Homework 4

Write a simple MATLAB (MAPLE, Mathematica) that can numerically solve balance equations

$$\frac{dn_2}{dt} = \frac{1}{\tau_2}(p - n_2 - n_2 n_p)$$
$$\frac{dn_p}{dt} = \frac{n_p}{\tau_p}(n_2 - 1) + \beta\frac{n_2}{\tau_2}$$

step by step for the time-dependent pump function (Super-Gaussian pulse of length t_{pulse}) $p(t) = p_0 e^{-t^6/t_{pulse}^6}$). Then plot the population inversion n_2(t) and photon density n_p(t) versus time (in units of photon life time) for different ratios of τ_2/τ_p (say 0.1,10, or your choice) with a few different pump peak powers (say p_0=1.1, 3,10) and a few different pulse lengths t_{pulse} (choose the latter to have interesting and meaningful results). Explain what you see on the plots. Choice of β is not all that important as long as it is reasonably small – you can test it.

MATLAB has ode45 program that can integrate ordinary diff. Equations, but you can write your own program.