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

Reg. No.										

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc (Physics)
END SEMESTER EXAMINATIONS, May 2019

SUBJECT [CODE PHY 5011]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 11-06-2019 MAX. MARKS: 50

Note: (i) Answer **ALL** questions
(ii) Draw diagrams, and write equations wherever necessary

1. a) Explain how sum and difference frequency generation is possible via nonlinear process? **(6)**
   b) What is phase-matching and what is its significance in nonlinear optics? Mention their types with a brief explantion. **(4)**

2. a) Define Pockel's and Kerr effects. **(2)**
   b) In electrooptic effect, how to reduce the half-wave voltage drastically? Explain with an example. (Use this data for KDP crystal: λ_0=0.6 μm, $r_{63}=10\times10^{-12}$ m/V, n_0=1.5) **(4)**
   c) How do we obtain phase modulation using electro optic effect in longitudinal mode for a KDP crystal? **(4)**

3. a) What is acoustooptic effect? Explain any one of its applications. **(3)**
   b) How large should be the cell width in the case of Raman-Nath diffraction? (Use this data: Λ=250 μm, n_0=1.33, λ_0= 632.8 nm) **(2)**
   c) List the different optical waveguide devices and mention their advantages. Explain the working of Mach-Zehnder interferometer modulator and switch. **(5)**

4. a) Consider a double heterojunction diode emitting of light of 0.95 eV. If the radiative and non-radiative recombination times are 25 and 90 ns, respectively. Drive current is 35 mA
   i) Find the quantum efficiency and internal power level. **(1)**
   ii) If n=3.5, what is the power emitted by such a LED **(2)**
   b) Explain the construction and working of the p-i-n photodetector. **(3)**
   c) Obtain the system rise time t_{sys} for a multimode link: Assume that the LED together with its drive circuit has a rise time of 15 ns. Take material-dispersion-related rise-time as 21 ns and modal-dispersion-induced rise time as 3.9 ns. The receiver has a bandwidth of 25 MHz **(2)**
   d) Explain the importance of InGaAs and InGaAsP alloy systems in optical fiber communication? **(2)**

5. a) How do you difine an ultra-short pulse? Explain any one of the applications of ultra-short pulses. **(4)**
   b) Explain briefly the open aperture and closed aperture z-scans. Mention their applications. **(6)**