CSE Department, North South University
ETE131: Introduction to Telecommunications & Computer Engineering (SyR)
Practice Questions on Cellular Access and Optical Fibre

Question 1
A circular city of diameter 50km needs to be covered by cellular technology. The radius of each cell is 2km. What is the number of cells required to cover the city?

City's radius = 50/2 = 25km, therefore City's area = $\pi x 25^2 = 1963.5km^2$
Area of each cell = Area of hexagon with radius 2 = $3\sqrt{3}r^2/2 = 10.4km^2$
No of cells = Area of city / area of each cell = 1963.5/10.4 = 188.8 ~ 189 cells

Question 2
The refractive index of water and glass are 1.33 and 1.50 respectively. If a ray of light passes from water to glass with an angle of incidence of 30^0, what is the angle of refraction?

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ (Snell's Law) or $1.33 \sin 30 = 1.5 \sin\theta$
or $\sin\theta = 1.33x0.5/1.5 = 0.4433$ or $\theta = 26.3^0$

What is the critical angle for a ray of light going from glass to water?

$\theta_c = \sin^{-1}(n_2/n_1) = \sin^{-1}(1.33/1.5) = 62.46^0$

Which of water and glass can be used as core and cladding of an optical fiber?
Calculate the acceptance angle for this fiber.

Glass can be used as core and water as cladding since $n_{glass} > n_{water}$
$\theta_{in} = \sin^{-1}\sqrt{(n_{glass}^2 - n_{water}^2)} = \sin^{-1}\sqrt{(1.5^2 - 1.33^2)} = \sin^{-1}0.693 = 43.92^0$

Question 3
The power input at one end of an optical fiber cable is 10W and the power output is 1W. If the length of the cable is 5km, what is the attenuation in the cable in dB/km?

Gain = 10 log (P_{out}/P_{in}) = 10 log (1/10) = -10dB,
i.e. Attenuation is 10dB in 5km, therefore Attenuation = (10dB/5km) = 2dB/km

Question 4
The power input at one of an optical fiber cable is 10W and the cable is marked as having attenuation of 4dB/km. If the length of the cable is 10km, what is the power output at the other end?

Attenuation = 4dB/km x 10km = 40dB, i.e. Gain = -40dB = 10 log (P_{out}/P_{in})
-40dB = 10 log (P_{out} /10W) or log (P_{out} /10W) = -4
or P_{out} /10W = 10^{-4} or P_{out} = 10^{-4} x 10W = 0.001W