)	6
3.a.(ii)	What are the different classes of clean rooms? Give the comparison table. (CO1, K2)	6

3.b. Answer any one of the following:-

3.b.(i)	Explain the working principle of Molecular Beam Epitaxy (MBE). Provide schematic diagram also. (CO2, K2)	6
3.b.(ii)	Derive the linear–parabolic form of the Deal–Grove model for oxide growth kinetics. (CO2, K2)	6

3.c. Answer any one of the following:-

3.c.(i)	Explain the complete process flow of optical lithography with neat diagrams. Discuss factors that limit resolution and depth of focus. (CO3, K2)	6
3.c.(ii)	Compare optical lithography, electron-beam lithography, and X-ray lithography in terms of resolution, throughput, and cost. Which is more suitable for VLSI scaling? (CO3, K2)	6

3.d. Answer any one of the following:-

3.d.(i)	Derive the one-dimensional form of Fick's second law and discuss its physical significance. (CO4, K2)	6
3.d.(ii)	Explain constant source and limited source diffusion with equations and typical concentration profiles. (CO4, K2)	6

3.e. Answer any one of the following:-

3.e.(i)	Explain the role of metallization in IC fabrication. Compare aluminum, copper, and tungsten as interconnect materials. (CO5, K2)	6
3.e.(ii)	Discuss electromigration as a reliability issue in interconnects. Explain its causes, effects, and mitigation techniques. (CO5, K2)	6

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SECTION-C 50

4. Answer any one of the following:-

4-a.	Explain how a four-point probe setup can be used to estimate average dopant concentration. Include all necessary figures in your explanations. (CO1, K2)	10
4-b.	With a neat sketch, distinguish between substitutional diffusion and interstitial diffusion mechanisms. (CO1, K2)	10

5. Answer any one of the following:-

5-a.	Describe the latch-up effect in CMOS circuits. How does SOI technology help in preventing this issue? (CO2, K2)	10
5-b.	Describe the operating principle of Molecular Beam Epitaxy (MBE) and mention its advantages. Provide the suitable diagram also. (CO2, K2)	10

6. Answer any one of the following:-

6-a.	Compare optical, electron-beam, and X-ray lithography in terms of pattern	10

resolution, throughput, and fabrication cost. Indicate which is best suited for deep-submicron VLSI. (CO3, K2)

6-b.	Discuss the various techniques for silicon dioxide film deposition. Contrast thermal oxidation and CVD oxide in terms of electrical and physical characteristics. (CO3, K2)	10

7. Answer any one of the following:-

7-a.	Derive Fick's First and Second Law in one dimension and explain its physical meaning in diffusion. (CO4, K2)	10
7-b.	Compare constant-source and limited-source diffusion, including governing equations and typical dopant profiles. (CO4, K2)	10

8. Answer any one of the following:-

8-a.	Explain the role of metallization in IC fabrication and compare aluminum, copper, and tungsten with respect to conductivity, reliability, and processing challenges. (CO5, K2)	10
8-b.	Discuss electromigration as a major interconnect reliability issue—its origin, effects on circuit lifetime, and common mitigation strategies. (CO5, K2)	10

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