

M.Sc (Instrumentation) Examination, 2019
(2nd Year, 1st Semester)

Subject : Plasma Based Instrumentation and Lasers(T- 304A)

Full Marks: 50

Time: 2 Hours

Answer any five questions.

1. Find expression of Electron Temperature (T_e). Describe double probe method to find plasma parameters (T_e , T_i , n_e). 4+6
2. Deduce dispersion relation for electron plasma wave. Draw dispersion curves and find phase velocity and group velocity. Describe experimental method for detection of electron plasma wave. 5+2+3
3. Obtain dispersion relation for electromagnetic waves in plasma. Describe the mechanism of radio wave communication in the Ionosphere. Calculate electron density of Ionospheric layer for Medium Wave radio communication of Kolkata A radio station ($\lambda = 456.8$ meter, $q = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ Kg, $\epsilon_0 = 8.85 \times 10^{-12}$ F/m). 4+3+3
4. Compare power generation mechanism in Nuclear Fission and Fusion. Discuss basic principle of plasma confinement by magnetic field. Obtain Lawson criterion for Fusion reaction by Nd-Yag Laser ($\lambda = 1.06 \mu\text{m}$). 2+4+4
5. Write short note on
 - (a) Drift of guiding centre in crossed magnetic and electric field.
 - (b) MHD power generator. 5+5
6. What is laser and how is it different from ordinary light sources? What are the main components of a basic laser system? Show that probability of absorption of radiation (B_{12}) is equal to probability of stimulated emission (B_{21}). Also find the ratio of probability of spontaneous emission (A_{21}) and stimulated emission (B_{21}). 2 + 3 + 4 + 1
7. What is population inversion? Show that the threshold condition of population inversion is

$$N_2 - N_1 \geq \frac{8\pi t_{sp} \nu^2}{c^3 t_p}$$

(the symbols imply usual meaning)

Why Ruby laser gives pulsed output? What are the usages of CO₂ laser? 2 + 4 + 2 + 2

8. Write a note on He-Ne laser. Why semiconductor lasers are called injection laser? Find the ratio of the rates of the stimulated to spontaneous emission at $T = 10^3$ K for visible radiation of wavelength 600 nm and microwave radiation of wavelength 300 mm. Comment on the result comparing the ratios. 3 + 2 + 4 + 1