1 Question 1

2 Question 2

3 Question 3

Refractive index, n, of silica at $1.59\mu m$:

$$n^2 - 1 = \frac{0.6961663\lambda^2}{\lambda^2 - 0.0684043^2} + \frac{0.4079426\lambda^2}{\lambda^2 - 0.1162414^2} + \frac{0.8974794\lambda^2}{\lambda^2 - 9.896161^2}$$

$$n^2 - 1 = \frac{0.6961663 \times 1.59^2}{1.59^2 - 0.0684043^2} + \frac{0.4079426 \times 1.59^2}{1.59^2 - 0.1162414^2} + \frac{0.8974794 \times 1.59^2}{1.59^2 - 9.896161^2}$$

$$n^2 = 1 + \frac{0.6961663 \times 2.5281}{2.5281 - 0.004679148} + \frac{0.4079426 \times 2.5281}{2.5281 - 0.01351206} + \frac{0.8974794 \times 2.5281}{2.5281 - 97.93400649}$$

$$n^2 = 1 + \frac{1.760047}{2.523420} + \frac{1.03131}{2.514587} + \frac{2.26891}{-95.40590649}$$

$$n^2 = 1 + 0.69748 + 0.41013 - 0.02378$$

$$n^2 = 2.0838$$

$$n = 1.44$$

Figure 1 plots the refractive index of silica from $0.3\mu m$ to $3.5\mu m$ using the above equation. The code used to calculate and plot the figure is shown in appendix A.1.

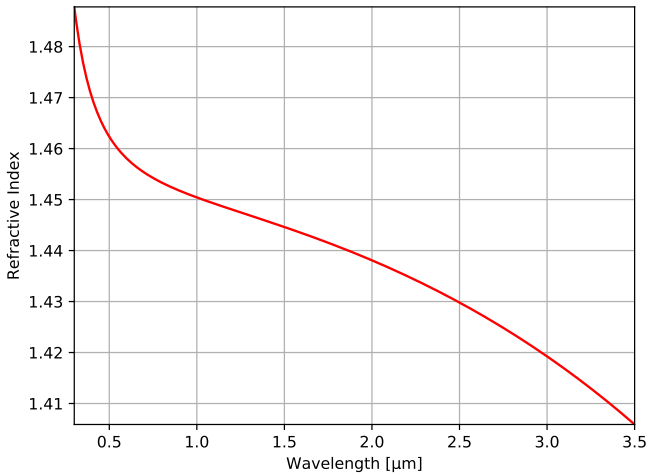

Figure 1: Plot of the calculated refractive index of silica using the Sellmeier equation above from a wavelength of $0.3\mu m$ to $3.5\mu m$

References

Appendices

A Python Scripts

A.1 Sellmeier Equation

```
import numpy as np
import matplotlib.pyplot as plt

# coefs should be in the form np.ndarray[[B1, B2, B3][C1, C2, C3]]
# wavelength should be in um
def sellmeier(wavelength, coef):

    B = coef[0]
    C = coef[1]

    try:
        output = np.zeros(len(wavelength))
    except TypeError:
        "Type has no len(), assuming single value"

    output = B[0]*np.square(wavelength) / (np.square(wavelength)-np.square(C[0]))   \
            + B[1]*np.square(wavelength) / (np.square(wavelength)-np.square(C[1]))  \
            + B[2]*np.square(wavelength) / (np.square(wavelength)-np.square(C[2]))

    output = np.sqrt(output+1)

    return output


def plotter(x, xlabel, y, ylabel, colour, save=False, name=False):

    plt.plot(x, result, colour)
    plt.xlim(np.min(x), np.max(x))
    plt.ylim(np.min(y), np.max(y))
    plt.xlabel(xlabel)
    plt.ylabel(ylabel)
    plt.grid(True, 'major','both')

    if name:
        if save:
            plt.savefig("{}.pdf".format(name), dpi=300, format="pdf")


if __name__ == "__main__":

    wavelength = np.float64(1.59)   #Sellmeier eqn uses um
    wavelength = np.arange(0.3, 3.51, 0.01)

    silica_sellmeier_coefs = np.array([[0.6961663, 0.4079426, 0.8974794], [0.0684043,
    0.1162414, 9.896161]])

    result = sellmeier(wavelength, silica_sellmeier_coefs)

    plotter(wavelength, "Wavelength [\u03BCm]", result, "Refractive Index",  'r-', save=True,
    name='silica_refractive_index' )
```