

## Homework problems # 3

1. Construct the Noether current in scalar electrodynamics described by the  $\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + (D_\mu\varphi)^*(D^\mu\varphi) - m^2\varphi^*\varphi$  with  $D_\mu\varphi \equiv (\partial_\mu - ieA_\mu)\varphi$ . Show that the current is conserved for fields which satisfy appropriate equations of motion.
2. Find the Noether current corresponding to space-time translations and the symmetric energy-momentum tensor in scalar electrodynamics.
3. Derive equations of motion for the Yang-Mills theory with the gauge group  $SU(2)$  interacting with  $SU(2)$  doublet of scalar fields.
4. For the same theory as above, find the symmetric energy-momentum tensor and show that it is conserved if equations of motion are satisfied.