1. **Metal Optics**
Plot the surface reflectivity $R (=|r|^2)$ versus wavelength ($\lambda$) for a metal having $\omega_p = 4 \times 10^{15}$ rad/sec and $\tau = 25$ femtosecond ($10^{-15}$ sec.). Assume normal incidence. Under white-light illumination, describe the color of the reflected (or scattered) light from this metal surface. (4 pts.)

2. **Reflection:**
Problem 2.22 (K&F) (3 pts.) (hint: angle of incidence!)

3. **TIR** (10 pts.)
   1. (a) Show that the phase difference $\Delta = \phi_n - \phi_\alpha$ in total internal reflection from a glass-air interface can be given by:

   $\tan(\Delta/2) = \frac{\cos \theta \sqrt{\sin^2 \theta - 1/n^2}}{\sin^2 \theta}$

   (where $n = n_{\text{glass}}/n_{\text{air}}$)

   (b) For a given glass with refractive index $n$, what is the largest phase difference ($\Delta$), and at what incident angle $\theta$?

   (c) In a Fresnel rhomb, as shown below, $\Delta_{\text{total}}$ (upon two reflections) should be $\pi/2$. Determine the angle $\alpha$ when $n = 1.55$.

   (d) In constructing a Fresnel rhomb, what restriction is imposed on the material’s refractive index?

4. **FTIR:**
Problem 2.29 (K&F) (3 pts.)