ADVANCED QUANTUM FIELD THEORY
Problem Sheet 1

1. If Ψ_i transforms as a doublet of $SU(2)$ show that the quantity

$$\partial_\mu \Psi_i$$

   does *not* transform as a doublet under $SU(2)$ transformations, whereas

$$\mathbf{D}_\mu \Psi_i$$

   does.

2. Draw all the Feynman graphs for the tree-level amplitude for two gauge bosons with momenta p_1 and p_2 to scatter into two gauge bosons with momenta q_1 and q_2. Label the momenta of the external lines of the graphs

3. In the case of QED, suppose that I wish to choose a gauge by imposing a condition on the quantity

$$\partial \cdot A + A \cdot A.$$

   Show that the effective Lagrangian (with the gauge fixing term added) gives rise to cubic and quartic interactions between the photons. Write down the Lagrangian for the corresponding Faddeev-Popov ghosts.