

Course Title: Optical Fiber Communication

Course Code: ETEG 422

Credit Hours: 3

Course Description:

This course intends to introduce light wave technology in optical communication and optoelectronic technologies their circuit and system applications.

Course Contents:

Unit 1: Introduction to Optoelectronics

Historical perspective, the basic optical communication system, Prime components employed in this system, Ray propagation in optical fiber- numerical aperture, Step index, Graded index; Ray propagation in step index fiber, Graded index fiber; Effect of material dispersion, Combined effect of multipath and material dispersion, Attenuation mechanisms of optical fibers.

Unit 2: Optical Fibers

Review of dielectric wave guide; Planar optical waveguide TE mode and TM modes; Wave propagation in cylindrical wave guides; Wave propagation in an ideal step index fiber and graded index fiber; Multimode and monomode fibers; Signal distortion in optical fiber; Optimum wavelengths in silica fibers; Single mode fibres ; Fiber material, Fiber fabrication methods; Optical fiber cables and connections, Optical ground wire (OPGW), All Dielectric Self-Supporting Optical Cable (ADSS), Optical fiber connections and related losses, Fiber splices and connectors.

Unit 3: Optical Sources

Review of semiconductor p-n junction, Injection luminescence and light emitting diode (LED) , LED materials, Hetero-junctions, LED designs, LASER optical sources, The basic principles of laser action, Spontaneous emission, Stimulated emission and absorption, The condition for laser action, Different types of laser - solid state laser, Gas laser, Semiconductor laser, Distributed Feedback Laser (DFB) laser, Feature of laser radiation, Media Converter.

Unit 4: Detector

Principles of photo detections, Absorption, Quantum efficiency, Responsivity, Photodiode as detector, PIN photodiode, Avalanche photo diode.

Unit 5: Other Devices

Modulators, Extrinsic modulator devices – electro optic modulator, Acousto-optic modulators, Practical amplifiers and beam splitters, Switches, Optical directional couplers, Modulators devices- Fiber coupling, Numerical aperture match, Optical fiber sensors.

Unit 6: Optoelectronic Integrated Circuits

Integrated Optical Passive and Active circuits, Slab and strip waveguides, Emitter and detectors

Unit 7: Optical communication Systems

Optical sources and detectors, Optical transmitter circuit, Optical receiver circuits, Regeneration of digital signals in an optical system, Coherent systems, Homodyne and heterodyne detection, Wavelength Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM), Optical amplifiers. Optical fiber link design- end to end design, power budget analysis, rise time budget analysis.

Case Study: Internet Service Provider (ISP) and Telecom optical fiber networks.

References:

1. T. L. Singal, *Optical Fiber Communications*, Cambridge University Press, 2016
2. J.Gowar, *Optical Communications Systems*, Prentice Hall 1993
3. J.Wilson and J.F.B.Hawkes, *Optoelectronics*, Prentice Hall 1996
4. Keiser, *Optical Fiber Communications* , Tata McGraw Hill, 4th edition, 2008

Evaluation:

In-Semester Evaluation: 50%

End-Semester Evaluation: 50%