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Roll No.:

NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR
(H.P)

END SEMESTER EXAMINATION, December 2022
Nanomaterials (CY-813)

Time: 3 hours

MM: 50

Note: All questions are compulsory.

Q.1

- I. Discuss the Jellium model of metallic nanoclusters? (3)
- II. In terms of the surface properties, nanomaterials are thermodynamically unstable. Explain. (3)
- III. What are the possible ways to reduce surface energy? (3)
- IV. Agglomeration and sintering in nanomaterials are thermodynamic favorable processes. why? (3)
- V. Compare the chemical potential of the curved surface to that of flat surface. Derive Young-Laplace equation. (3)
- VI. What do you mean by the DOS? Compare the DOS of, 2D, 1D and 0D nanomaterials. (3)
- VII. In DLVO plot there is two minima and one maximum. Explain their origin and significance. (3)
- VIII. Explain Sol-Gel process of the nanoparticle synthesis? (3)
- IX. Write a short note on Photolithography. (3)
- X. Explain the nano-particle catalysis of carbon monoxide (CO) to carbon dioxide (CO₂) (3)

Q2. Explain the electrical double layer theory including stern layer and Gouy-Chapman layer. What is zeta potential and its significance. Use neat and clean diagram (2.5+2.5=5)

Q3. What do you mean by the inter-band, intra-band transition, absorption onset, band edge fluorescent emission and red-shifted defect fluorescent emission of semiconductor nanoparticle using suitable example and neat and clean diagram. (5)

Q4. Explain the working principle of SEM with neat diagram. How is it different from AFM? (5)

Q5. a.) The Bragg angle corresponding to the first order reflection from (111) plane in a crystal is 30° when X-ray of wavelength 1.75 Å (angstrom) is used. Calculate the lattice constant of the crystal.
b.) How much surface ratio do you expect if a spherical shaped Al of radius 10m is divided into small sphere of radius (1)1nm (10nm) and 1Å. (3+2=5)