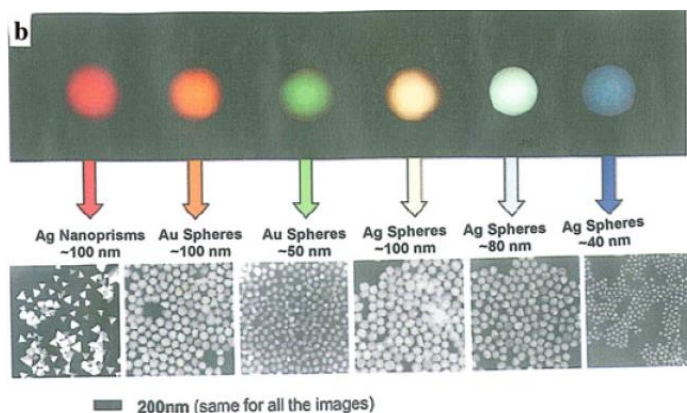## Topics in Nanosciences_Assignment_24-3

Problems

P1.   Distinguish between the mechanisms responsible for the appearance of colors in the suspensions of silver or gold metal nanoparticles and semiconductor quantum dots.   [6]

P2. See the adjoining Figure. From the Figure, conclude about the factors of the nanocrystals that can be controlled and manipulated to produce nanoparticles with distinct light-scattering profiles.   [3]

Ag Nanoprisms ~100 nm   Au Spheres ~100 nm   Au Spheres ~50 nm   Ag Spheres ~100 nm   Ag Spheres ~80 nm   Ag Spheres ~40 nm

200nm (same for all the images)

P3. Why do very small nanoparticles (<1–2 nm) not show the LSPR?   [2]

P4. Below are two absorption plots. One was obtained from a solution of an organic dye and the other from a quantum dot suspension. Which plot was obtained from which solution? Explain your reasoning.   [2,2]
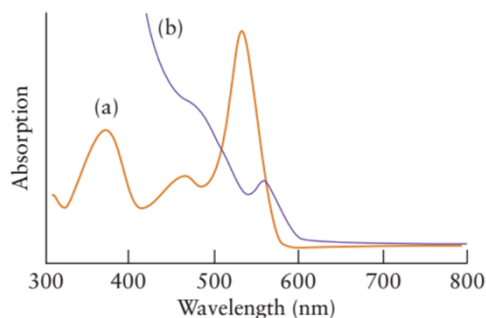
P5. Discuss about the conditions when maximum enhancement of the local field can be observed on a spherical plasmonic nanoparticle.   [4]

P6. Discuss the roles of the plasmonic nanoparticles in the Surface-Enhanced Raman Scattering (SERS) spectroscopy.   [8]

P7. Prove that the entire series of spherical fullerenes containing $60 + (k \times 6)$ atoms, where k = 0, 2, 3, 4, ..., etc., satisfies Euler's Theorem. [8]

P8. Given that a carbon atom can be assumed to have a diameter of 0.22 nm, estimate the diameter of a C_{60} molecule. [3]

P9. Draw the unit cell (smallest graphene sheet structure) of a (6, 6) tube and a (9, 0) tube. What kind of tubes are these? [4,4]

P10. In the following, the chiral vectors of some CNTs are given:
(i) $c = 9 a_1$ (ii) $c = 9 a_2$ (iii) $c = 9a_1 + 9a_2$ (iv) (10, 10) (v) $c = 10a_1 + 9a_2$ and (vi) (9, 7).
Arrange these tubes in the order of increasing diameter. [12]