Homework Set # 1, due February 11, 2007

1. Derive the formula for Mott cross section (see R. Hofstadter, Ann. Rev. Nucl. Sci. 7, 231 (1958)).

2. Shown that $F^a_{\mu\nu}F^a_{\mu\nu}$ is gauge invariant with $F^a_{\mu\nu}$ give by

$$F^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu + g C_{abc} A^b_\mu A^c_\nu, \tag{1}$$

   and C_{abc} the structure constants of the gauge group.

3. Consider Eulidean γ-matrices defined by

$$\gamma_k = \begin{pmatrix} 0 & -i\sigma_k \\ i\sigma_k & 0 \end{pmatrix}, \quad k = 1..3, \qquad \gamma_4 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}. \tag{2}$$

   a) Show that $\{\gamma_\mu, \gamma_\nu\} = 2\delta_{\mu\nu}$.

   b) Calculate $\gamma_5 \equiv \gamma_1\gamma_2\gamma_3\gamma_4$.

   c) Show that $(1 \pm \gamma_5)/2$ are projectors, i.e. they satisfy the property $P^2 = P$.