

## Homework #7

### Problem 4:

We want to write the continuity equation

$$\frac{\partial \rho}{\partial t} + \nabla \cdot \mathbf{J} = 0, \quad (1)$$

in covariant form knowing that  $J^\mu = (c\rho, \mathbf{J})$  is a 4-vector.

We know that the covariant derivative is given by

$$\partial_\alpha = \left( \frac{\partial}{c\partial t}, \nabla \right). \quad (2)$$

We see that

$$\partial_\alpha J^\alpha = \frac{\partial \rho}{\partial t} + \nabla \cdot \mathbf{J}. \quad (3)$$

Then, the covariant form of Eq.(1) is

$$\partial_\alpha J^\alpha = 0. \quad (4)$$