PHOTONICS

1. KEY INDICATORS

CFU/ECTS: 6
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2. OBJECTIVES OF THE COURSE

The course provides a consistent knowledge of characteristics and design techniques of fiber optics components and systems for wavelength division multiplexing communication systems. Both class lectures and laboratory projects will be given. The student will acquire the expertise to design and to evaluate performance of most fiber optic communication systems.

3. ACQUIRED ABILITIES

The students wiil be able to design WDM (Wavelength Division Multiplexing) wide band fiber optical links and to evaluate their performance. Furthermore state of the art in the field of fiber optic communication systems will be presented by means of seminars given by invited experts of international level.

4. PROGRAM OF THE COURSE

Return-to-zero (RZ) and non-return-to-zero (NRZ) optical signals. Optical channel capacity. Multi-mode Fibers: propagation and multipath dispersion. Single-mode fibers: propagation characteristics, dispersion and limitations in optical communication systems. Bit-rate and link length product. Dispersion management. Fiber nonlinear optical effects. Fiber cables and connectors. Optical transmitter deisgn. Direct modulation. Frequency chirp. Intensity and mode partition noise, spectral linewidth. Source-fiber coupling, optical feedback and isolators, driving electronic circuits, integrated optic modulators. Receiver design: front-end, linear channel, data recovery. Receiver sensitivity and power penalties. Receiver performance measurements: eye-diagram, BER vs received power, sensitivity vs bitrate diagrams. Design and performance evaluation of a fiber optics communication system. Point-to-point fiber links and optical networks. Power and rise time budgets. Degradation of system performance and power penalty evaluation. Optical system CAD. Photonic switching systems. Wavelength division multiplexing systems: architectures, components and performance. Linear and nonlinear crosstalk. Optical amplifiers. Spectrum, bandwidth, gain saturation and noise. Semiconductor amplifiers. Erbium-doped fiber amplifiers: pumping schemes, gain spectrum characteristics: gain vs pump power, gain vs amplifier length. Amplifier noise. Sensitivity of an optical receiver with an optical pre-amplifier. Non uniformity gain equalization techniques. Cascaded in-line amplfiers. Outlines of Raman and Brillouin optical amplification.

5. REFERENCES

G. P. Agrawal, Fiber-Optic Communication Systems, 2nd edition, Wiley Interscience, 1997
B. E. A. Saleh, M. C. Teich, Fundamentals of Photonics, Wiley-Interscience, 1991

D. K. Mynbaev, L. L. Scheiner, Fiber Optic Communications Technology, Prentice-Hall, Inc., 2001.
B. Crosignani, G. De Marchis, Fibre Ottiche, Edizioni Scientifiche, SIDEREA, 1981
H. Nishihara, H. Masamitsu, S. Toshiaki, Optical Integrated Circuits, McGraw-Hill, 1989
H. Scott Hinton, An introduction to Photonic Switching Fabrics, Plenum Press, 1993
J. Powers, An Introduction to Fiber Optic Systems, Irwin, 1997
P. E. Green, jr., Fiber Optics Networks, Prentice Hall, 1993
Professor's notes and PP slides

6. Website of the Course

http://elearning2.uniroma1.it/course/view.php?id=91 (registration required)