Reg. No.

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc (Physics)
END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: LASERS AND OPTICAL FIBERS [PHY 5002]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours   MAX. MARKS: 50

Note: (i) Answer **ALL** questions

(ii) Missing data may be assumed suitably

1A. Obtain the expressions for Einstein coefficients and hence obtain the ratio of the number of spontaneous to stimulated emission under thermal equilibrium. [5]

1B. Show that population inversion is essential for light amplification. [3]

1C. Estimate the wavelength at which stimulated emission rate becomes 1/10th of spontaneous emission rate at room temperature (300 K). [2]

2A. What is Q switching? Write the importance of Q-switching and explain any two techniques for Q-switching. [5]

2B. Given: $a = b = 1$ cm, $d = 8$ cm. Estimate θ_x, θ_y and θ_z for the mode defined by $m = 0$, $n = 1$, $q = 10^6$.
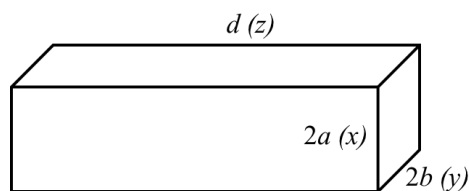
[3]

2C. Consider a typical cavity of a He – Ne laser (λ_0 = 632.8 nm) with following specifications. Cavity length d = 20 cm, n_0 = 1, reflectivity R_1 = 1 and R_2 = 0.98, α_1 = 0. Estimate the quality factor. [2]

3A. With relevant diagram and equations, explain the continuum radiation mode in leaky planar structure. [5]

3B. With necessary diagrams, explain the working of He - Ne laser. [3]

3C. The multimode fiber with core r.i. 1.500, relative r.i. difference 3% is operated at 0.82 μm. Estimate the critical radius of curvature at which large bending loss occurs. [2]

4A. Do the modal analysis of TE modes of a symmetric step index planar wave guide. [5]

4B. An optical fiber has n_1 = 1.50 with core diameter 3 μm. Estimate the range of r.i allowed for cladding if it has to support 3 modes (λ_0 = 0.85 μm) [3]

4C. Write a note on laser safety. [2]

5A. Explain the fabrication of Fiber Bragg Grating (FBG). How an FBG can be used as temperature sensor? [5]

5B. What is the maximum rate (frequency) at which the information can be sent along a 10 km fiber of core r. i. 1.48 and $(n_1 - n_2)/n_1$ = 0.01. [3]

5C. Explain the working of Erbium Doped Fiber Amplifier (EDFA). [2]

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