

## QUANTUM MECHANICS II (524)

## PROBLEM SET 10 (hand in April 24 and the numerical work asap)

25) (10 points) Calculate the magnetic contribution to the energy of the free electromagnetic field in terms of Fourier components of the vector potential.

26) (10 points) Consider the state with  $n_{\mathbf{k}\alpha}$  photons

$$|n_{\mathbf{k}\alpha}\rangle = \frac{(a_{\mathbf{k}\alpha}^\dagger)^{n_{\mathbf{k}\alpha}}}{\sqrt{n_{\mathbf{k}\alpha}!}} |0\rangle.$$

Show that this state is properly normalized.

27) (10 points) Work out the momentum operator of the free electromagnetic field expressed in photon addition and removal operators.