

[Time: Three 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 Illustrate answers with sketches wherever required and Diagram at appropriate places carries marks
  - 5 Assume suitable data if necessary and indicate it clearly.

- 1 Write short note on
  - (a) Molecular Recognition. (05)
  - (b) Sintering - Fullerene synthesis method. (05)
  - (c) Top-down and bottom-up approach. (05)
  - (d) Atomic and Electron beam lithography. (05)
- 2 (a) How does the pH of the medium affect the biomolecules – nanoparticle interaction? (10)  
(b) Describe the Laser Ablation synthesis method based on pellet formation for Carbon Nanotube preparation with neat diagram. (10)
- 3 (a) Describe Sol Gel Nanostructure process. (10)  
(b) Explain in detail Solar process for synthesis of Fullerene with neat diagram. (10)
- 4 Calculate the volumetric rate, duct particulate flow rate in g/s, mg/s,  $\mu\text{g/s}$  and ng/s and average concentration in  $\text{lb/ft}^3$ ,  $\text{g/ft}^3$ ,  $\text{g/m}^3$ ,  $\mu\text{g/m}^3$ ,  $\text{ng/m}^3$  of fluid flowing through a 2 feet by 4 feet rectangular parrallelpiped. The velocity  $v(i,j)$  in ft/s and concentration  $c(i,j)$  in  $\text{mg/m}^3$  passing each of equal areas is provided as follows:

$v(1,1) = 13$	$v(1,2) = 15$	$v(1,3) = 25$	$v(1,4) = 18$	$v(1,5) = 13$
$v(2,1) = 24$	$v(2,2) = 28$	$v(2,3) = 31$	$v(2,4) = 26$	$v(2,5) = 23$
$v(3,1) = 27$	$v(3,2) = 29$	$v(3,3) = 31$	$v(3,4) = 27$	$v(3,5) = 25$
$v(4,1) = 25$	$v(4,2) = 28$	$v(4,3) = 29$	$v(4,4) = 26$	$v(4,5) = 24$
$v(5,1) = 17$	$v(5,2) = 19$	$v(5,3) = 25$	$v(5,4) = 20$	$v(5,5) = 17$
$c(1,1) = 201$	$c(1,2) = 222$	$c(1,3) = 222$	$c(1,4) = 219$	$c(1,5) = 198$
$c(2,1) = 213$	$c(2,2) = 227$	$c(2,3) = 231$	$c(2,4) = 226$	$c(2,5) = 213$
$c(3,1) = 214$	$c(3,2) = 233$	$c(3,3) = 240$	$c(3,4) = 229$	$c(3,5) = 216$
$c(4,1) = 214$	$c(4,2) = 230$	$c(4,3) = 233$	$c(4,4) = 229$	$c(4,5) = 212$
$c(5,1) = 201$	$c(5,2) = 226$	$c(5,3) = 228$	$c(5,4) = 225$	$c(5,5) = 196$

- 5 (a) Explain Arc Discharge method for Carbon Nanotube preparation with neat diagram. (10)
- (b) Describe the characterization mechanism of Transmission Electron Microscope with neat diagram. (10)
- 6 Three different sized particles from a nano-operation settle through air. (20)  
Calculate the particle terminal velocity and determine the how far each will fall in 35 s. Also calculate the size of the particle that will settle with a velocity of 1.384 ft/s. Assume the particles are spherical.

Data:

Nano-operation particle diameters= 0.4, 40, 400  $\mu\text{m}$ .

Air temperature and pressure = 70°F, 1 atm.

Density of particle = 144.14 lb/ft<sup>3</sup>

Viscosity of air = 0.021 cP

Cunningham correction factor = 1.415

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