

Homework 5

Consider a Nd:YAG laser rod that is 2 mm long and pumped by the beam from laser diode with beam size 0.5 mm in diameter. The material parameters are given in Lecture 5. Assume the intrinsic absorption/scattering losses of the order $\alpha \sim 0.15 \text{ cm}^{-1}$. The laser is pumped at 800nm and emits at 1060nm. Pumping efficiency (percent of the power actually absorbed by the Nd atoms is $\eta_{\text{pump}} \sim 50\%$.)

Pumping power is a) 0.5W b) 3W c) 10W.

1. Calculate maximum laser gain for each pump power.
2. Introduce laser cavity with the reflectivity $R_1=100\%$ $R_2=R$. Now plot input/output power graphs for four different reflectivities R (your choice). Then determine optimal reflectivity R and maximum output power for the aforementioned pump powers a) 0.5W b) 3W c) 10W
3. How much energy can you store in this rod and how much pump energy is required for that? What should be the pump pulse length and peak power to efficiently store this energy?
4. What would be the optimum reflectivity of the output mirror to get as much as possible of the stored energy in a single Q-switched pulse? What would be the length of that Q-switched pulse?
5. Do you think laser diode would be a good source for the Q-switched operation? Why?
6. What do you need to do to increase the energy of Q-switched pulse?
7. How can you further reduce the length of the pulse?