Course Specification
(Bachelor)

Course Title: Fiber Optics
Course Code: PHYS 0433
Program: BSc in Physics
Department: Physics
College: Science
Institution: Majmaah University
Version: 2
Last Revision Date: 30/12/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3,0,0)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Elective Course level/ year)					
4. Course General Description:					

This course provides students foundations of Fiber optics Technology and Basic knowledge of light, Ray representation of light, Fiber optic types, transmission characteristics: attenuation and dispersion, Bit rate and distance limits: link budget calculations, Light sources: LEDs and Semiconductor Lasers, Light detectors: PIN and APDs, Digital transmission: PDH, SDH/SONET, WDM systems.

Major Instructional Areas

1. Fiber optic communication and advantages of fiber optics
2. Basic theory of light propagation in optical fibers
3. Different varieties of optical fibers, attenuation and dispersion in fibers, and cabling
4. Light sources: diode laser and LEDs and optical transmitters
5. Photo detectors: p-i-n and avalanche photodiodes and optical receivers
6. Connectors and splices for joining fibers and directional couplers
7. Single channel fiber optic link design, signal-to-noise ratio, bit-error-rate calculation, power and rise-time budget calculation
8. Erbium doped fiber amplifiers, optical repeaters, and dispersion compensation
9. Time and wavelength division multiplexing and demultiplexing and multi-channel systems

5. Pre-requirements for this course (if any)**:**

Physical optics PHYS 0332

6. Co-requisites for this course (if any)**:**

NA

7. Course Main Objective(s):

The students after the completion of this course would be able to:

1. Analyze the need for fiber-optic communications.
2. Describe optical fibers, their properties, and basic fiber-optics components.
3. Describe the role of light sources and optical transmitters in converting electrical signals to optical form in a fiber-optic system.

4. Describe the role of photodetectors and optical receivers in converting optical signals to electronic form in a fiber-optic system.
5. Analyze the role of various passive and active components that are used to manipulate optical signals in fiber-optic systems.
6. Explain how fiber-optic components are assembled into systems to provide communication and network services.
7. Analyze design considerations for single-channel optical systems to meet loss and bandwidth requirements.
8. Describe the importance and use of multi-channel fiber-optic systems.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45 hours	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning	0	0

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45 hours**
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		**45 hours**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.2	• Learn light propagation in an optical fiber and identify the	**K (2):** Recognize the basic knowledge of fundamental concepts in	Lecture	Exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	various types of optical fibers.	fiber optics and its application.	Exercises Quizzes Problem solving	Quizzes Homework Assignments
1.3	• Determine the dispersion characteristics for various types of optical fibers and Discuss fiber losses and loss mechanism.	**K (3):** Understand the importance of physics laws for light spread in fiber optics.		
2.0	**Skills**			
2.2	• Learn the principle of operation of optical detector – PIN photodiode and evaluate a typical fiber optics transmitter and receiver.	**S (2):** Develop the skill for analysing/solving the physics-based problems in the fields of fiber optics. S (3) Analyze the need for fiber-optic communications.	Oral quizzes Class discussion Class Activity	Exams Homework Assignments Presentations
2.3	• Calculate and design of link budgets of fiber optic networks and architectures.			
3.0	**Values, autonomy, and responsibility**			
3.2	• Present a short report in a written form and orally using appropriate scientific language	**V (2):** Learn how to collect and classify the required topics using internet communication tools.	Give time bound task.	Observation Group discussion

C. Course Content

No	List of Topics	Contact Hours
1.	• Optical Fibers: Basics of light, and ray representation of light. Fiber optic types: Step index fiber, graded index fiber, multimode fiber, single mode fiber. • Signal degradation in Optical Fibers: Transmission characteristics of fibers: attenuation and dispersion	9 hours
2.	• Bit rate and distance limits: Link budget calculations.	6 hours

	• Optical Sources: Photon matter interaction, spontaneous and stimulated interaction.	
3.	• spontaneous and stimulated interaction. • Light Emitting Diode LED, structure, characteristics, quantum efficiency, modulation bandwidth, source to fiber power launching.	6 hours
4.	• Semiconductor Laser source, structure, characteristics, heterostructure, modulation bandwidth. • Photodetectors: Light detection, photodetector noise, detector response time, PIN photodetector.	9 hours
5.	• Avalanche photodiode, Avalanche multiplication, structure, temperature effect on Avalanche gain, comparison of photodetectors. • Optical Amplifiers: Optical amplifiers, Raman amplifier, erbium doped fiber amplifier.	6 hours
6.	• WDM Concepts and Components: Wavelength division multiplexing. • Optical fiber components, fiber couplers, fiber isolator, fiber Bragg grating, Intensity and phase modulators. • Optical networks	9 hours
Total		**45 hours**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First Mid-Term exam	Week #6	**15%**
2.	Second Mid-Term exam	Week #11	**15%**
3.	E-learning quizzes	Once/ semester	**10%**
4.	Presentation	Once/ semester	**20%**
5.	Discussions	Every week	
6.	Home Work	Every week	
7.	Final exam	End of the semester	**40%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• **"Understanding Fiber Optics, 2012** (Custom 5th ed.). Author's: Hecht, J. Boston, MA: Pearson Custom.2012 • **"Optical Fiber Communications",4th Edition,** 2011, Author's: Gerd Keiser, McGraw-Hill, 2011.
Supportive References	• **"Fiber optics communication"**, (5th ed.), 2004, Author's: Palais, J.C. Upper Saddle River, NJ: Prentice Hall. 2004. • **"Fiber Optic Communication Systems"**, 4th Edition, 2011, Author's: Govind P. Agrawal, Wiley; 2011.
Electronic Materials	• Saudi Digital Library (SDL) • https://www.wikipedia.org/ • Web of Knowledge • Physics Today (web version) • MIT Courseware • www.eagle.co.uk/news/ppnews.html • http://faculty.mu.edu.sa/ • http://vlib.org/physics.html • http://dir.yahoo.com/science/physics • http://demonstrations.wolfram.com • http://askthephysicist.com • http:// cyberphysics.co.uk
Other Learning Materials	• Excel software for drawing graphs. • MS Office for writing reports and presentations.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms, Physics Laboratory and computer with internet lab.
Technology equipment (projector, smart board, software)	Computer Lab. and internet lab, data show, Smart Board.
Other equipment (depending on the nature of the specialty)	Library with textbook for search and revision, Wi-Fi internet connections

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Internal Reviewer committee	Direct
Effectiveness of Students' assessment	Student Self-Assessment and Peer Assessment.	Indirect

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Peer Reviewer	Direct
The extent to which CLOs have been achieved	Internal Reviewer committee	Direct
Other	Internal Reviewer committee	Direct

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**16**
DATE	**30/12/2024**