Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2020-2021
Course Handout Part II

Date: 12-08-2020

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. **: EEE G591**

Course Title **: Optical Communication**

Instructor-in-charge**: Prasant Kumar Pattnaik**

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; focussing and coupling schemes to optical repeators; optical amlifiers; optical field reception; coherent and non-coherent lightwave systems; fibre optic communication system design and performance; multichannel lightwave systems; long haul communications; fibre
optic networks.

Course Description:

Basic concepts of optical Communication systems, linear and non-linear optical fibre characteristics, optical sources and transmitters (design, performance), modulator (direct/indirect), optical coupling/distribution, optical amplifiers, coherent light wave system, long-haul and distribution optical communication systems, WDM & TDM light wave system, soliton based communication system and new advances in optical communication.

Scope and objective of the course:

This course is intended for a specialized degree of communication engineering/Science students at senior levels. This course covers a detailed discussion on optical communication concepts, components, system and applications. The goal of this course is to enhance the basics and concepts of optical communication system design

1. **Text Book :**
   Govind P. Agrawal, "Fiber-optic Communication Systems" Third Edition, John Wiley 2002.

2. **Reference Books :**
   i) RB1: Harold Kolimbris, "Fiber Optic Communications", Pearson Education, 2008.

ii) RB2: Gerd Keiser, “Optical Fiber Communications”, McGraw Hill Education (India) Pvt. Ltd., Fifth Ed., 2013

iii) RB3: Rajiv Ramaswami, Kumar N. Sivarajan, “Optical Networks-A Practical Perspective”,Morgan Kaufmann Pub. Second Ed.,2004

3. **Course Plan:**

L No.	**Learning Objective**	**Topic to be Covered**	**Ref*.Chap/ Sec./ (Book)**
1.	Introduction; Concept of field propagation in optical fibres	Optical Confinement, cutoff condition, single mode/multimode concept.	1,2(T)
2.	Concept of field absorption, scattering, loss	Fiber loss, linear scattering	2(T)
3.	Concept of pulse broadening and bandwidth limitation	Dispersion in fibers	2(T)
4.	Concept of dispersion reduction and B.L optimization.	Zero dispersion concepts, DSF, DFF	Class discussions Ch.3 (R2)
5.	Nonlinear effects in optical fibers	SRS,SBS,SPM,XPM,FWM	Class, 12 (R2)
6.	Concepts of dispersion compensation	Dispersion management, FWM Tech.	3.3 (R2)
7.	Concept of semiconductors sources	LED & ILD	5.3 (R1), 3 (T)
8.	Concepts of optical gain	Laser modes, laser action, mode selection	Class, 3(T)
9.	Concept of high speed S.C lasers	Chirping control, mode selection	Class, 6.6 (R2)
10.	Concept of Electo-Optic effect	Pockel effect & Kerr effect based devices	17 (R3)
11.	Concept of Acousto-Optic effect	Raman & Bragg modulators, deflectors	17 (R3)
12.	Concepts of Transmitter design.	Coherent light wave Transmitters	Class notes
13.	Concept of performance issues of transmitters	Reliability, Testing, chirping and performance study	Class notes
14.	Concept of photo detection	PIN,APD, MSM.	6(R1),4(T)
15.	Concept of optical receiver	Receiver design, S/N Estimation, Digital optical receivers	10(T) Class
16.	---Do---	Digital receiver sensitivity (Coherent receivers)	6.3-6.4(R1) 10(T)
17.	Concept of receivers performance	Design issues, S/N and BER optimization.	10(T),6.4, 6.5 (R1)
18.	Concept of receivers overview	Practical receiver discussion	Class,10(T)
19.	Concept of Semiconductor laser amplifier	SLA	6(T)
20.	Concept of active fiber amplifiers	SRA, SBS	6(T)

21.	Concepts of Doped fiber amplifiers	EDFA	6(T), Class notes
22.	Concept of light wave amplifier systems.	Design and application of amplifiers	6 (T)
23.	Concept of light wave communication systems	Design issues of communication systems	Class
24.	Concept of design Power penalty	Power penalty estimation and reduction approaches.	5.4 (T)
25.	Concept and design guide-lines for optical link	Power penalty considerations and link budget.	5.4 (T)
26.	Concept of optical network and system architectures	Different topologies used in optical network	8 (R1),6(R3)
27	Concept of Optical Networks	Optical LAN , WANS, SONET/SDH	8 (R1),6(R3)
28.	Concept WDM light wave system	Channel spacing decision, multipliers, design issues	8(T)
29.	Concept of WDM system components	couplers/routers/switches	8(T)
30.	--Do --	Optical filters	Class, 10 (R2)
31.	Concepts of WDM Transmitters/Receivers	Practical Transmitters /Receivers	Class,11 (R1)
32.	Concept of WDM system performance	Linear and Nonlinear effects	8(T)
3335	Concepts of WDM Networking	WDM Network routing/management	8(R3)
36	Concept of time division multiplexing	Optical TDM techniques.	7.4 (R1)
37	Concept of soliton communication	Soliton Generation	19 (R2), 9(T) 7.10 (T)
38	--Do--	Soliton Interaction	9(T)
39	--Do--	High capacity soliton systems and jitter reduction	9(T)
40	Concept of WDM soliton system	Soliton Multiplexing techniques	Class notes
41	To learn new development in optical communication	New trends in optical communication	R3,Class notes
42	------Do-----	Networking, communication	R3,Class notes

3. List of Experiments

S. No	Experiment/ Activity Name	Schedule
1.	Modes in Multimode fiber	August 24 – August 29
2.	Single Mode Fiber - Dispersion Effects	August 31- September 5
3.	Non-linear effects in Single Mode fiber	September 7 – September 12
4.	LASER Characteristics	September 14 – September 19
5.	PIN and Avalanche Photodiode Characteristics	September 21 – September 26
6.	Power Budget of Fiber Optic Link	September 28 – October 3
7.	PROJECT WORK	October 5 – October 17
8.	Rise Time / Dispersion Budget of Fiber	October 19 – October 24

	Optic Link	
9.	Optical Amplifiers - EDFA - Characteristics	October 26 – October 31
10.	Design of Fully compensated OOK link	November 2 – November 7
11.	WDM and OTDM Link Design and Demultiplexing	November 9 – November 14
12.	Design of QAM Transmitter and Receiver	November 16 – November 21
13.	PROJECT WORK	November 23 – November 28

4. Evaluation Scheme:

Component	Duration	Percentage	Marks	Date & Time	Evaluation type
Test-1	30 min	10%	30	To be announced	Open Book
Test-2	30 min	15 %	45	To be announced	Open Book
Test-3	30 min	15 %	45	To be announced	Open Book
Regular Labs	--	10%	30	-----	Open Book
Project	--	20%	60	-----	Open Book
Compre. Exam.	2 hours	30%	90	07/12 FN	Closed Book
Total			**300**		

5. Chamber Consultation Hour: To beannounced in the class

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6. Notices: All course related notice will be displayed in **CMS**

7. Make-up Examination:

No make-up will be given for project work.However, for Tests and Comprehensive Examination, make-up examination will be given only in **extremely genuine cases** for which prior permission of the instructor-in-charge is required.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and any mode of academic dishonesty will not be acceptable.

Dr. Prasant Kumar Pattnaik
Instructor-in-charge
EEE G591