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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM EXAMINATION – AUGUST 2024

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| **Semester : Summer Term** | **Date : 05-08-2024** |
| **Course Code : ECE3044** | **Time : 01:00 P.M. – 04:00 P.M.** |
| **Course Name : IC Fabrication Technology** | **Max Marks :100** |
| **Program :B. Tech. (ECE)** | **Weightage :50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 3 QUESTIONS 3Q X 5M = 15 M** | | | |
| 1 | Diffusion is the net movement of anything (for example, atoms, ions, molecules, energy) generally from a region of higher concentration to a region of lower concentration. State and explain Fick’s first law of diffusion. | (CO 1) | [Knowledge] |
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| 2 | Etchings were first produced around 1500 in southern Germany. These early German etchers made use of iron plates, stronger than copper yet susceptible to rust and harder to work. Define Etching in IC Fabrication process using suitable diagram and example. | (CO 2) | [Knowledge] |
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| 3 | Epitaxial growth is broadly defined as the condensation of gas precursors to form a film on a substrate. Write the basic chemical reaction in the epitaxial growth processes of pure silicon. | (CO 1) | [Knowledge] |
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| 4 | Oxidation is a process in which a chemical substance changes because of the addition of oxygen. (i)What is the purpose of oxidation? (ii) State chemical reactions involved in oxidation process. | (CO 2) | [Knowledge] |
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| 5 | Deal and Grove model assumes that the oxidation reaction occurs at the interface between the oxidation layer and the substrate materials, rather than between the oxide and the ambient gas. Define the function of τ. | (CO 2) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 20M = 40M** | | | |
| 6 | In order to calculate the oxide growth rate, we define N1 as the number of oxidant molecules incorporated into a unit volume of the oxide layer. If oxygen is the reactant then N1 = 2.2 x  10^{22} /cm^{3} because the density of SiO2 is 2.2 x 10^{22} /cm^{3}. With an initial condition of d_{o}(t = 0) = d_{i} , analyze the rate of change of oxide thickness with respect to oxidation times. Use basic model of thermal oxidation of Silicon under steady state. | (CO 2) | [Comprehension] |
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| 7 | In wet oxidation of silicon at 950 deg Celsius, the following data are obtained:  Show how to graphically determine the linear and parabolic rate constants from these experimental data. Assume that τ = 0 for wet oxidation. | (CO 2) | [Comprehension] |
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| 8 | Chemical vapor deposition technology produces high-quality material building blocks that underpin various fields of applications. Apparatus in which the substrate is brought into contact with the solution. Identify the apparatus used for this and explain in brief using required diagram. | (CO 2) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 3 QUESTIONS 3Q X 15M=45M** | | | |
| 9 | Routine evaluation of ingots or boules involves measuring the resistivity, evaluating their crystal perfection, and examining their mechanical properties, such as size and mass. Its necessity is throughout the fabrication of integrated circuits but its primary use is to serves as mask against implant or diffusion atoms into silicon. Relate the oxide thickness with respect to time using relevant model and equations. | (CO 2) | [Application] |
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| 10 | The regions of wafer that got exposed to UV light generates a pattern on the wafer. 1. Analyze the method and complete the overall process. 2. If the gap spacing between the resist and the mask is 40um and diameter of the source is 3mm and distance of source from mask is 50 cm. Calculate penumbral effect (§). | (CO 3) | [Application] |
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| 11 | Fabrication is a value added process that involves the construction of machines and structures from various raw materials. Explain PMOS Fabrication steps using suitable diagram. | (CO 2) | [Application] |
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| 12 | Consider the following cross section that is to be doped with Arsenic using ion implantation to form the source/drain regions. Assume the Si substrate is initially doped with B with a uniform concentration of 10^16 cm-3 . http://guqbms.inpods.com:57953/api/v1/downloadFile?fileId=40790&tenantid=13 (a) Assume that the SiO2 and polysilicon layers have the same ion stopping power as Si, and that SiO2 thickness is 60 nm. What are the ion implantation dose and energy required to achieve a peak concentration of 10^19 cm-3 of As at the SiO2 and Si interface in the source/drain regions (i.e., y = 60 nm)? (b) Calculate the junction depth of the source/drain regions. | (CO 3) | [Application] |
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