(C) In context with optical fiber, define the following terms :

(i) Acceptance angle

(ii) Numerical aperture

(iii) Multimode fiber

(iv) Single mode fiber

(v) Step index fiber

(vi) Graded index fiber. 6

OR

(P) Write four advantages of using laser over conventional techniques for material processing applications. 4

(Q) How laser is used in reading and writing data on the DVD/CD ? 6

(R) Why we need precision spectroscopy ? 4

(S) What is frequency comb ? 2

AQ–892

M.Sc. (Semester—II) (CBCS Scheme) Examination

PHYSICS

2 PHY-4 (ii)

(Lasers and Laser Applications)

Time—Three Hours] [Maximum Marks—80

Note :— All questions are compulsory and carry equal marks.

1. (A) What are stipulated and spontaneous emissions ? 2

(B) Derive the ratio of stimulated to spontaneous emission rates from upper energy level 'u' to lower energy level 'l'. 6

(C) Mathematically, show that the population inversion is necessary and saturation intensity is sufficient condition for obtaining lasing action. 8

OR

(P) Derive the expression for longitudinal mode number. 4

(Q) What are the requirements for the development of longitudinal laser modes ? 4

(R) Write out the mode distributions at the mirrors for the TEM_{00}, the TEM_{01} and the TEM_{11} modes in terms of the transverse variables x, y and $\rho = \sqrt{x^2 + y^2}$. 8

2. (A) Derive the steady state population inversion condition in four level laser. Give example. 8

(B) Explain how pulse compression of a chirped pulse is possible using grating pair. Draw appropriate diagram wherever necessary. 8

OR

(P) Draw and explain the stability diagram for two mirror laser cavity with radii of curvature R_1 and R_2. 8

(Q) Compare the properties of real and ideal Gaussian laser beam. Explain the physical significance of M^2 parameter (propagation factor). 8

3. (A) Write the working principle of Ammonia MASER. Draw the schematics of its experimental set up. 8

(B) With the help of energy level diagram, explain the working of Nitrogen laser. 8

OR

(P) What are the different types of laser structures used for the CO_2 laser ? Draw and briefly explain all of them. 10

(Q) Explain the transfer down process in an Excimer laser with help of appropriate diagram. 6

4. (A) Draw neat and labelled experimental schematics of Laser Induced Fluorescence (LIF) set up. 6

(B) Write any four applications of laser induced multi photon processes. 4

(C) Elaborate on the use of Raman spectroscopy in material science. 6

OR

(P) Write names of at least two major 2nd order optical nonlinear effects. 2

(Q) Explain how multiphoton spectroscopy can be used to study the states which are not accessible from the ground state because of selection rule and also high lying electronic states. 6

(R) Draw and compare the Jablonski energy diagram of conventional one photon excited fluorescence with two and three photon excited fluorescence. 8

5. (A) Explain with a neat labelled diagram principle of light propagation inside optical fiber. 6

(B) What are the advantages of using optical fiber over coaxial cable ? 4