Academic Course Description

King Saud University
College of Engineering - Electrical Engineering Department

EE464: Optical Communications

Semester S2012

Compulsory/Elective course: Elective

Course (catalog) description:

Optical filters, power couplers/splitters, isolators, circulators, multiplexer, AWG, Bragg gratings, Single and Multi-mode fibers, Absorption and Attenuation, dispersion, polarization and birefringence, Laser; LED; Photodetectors, Modulators. Optical Amplifiers, Wavelength Division Multiplexers/de-multiplexers, Optical Switches, Electro-Optical Switches, Optical Routers, Optical Dispersion Compensators.
Fiber optic Single and multi-wavelength design: Multiplexing/de-multiplexing, point-to-point, Ring topology, Mesh, tree and bus topologies.

Introduction to Free Space optical communication, FTTH, Access, Metropolitan, long-haul and undersea networks, Optical Test and Measurement instruments**:** OTDR, Optical Spectrum Analyser, Broadband source, power-meter, Tunable Laser, Optical Return Loss Measurement, Dispersion measurement, cross-talk, passive and active devices characterization.

Pre-requisites: EE 423 **Co-requisites:** *None*

Textbook: **Optical Fiber Communications**, Gerd Keiser, McGraw Hill, Fourth Edition, McGraw-Hill Companies Inc. 2011. ISBN 978-0-07-338071-1

References: S.O. Kasap, "**Optoelectronics and Photonics Principles and Practices**", Prentice Hall, 2009.
2) Chin-Lin Chen, "**Building Electro-Optical Systems Making It All Work**", John Wiley & Sons Inc., New York, 2000.

Course Learning Outcomes:

1- Apply key math, science and engineering tools in the optical communication field for analysis or design issues.
2- identify, formulate and solve engineering problems that need optical communications devices and systems.
3- Recognition of the need for and an ability to engage in life-long learning related to the field optical communications devices, links, and networks.
4- Knowledge of contemporary issues that involve optical communication devices and systems.

Topics Covered:

Passive Optical Devices: thin film filters, power couplers/splitters, isolators, circulators, wavelength division multiplexer, Array Wave Guide gratings, Bragg gratings.
Optical Fibre: Single mode vs Multimode fibers, Absorption and Attenuation, Linear and non-linear scattering losses, dispersion, polarization and birefringence.
Active Optical Devices: Laser Source; Light Emitting Diodes; Photodetectors, External data modulators.

Optical Subsystems: Amplifiers (Erbium Doped Fiber and Raman Amplifiers, Semiconductor Optical Amplifiers), Wavelength Division Multiplexers/de-multiplexers, Optical Switches, Electro-Optical Switches, Optical Routers, Optical Dispersion Compensators.

Optical Systems and Networks: Single channel link design (Transmitter and Receiver choice, bandwidth and power/loss budget planning, amplification/Regeneration, dispersion management); and Multichannel design: Multiplexing/de-multiplexing, point-to-point, Ring topology, Mesh, tree and bus topologies. Moreover, this includes new emerging applications including, Free Space optical communication systems, FTTH, Access, Metropolitan, long-haul and undersea networks.

Optical Test and Measurement**:** OTDR, Optical Spectrum Analyser, Broadband source, power-meter, Tunable Laser, Dispersion measurement, cross-talk, passive and active devices characterization.

Class/Tutorial Schedule: Three lectures/one Tutorial per week with 50 minute for each.

Contribution to the Professional Component:

a) College level mathematics and basic sciences — 0.0 Credit hours.
b) Engineering Topics (science and/or design) — 3.0 Credit hours
c) General education — 0.0 Credit hours

Design experiences:

(1) Design optical Fiber Communication Link; (2) Design wavelength division multiplexer/de-multiplexer. Design of filters, multiplexers and fibers.

Relationship to ABET Learning Outcomes (a - k):

Outcome A: *Apply math, science and engineering*: The student is taught how he writes by himself the key equations describing light wave behaviors in a waveguide, defines and describes the design and engineering constraints and then determine the parameters and characteristics of a component, and illustrates a transfer function of a system or a module, etc.

Outcome E: *identify, formulate and solve engineering problems:* Most of the examples and problems call to specific real applications, that call the student to face a real engineering challenge, including identifying and formulating the key problems and issues and search for solution.

Outcome i: *recognition of the need for and an ability to engage in life-long learning:* This course is nurtured with a wide range of real life applications including fiber and free-space communications, optical transoceanic, national, metropolitan, and local area networks, healthcare and medical applications, military and security applications, industry sensing, solar energy, etc. The broad range of applications enables the student to recognize the need of the material in real life; in addition to provide him the tools for autonomous future discovery and long-life learning.

Outcome j: *knowledge of contemporary issues:* A large part of the applications are selected to deal with contemporary issues including the environment, pollution, green and renewable energy, safety, healthcare, communications etc.

Evaluation: There are two 2-hours mid-term exams and a three hour final exam. The grade distribution is as follows: First Mid-Term Exam (15%), Second Mid-Term Exam (15%), Homework and Quizzes (10%), Mini project (report and presentation: 20%), and Final Exam (40%). The total grades are 100%.

Weekly Teaching Plan

Week #	Deliverables	Learning outcomes
1&2	Ch1-Overview of Optical Fiber Communications	A and I
3&4	Ch2-Optical fibers	E and J
5	Ch3-Attenuation and Dispersion,	A and E
6&7	Ch4-Optical Sources & Ch7-Photodetectors and Receivers	E and J
8&9	Ch8-Digital Links	A and I
10&11	Ch10-WDM Concepts and Components	E and J
12&13	Ch13-Optical Networks	A and E
14&15	Ch14-Performance Measurement and Monitoring	I and J

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