First Semester 2015-2016
Course Handout (Part II)

Date: 03/08/2015

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 & Optoelectronics**
Instructor-in-charge : **RAHUL SINGHAL**

1. Course Description:

Theory of optical fibers, image transmission by fibers, technology of fiber production, fiber testing, characterization of optical fibers, detectors and sources for fiber optic systems; active fibers, applications of optical fibers; optoelectronic devices and applications.

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 undergraduates 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 as well as sensing.

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:

Lect. No.	Topic (s) to be covered	Learning Objectives	Reference to chap/ sec. of TB
1	A generalized configuration of a fiber optic system, Advantages, Role of fiber optic systems.	Basic configuration of a fiber-optic system, Merits of FO system, Roleplay in the sociological evaluation	Chap1./Sec 1.1 - 1.3,1.4, 1.5-1.6
2, 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	Ray propagation through different types of optical fibers, Estimation of causes of pulse broadening, Calculation of different parameters of optical fibers	Chap2/Sec.2.2, Sec 2.3, Sec. 2.4, Sec. 2.5, Sec. 2.6, RQ. of Chap2

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, Numerical Problems	Familiarization with the background for learning electromagnetic wave propagation, Modal analysis of planar optical wave guides	Chap3/Sec. 3.2, Sec. 3.3, Sec. 3.4, Sec. 3.5, Sec. 3.6, RQ. of Chap3
9, 10, 11	Wave propagation in an ideal SI fiber, Modal power distribution in SI fibers, Wave propagation in GI fiber	Modal analysis of cylindrical optical waveguide	Chap 4/Sec 4.2, Sec. 4.3, Sec. 4.4
12, 13, 14	Propagation through Single mode fibers, Single mode fibers	Characteristic parameters of SM fibers, Dispersion in SM fibers, Attenuation in SM fibers, Design of SM fibers and related problems	Chap 5/ Sec.5.2-5.3, Sec. 5.4, Sec. 5.5, Sec. 5.6 & RQ. of Chap5
15, 16, 17	Fabrication of low loss optical fibers, Design aspects of optical fiber cables and connections, Evaluating the performance of optical fibers	Fiber material requirements, Fiber fabrication methods, Fiber optic cables, connection and related losses, Characterization of optical fibers	Chap6/Sec. 6.2, Sec. 6.3, Sec. 6.4 – 6.7, Sec 6.8
18, 19, 20, 21, 22, 23, 24	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.	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.	Chap7/Sec. 7.2 and 7.3, Sec.7.4, Sec. 7.5, Sec. 7.6, Sec 7.7, Sec. 7.9, Sec. 7.10, & RQ. of Chap7
25, 26	Principle of operation and types of optoelectronic detectors.	Basic principle of opto-electronic detection, Types of photodiodes	Chap8/Sec. 8.2 to 8.3, Sec 8.4, & RQ. of Chap8.
27, 28, 29	Review of basic principles of optoelectronic modulator, Electro optic effect and related modulators, Acousto-optic effect and related modulators	Polarization, birefringence, retardation plates, Electro optic modulators and related problems, Acousto-optic modulators & related problems.	Chap9/Sec. 9.1 & 9.2, Sec 9.3, Sec. 9.4.
30, 31, 32	Optical amplification	Semiconductor optical amplifiers, Erbium doped fiber amplifiers, Fiber Raman amplifiers	Chap.10/Sec 10.2, Sec. 10.3, Sec. 10.4
33, 34	Wavelength division multiplexing	WDM & DWDM, Components	Chap. 11/Sec. 11.2 – 11.3, Sec. 11.4
35, 36, 37	Fiber- optic communication systems	System design considerations, System architectures, Non-linear effects and system performance	Chap. 12/Sec. 12.2, Sec.12.3, Sec. 12.4 – 12.5
38, 39, 40	Fiber optic sensors (FOS)	Classification of FOS, Intensity-modulated FOS, Phase-modulated and spectrally-modulated FOS, Distributed FOS and Smart Structures	Chap. 13/Sec. 13.2 – 13.4, Sec. 13.5 – 13.6, Sec. 13.7- 13.9

6. Evaluation Scheme:

EC. No.	Evaluation Component	Weightage	Duration	Date, Time & Venue	Nature of Component
1.	Mid Semester Test	30	90 min.	7/10 8:00 - 9:30 AM	CB/OB
2.	Quiz	20	Regular (Details in Class)		CB/OB
3.	Assignment	10	Details in Class		
4.	Comprehensive Exam	40	3 hrs.	5/12 FN	CB+OB

7. Chamber Consultation Hour: To be announced in the class.

8. Notices: Notices concerning this course will be displayed on EEE Notice Board or on *nalanda.bits-pilani.ac.in.*

Instructor-in-charge

EEE F426