1) In the demo session, a soda-lime glass rod and a borosilicate glass rod were fused together and drawn into a double strand thin wire. Bending radius of the wire was measured to be 6.7 cm after it cooled down to room temperature. The soda-lime and borosilicate strands have an identical thickness of about 0.2 mm. The coefficients of thermal expansion of soda-lime and borosilicate glasses are 9.2 ppm/°C and 3.2 ppm/°C, respectively. The Young's moduli for soda-lime and borosilicate glasses are 72 GPa and 67 GPa.
Part a): Estimate the misfit strain between the two glass strands at room temperature (hint: you can use the bimetallic strip equation to model the system as a first order approximation).
Part b): Based on your result in Part a), what is the temperature at which the misfit strain starts to accumulate? Do you think this is a reasonable result? Why?

2) The Maxwell equations dictate that a material's (relative) dielectric constant ε is related to its refractive index n by: $\varepsilon_r = n^2$. For a potassium silicate glass with the molar composition $K_2O{\cdot}4SiO_2$, its refractive index was determined using index matching fluid to be 1.494 [*J. Am. Ceram. Soc.* **21**, 320 (1938)], and its dielectric constant was evaluated through capacitance measurements to be 7.20 [Stockdale, *Univ. of Illinois Bulletin*].
Part a): List the microscopic entities contributing the measured dielectric constant and refractive index of the potassium silicate glass.
Part b) Explain why the equation $\varepsilon_r = n^2$ does not appear to hold for this glass composition.

3) Silica has a remarkably low intrinsic material attenuation of 0.2 dB/km at 1550 nm wavelength. Based on what you learnt in class, can you name a glass composition with even lower intrinsic material loss? Please list your assumptions and justify your hypothesis.

4) Low-temperature polycrystalline silicon (LTPS) generally refers to polycrystalline silicon synthesized at relatively low temperatures (< 650 °C, e.g. by using laser annealing of a-Si:H films). For the following applications, compare the performance of LTPS and a-Si:H:
a) thin film transistors;
b) thin film solar cells;
c) planar optical waveguides.

5) In addition to the PECVD process described in class, amorphous silicon can also be prepared using thermal evaporation in high vacuum. Which type of amorphous silicon do you expect to have higher DC electrical conductivity at cryogenic temperatures (e.g. ~ 100 K)? Why?