Sabanci University
Faculty of Engineering and Natural Sciences

EE 567: Nano-optics

Instructor: Kürşat Şendur **Office:** 1065 **Tel:** 9527
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Class Hours: Tuesday 08:40-11:30 (Synchronous)
In-Person Class Location: FASS G006

Zoom Link and ID:
https://sabanciuniv.zoom.us/j/97595641870?pwd=M3FnOGU2WWJBMGtiVXRrdG5DZENPQT09

Meeting ID: 975 9564 1870
Passcode: 567567

Text Book:

Principles of Nano-optics, Lukas Novotny and Bert Hecht, Cambridge University Press, 2006.

Reference Books:

1. *Nano-optics*, Satoshi Kawata, Motoichi Ohtsu, and Masahiro Irie, Springer, 2002.
2. *Surface Plasmons on Smooth and Rough Surfaces and on Gratings*, Heinz Raether, Springer-Verlag, 1988.
3. *Nanophotonics with Surface Plasmons*, Vlademir Shalaev and Satoshi Kawata, Elsevier, 2007.
4. *Tip Enhancement*, Satoshi Kawata and Vlademir Shalaev, Elsevier, 2007.
5. *Near-Field Optics and Surface Plasmon Polaritons*, Satoshi Kawata, Motoichi Ohtsu, and Masahiro Irie, Springer-Verlag, 2001.

Course Objectives:

- Understand the limitations of classical optical systems.
- Learn existing and emerging applications of nano-optics.
- Learn different operational modes of nano-optical microscopes.
- Understand the differences between various nano-optical probes, nano-waveguides, and nano-antennas.
- Gain hands-on experience in the modeling and design of simple nano-optical systems.

Course Overview:

Nano-optics is a rapidly growing field with the potential for many applications, including scanning near-field microscopy, data storage, nano-lithography, and bio-chemical sensing. The resolution and scanning time of scanning near-field optical microscopes are limited by spot size and transmission efficiency of the nano-optical systems. Therefore, advances in nano-optical transducers benefit scanning near-field optical microscopes and applications that utilize these microscopes. Near-field optical techniques that enhance localized surface plasmons are potential candidates to obtain intense optical spots beyond

the diffraction limit for optical data storage. The magnetic storage industry is also interested in sub-wavelength optical spots for heat assisted magnetic recording to overcome the superparamagnetic limit. The interaction of light with nanostructures reveals unique information about the structural and dynamic properties of matter, and is of great importance for biological and solid-state applications. In addition, intense sub-wavelength optical spots have potential applications in nanolithography and bio-chemical sensing. This course will cover nano-optical devices and transducers and their applications for manipulating light on the nanoscale. Interaction of light with nano-structures, thin-films, metallic nano-antennas has many potential applications. This course is intended to teach students the principals of nano-optics encountered in different applications.

Grading (Tentative):

The course work for this class has three main components: Homework assignments (4 or 5 assignments), one exam, and two computer projects that allow students to gain hands-on experience in the modeling of various nano-optical systems.

Homeworks: 25%
Exam : 30%
Project1: 25%
Project2: 20%

Tentative Syllabus:

01.03.2022 Week 01	Introduction
08.03.2022 Week 02	Examples of nano-optical systems and potential applications
15.03.2022 Week 03	A review of electrodynamics for nano-optics
22.03.2022 Week 04	Reflection and Transmission at Planar Interfaces
29.03.2022 Week 05	Polarization, Guided Waves, MATLAB Tutorial
05.04.2022 Week 06	Field propagators, paraxial approximation, Gaussian Beams, Laguerre-Gaussian Beams, Hermite-Gaussian Beams
12.04.2022 Week 07	Exam
19.04.2022 Week 08	Propagation and focusing of fields, Focusing near planar interfaces
26.04.2022 Week 09	Spatial resolution, principles of near-field microscopy
10.05.2022 Week 10	Spatial resolution, principles of near-field microscopy/ Nanoscale optical microcopy
17.05.2022 Week 11	Nano-optical probes
24.05.2022 Week 12	Optical Properties of Metals
31.05.2022 Week 13	A brief introduction to Surface Plasmons
07.06.2022 Week 14	Tutorial for Project