BEL 721 Bionanotechnology
IInd Semester 2007-2008
Major Test

Max. Marks: 30
Max. Time 2 hrs

Answer part A and B in separate answer books

Part A

Brevity is the soul of communication.
(*Points will be deducted for extraneous information*)

1. Using a cube of side a, draw the plane with miller indices of (111). Using a cuboid of sides a,b,c, draw the planes with miller indices of (102) and (201).
(1+1.5+1.5 = 4)
2. 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 phospholipid bilayer as $\kappa_b \sim 20k_BT$, Calculate the elastic energy of a spherical vesicle of radius R whose membrane has zero spontaneous curvature (in units of k_BT). Show graphically the dependence of the elastic energy of the spherical vesicle on its radius.
(2+1 = 3)
3. Select Y (for Yes) or N (for No) for the functionalities provided in regard to the following → Nano-technological applications in drug delivery aim at:
   (a) Increasing bioavailability
   (b) Targeted delivery
   (c) Enhancing drug biocompatibility
   (d) Selective distribution of the drug in the body
   (e) Maintenance of therapeutic levels for controlled periods of time
   (f) Enhancing the rate of drug action
(0.5 x 6 = 3)
4. (a) What is the spatial resolution achievable in conventional optical microscopy? (b) State a principle that can be utilized to achieve spatial resolutions beyond the limits of conventional optical microscopy for living samples. Draw a schematic for a technique that utilizes the above principle.
   (c) What is the best achievable resolution for the technique in (b)?
(1+3+1 = 5)