DEPARTMENT OF PHYSICS

PHL 752: LASER SYSTEMS AND APPLICATIONS

Majors **Max. Marks 40**

Duration: 2hrs **May 6 , 2010**

Answer all questions in sequence.
Please answer in points whereever possible and circle your final answer whereever applicable.
Scattered parts will not be graded.
Good Luck !!!

1. Explain why the output power of a He-Ne does not increase monotonically with the discharge current. What is the mechanism of excitation in an KrF excimer laser? **[5]**
2. In a GaAs quantum well, the effective mass of a conduction electron in GaAs is $0.07m_e$, where m_e is the electron mass in vacuum. Calculate the first two electron energy levels for a quantum well of thickness 10nm. What is the hole energy below E_v of GaAs, if the effective mass of the hole is about 0.05 m_e? What is the change in the emission wavelength with respect to bulk GaAs which has an energy band gap of 1.42eV?**[5]**
3. Nd^{3+} 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 μm ? If the power radiated from one cubic centimeter could be concentrated into a spot of 1mm in diameter, what would be the intensity (power/m^2)? **[5]**
4. Write about the advantages and disadvantages of drilling holes using a laser. **[5]**
5. What are the various classes of lasers based on the ANSI classification? Why is the CO_2 laser very harmful for the skin? [5]
6. Explain the principle of working of a Gas Dynamic CO_2 laser with the help of a diagram.**[5]**
7. Calculate the efficiency of a 5mW He-Ne laser operating at a dc voltage of 2000V and carries a current of 7mA. The output beam has a diameter of 1mm and a divergence of 1mrad. What is the diameter of the beam at a distance of 10m? **[5]**
8. Derive the condition for laser amplification in a semiconductor material.**[5]**

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Mass of an electron: 9.10×10^{-31}kgs