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**Assignment –4**  
**(PHY-102) B. Tech. Semester - I**

1. What do you mean by spectrograph? Give the working of mass spectrograph in detail.
2. Discuss the working and limitation of cyclotron and how the problem of cyclotron has been resolved by synchrocyclotron?
3. Deuterons in a cyclotron describe a circle of radius 0.32m just before emerging from the dees. The frequency of the applied emf is 10 MHz. Find the flux density of the magnetic field and velocity of deuterons emerging out of the cyclotron. Mass of deuterium =  $3.32 \times 10^{-27}$  kg;  $e = 1.6 \times 10^{-19}$  C.
4. In a betatron  $B_{\max}$  applied  $0.5 \text{ wb/m}^2$  with orbital diameter 1.5m. If the electromagnet is energized at 50Hz, calculate average energy gained by electrons in a revolution. Also calculate the total time of flight of electrons.
5. Explain three level and four level pumping scheme. Which one is better and why?
6. What do you mean by Bethe's law? Also discuss electrostatic lens using Bethe's law.
7. In a laser action due to transition from the excited to the ground state, a beam of wavelength  $6930 \text{ \AA}$  is obtained. Assuming the energy of ground state to be zero, find the energy of the excited state.
8. A three level laser emits light of wavelength 550 nm. (a) What is the ratio of population of the upper level ( $E_2$ ) to that of ( $E_1$ ) in laser transition, at 300 K? (b) At what temperature the ratio of the population of  $E_2$  to that of  $E_1$  becomes half?
9. A ruby laser emits photons of wavelength 694.4nm. If the energy release per pulse is 150 mJ and lasts for 12.0 ps, calculate the (i) length of the pulse (ii) the number of photons in each pulse.
10. He-Ne laser emits light of wavelength of 632.8nm and has an output power of 2.3mW. How many photons are emitted each minute by this laser when operating?