



Fiber Optics

ABOUT THE COURSE

The course is aimed at equipping the undergraduate Engineering and Physics students with the basic understanding of optical fibers and optical fiber communication. The course provides knowledge of optical fiber waveguide at fundamental level, essentials of an optical fiber communication system and understanding of various components of an optical fiber telecommunication system.

COURSE LAYOUT

Week 1: Introduction, need for optical communication, salient features of optical fibers, ray theory of light guidance, numerical aperture, modes of a fiber, single and multimode fibers, step-index and graded-index fibers, fiber fabrication techniques

Week 2: Transmission characteristics of optical fibers, attenuation, pulse broadening mechanism, intermodal dispersion, bit rate - length product, material dispersion, electromagnetic wave analysis of light propagation in an infinitely extended medium, em waves in dielectrics, boundary conditions

Week 3: Electromagnetic analysis of planar optical waveguides, TE and TM modes, planar mirror waveguide, dielectric symmetric step-index, planar waveguide, symmetric and anti-symmetric modes, b-V curves, modal fields

Week 4: Power associated with modes of dielectric symmetric planar waveguide, asymmetric planar waveguide, single polarization single mode waveguide, excitation of guided modes by prism coupling technique, radiation modes, optical fiber waveguide, EH and HE modes, weakly guiding fibers, LP modes, mode cut-offs, b-V curves

Week 5: Optical fiber modes, field patterns, degeneracies, fractional power in the core, single mode fiber, cut-off wavelength, mode field diameter, bend loss, splice loss, waveguide dispersion, group delay

Week 6: Total chromatic dispersion, pulse broadening and chirping, dispersion in graded-index and multilayer fibers, optical fiber components and devices, directional coupler, power splitter, WDM coupler, polarization controllers, fiber Bragg gratings

Week 7: Various types of fiber Bragg gratings, fabrication methods, applications, long period gratings, optical fiber amplifier, erbium doped fiber amplifier, dispersion management, dispersion shifted fiber, dispersion compensating fiber, sources for optical fiber communication, light emitting diode, internal and external quantum efficiencies, LED characteristics, laser diode

Week 8: Detectors for optical communication, p-i-n photodetector, APD, System design, dispersion and attenuation limited systems, BER, power budgeting of fiber link, recent advances