Sabanci University
Faculty of Engineering and Natural Sciences

EE 567: Nano-optics

Instructor: Kürşat Şendur **Office:** 1065 **Tel:** 9527

Class Hours: Monday 13:30-14:50 (Synchronous)
Wednesday 13:30-14:40 (Synchronous)

Zoom Link and ID:
https://sabanciuniv.zoom.us/j/98330535791?pwd=WjFPWjRmVndxRWVlWTloVVVucGxjUT09

Meeting ID: 983 3053 5791
Passcode: 093260

E-Mail: **sendur@sabanciuniv.edu**

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. Therefore, this course can be of interest for students in many departments. 4-5 homework sets and 2 projects will be assigned to students to apply their new knowledge of nano-optical systems in different applications.

Grading (Tentative):

The course work for this class has two main components: 1. Homework assignments, 2. Two computer projects that allow students to gain hands-on experience in the modeling of various nano-optical systems.

Homework:	30%
Project1:	40%
Project2:	30%

Tentative Syllabus:

The following is a tentative list of topics that will be covered in this course:

Week 1	Introduction
Week 2	Examples of nano-optical systems and potential applications
Weeks 3-4	A review of electrodynamics for nano-optics
Weeks 5-7	Propagation and focusing of fields/ MATLAB tutorial
Weeks 8-9	Spatial resolution, principles of near-field microscopy
Weeks 10	Nanoscale optical microcopy
Weeks 11	Nano-optical probes
Weeks 12-13	A brief introduction to Surface Plasmons