ES 412 Optical Fiber Communication (3-0-0-4)
Sem 3, 2019-2020
Course plan
Duration of course: Tuesday, 21st April 2020 - 7th June 2020 (7 weeks)
Lectures: Slot 15:00 – 16:00 on Mon, Wed, Fri
Discussion hour: 1 hour at a mutually convenient time slot
Evaluation components: Assignments (40), Interview / Quiz (30), Endsem (30)

Week	Date	Topic	Objective / Reading / Activity
1	21 Apr 2020	**Overview of modern communications** 1. Information : unpredictable/random 2. Source : laser diode 3. Channel : optical fiber 4. Detector : photodiode 5. Noise : channel & detector	How the optical fiber has revolutionized the way the world is connected. Examine the basic building blocks of a communication system
	22 Apr 2020	**The essential mathematics** 1. Energy and power of a signal 2. Concept of bandwidth 3. Fourier transform & its properties 4. Linear and nonlinear systems 5. Concept of modes of a system	What mathematical framework will we need for the course? How do you estimate bandwidth? How is energy transmitted through an energy guiding system?
	24 Apr 2020	**Modulation – impressing information** 1. Analog vs digital modulation 2. Introduction to amplitude modulation and frequency modulation	How is information encoded? Which is a better modulation method?
2	27 Apr 2020	**Review of EM waves & Optics** 1. Maxwell's equations 2. Phase velocity and group velocity 3. Polarization of light 4. Interference of light 5. Polarization of the medium – linear & nonlinear	The wave nature of light. Aspects of the wave nature that are relevant to this course How does the medium respond to the light that propagates?
	29 Apr 2020	**The basics of the optical fiber** 1. Construction of an optical fiber 2. Mechanism of light guidance	The ray picture of light guidance. How easy is it to get light into a fiber? How is light guided within a fiber?
	1 May 2020	**Types of optical fiber** 1. Step-index and graded-index 2. Single-mode & multimode fiber	What effect does the construction of the fiber have on its properties?
3	4 May 2020	**Modes of a planar waveguide** 1. Modes of the waveguide 2. Propagation characteristics	How is the energy distributed? Does it matter?
	6 May 2020	**Modes of a circular waveguide** 1. Step-index waveguide 2. Propagation characteristics	How is the energy distributed in a fiber?
	8 May 2020	**Single-mode fibers (SMF)**	

4	11 May 2020	**Dispersion in fibers** 1. Waveguide dispersion 2. Material dispersion 3. Modal dispersion	Why can we not transmit at arbitrarily high data rates? What limits data rate?
	13 May 2020	**Losses in fibers** 1. Absorption & bend loss 2. Scattering loss	How can losses be minimized and the range be maximized?
	15 May 2020	**Power launching in fibers**	
5	18 May 2020	**Modulation of light** 1. Electro-optic phase modulation 2. Electro-optic intensity modulation	Impressing information on a carrier wave
	20 May 2020	**Semiconductors & pn junctions** 1. Electrons and holes – conduction band and valence band 2. The E-k diagram – origin and implication 3. Electro-luminescence - light emission 4. Photoconductivity – light detection	Why use semiconductors? How do electrons behave in a semiconductor? What is required to make electrons emit light? How is light detected?
	22 May 2020	**The laser diode** 1. Principle of operation of a laser 2. Important properties – spectrum, power, directionality	The basic principle of a laser
6	25 May 2020	**Modulation of laser diodes** 1. Amplitude modulation 2. Phase modulation	Direct current modulation of laser diodes
	27 May 2020	**Detection of light** 1. Principle of photodetection 2. Spectral response 3. Speed of response	What precisely does one detect? Can you detect all wavelengths? Can you detect very rapidly changing signals? What decides that?
	29 May 2020	**Photodetctors** 1. p-i-n photodiode 2. avalanche photodiode (APD)	How is light detection optimized?
7	1 June 2020	**Optical components** 1. Directional couplers 2. Wavelength division multiplexers	How are signals combined, routed, filtered in a network?
	3 June 2020	**Optical components contd** 1. Spectral filters – fiber Bragg gratings (FBGs)	How do you combine many signals? How do you separate different signals?
	5 June 2020	**Summary**	

Note:

1. An introductory session regarding the course will be held at 11 am on Monday 20 April 2020. We will use Google Meet for the meeting. Use the code "ee412" to join the meeting.
2. Instructor's details: Dr Arup Lal Chakraborty, Electrical Engineering, Email: arup@iitgn.ac.in, Tel: +91 7600 6545 76.