(10 points)
1) Experimental measurements with a light beam incident from air onto the surface of an unknown glass gave a Brewster angle of 58º. a) What is the refractive-index of this particular piece of glass? b) For which polarization is the Brewster angle defined (s, p or both)? c) For light propagating inside this glass, what is the critical angle for the glass/air interface? d) For which polarization is the critical angle defined (s, p or both)?

(40 points)
2) Calculate the reflectance and transmittance (at both s- and p- polarizations) for a beam of light incident from air (n = 1.00) onto a flat surface of a silicon wafer (n = 3.20). Make a plot of the reflectance and transmittance (at each polarization) versus the incident angle varying from 0º to 90º. Determine the Brewster angle and label it in your plot.

(30 points)
3) A plane z = 0 separates two media: water (n_1 = 1.33 for z < 0) and glass (n_2 = 1.52 for z > 0). A helium-neon (He-Ne) laser beam has a wavelength in vacuum of 633 nm. a) When this He-Ne laser beam propagates in the x-z plane (as sketched below) from the water side towards the water/glass interface at an angle of incidence of 60º (angle between the incident beam and the normal to the interface), what are the Cartesian components of the k-vector for the incident, reflected, and transmitted beams. b) If the incident beam is polarized perpendicular to the plane of incidence, what are the Cartesian components of the electric field of the incident beam? c) If the incident beam is polarized parallel to the plane of incidence, what are the Cartesian components of the electric field of the incident beam? For items b) and c) assume that the electric field has unit amplitude.

(10 points)
4) Prove that the amplitude reflection coefficient for the s-polarized light (r_s) is negative for any angle of incidence when the incident media has a lower refractive index than the medium of transmission. Hint: use Snell’s relation and the Fresnel reflection coefficient for the s-polarized light.