Astro 448: Problem Set 4

Due October 31

# 1 Problem 1: Polarization and Coordinate Transformation

- (a) Write down the Jacobian matrix associated with a counterclockwise rotation of the 2D $\mathbf{x}$, $\mathbf{y} \to \mathbf{x}'$, $\mathbf{y}'$ axes by an angle $\psi$.
- (b) Consider the polarization matrix

$$\begin{pmatrix} \Theta + Q & U - iV \\ U + iV & \Theta - Q \end{pmatrix} \tag{1}$$

  Under rotations, the polarization matrix transforms as a contravariant tensor. Write down the transformed polarization matrix and extract its components $(\Theta', Q', U', V')$.
- (c) Construct the quantity $Q \pm iU$. How does it transform under rotations?