MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.										

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc (Physics)
END SEMESTER EXAMINATIONS, DECEMBER 2018

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

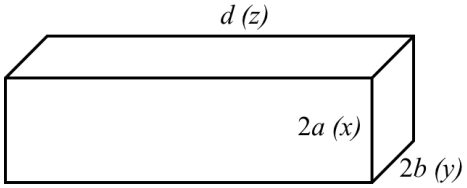
1A. Explain the variation of laser power around threshold. [5]

1B. Define passive cavity life time and obtain an expression for it. [3]

1C. Estimate the wavelength at which spontaneous to stimulated emission rate becomes half at room temperature (300 K). [2]

2A. Do the qualitative analysis of ultimate linewidth of the laser. [5]

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



[3]

2C. 50 cm long He – Ne laser operating at 632 nm has oscillating bandwidth of 1500 MHz. Calculate the number of longitudinal modes which can oscillate in the laser. [$c = 3 \times 10^8$ m/s] [2]

3A. What is the significance of mode selection in lasing systems? Explain any two of the mode selection techniques. [5]

3B. With necessary diagrams, explain the working of Ruby 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. What is Q-switching? Write the importance of Q-switching and explain any two techniques for Q-switching. [5]

4B. Compute the largest thickness that will guarantee single TE mode operation at 800 nm in a wave guide with $n_1 = 1.5$ and $n_2 = 1.48$. [3]

4C. Write a note on photonic crystals. [2]

5A. Obtain the expression for pulse dispersion in step index fibers and hence define the maximum bit transfer rate. [5]

5B. The numerical aperture of an optical fibre is 0.2 when surrounded by air. Determine the refractive index of its core. The refractive index of the cladding is 1.59. Also find the acceptance cone half-angle when the fibre is in water. Refractive index of water is 1.33. [3]

5C. Briefly explain the working of Fiber Bragg grating. [2]

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