Course Number : PHYS 485	**Course Title :** Photonics
Required / Elective : Elective	**Pre / Co-requisites :** -
Catalog Description: Maxwell's equations and light propagation. Interference, temporal and spatial coherence. Diffraction and diffraction gratings. Dielectric waveguides and optical fibers; dispersion in optical fibers. Polarization, interaction of light and matter. Light propagation in crystals; birefringence, optical activity. Electro-optic effects: Pockels and Kerr effects with electro-optic devices based on the Pockels and Kerr cells. Acousto-optic modulators and magneto-optic effect. Nonlinear optics and 2nd Harmonic Generation. Semiconductor fundamentals. Stimulated emission, gas lasers, semiconductor lasers, and laser amplifiers. Quantum wells, quantum dots, VCSELs, and holography. Semiconductor photon detectors.	**Textbook / Required Material :** Richard S. Quimby. *Photonics and Lasers, an Introduction*, Wiley, 2006.
Course Structure / Schedule : (3+0+0) 3 / 6 ECTS	

Extended Description :

Maxwell's equations, wave equation in free space and matter. Plane waves in matter, attenuation, and boundary conditions. Review of optics: Snell's law, reflection, refraction, diffraction, and interference. Planar waveguides: waveguide modes, mode velocities, mode patterns, and dispersion. Cylindrical waveguides: acceptance angle, numerical aperture, waveguide modes, mode patterns, single and multimode fibers. Losses in optical fibers: absorption, scattering, and bending losses. Optical fibers: mode coupling, cladding modes, step and graded index fibers. Dispersion in optical fibers: intermodal and intramodal dispersion. Fiber connections and diagnostics. Semiconductor physics: energy bands, valance band, conduction band, bandgap, emission and absorption processes, reduced zone scheme, direct and indirect gap materials, photodetectors, light emitters, radiative efficiency. Layered semiconductors: n-type, p-type semiconductors, p-n junctions, heterojunctions, metal-semiconductor junctions. Light sources: LED, laser diode. Optical detectors: thermal detectors, photon detectors. Photodiode detectors: biasing, output saturation, response time. Lasers and coherent light: laser operation, optical coherence. Optical communications: fiber optic communications systems, signal multiplexing, optical amplifiers.

Design content : Students design measurement setups for simple optical measurements.	**Computer usage**: Students use computational and graphics software in the analysis and presentation of their data obtained in the laboratory work and in the research towards their term papers.

Course Learning Outcomes [relevant program outcomes in brackets]**:**

On successful completion of this course students will be able to

1. demonstrate a knowledge of the nature and propagation of light in vacuum and matter [1, 2];
2. devise waveguiding of light and fiber-optics [1, 6];
3. outline the basics of semiconductor physics [1, 6];
4. describe how light can be produced and its properties can be determined [6];
5. discuss the operating principles of lasers [7];
6. develop an insight into optical communication systems and their operating principles [7];
7. perform simple measurements in optics [6, 11];
8. show an increased competence to effectively communicate an accomplished project in both written and verbal form [9].

Recommended reading:

Bahaa E. A. Saleh, Malvin Carl Teich, *Fundamentals of Photonics, 2nd Edition,* Wiley, 2007.

Teaching methods:

Lectures of approximately 3 hours per week, pre-readings, homework problems, laboratory work, and a term paper.

Assessment methods:

Two mid-term examinations, weekly homework assignments, quizzes, and a term paper.

Student workload:

Pre-reading	5 hrs
Lectures, discussions	45 hrs
Homework	25 hrs
Independent work	42 hrs
Laboratory work	5 hrs
Examinations	3 hrs
TOTAL ………………………………	**125 hrs … to match 25 x 5 ECTS**

Prepared by : İsmail Karakurt , 01.02.2010	**Revision Date :**