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Question Paper Code:U4303

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2025

Professional Elective

Electronics and Communication Engineering

21ECV303– NANO ELECTRONICS

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Lithium crystallizes in BCC structure. Calculate the lattice constant, given that the atomic weight and density for Lithium are 6.94 gram and 530 Kg/m³ respectively. CO2-App
2. An element A (atomic weight =100 amu) having bcc structure has unit cell edge length of 400 pm. Calculate the density of A. CO2-App
3. Distinguish the top down and bottom up approach for fabrication of Nanostructures. CO1- U
4. The reflecting plane of lithium fluoride analyzing crystal has an interplanar Distance of $4A^0$. calculate the wavelength of 2nd order differential line which has a glance angle of 30. CO2-App
5. Compare the Spectroscopic techniques UV-Visible and Infra-red Spectroscopy. CO1- U
6. Compare and contrast the features of IR and RAMAN Spectroscopy CO1- U
7. Mention the procedure to put the other atoms between the plates of Graphitic Sheets. CO1- U
8. What do you mean by Carbon Clusters? How many carbon atoms are there in a Bucky ball? CO1- U
9. In Spintronics, how can this control of the spin for long distances be Conceivable? CO1- U
10. A nano-beam in a NEMS device has a surface area $A=1\mu\text{m}^2$, and the surface energy density is $\gamma=0.5\text{J/m}^2$. Calculate the total surface energy. CO1- U

PART – B (5 x 16= 80 Marks)

11. (a) When a semiconductor material can be treated as a bulk, quantum well, quantum wire, quantum dot or nano - particle? Illustrate in terms of density of states, electronic properties, optical properties and also Energy level structures. CO1- U (16)
- Or
- (b) Classify the materials based on its energy band structures. Also Explain in detail about Excitons and Mobility. CO1- U (16)
12. (a) Fabricate a Nanofilm by Applying the concept of photolithography techniques in the Nano materials study. CO3- App (16)
- Or
- (b) An atom has two nondegenerate electronic quantum states in a thin film nanomaterial with energy at $E_1 = 1.1 \text{ eV}$ and $E_2 = -0.96 \text{ eV}$ from the vacuum level. Analyze, the average number of electron count in each atom at the E_1 & E_2 at room temperature. CO3- App (16)
13. (a) Explain how Transmission Electron microscopy is used in characterization of nano materials. CO1- U (16)
- Or
- (b) Determine how Field ion microscopy is used in characterization of nano materials. State all your assumptions clearly. CO1- U (16)
14. (a) Classify the vibrational and mechanical properties of the CNT by applying scanning electron microscopy. Compare their performances. CO6- Ana (16)
- Or
- (b) Compare the properties of Carbon Clusters, Alkali Doped C60 And Superconductivity in C60. Analyze the properties and identify the appropriate Application Areas. Justify your Answer. CO6- Ana (16)
15. (a) A rectangular silicon MEMS cantilever beam has a length $L=200 \mu\text{m}$ width $w=50 \mu\text{m}$, and thickness $t=10 \mu\text{m}$. The density of silicon is $\rho=2330 \text{ kg/m}^3$ and Young's modulus $E=170 \text{ GPa}$. Calculate the fundamental resonant frequency. CO2- App (16)
- Or

- (b) A parallel-plate MEMS capacitor has an initial gap $d_0=3\mu\text{m}$, plate area $A=200\mu\text{m}\times 200\mu\text{m}$, and a permittivity $\epsilon_0=8.854\times 10^{-12}\text{F/m}$. If the gap is reduced to $d=1.5\mu\text{m}$ due to an applied voltage, calculate the change in capacitance. CO2- App (16)

