



**First Semester 2020-2021**  
**Course Handout (Part II)**

Date: 19/08/2020

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific detail regarding the course:

**Course No:** **EEE F426**  
**Course Title:** **Fiber Optics and Optoelectronics**  
**Instructor-in-charge:** **RAHUL SINGHAL**

**1. Course Description:**

Optical communication systems and components; optical sources and transmitters (basic concept, design and applications); modulators (electro-optic, acousto-optic and laser modulation techniques); beam forming; focusing and coupling schemes to optical repeaters; optical amplifiers; optical field reception; coherent and non-coherent light wave systems; fiber optic communication system design and performance; multichannel light wave systems; long haul communications; fiber optic networks.

**2. Scope & Objective:**

In the recent past, tremendous advances have been achieved in fiber optics and associated optoelectronics. These developments have made fiber - optic communication synonymous with the current worldwide revolution in information technology. This course aims at providing the students with a firm grounding in the major aspects of this emerging technology. Thus the course deals with the study of various building blocks of fiber optic systems, e.g. optical fibers, sources, detectors, modulators, optical amplifiers, etc. together with overall system design and performance analysis for communication applications.

**3. Text Book (TB):**

- Khare, R.P.: "Fiber Optics and Optoelectronics" Oxford University Press (2004)

**4. Reference Book (RB):**

- Keiser, G., "Optical Fiber Communications", 5/e, McGraw Hill, 2013

**5. Course Plan:**

Module	Lect. No.	Topic (s) to be covered	Reference to chapter of TB/RB	Learning Outcomes
I	1,2	A generalized configuration of a fiber optic system, Advantages, Role of fiber optic systems.	Chapter 1 (TB, RB)	Basic configuration of a fiber-optic system, Merits of FO system, Role-play in the sociological evaluation
	3, 4	Review of fundamental laws of optics, Ray propagation in step index fibers, Ray propagation in graded index fibers, Effect of material dispersion, Effect of multipath-dispersion and combined effect, Numerical problems	Chapter 2 (TB, RB)	Ray propagation through different types of optical fibers, Estimation of causes of pulse broadening, Calculation of different parameters of optical fibers





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II	5, 6, 7, 8	Maxwell's equations, Solution in an inhomogeneous medium, Planar optical waveguide, TE modes of a symmetric step index planar waveguide, Power distribution and confinement factor, Wave propagation in an ideal SI fiber, Modal power distribution in SI fibers, Wave propagation in GI fiber	Chapter 2 (RB), Chapter 3 (TB), Chapter 4 (TB)	Familiarization with the background for learning electromagnetic wave propagation, Modal analysis of planar optical waveguides, Modal analysis of cylindrical optical waveguide
III	9, 10, 11, 12	Propagation through Single mode fibers, Single mode fibers, Fabrication of low loss optical fibers, Design aspects of optical fiber cables and connections, Evaluating the performance of optical fibers	Chapter 2, 3, 14 (RB)	Characteristic parameters of SM fibers, Dispersion in SM fibers, Attenuation in SM fibers, Design of SM fibers and related problems, Fiber material requirements, Fiber fabrication methods, Fiber optic cables, connection and related losses, Characterization of optical fibers
IV	13, 14, 15, 16	Fundamental aspects of optoelectronic sources, Principle of operation of light emitting diodes(LED), Design aspects of LED, Principles of injection laser diode (ILD), Design aspects of ILD and source fiber coupling.	Chapter 4, 5 (RB)	Intrinsic and extrinsic semi-conductors, p-n junction, Life time and diffusion length of minority carriers, Current density and injection efficiency, LED, its internal and external quantum efficiency, Heterojunction, LED designs, ILD, condition for laser action, laser modes & laser action in semi conductors, ILD structures, Source Fiber coupling.
V	17, 18, 19, 20	Principle of operation and types of optoelectronic detectors.	Chapter 6, 7 (RB)	Basic principle of opto-electronic detection, Types of photodiodes
VI	21, 22, 23, 24	Review of basic principles of optoelectronic modulator, Electro optic effect and related modulators, Acousto-optic effect and related modulators	Chapter 9 (TB)	Polarization, birefringence, retardation plates, Electro optic modulators and related problems, Acousto-optic modulators & related problems.
VII	25, 26, 27, 28	Optical amplification and amplifiers	Chapter 11 (RB)	Semiconductor optical amplifiers, Erbium doped fiber amplifiers, Fiber Raman amplifiers
VIII	29, 30, 31, 32	Wavelength division multiplexing, Fiber- optic communication systems	Chapter 8, 9, 10, 13 (RB)	WDM & DWDM, Components, System design considerations, System architectures, Non-linear effects and system performance
IX	32,34, 35,36	Fiber Optic Sensors, Classification of Fiber optic sensors	Chapter 13 (TB)	Sensors based on fiber optic cable, sensing principles, Extrinsic and Intrinsic Sensors
X	37,38, 39,40	Intensity-, Phase-, Spectrally-Modulated Sensors, Distributed Fiber-optic Sensors.	Chapter 13 (TB)	Distinct Types of Sensors, Industrial Applications





#### 6. Evaluation Scheme:

EC. No.	Evaluation Component	Weightage (%)	Duration	Date, Time & Venue	Nature of Component
1.	Test-1	10	30 min.	TBA on Nalanda Coursepage	Open Book
2.	Test-2	10	30 min	TBA on Nalanda Coursepage	Open Book
3.	Test-3	10	30 min	TBA on Nalanda Coursepage	Open Book
4.	Quiz (Surprise)	20	(10-15 min) During or After Class		Open Book
5.	Assignment	10	TBA on Nalanda Coursepage		Open Book
6.	Comprehensive Exam	40	3 hrs.	02/12/2020 FN	Closed Book or Open Book

**7. Consultation Hour:** During working hours with prior appointment through email.

**8. Notices:** Notices concerning this course will be displayed on **Nalanda Coursepage**.

**9. Make-up Policy:** Make-up in Tests/ Comprehensive Examination shall be given for genuine reasons (e.g. medical, personal emergencies, etc.) on submission of documents, only if applied in advance to scheduled test/exam. **No make-up is allowed for quiz component** due to buffers as applicable.

**Instructor-in-Charge**

**EEE F426**

