
DEPARTMENT OF PHYSICS
PHL 752: LASER SYSTEMS AND APPLICATIONS

Majors
Duration: 2hrs

Max. Marks 40
May 9, 2007

Note:

Answer all questions *in sequence*.

Please answer in points wherever possible and **circle your final answer wherever applicable**.

Scattered parts will **not** be graded.

Good Luck !!!

1. Explain the principle and working of a CO₂ gas dynamic laser with the help of a diagram [4].
2. Compare the Nd:YAG and the Nd:glass laser. [4].
3. Explain the working of a laser printer with the help of a diagram [4].
4. Nd³⁺ ions are doped into YAG at a 1% atomic concentration, which corresponds to a density of Nd atoms of 1.38×10^{26} per cubic meter in the laser rod. If all of these atoms were instantly pumped to the upper laser level and then began to radiate, what would be the radiated energy per cubic meter and the average power per cubic meter radiated from this material at the emission wavelength of $1.06 \mu\text{m}$? If the power radiated from one cubic centimeter could be concentrated into a spot of 1mm in diameter, what would be the intensity (power/m²)? What are the disadvantages of drilling holes using a laser? [4]

5. Determine the pulse coded modulation bit stream for the signal

$$y(t) = 2\cos(2\pi t) + 5\sin^2(7\pi t)$$

where, each sample is represented by 3 bits (the first sample being taken at $t = 0$). [4]

6. Determine the depth of a hole drilled in aluminum using a laser with an energy of 10J and focused to an area of 10^{-3}cm^2
Density = 2.7gm/cm^3 , Heat capacity = 0.97J/gm-deg , Latent heat of vaporization = $10,900\text{J/gm}$ and change in temperature = 2447°C [4].
 7. How is the low threshold current density achieved in a double heterostructure laser? [4]
 8. Compare the gain guided with the index guided semiconductor laser. [4]
 9. Explain the isoelectronic scaling of energy levels with the help of an example. Calculate the numerical aperture of a silica glass fiber with the refractive index of the core and cladding as 1.475 and 1.460 respectively. [4]
 10. What is amorphous crystal broadening? Draw the electric field and the intensity distribution at the laser mirrors for the TEM₀₀ and the TEM₀₁ laser modes. [4]
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