EC770 – Guided Wave Optoelectronics
Fall 2024

Instructor: Tianyu Wang (office: PHO 725, email: wangty@bu.edu**)**
Lecture time: Tue/Thu 3:30–5:15 pm,
Lecture location: 8 St. Mary's Street, PHO 207
Office hours: After each lecture, or by appointment.

Course Websites: https://learn.bu.edu
Search for: **24fallengec770_a1**

Course Description:

We will use both analytical and numerical methods to study the behavior of electromagnetic fields in material waveguides, as well as to understand how it depends on the geometry and material of the waveguides. Additionally, we will examine optoelectronic devices based on guided optical waves and explore their applications in communication, sensing, and computing.

Prerequisite: EC 560 Introduction to Photonics, or EC 565 Introduction to Electromagnetics and Photonics, or other equivalent courses offered by Physics (Please consult me if you are unsure).

Grading:

Homework	35%
Attendance	15%
Project I	20%
Project II	30%

Homework: There will be a total of 4 homework assignments.

Homework problems will be posted on the course website, and the posting of homework will be announced during lectures.

Your answers to homework problems should be submitted to the course website. Late homework will face 20% score deduction per day (e.g., if you should get 96%, you will get 96% - 20% = 76% if being submitted 1 day late, 56% for being 2-day late, and so on…)

Homework will be graded based on correctness and effort, and solutions will be posted on the course site.

Collaboration on Homework:

You are permitted to collaborate on homework, however each of you needs to submit your own original work. If you collaborate with someone also taking the class, both you and your collaborator should highlight the section you collaborated on and put your names. If you collaborate with someone outside the class, please also put the name of your collaborator. All students must comply with the University's Universal Academic Conduct Code:
http://www.bu.edu/academics/resources/academic-conduct-code/.

Lecture: In-person attendance at lecture is expected and will be graded. Absence without permission in advance will face 2% penalty in the final grade per lecture.

Handouts: I will use lecture notes rather than following a particular textbook. Lecture notes will be distributed on the course website.

Textbooks for reference (purchase is optional):

Jin, Jian-Ming. (2005) Theory and computation of electromagnetic fields (2nd ed.). J. Wiley-EEE Press.

Orfanidis, Sophocles. J. Electromagnetic waves and antennas (freely available for download in pdf).

Coldren, L. A. and Corzine, S. W. (2012) Diode Lasers and Photonic Integrated Circuits. John Wiley & Sons. ISBN: 9781118148167

Yariv, Amnon, and Yeh, Phochi. Photonics – optical electronics in modern communications (6th ed.) Oxford University Press. ISBN 978-0-19-517946-0

The Feynman Lectures on Physics: https://www.feynmanlectures.caltech.edu

Jackson, John D. (1999). *Classical Electrodynamics* (3rd ed.). New York: John Wiley & Sons. ISBN 978-0-471-30932-1.

Haus, Hermann. A. (1984) Waves and Fields in Optoelectronics. Princeton Hall. ISBN 0-13-946053-5

Joannopoulos, John D., Johnson, Steve G., Winn, Joshua N. Meade, Robert D. (2008) Photonic Crystals (2nd ed.). Princeton University Press. ISBN 978-0-691-12456-8

Tentative Syllabus (subject to change based on class size and student interest):

	Date		Topic
1	Sep 03, 2024	T	Introduction (HW1 release)
2	Sep 05, 2024	R	Practical vector calculus for Maxwell's equations
3	Sep 10, 2024	T	Wave equations, plane waves, spherical waves, and Green's functions
4	Sep 12, 2024	R	Maxwell's equations in materials and optical modes (HW2 release)
5	Sep 17, 2024	T	Theorems on optical modes; Fresnel equations
6	Sep 19, 2024	R	The analytical solution of optical modes in dielectric slab waveguides (HW1 due)
7	Sep 24, 2024	T	Dispersion (HW2 due; HW3 release)
8	Sep 26, 2024	R	Gain and loss in waveguides
9	Oct 01, 2024	T	Coupled mode theory
10	Oct 03, 2024	R	Coupling between guided modes: Bragg reflector (HW3 due)
11	Oct 08, 2024	T	Coupling to waveguides: fibers, gratings, and prisms (HW4 release)
12	Oct 10, 2024	R	Numerical simulation with finite difference methods
13	Oct 17, 2024	R	Simulation with Tidy3D / Lumerical (HW4 due; Project I announcement)
14	Oct 22, 2024	T	Multimode waveguides
15	Oct 24, 2024	R	Guest lecture 1: online tutorial on Tidy3D
16	Oct 29, 2024	T	Approximate method: beam propagation method
17	Oct 31, 2024	R	Project I presentation
18	Nov 05, 2024	T	Mach-Zehnder interferometers and its networks (Project II announcement)
19	Nov 07, 2024	R	Adjoint optimization and inverse design
20	Nov 12, 2024	T	Guest lecture 2: Prof. Selim Ünlü
21	Nov 14, 2024	R	Guest lecture 3
22	Nov 19, 2024	T	Flexible topic: more on optical computing?
23	Nov 21, 2024	R	Flexible topic: optical interconnects?
24	Nov 26, 2024	T	Flexible topic: nonlinear optics in waveguides?
25	Nov 28, 2024	R	Flexible topic: waveguide fabrication & materials?
26	Dec 03, 2024	T	Flexible topic: photonic crystals?
27	Dec 05, 2024	R	Project II presentation
28	Dec 10, 2024	T	Flexible topic: intro to quantum optics?