Printed page: 02…. **Subject Code: AMTVL0114**

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY ,GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

MASTER OF TECHNOLOGY (M. Tech)

(SEM: 1st Theory Examination (2020-2021)

SUBJECT NAME: MICROCHIP FABRICATION TECHNOLOGY

Time: 3 Hours **Max. Marks: 70**

General Instructions:

- All questions are compulsory. Answers should be brief and to the point.
- This Question paper consists of ……02…pages & …8………questions.
- It comprises of three Sections, A, B, and C. You are to attempt all the sections.
- Section A -Question No- 1 is objective type questions carrying 1 mark each, Question No- 2 is very short answer type carrying 2 mark each. You are expected to answer them as directed.
- Section B - Question No-3 is Long answer type -I questions with external choice carrying 4marks each. You need to attempt any five out of seven questions given.
- Section C - Question No. 4-8 are Long answer type –II (within unit choice) questions carrying 7 marks each. You need to attempt any one part *a or b.*
- Students are instructed to cross the blank sheets before handing over the answer sheet to the invigilator.
- No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION – A

1. Answer all the parts- **[5x1=5]** **CO**

a. Numbers of atoms found inside a unit cell of a body centred cubic crystal are ……….. **(1)** **CO1**

b. Wet Oxidation is preferred to grow **(1)** **CO2**

[i] Thin oxidation layer
[ii] Thick oxidation layer
[iii] In the low pressure conditions
[iv] In the low temperature conditions

c. Which lithography technique will offer higher resolution **(1)** **CO3**

[i] Optical
[ii] Ion beam
[iii] x-ray
[iv] electron beam

d. Which of the following process is not used for adding impurity? **(1)** **CO 4**

[i] Doping
[ii] Diffusion
[iii] Ion Implantation
[iv] Metallization

e. The typical thickness of poly-silicon layer is……. **(1)** **CO5**

[i] In the range of 1 to 5 nm
[ii] In the range of 10 to 50 nm
[iii] In the range of 100 to 200 nm
[iv] In the range of 500 to 600 nm

2. Answer all the parts- **[5×2=10]** **CO**

a. Why crystal growth in {111} direction preferred in silicon? **(2)** **CO 1**

b. Discuss the significance of diffraction limited geometry in photolithography **(2)** **CO 2**

c. Compare Dry Etching with Chemical Wet Etching. **(2)** **CO 3**

d. Calculate the total amount of dopants introduced after boron pre-deposition performed at 950^0C for 30 minutes in a natural ambient. Assume substrate is n-type silicon with $N_D=1.8x10^{16}cm^{-3}$ and boron surface concentration is $C_s=1.8x10^{20}cm^{-3}$. **(2)** **CO 4**

e. What is meant by epitaxy? What are the advantages? **(2)** **CO 5**

SECTION – B

			Marks	CO
3.		**Answer any <u>five</u> of the following-**	**[5x4=20]**	**CO**
	a.	The seed crystal used in the Czochralski process is usually necked down to a small diameter (6.6mm) as a means to initiate dislocation free growth. If the critical end strength of silicon is $3x10^6$ gm/cm^2, calculate the maximum length of silicon ingot 200 mm in diameter that can be supported by such a seed. Density of Si is $2.33 gm/cm^3$	**(4)**	**CO 1**
	b.	Explain the significance of Low dielectric materials. Enlist the names for few of the Low-K materials. And also explain the application associated with them	**(4)**	**CO 2**
	c.	Explain the process of Optical Lithography.	**(4)**	**CO 3**
	d.	Explain the ion stopping mechanisms in ion implantation? What are the various ways to reduce the effect of channelling in ion implantation process?	**(4)**	**CO 4**
	e.	How are the ICs classified? Give example.	**(4)**	**CO 5**
	f.	Explain why a shaped beam promises higher throughput than a Gaussian beam in e-beam lithography.	**(4)**	**CO 3**
	g.	Explain the process of rapid thermal annealing (RTA). Discuss its significance in IC processing.	**(4)**	**CO 5**

SECTION – C

			Marks	CO
4		**Answer any <u>one</u> of the following-**	**[5×7=35]**	**CO**
	a.	We use the float zone process to purify a silicon ingot that contains a uniform Ga concentration of $5x10^{15}$ cm^{-3} . One pass is made with a molten zone of 5 cm long. Over what distant is the resulting Ga concentration below $5x10^{15}$ cm^{-3}?	**(7)**	**CO 1**
	b.	Derive the following relation $$x^2+Ax=B(t+\tau)$$ Where x : oxide thickness after an oxidizing time 't' τ: time co-ordinate shift to account for the initial oxide layer B: parabolic constant, B/A: linear constant	**(7)**	**CO 1**
5.		**Answer any <u>one</u> of the following-**		
	a.	Explain and discuss the significance of: (i) Liquid Encapsulated Czochralski (LEC) (ii) Equilibrium segregation coefficient.	**(7)**	**CO 2**
	b.	Explain the various steps of basic wafer fabrication?	**(7)**	**CO 2**
6.		**Answer any <u>one</u> of the following-**		
	a.	How does the etching of the following take place? (i)Silicon dioxide (ii) Silicon Nitride	**(7)**	**CO 3**
	b.	Explain in detail various steps of patterning process.	**(7)**	**CO 3**
7.		**Answer any <u>one</u> of the following-**		
	a.	What is Plasma enhanced CVD systems? Explain the technique in detail.	**(7)**	**CO 4**
	b.	For Boron diffusion in silicon at 1000^0C, the surface concentration is maintained at 10^{19} cm^{-3} and the diffusion time is 1 hour. Find Q(t) (total no. of atoms per unit area)and the gradient at x=0 and at a location where the dopant concentration reaches 10^{15} cm^{-3}?	**(7)**	**CO 4**
8.		**Answer any <u>one</u> of the following-**		
	a.	Write a short note on any one of the following (i) Physical Vapour Deposition (ii) Vacuum Deposition	**(7)**	**CO 5**
	b.	How monolithic ICs realized? How does integration of the following components take place? (i) Resistors (ii) Capacitors	**(7)**	**CO 5**