47. Course Specification of Optical Communications

I. Course Identification and General Information:

1.	Course Title:	Optical Communications				
2.	Course Code & Number:	CNE426				
3.	Credit hours:	C.H.				Total C.H.
		Th.	Tu.	Pr	Tr.	
		2	2	2	-	4
4.	Study level/ semester at which this course is offered:	4^{th} Level/ 2^{nd} Semester				
5.	Pre –requisite (if any):	Electromagnetic Field Theory 2 (CNE212), & Communication Principles (CNE221)				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Communication Engineering and Networks				
8.	Language of teaching the course:	English				
9.	Location of teaching the course:	A class room in the Faculty of Engineering campus, Sana'a University				
10.	Prepared By:	Assoc. Prof. Mohammed A. Saeed Al-Mekhlafi				
11.	Date of Approval					

II. Course Description:

This course introduces the fundamental principles of optical communications. Topics include: Introduction to optical fiber communications, optical system components, optical fiber waveguides, ray and mode theories, optical fibers transmission characteristics, methods of manufacturing optical fibers and cables, optical sources and detectors, fiber connectors and couplers, optical receivers, analog and digital links, design of a simple optical fiber communication link, wavelength division multiplexing (WDM) concepts and operation, optical multiplexers, isolators and circulators, optical amplifiers, and optical networks.

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	III. Course Intended Learning Outcomes (CILOs)	Referenced PILOs
a1	Demonstrate knowledge and understanding of the key math, science and the fundamental principles of optics and light wave.	A1
a2	Demonstrate knowledge of contemporary issues that involve optical communication devices and systems.	A3
b1	Solve engineering problems that need optical communications devices and systems.	B1
b2	Evaluate the performance of the optical systems.	B2
c1	Apply the concepts of optical fibers and light wave to design optical communication systems.	C1
c2	Design optical fiber communication links using appropriate optical fibers light sources, detectors.	C2
d1	Recognize the need for and an ability to engage in life-long learning related to the field optical communications devices, links, and networks.	D2

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1- Demonstrate knowledge and understanding of key math, science and the fundamental principles of optics and light wave for analysis and design optical fiber communication systems.	▪ Lectures ▪ Class Discussions ▪ Problem Solving ▪ Demonstrations	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam
a2- Demonstrate knowledge of contemporary issues that involve optical communication devices and systems.	▪ Lectures ▪ Class Discussions ▪ Problem Solving ▪ Independent readings	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam

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(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Solve engineering problems that need optical communications devices and systems.	▪ Lectures ▪ Class Discussions ▪ Problem Solving ▪ Independent readings	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam
b2- Evaluate the performance of the optical systems.	▪ Lectures ▪ Class Discussions ▪ Problem Solving ▪ Projects	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam ▪ Written Reports

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1- Apply the concepts of optical fibers and light wave to design optical communication systems.	▪ Interactive Lectures ▪ Class Discussions ▪ Problem Solving ▪ Independent readings ▪ Projects	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam ▪ Written Reports
c2- Design optical fiber communication links using appropriate optical fibers light sources, detectors.	▪ Interactive Lectures ▪ Class Discussions ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam

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(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Recognize the need for and an ability to engage in life-long learning related to the field optical communications devices, links, and networks.	▪ Web-based Investigations ▪ Independent readings	▪ Written Reports

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Overview of Optical Fiber Communications	a1, b1, c2	Historical Development, General System, Optical Spectral bands, Elements of Optical Fiber Systems, Advantages and Applications of Optical Fiber Communications, Standards for Optical Fiber Communications	1	2
2.	Optical Fibers: Structures, Waveguides, and Fabrication	a1, a2, c2	The Nature of Light, Basic Optical Laws and Definitions, Optical Fiber Modes and Configurations, Mode Theory for Circular waveguides, Single-Mode Fibers, Graded-Index Fiber, Fiber Materials, Photonic Crystal Fibers, Fiber Fabrication, Fiber Optic Cables.	2	4
3.	Transmission Characteristics of Optical Fibers	a1, c2	Attenuation, Absorption, Scattering Losses, Bending Loss, Dispersion, Inter Modal Dispersion, Polarization.	1	2
4.	Optical Sources	a1, b1, c2	Light Emitting Diodes (LEDs), Laser Diodes, Line Coding, Light	1	2

			Source Linearity, Reliability Considerations.		
5.	Optical Detectors	a1, b1, c2	Photo Detectors, Photo Detector Noise, Response Time, Double Hetero Junction Structure, Photo Diodes, Comparison of Photo Detectors	1	2
6.	Fiber Couplers and Connectors	a2, b1, c1	Fiber Alignment and Joint Loss, Single-Mode Fiber Joints, Fiber Splices, Fiber Connectors, and Fiber Couplers.	1	2
7.	Optical Receiver	a2, b2, c1	Optical Receiver Operation, Receiver Sensitivity, Quantum Limit, Eye Diagrams, Coherent Detection, Burst Mode Receiver Operation, Analog Receivers.	1	2
8.	Analog Links	a1, c2	Overview of Analog Links, Carrier-to-Noise Ratio (CNR), Multichannel Transmission Techniques, RF over Fiber, Key Link Parameters, Radio-over-Fiber Links, Microwave Photonics.	1	2
9.	Digital Links	a1, c2	Point–to–Point Links, System Considerations, Link Power Budget, Resistive Budget, Short Wavelength Band, Transmission Distance for Single Mode Fibers, Power Penalties, Nodal Noise and Chirping.	1	2
10.	WDM Concepts and Components	a1, b1, c1, d1	WDM concepts, Overview of WDM Operation Principles, WDM Standards, Mach-Zehender Interferometer, Multiplexer, Isolators and	2	4

			Circulators, Direct Thin Film Filters, Active Optical Components, MEMS Technology, Variable Optical Attenuators, Tunable Optical Fibers, Dynamic Gain Equalizers, Optical Drop Multiplexers, Polarization Controllers, Chromatic Dispersion Compensators, Tunable Light Sources.		
11.	Optical Amplifiers	a1, b1, c1	Basic Applications and Types, Semiconductor Optical Amplifiers, EDFA,	1	2
12.	Optical Networks	a1, b1, c1, d1	Network Concepts and Topologies, Introduction to SONET/SDH Optical Networks, Optical Add/Drop Multiplexing, Optical Switching, SONET/SDH Rings	1	2
Number of Weeks /and Units Per Semester				**14**	**28**

B - Tutorial Aspect:

Order	Topic List	Number of Weeks	Contact Hours	Learning Outcomes
1.	Optical Fibers: Structures, Waveguides, and Fabrication	3	6	a1, a2, c2
2.	Transmission Characteristics of Optical Fibers	1	2	a1, c2
3.	Optical Sources	1	2	a1, b1, c2
4.	Optical Detectors	1	2	a1, b1, c2
5.	Fiber Couplers and Connectors	1	2	a2, b1, c1
6.	Optical Receiver	1	2	a2, b2, c1
7.	Analog Links	1	2	a1, c2
8.	Digital Links	1	2	a1, c2

9.	WDM Concepts and Components	2	4	b1, c1, d1
10.	Optical Amplifiers	1	2	a1, b1, c1
11.	Optical Networks	1	2	a1, b1, c1, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures
- Class discussions
- Problem Solving
- Projects
- Independent readings
- Web-based Investigations
- Demonstrations

VI. Assignments:

No	Assignments	Aligned CILOs	Week Due	Mark
1.	Problems on optical fibers: structures, waveguides, and fabrication	a1, a2, c2	4th	0.75
2.	Problems on transmission characteristics of optical fibers	a1, c2	5th	0.75
3.	Problems on optical sources	a1, b1, c2	6th	0.75
4.	Problems on optical detectors	a1, b1, c2	7th	0.75
5.	Problems on fiber couplers and connectors	a2, b1, c1	10th	0.75
6.	Problems on optical receiver	a2, b2, c1	11th	0.75
7.	Problems on analog and digital links	a1, c2	13th	0.75
8.	Problems on WDM Concepts and Components	a1, b1, c1, d1	15th	0.75
9.	Optical Amplifiers	a1, b1, c1	16th	0.75
10.	Optical Networks	a1, b1, c1, d1	17th	0.75
	Total			**7.5**

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VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments	4^{th} ,5^{th} , 6^{th} , 7^{th} , 10^{th} & 11^{th} 13^{th} , 15^{th}, 16^{th} , 17^{th}	7.5	5%	a2, b1, b2, c1, c2
2.	Quizzes	NA	15	10%	b1, b2, c1, c2
3.	Participation	Weekly	7.5	5%	a1, b1, c1, c2
4.	Midterm Exam	7^{th}	30	20%	a1, a2, b1, c1, c2
5.	Final Exam	16^{th}	90	60%	a1, a2, b1, b2, c1, c2
6.	In-class performance	NA	Extra 5 pts	Extra 5 pts	a1, b1, c1, c2
Total			**150**	**100%**	

VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1. Gerd Keiser, 2008, "Optical Fiber Communications," Fourth Edition, India, Tata McGraw-Hill.
2. John M. Senior, 2009, "Optical Fiber Communications: Principles and Practice," Third Edition, UK, Pearson Education Limited.

2- Essential References.

1. Joseph C Palais, 2004, "Fiber optic communication," Fourth Edition, UK, Pearson Education.

3- Electronic Materials and Web Sites etc.

1. Goggling the Internet

IX. Course Policies:

1.	**Class Attendance:**

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	A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.
3.	**Exam Attendance/Punctuality:** A student should attend the exam on time. He is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam-
4.	**Assignments & Projects:** The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time-
5.	**Cheating:** For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty-
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my given directly to students using soft or hard copy

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Asst. Prof. Dr. Nasser H. Almofari**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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