

**Course objective:** This course is aimed at providing a comprehensive review of the guided wave propagation in linear and nonlinear media, which are the backbone of modern communication system. The underlying physics will be discussed in detail.

**Course contents:**

1. Guided TE and TM Modes of Symmetric and anti-symmetric Planar waveguides. Stepindex and graded-index waveguides. Strip and channel waveguides, anisotropic waveguides, Effective-Index method and perturbation method of analysis. Directional couplers, Coupled mode analysis of uniform and reverse delta-beta couplers. Mach-Zehnder interferometer based devices, Acousto-optic waveguide devices.
2. Rays and ray paths in optical fibers, step index and graded index fibers. Attenuation in optical fibers. Modal analysis of optical fiber, TE, TM and HE modes, power flow. Linearly polarized (LP) modes in step-index optical fibers. Mode cutoff and single mode operation. Mode field diameter in single mode fibers, LP modes of infinitely extended parabolic medium, intermodal dispersion in multimode fibers, optimum profile fibers. Dispersion and chirping of pulses in single mode fibers, Dispersion compensation and dispersion tailoring. Birefringence in optical fibers, polarization mode dispersion. Photonic crystal fibers.
3. Basics of nonlinear optical effects, Second harmonic generation, phase matching, quasi phase matching, sum and difference frequency generation, parametric amplification and parametric oscillation, third order nonlinear optical effects, Self phase modulation and soliton formation, Cross phase modulation and four wave mixing, stimulated Raman and Brillouin scattering.
4. Wave guidance at surface: Long and short range surface Plasmon modes, Whispering -gallery waves

**Textbooks and References:**

1. Optical Electronics, Ajoy Ghatak and K Thyagarajan, Cambridge University Press, 1989
2. Optical Waveguide Theory, A.W. Snyder, J. Love, Springer, 1983
3. Photonics, A Yariv and P. Yeh, Oxford Univ. Press, 2007.
4. Introduction to fiber optics, A Ghatak and K Thyagarajan, Cambridge Univ. Press, UK, 1998
5. Fundamentals of optical waveguides, K. Okamoto, Elsevier, 2005
6. Optical Fiber Communication, G. Keiser, McGraw Hill, 2000.
7. Fundamentals of Photonics, BMA Saleh and MC Teich, John Wiley, NY, 2007
8. Nonlinear Fiber Optics, G P Agarwal, Academic Press, Boston, 2013
9. Nonlinear Optics, Robert W. Boyd, Academic Press is an imprint of Elsevier, 2008

**Course policies:**

1. Your performance will be graded based on: one mid-sem exam (30% waitage), one end-sem exam (45% waitage), two quizzes (10% waitage) and two assignments (15% waitage).
2. A minimum of 90% attendance is compulsory. Only the leave granted by competent authorities will be accepted.
3. Cheating or use of any unfair means will not be tolerated, the culprit will be deregisterd from the course and the case will be referred to higher authorities for further strict actions.