

## **EE221 Physical Optics and Concepts of Modern Physics (4-0)**

2019 Fall, Monday: 8:45-10:30 / Wednesday: 8:45-10:30

**Text Books:** **Physics for Scientists & Engineers**  
**A strategic approach with Modern Physics**  
4<sup>th</sup> edition  
Randall D. Knight  
Pearson

**Fundamentals of Physics, Extended**  
Tenth edition  
D. Halliday, R. Resnick, J. Walker  
John Wiley & Sons, Inc.

**Physics for Scientists & Engineers with Modern Physics**  
Douglas C. Giancoli  
Prentice Hall

### **Additional Reading:**

**Işığın Öyküsü 2007**  
Prof.Dr. Hüseyin Gazi Topdemir  
Tübitak, Fizik

**Fundamentals of Photonics 2007**  
B.E.A. Saleh, M.C. Teich  
Wiley-Interscience

**Optics and Photonics 2008**  
F.Graham Smith  
Terry A. King  
Dan Wilkins  
John Wiley and Sons Ltd.

**Course Coordinator:** Dr. Kıvılcım Yüksel Aldoğan (office hours: **Wednesday, 10:30-12:00**)

**Assistants:** Enes Ataç (Office Hrs: **Wednesday 11:00-12:00, Thursday 15:30-16:30**),  
Ertunga B. Koçal (Office Hrs: **Monday 10:30-12:30**),  
Çağın Ekici (Office Hrs: **Tuesday 9:00-10:00, Wednesday 11:00-12:00**).

### **Grading**

Midterm..... 30 %  
Final Exam..... 40 %  
Quiz Score..... 30 %

**Quiz-1:** Maxwell's Equations, Interference and diffraction

**Quiz-2:** Special Theory of Relativity

**Quiz-3:** Quantum theory

During the semester, a total of six *Problem Sessions* will be held.

**Students are expected to attend at least 70% of the lectures and problem sessions**

## Contents

- 1) Maxwell's Equations and Electromagnetic Waves
  - a. Maxwell's equations
  - b. Wave equation
  - c. Electromagnetic wave spectrum
  - d. Poynting vector
  - e. Polarization (Jones Matrices)
- 2) Interference: Light as a Wave
  - a. Review of Ray model of light (reflection, refraction, dispersion, matrix method)
  - b. Huygens Principle and Diffraction
  - c. Interference
  - d. Coherence
  - e. Luminous Intensity
- 3) Diffraction
  - a. Diffraction by a single slit
  - b. Diffraction in the double slit experiment
  - c. Limits of resolution
  - d. Diffraction grating
- 4) Special Theory of Relativity
  - a. Galilean-Newtonian Relativity
  - b. Postulates of the Special Relativity
  - c. Simultaneity, Time dilation and the Twin Paradox
  - d. Length Contraction
  - e. Four-Dimensional Space Time
  - f. Lorentz Transformation
  - g. Relativistic Momentum and Mass
  - h. Energy and Mass
  - i. Doppler Shift for Light
- 5) Photon Theory of Light
  - a. Planck's Quantum Hypothesis
  - b. Photon Theory and Photoelectric Effect
  - c. Photons and Compton Effect
  - d. Photon Interaction; Pair Production
  - e. Wave Nature of Matter
- 6) Introduction to Quantum Theory
  - a. Quantum approach
  - b. The wave function and its interpretation
  - c. Double Slit Experiment
  - d. The Heisenberg Uncertainty Principle
  - e. Probability versus Determinism
  - f. The Schrödinger Equation in One Dimensional-Time independent

**Course plan:**

Week-1	Maxwell's Equations and Electromagnetic Waves	K. Yüksel
Week-2/1	Maxwell's Equations and Electromagnetic Waves	K. Yüksel
Week-2/2	Problem session-I (Maxwell Eqn.)	E.B. Koçal
Week-3	Interference: Light as a Wave	K. Yüksel
Week-4	Diffraction	K. Yüksel
Week-5/1	Applications of diffraction	K. Yüksel
Week-5/2	Problem session-II (Interference, diffraction)	E.B. Koçal
Week-6/1	QUIZ-1	E.B.K, E.A, Ç. E
Week-6/2	Review, Intro to Special Theory of Relativity	K. Yüksel
Week-7	Special Theory of Relativity	K. Yüksel
Week-8/1	Problem session-III (Special relativity)	E. Ataç
Week-8/2	Problem session-IV (Special relativity)	E. Ataç
Week-9/1	QUIZ-2	E.B.K, E.A, Ç. E
Week-9/2	MIDTERM	E.B.K, E.A, Ç. E
Week-10	Photon Theory of Light	K. Yüksel
Week-11	Photon Theory of Light	K. Yüksel
Week-12/1	Problem Session-V (Photon theory of light)	Ç. Ekici
Week-12/2	Introduction to Quantum Theory	K. Yüksel
Week-13	Quantum Theory	K. Yüksel
Week-14	QUIZ-3	E.B.K, E.A, Ç. E
Week-15/1	Problem Session-VI (Quantum theory)	Ç. Ekici
Week-15/2	Quantum Theory	K. Yüksel
Week-16	FINAL	E.B.K, E.A, Ç. E

**Note**

The instructor reserves the right to make changes to this syllabus as necessary.