

Assignment 3

1. Consider a helium neon laser that is advertised to have a far field divergence angle of 1 milliradian at $\lambda_0 = 632.8$ nm.
 - a) What is the spot size ω_0 ?
 - b) The power emitted by this laser is 5 mW. What is the peak electric field in volts/cm at $r = z = 0$?
 - c) How many photons per second are emitted by this laser beam?

2. Given a 1 W TEM_{00} beam of $\lambda_0 = 514.5$ nm from an argon ion laser with a minimum spot size of $\omega_0 = 2$ mm located at $z = 0$.
 - a) How far will this beam propagate before the spot size is 1 cm?
 - b) What is the radius of curvature of the phase front at this distance?
 - c) What is the amplitude of the electric field at $r = 0$ and $z = 0$?

3. Consider an optical fiber having an index of refraction given by:

$$n(r) = n_0 \sqrt{1 - \frac{r^2}{d^2}}$$

Solve the wave equation to find the electric field modes.