Department of Electrical Engineering
Indian Institute of Technology Kanpur

EE 798I: NANOPHOTONICS **2025-26 Odd Semester**

Instructor: Rituraj (rituraj@iitk.ac.in)

TAs:
Yasir Ahmad Bhatt (yasirab22@iitk.ac.in)

Lecture hours: Wed, Fri 9:00 – 10:15 in T111

Office hours: Mon 10:15 – 11:15 in ESB-2, 608.

Syllabus (tentative):

Part 1: Introduction to Maxwell's equations

- Different formulations of Maxwell's equations, Eigenvalue problem, Conservation laws and Symmetries
- Solutions of Maxwell's equations, Dispersion relation, Reflection, Refraction, Diffraction
- Light matter interaction, Lorentz-Drude model, Sources of EM waves and DoS

Part 2: Waveguides, Resonators, Periodic structures

- Dielectric slab waveguides, Surface plasmon polariton
- Photonic crystals, Bloch's theorem and band-structure, Defects and Resonances, Applications

Part 3: Making sensible Simplifications/Approximations

- Dispersion in single mode waveguide, Paraxial wave equation, Diffraction gratings
- Perturbation theory, Coupled mode theory, Scattering matrices and their properties

Part 4: Recent advances (topics to be selected based on students' feedback)

- Analog photonic computer, Passive edge detection
- Metamaterials (cloaking, perfect lens) and Metasurfaces (flat optics)
- Inverse design using adjoint gradient method, Transformation optics,
- Numerical methods (FDTD, FDFD, PWEM, RCWA etc.), COMSOL
- Light trapping in solar cells

Reference books:

1. "Waves and Fields in Optoelectronics", H. A. Haus
2. "Photonic Crystals: Molding the Flow of Light", Joannopoulos, Johnson, Winn and Meade

Grading Scheme (tentative):

Quiz (10%), Assignment (20%),

Class participation (5%)

Final presentation & Term paper (15%),

Mid Semester Examination (20%), End Semester Examination (30%)