Part 1: *Using the Jones calculus*, show that a half-wave plate will convert right-hand circularly polarized light into left-hand circularly polarized light, regardless of the angle of the plate. (2 pts)

Part 2: Consider an inhomogeneously-broadened gas laser that is 1 meter long. The laser is pumped at such a rate that 51 longitudinal modes are present. Each mode has a line width (full-width-half-maximum) of 1 MHz. (Assume the index of refraction of the laser gain medium is unity).

a) A Fabry-Perot etalon is inserted inside the laser cavity. It consists of a single piece of glass (index of refraction n=1.5) with reflection coatings on both sides. Each coating has an intensity reflectance of R. What is the maximum thickness of the etalon that will ensure lasing of only a single longitudinal mode? (Neglect all absorption and scattering losses in the etalon). Note: The maximum length occurs when the central longitudinal mode (i.e. the 26th mode) is selected.(1 pt)

b) Assuming that any longitudinal mode will stop lasing when a single pass loss of 0.5 is inserted in the cavity, determine the minimum etalon finesse and the minimum reflectivity of the etalon mirror coating to ensure single mode operation when the peak transmittance of the etalon is centered on a longitudinal mode (neglect intensity variation from mode-to-mode). (1 pt)