BEL 721 Bionanotechnology: IInd Semester 2006-2007

Major Test

Max. Marks: 40
Max. Time 2 hrs

Answer part A and B in separate answer books

Part A

1 a How will you use LbL deposition method for preparation of polymer nano- containers? What are the limitations of this method? [2]

b What do you understand by pateh clamp technique? What are different forms of pateh clamping? [1+2]

2 a Discuss the characteristic features and applications of biomimetie ferritin [2]

b What are the challenges in the development of carbon nanotube based enzyme biosensor? Give schematic diagram for fabrication protoeols used to prepare enzyme electrode covalently attached to SWNT elecirode array. [1+2]

Part B

Brevity is the soul of communication!

Extraneous information will result in negative marking

No essays will be awarded points, use quantitative proofs wherever applicable (most of the "why" questions)

1. (i) What is Ostwald Ripening? Why is it important in nano-assembly?

(2+2 = 4)

(ii) Using cuboidal structures of edges a, b & c, draw the planes with miller indices of (101), (102) and (201). Any assumption about a, b & c can be made, while being explicitly stated.

(6)

2. (i) What is/are the advantage(s) of molecular motors in cellular systems? Provide a specific example that highlights the advantage(s).

(2+1 = 3)

(ii) Provide the resolution achievable (in <u>mm</u>) for the following techniques:

(a) Light Mieroscopy
(b) Fluorescenee Microscopy
(c) SEM
(d) TEM
(e) Cryo-TEM

The above techniques provide size characteristics of a very few objects in a population. Thus, it is difficult to obtain good estimates of population distributions of sizes of nanoparticles in a solution/suspension. Briefly describe a technique that overcomes this limitation.

(5+2 = 7)

3. (i) Why is excitation wavelength of a fluorophore always less than the emission wavelength?

(2)

(ii) Define processivity of a nanomachine. What is the proeessivity of the influenza hemagglutinin-mediated membrane fusion machine? What is the processivity of Kinesin-1?

(1+1+1 = 3)

(iii) What are the advantages of microbial nanoparticle production compared to chemical synthesis? The answer should be provided in a numbered format and NOT an essay.

(2)

4. Bending energy of a membrane as a function of deformation is given by $F_{bend} = (1/2)A.\kappa.(J - Js)^2$. J is the total curvature, Js is the spontaneous curvature, A is the area and κ is the bending rigidity. Given the bending rigidity of a phospho-lipid bilayer as $\kappa_b \sim 20k_BT$, Calculate the elastie energy of a spherical vesicle of radius = 100 nm whose membrane has zero spontaneous curvature. Show graphically the dependence of the elastie energy of the spherieal vesicle on its radius from 100 to 500 nm (discrete points 100 nm apart would be sufficient).

(1+2 = 3)