

[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) Electrical Conduction and Ohm's Law. (05)
  - (b) Crystal formation with neat diagram. (05)
  - (c) Top-down and bottom-up approach. (05)
  - (d) Morphology of CNTs. (05)
- 2
  - (a) Explain Electric Arc Process for Fullerene synthesis. (10)
  - (b) Describe the Laser Ablation synthesis method based on pellet formation for Carbon Nanotube preparation with neat diagram. (10)
- 3
  - (a) Explain SEM for characterizing of nanostructure. (10)
  - (b) Describe Chemical Vapor Deposition (CVD) method for synthesis of Carbon Nanotube. (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 parallelepiped. 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: (20)

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

- 5 (a) Explain Influence of Electrostatic Interactions in the binding of proteins with Nanoparticles. (10)
- (b) How does the pH of the medium affect the biomolecules – nanoparticle interaction? (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 30 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