ADVANCED QUANTUM FIELD THEORY

Problem Sheet 2

1. Consider one-loop the photon self-energy graph, with photon momentum q. Show explicitly that the contribution from this graph proportional to $q^\mu\, q^\nu$ is $-q^2$ times the contribution (calculated in the lectures) proportional to $g^{\mu\nu}$.

2. For a charged scalar particle of charge e, the Feynman rule for the vertex coupling to a photon with Lorentz index μ is

$$-\,i\,e\,(p_1 + p_2)^\mu,$$

where p_1 and p_2 are the momenta of the charged particle flowing into and out of the vertex, respectively.

For such a charged scalar particle, calculate the pole parts of Z_1, Z_2 and the contribution from a scalar particle loop to Z_3

(if you are feeling energetic you might try to calculate the finite parts as well - but leave your answers in terms of integrals over Feynman parameters wherever necessary.)