Problem: Chapters 6 & 7

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During the lecture I showed some calculations of single pass amplifiers, in particular there was one picture of the output intensity versus the input intensity for different gains, in units normalized by the saturation intensity. The task is to make a similar numerical calculation of the output intensity, but this time versus the amplifier length instead of the input intensity, using physical rather than normalized units. To see some different examples, the calculations should be done for gas and solid-state gain media with data given below. For each case try with the input intensity being 10^{-2}, 10^{-1}, 1 and 10 times the saturation intensity.

The gain coefficients below apply when the system is pumped into population inversion. A non-inverted absorbing system would correspond to a negative gain coefficient. Try some different positive and negative values of alpha to see this effect.

Material data:

Gas (CO_2),

$$\alpha_{m0} = 2\ m^{-1}$$
$$I_{sat} = 1\ Wcm^{-2}$$
$$L = 1.3\ m$$

Solid state (Nd:YAG),

$$\alpha_{m0} = 10\ m^{-1}$$
$$I_{sat} = 1000\ Wcm^{-2}$$
$$L = 0.13\ m$$

If you'd like more details, the sources are available at:

Nd:YAG,
http://iopscience.iop.org/2040-8986/16/1/015709/pdf/2040-8986_16_1_015709.pdf

CO_2,
http://scrivens.web.cern.ch/scrivens/lis/reports/lumonssg/lumonssg.html