OPT 462: Homework Set 9 — Due on April 11, 2001

1 Average radiation of damped oscillator

- Derive equation (41) and (43) in the class notes.

2 Acceleration of damped oscillator

- Derive the equation of motion for an undriven oscillator. Include the radiation reaction force.
- Solve for the acceleration and determine the associated time-constant. How do you interpret this result? ($\rightarrow$ Jackson, Chapter 17).

3 Total energy radiated by an undriven oscillator

- Determine the total anergy W radiated by an undriven oscillator by integrating $dW/(d\Omega d\omega)$ and show that the energy is indeed equal to the oscillator's initial energy at $t=0$.
- The radiated energy has to be equal to the photon energy $\hbar\omega_o$. Determine the displacement Δx between electron and nucleus at time $t=0$ as a function of the emission wavelength. Give the value for $\lambda=500\,nm$.

4 Parseval's theorem

At time $z = 0$ the electric field of a one-dimensional field propagating in z-direction reads as

$$\mathbf{E}(t) \;=\; E_o \cos\omega_o t \;\, \mathrm{e}^{-(\gamma_o t)^2}\, \mathbf{n}_z \tag{1}$$

- Determine the field anywhere in space.
- Determine the energy per cross-sectional area dW/dA of the field.
- Determine the energy spectrum per cross-sectional area $dW/(d\omega dA)$ of the field.