INDIAN INSTITUTE OF TECHNOLOGY PATNA
DEPARTMENT OF PHYSICS
End Semester Examination
PH201: OPTICS AND LASERS

Date: 23 /04/ 2018	**Duration: 3 hours**	**Maximum marks: 50**

Attempt all questions

S.I No		Marks
1	Inside the laser cavity which of the following phenomenon leads to longitudinal modes? a. Refraction b. Dispersion c. Diffraction d. Interference	2
2	Tunable External Cavity Laser (ECL) has a. Transmission grating b. Reflection grating c. Prism d. glass plate	2
3	Laser diode is very good for digital modulation because a. $\frac{\Delta P}{\Delta I}$ is large b. $\frac{\Delta P}{\Delta I}$ is small c. frequency band width is small d. frequency band width is large note: P is output laser power and I is pump current	2
4	Two slits separated by a distance of 0.2 mm are illuminated by a monochromatic light of wave length 550nm. Calculate the fringe width on a screen at a distance of 1 m from the slits. a. 1.75 mm b. 1.75 cm c. 2.75mm d. 2.75 cm	2
5	Two coherent sources of intensity 10 W/m^2 and 25 W/m^2 interfere to from fringes. Find the ratio of maximum intensity to minimum intensity. a. 0.4 b. 2.5 c. 20.73 d. 19.73	2
6	In Young's double slit experiment, a viewing screen is separated from the double slit by 1.2 m. The distance between the two slits is 0.030 mm. The 2nd order bright fringe (m=2) is 4.5 cm from the central maximum. Determine the wavelength of light. a. 5.62 X 10^{-5} m b. 5.62 X 10^{-6} m c. 5.62 X 10^{-7} m d. 5.62X 10^{-9}m	2
7	A ray of light is incident on a glass surface of refractive index 1.732 at polarizing angle. The angle of refraction of the ray will be a. 30 degrees b. 60 degrees c. 45 degrees d. 90 degrees	2
8	A material having a refractive index of 4.5 at 1300nm is used for making a laser which	3

	has a cavity of length 400 micrometre 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 adjacent cavity modes?	
9	A GaAs laser has a 400 micrometer long cavity with a refractive index of 3.6. The material gain function is Gaussian with its peak (G_{peak}) at 800nm (λ_{center}) and its Gaussian width σ is 2nm. The maximum gain at 800nm is 50 cm^{-1} (G_{peak}). If the loss in the cavity is 30 cm^{-1} and is independent of the wavelength. Find the number of modes which will exist in the laser? Gain is given as $G(\lambda) = G_{peak} e^{-\frac{[\lambda - \lambda_{center}]^2}{2\sigma^2}}$	3
10	In a two level atomic system electron density in the excited state E_2 at a time t = 0s is given as $N_2(0)$. If a spontaneous emission event occurs what will be the electron density $N_2(t)$ after a time 't' seconds?	3
11	A semiconductor laser diode operating at a wavelength of 1.3 micrometer has a cavity length of 300 micrometre. If one of the laser facets is coated to produce Reflectivity (R_1) 0.9 and another facet assume R_2 to be 0.99 , what should be the minimum gain for lasing, if the absorption loss of the material is of the form $e^{-\alpha}$, where α to be 10	3
12	Explain how light amplification occurs inside the gain medium of Laser in the presence of an optical pump?	4
13	What is the principle behind wavelength division multiplexing (WDM) in fiber optical communication? Draw a neat diagram for explaining WDM?	4
14	Explain how a grating is used to get a single mode (frequency) operation? Use a neat diagram to explain its operation.	4
15	Explain the working mechanism of Ruby Laser? Sketch a neat diagram and label all the components.	4
16	Explain how absorption spectroscopy is done using External Cavity Laser? Sketch the schematic and label all the components.	4
17	Explain an experimental technique (show the schematic diagram) for stabilizing the laser intensity?.	4