Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electronics and Communication Engineering

BEC701 Fibre Optic Communication

Seventh Semester, 2015-16 (Odd Semester)

Course (catalog) description

This course is intended to bring to the students the information necessary to understand the design, operation and capabilities of fiber systems. Students will be introduced to the fundamental concepts of various optical components. Latest topics are included to keep in touch with the recent trends

Compulsory/Elective course: Compulsory for ECE students

Credit hours **:** 3 credits

Course Coordinator **: Ms.K.Subbulakshmi**,Asst.Professor,Department of ECE

Instructor(s) **:**

Name of the instructor	Class handling	Office location	Office phone	Email (domain: @bharathuniv.ac.in)	Consultation
Ms.K.Subbulakshmi	IV ECE			Subbulakshmi @bharathuniv.ac.in	12.45-1.15 PM
Ms S.Arulselvi	IV ECE			arulselvi.ece @bharathuniv.ac.in	12.45-1.15 PM

Relationship to other courses

Pre-requisites : BEC703-Microwave Engineering

Assumed knowledge : Basic Knowledge in Optical fibre fundamentals and communication

Following courses : BET603-Telecommunication Switching Systems

Syllabus Contents

UNIT 1 INTRODUCTION TO OPTICAL FIBER **9 HOURS**

Evolution of fiber Optic system – Element of an Optical Fiber Transmission link – Ray Optics – Optical Fiber Modes and Configurations – Mode theory of Circular Wave guides – Overview of Modes – Key Modal concepts – Linearly Polarized Modes – Single Mode Fibers – Graded Index fiber structure

UNIT 2 SIGNAL DEGRADATION IN OPTICAL FIBER **9 HOURS**

Attenuation – Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides – Information Capacity determination – Group Delay – Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers – Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers – Mode Coupling – Design Optimization of SM fibers – RI profile and cut-off wavelength.

UNIT 3 FIBER OPTICAL SOURCES **9 HOURS**

Direct and indirect Band gap materials – LED structures – Light source materials – Quantum efficiency and LED power, Modulation of a LED, Laser Diodes – Modes and Threshold condition – Rate equations – External Quantum efficiency – Resonant frequencies – Laser Diodes structures and radiation patterns – Single Mode lasers – Modulation of Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers.

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UNIT 4 FIBER OPTICAL RECEIVERS **9 HOURS**

PIN and APD diodes – Photo detector noise, SNR, Detector Response time, Avalanche multiplication Noise – Comparison of Photo detectors – Fundamental Receiver Operation – pre-amplifiers - Error Sources – Receiver Configuration – Probability of Error – The Quantum Limit.

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UNIT 5 DIGITAL TRANMISSION SYSTEM **9 HOURS**

Point-to-Point links – System considerations – Fiber Splicing and connectors – Link Power budget – Rise-time budget – Noise Effects on System Performance – Operational Principals of WDM, Solutions.

TOTAL 45 HOURS

TEXT BOOK(S) AND/OR REQUIRED MATERIALS

TEXT BOOK

T1.Gerd Keiser, —Optical Fiber Communications Tata McGraw– Hill education private Limited, New Delhi, fifth Edition, 2008, Reprint 2009.

REFERENCES

R2 J. Senior, —Optical Communication, Principles and Practice , Prentice Hall of India, third Edition, 2004.

R3.J.Gower, —Optical Communication System , Prentice Hall of India, 2001

R4.Yarvi.A. QuantumEletronics , John Wiley 4th edition, 1995

Computer usage: Nil

Professional component

General	-	0%
Basic Sciences	-	40%
Engineering sciences & Technical arts	-	0%
Professional subject	-	60%

Broad area : Communication

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To learn the basic elements of optical fiber transmission link, fiber modes, configurations and structures, different kind of losses, signal distortion, SM fibers, optical sources, Materials and fiber splicing, fiber optic receivers ,noise performance in photo detectors, link budget, WDM, solitons and SONET/SDH network. This course emphasizes:	Correlates to program outcome		
	H	**M**	**L**
1. Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	a,h	C,f	-
2. Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers	c,g,j	a	b,i
3. Describe the principles of optical sources and power launching coupling methods	b,d,k	a,f	g
4. Compare the characteristics of fiber optic receivers.	b.d	a,i,k	
5. Design a fiber optic link based on budgets		e,f,g,k	b,i
6. To access the different techniques to improve the capacity of the system	f	d.g	

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
UNIT 1 INTRODUCTION TO OPTICAL FIBER			
1.	Introduction, Evolution of fiber Optic system	No	
2.	Element of an Optical Fiber Transmission link	No	
3.	Ray Optics	No	
4.	Optical Fiber Modes and Configurations	Yes	
5.	Mode theory of Circular Wave guides	Yes	[T1] chapter-1,2
6.	Overview of Modes, Key Modal concepts	Yes	[R1]chapter-3
7.	Linearly Polarized Modes	Yes	
8.	Single Mode Fibers	Yes	
9.	Graded Index fiber structure	Yes	
UNIT 2 SIGNAL DEGRADATION IN OPTICAL FIBER			
10.	Attenuation – Absorption losses	No	
11.	Scattering losses, Bending Losses, Core and Cladding losses	No	
12.	Signal Distortion in Optical Wave guides	No	
13.	Information Capacity determination – Group Delay	Yes	
14.	Material Dispersion, Wave guide Dispersion	Yes	[T1] chapter –3
15.	Signal distortion in SM fibers – Polarization Mode dispersion	Yes	[R1]chapter-3
16.	Intermodal dispersion, Pulse Broadening in GI fibers	No	
17.	Mode Coupling , Design Optimization of SM fibers	Yes	
18.	RI profile and cut-off wavelength	No	

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
UNIT 3 FIBER OPTICAL SOURCES			
19.	Direct and indirect Band gap materials	No	
20.	LED structures, Quantum efficiency and LED power	No	[T1] chapter – 4
21.	Modulation of a LED	No	[R1] chapter - 6
22.	Laser Diodes – Modes and Threshold condition – Rate equations	Yes	
23.	External Quantum efficiency, Resonant frequencies	Yes	
24.	Laser Diodes structures and radiation patterns	No	
25.	Single Mode lasers, Modulation of Laser Diodes	Yes	
26.	Temperature effects, Introduction to Quantum laser	No	
27.	Fiber amplifiers	No	
UNIT 4 FIBER OPTICAL RECEIVERS			
28.	PIN and APD diodes	No	
29.	Photo detector noise	No	
30.	SNR, Detector Response time	Yes	
31.	Avalanche multiplication Noise	Yes	[T1] chapter–7,6
32.	Comparison of Photo detectors	No	[R1] chapter–2
33.	Fundamental Receiver Operation	No	
34.	Pre-amplifiers, Error Sources	No	
35.	Receiver Configuration	No	
36.	Probability of Error – The Quantum Limit	Yes	
UNIT 5 DIGITAL TRANMISSION SYSTEM			
36.	Point-to-Point links	No	
37.	System considerations	No	
38.	Fiber Splicing	No	
39.	Fiber connectors	No	[T1] chapter– 8,11
40.	Link Power budget	Yes	[R1] chapter-9
41.	Rise-time budget	Yes	
42.	Noise Effects on System Performance-Modal noise, Partition noise	No	
43.	Chirping and Reflection noise	No	
44.	Operational Principals of WDM	No	
45.	Solitons	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	10%
Cycle Test – II	-	10%
Model Test	-	25%
Attendance	-	5%
Final exam	-	50%

Prepared by: K.Subbulakshmi, Assistant Professor, Department of ECE **Dated :**

Addendum

ABET OUTCOMES EXPECTED OF GRADUATES OF B.TECH / ECE / PROGRAM BY THE TIME THAT THEY GRADUATE:

a) An ability to apply knowledge of mathematics, science, and engineering fundamentals.
b) An ability to identify, formulate, and solve engineering problems
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) An ability to design and conduct experiments, as well as to analyze and interpret data
e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
f) An ability to apply reasoning informed by a knowledge of contemporary issues
g) An ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
h) An ability in understanding of professional and ethical responsibility and apply them in engineering practices
i) An ability to function on multidisciplinary teams
j) An ability to communicate effectively with the engineering community and with society at large
k**)** An ability in understanding of the engineering and management principles and apply them in Project and finance management as a leader and a member in a team.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: To provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Electronics And Communication Engineering.

PEO2: To enhance the skills and experience in defining problems in Electronics And Communication Engineering design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: To enhance their skills and embrace new Electronics And Communication Engineering Technologies through self-directed professional development and post-graduate training or education

PEO4: To provide training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: Apply the ethical and social aspects of modern communication technologies to the design, development, and usage of electronics engineering.

Course Teacher	Signature
Ms.K.Subbulakshmi	
Ms S.Arulselvi	

Course Coordinator	Academic Coordinator	Professor In-Charge	HOD/ECE
(Ms.K.Subbulakshmi)	( )	(Dr.)	(Dr.M.Sundararajan)