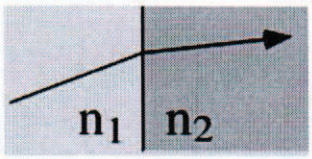
INDIAN INSTITUTE OF TECHNOLOGY PATNA
DEPARTMENT OF PHYSICS

End Semester Examination

PH201: OPTICS AND LASERS

Date: 30/04/2016	**Duration: 3 hours (2PM TO 5PM)**	**Maximum marks: 50**
	Attempt all questions	**Total number of questions: 15**

S.No	Questions	Marks
1	Consider a plane wave of wavelength 6000 Å incident normally on a circular aperture of radius 0.01 cm. Calculate the brightest and the darkest points on the axis. $[I = I_0 \sin^2 \frac{p\pi}{2}, \quad where \quad p = \frac{a^2}{\lambda d}]$.	4
2	A ray of light is incident on a medium of refractive index 1.75 at a polarizing angle. Find angle of incidence and angle of refraction.	2
3	Explain (show the schematic diagram) the working principle of a Mach-Zehnder interferometer	2
4	The amplifying medium of a Laser has an amplification spectral band equal to 1 GHz at 633 nm. For simplicity, the spectral profile is assumed to be rectangular. The linear cavity is 30 cm long. Calculate the number of longitudinal modes that can oscillate in this cavity?	2
5	Obtain the ray transfer matrix for refraction on a planar surface (n_1 is the refractive index of first medium and n_2 for the second medium) 	3
6	A material having a refractive index of 4.5 at 1300nm is used for making a laser cavity 400 micrometer long. The refractive index varies linearly as a function of wavelength at a rate of 10^{-3}/ nm around 1300nm wavelength. Find the separation between the cavity modes?	3
7	Why two level Lasers doesn't work ? Why three or more levels are important for laser operation?	3

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8	The output of a Laser has linear increase in the intensity as a function of time due to heating issues of pump power supply. Explain an experimental technique (show the schematic diagram) for stabilizing the laser intensity?	4
10	(a) Explain the frequency tuning mechanism in External Cavity Diode Lasers (ECDL) using grating ? (b) Explain how ECDL are used in performing absorption spectroscopy? (draw neat schematic diagram for (a) and (b))	(4+4)
11	Explain the principle of wavelength division multiplexing (WDM) technique in fiber optical communication?	4
12	Explain the working principle of semiconductor diode lasers?	3
13	(a) Show that photon flux density inside a gain medium which has population inversion increases exponentially? (b) Why Laser output has high spatial coherence?	(3+2)
14	Explain the working principle of Ruby Laser? (Give a neat sketch of Laser components and Energy level diagram)	4
15	(a) Explain the longitudinal modes of Laser cavity? (b) How single mode operation is done?	(1.5+1.5)