

(3 Hours)

(Marks: 80

- N.B.:**
- 1 Question **ONE** is **compulsory**.
 - 2 Attempt any **THREE** questions out of the **remaining**.
 - 3 **Figure** to the **right** indicate **full marks**.
 - 4 **Diagram** at appropriate places **carries marks**.
 - 5 Assume suitable **data** if **necessary**.

- 1 Write short note on :
 - (a) Sol- Gel processing. (06)
 - (b) Condensed Phase Synthesis of nanostructures. (07)
 - (c) Electronic effects of biomolecules-nanoparticle interaction. (07)
- 2 (a) Explain in detail the Combustion Flame Synthesis method for Fullerene (10) with neat diagram of primary zone reactor in conjunction with secondary zone reactor.
 - (b) Describe the Laser Ablation synthesis methods based on pellet formation (10) for Carbon Nanotube preparation with neat diagram.
- 3 (a) Explain in detail counter diffusion and fullerene crystal formation at the (10) interface with neat diagram.
 - (b) Describe the characterization mechanism of Transmission Electron (10) Microscope with neat diagram.
- 4 Calculate the volumetric rate, duct particulate flow rate in g/s, mg/s, $\mu\text{g/s}$ (20) and ng/s and average concentration in lb/ft^3 , g/ft^3 , g/m^3 , $\mu\text{g/m}^3$, ng/m^3 of fluid flowing through a 2 feet by 4 feet rectangular parallelepiped. The velocity $v(i,j)$ in ft/s and concentration $c(i,j)$ in mg/m^3 passing each of equal areas is provided as follows :

$v(1,1) = 14$	$v(1,2) = 17$	$v(1,3) = 23$	$v(1,4) = 16$	$v(1,5) = 16$
$v(2,1) = 26$	$v(2,2) = 28$	$v(2,3) = 31$	$v(2,4) = 27$	$v(2,5) = 25$
$v(3,1) = 26$	$v(3,2) = 29$	$v(3,3) = 31$	$v(3,4) = 28$	$v(3,5) = 25$
$v(4,1) = 24$	$v(4,2) = 28$	$v(4,3) = 30$	$v(4,4) = 27$	$v(4,5) = 24$
$v(5,1) = 17$	$v(5,2) = 19$	$v(5,3) = 24$	$v(5,4) = 19$	$v(5,5) = 17$
$c(1,1) = 201$	$c(1,2) = 222$	$c(1,3) = 222$	$c(1,4) = 219$	$c(1,5) = 198$
$c(2,1) = 213$	$c(2,2) = 227$	$c(2,3) = 231$	$c(2,4) = 226$	$c(2,5) = 213$
$c(3,1) = 214$	$c(3,2) = 233$	$c(3,3) = 240$	$c(3,4) = 229$	$c(3,5) = 216$
$c(4,1) = 214$	$c(4,2) = 230$	$c(4,3) = 233$	$c(4,4) = 229$	$c(4,5) = 212$
$c(5,1) = 201$	$c(5,2) = 226$	$c(5,3) = 228$	$c(5,4) = 225$	$c(5,5) = 196$

TURN OVER

- 5 (a) Write short note on Quantum Mechanics and Quantum Dots (06)
 (b) Explain in brief about X ray Diffraction (07)
 (c) How does the pH of the medium affect the biomolecules - nanoparticle interaction? (07)
- 6 Three different sized nanoparticle from a nano operation settle through the air. Assume the particles are spherical having the diameter 0.4, 1 and 400 μm . Calculate the settling velocity of a particle moving in a gas stream and determine how far each fall in 50 sec. Air temperature and pressure: 70 $^{\circ}\text{F}$ and 1 atm.
 Use Cunningham correction factor = 1.415, To calculate the settling velocity of a particle moving in a gas stream for particles diameter less than 1 μm .

$\rho_p = 2309 \text{ kg/m}^3$	$\mu_{(\text{AIR})} = 2.1 \times 10^{-5} \text{ kg/m.s}$
$\rho = 1.2 \text{ kg/m}^3$	$g = 9.8 \text{ m/s}^2$
$C = 1.415$	