Assignment 2: To be submitted on Friday 21 March 2014 at the beginning of the class. You may do this in a couple with the same group personnel. Do this with your own font!

1. A multimode step index fiber has a relative refractive index difference of 1% and a core refractive index of 1.46. The maximum optical bandwidth that may contain with a particular source on a 4.5 km link is 3.1 MHz.
   a) Determine the rms pulse broadening per kilometer resulting from intramodal dispersion mechanisms.
   b) Assuming waveguide dispersion may be ignored, estimate the rms spectral width of the source used, if the material dispersion parameter for fiber at the operating wavelength is 90 ps nm^{-1} km^{-1}.

2. a). An LED operating at 850 nm has a spectral width of 45 nm. What is the pulse spreading in ns/km due to the material dispersion? What is the pulse spreading when a laser diode having 2-nm spectral width is used?
   b). Find the material-dispersion-induced pulse spreading at 1550 nm for an LED with a 75-nm spectral width.?

3. Compare the rms pulse broadening per kilometer for the following three fibers:
   a) A multimode step-index fiber with core index n_1 = 1.49 and relative index difference Δ = 1%.
   b) A graded index fiber having an optimum parabolic index profile and the same core index (n_1 = 1.49) dan relative index difference (Δ = 1%) as the step index fiber in a).
   c) The same type of graded index fiber as in b) but with Δ = 0.5%.

4. Consider an optical link consisting of a 5-km long step-index fiber with the core index n_1 = 1.49 and relative index difference Δ = 1%.
   a) Find the delay difference at the fiber and between the slowest and the fastest modes.
   b) Find the rms pulse broadening caused by the intramodal dispersion
   c) Calculate the maximum bit rate B_T that can be transmitted over the fiber without significant errors, which is given by $B_T = 0.2/\sigma_{step}$
   d) Assuming the maximum bit rate equals the bandwidth, what is the bandwidth distance product of this fiber?
5. A multimode, optimum near parabolic profile graded index fiber has a material dispersion parameter of 30 ps nm^{-1} km^{-1} when used with a good LED source of rms spectral width 25 nm. The fiber has a numerical aperture of 0.4 and a core axis refractive of 1,48. Estimate the total rms pulse broadening per kilometer within the fiber assuming waveguide dispersion to be negligible.