भारतीय प्रौद्योगिकी संस्थान पटना

INDIAN INSTITUTE OF TECHNOLOGY PATNA

DEPARTMENT OF PHYSICS

PH201: Optics and Lasers (End semester examination)

Date: 30-04-2019 **Time duration: 3 Hrs** **Total marks: 60**

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 4 MARKS.

1	Explain the role of Brewster window in a laser resonator?
2	In 4 level laser system, the lifetime values of 2, 3, 4 levels are 1 ps, 1 ms, 1 ps. The times taken for transitior from level 4 to 3, level 4 to 1, level 3 to 2, level 3 to 1, and level 2 to 1 are 10 ps, 1 ns, 1 ms, 1 ns, 1 ps. Estimate the laser quantum efficiency (LQE). What is the importance of LQE?
3	Can we call the laser beam as a Gaussian beam? Justify your answer.
4	In four level system, the transition times for level 4 to 1, level 4 to 2, level 4 to 3, level 3 to 2, level 2 to 1 are 10 ns, 20 ns, 1 ps, 1 ms and 5 ns. Estimate the lifetime of the 4^{th} level.
5	Define the Rayleigh range of a focused laser beam. How to achieve short Rayleigh Range?
6	Explain briefly about the laser spiking in a Ruby laser?
7	(a). What is the role of Helium gas in He-Ne laser? (b). Draw the schematic of a He-Ne laser and label all parts
8	(a). What is difference between laser resonator and Fabry-Perot interferometer? (b). A heterostructure diode has a cavity length of 400 microns. The peak wavelength of radiation is at 600 nm and the complex refractive index of the medium is 2+3i. Find the longitudinal mode separation.
9	(a) What is the difference between internal and external reflections? (b) Can we achieve total internal reflection at air-metal interface? Justify your answer.
10	What is difference between loop gain and active medium gain?
11	What are the differences between LED and semiconductor Diode laser?
12	Is it possible to achieve the population inversion in 2 level systems? Justify your answer.
13	A Ruby laser has line width 10 MHz. Estimate the temporal coherence time of the laser light.
14	Write name and wavelength of all the lasers which you have seen in the optics laboratories in Block 04 during lab visit.
15	Write the differences between continuous wave (CW) laser and pulsed laser. Why pulsed lasers are powerful than CW lasers?