Department of Physics

College of Education

Salahaddin University-Erbil

Subject: Optics I

Course Book – (Year 2)

Lecturer's name:

Assist. Prof. Dr. Saman Q. Mawlud

(PHD Nanoglass Materials Science)

Academic Year: 2023/2024

Course Book

1. Course name	**Geometrical Optics**
2. Lecturer in charge	**Dr. Saman Qadir Mawlud**
3. Department/ College	**Physics/Science**
4. Contact	**e-mail: saman.maulud@uor.edu.krd** **Tel:009647504789074**
5. Time (in hours) per week	**Theory: 2** **Practical: 1**
6. Office hours	**Monday from 9:00-11:00 AM or by an appointment**
7. Course code	
8. Teacher's academic profile	https://academics.su.edu.krd/saman.mawlud
9. Keywords	**Geometrical Optics, Concepts and theories** **Light Characteristics**

10. Course overview:

This course is titled "**Geometrical Optics**" but could as well have been titled "**Ray Optics**". It is an introductory course in optics, so in fact there is more "**Geometrical Optics**" in it. The chief purpose is for students to obtain a solid understanding of the basic principles of optics and to be familiar with the operation of most common optics branches. The course is taught in the classical approximation.

11. Course objective:

The goal of this course is to provide BSc. students with knowledge and understanding of fundamental aspects of geometrical optics. The course will give students a better understanding of a number of important phenomenon and topics in geometrical optics and will enable the students to:

1- Provide a good foundation in geometrical optics

2- Provide knowledge of the behaviour of light

3- Inspire interest for the knowledge of concepts in geometrical optics

4- Be able to formulate reasonably complicated problems in geometrical optics and provide solutions to the same

12. Student's obligation

A list of additional useful problems will be given to help the student further sharpen your understanding of the subject and your problem solving skills. The students are required to do these problems, although you may find it useful to do so. Because this subject is One course, so that the students are required to do at least two closed exams during this semester besides other assignments and each student must prepare full report at the end of the year. All exams have marks, full report also has marks, the classroom activities count marks and mark for attendance too.

13. Forms of teaching

Our lecture is depending directly on showing the strong point in the lecture via data show depending on the power point program… and solve problem on the white board with the students.

14. Assessment scheme

All exams have 20 marks, full report has 5 marks, the classroom activities count (Homework) has 10 and for Quiz 5 Marks. So that the final grade will be based upon the following criteria:

- Mid- semester exam: 10%
- Homework, Classroom participation and assignments: 2%
- Quiz: 3%
- Final Exam: 50%

15. Student learning outcome:

Geometrical optics plays a very important role in the physics field. During my years of experience teaching geometrical optics, I have noticed that students generally find it easier to learn its underlying ideas than to handle the practical aspects of formalism. What is true is that the students in the Physics department who were all selected after a stiff entrance examination, and whose ambitions in life were diverse in science, industry, business, in high public office all had to follow this introductory physics course. As a consequence, the challenge was to try to get them interested in the field whatever their future goals were. Of course, geometrical optics is an ideal subject because one can be interested in it for a variety of reasons, such as the physics itself, the mathematical structure of the theory, its technological spinoffs, as well as its philosophical or cultural aspects. So, the task was basically to think about the pedagogical aspects, in order to satisfy audiences that went up to many students during the last 10 years.

16. Course Reading List and References:

Textbook: A Textbook of Optics, N.S. Brijlal, S.Chand & Co. Ltd., New Delhi, 2009.

Books: There are many good introductory texts on Geometrical Optics, for example:

- Physical optics, A. K. Ghatak Tata McGraw Hill Publishing House Co. Ltd., New Delhi, 2006.
- Fundamentals of Optics by Jenkins A. Francis and White E. Harvey, McGraw Hill Inc. Magazines and review (internet)

17. The Topics:

CH1. Light

Introduction; Brief History; The Four Important Theories; The Sources of Light; Properties of Light; Refractive Index; Optical Path; Dispersion; Photons; The Dual Nature

CH2. Fermat's Principle and its Applications

Introduction; Fermat's Principle of Least Time; Laws of Reflection; Laws of Refraction; Law of Refraction at a Spherical Refracting Surface; The Thin Lens Formula

CH3. Reflection and Refraction

Introduction; Reflection at Plane Surfaces (Mirrors); Reflection at Spherical Mirrors; Graphical Method; Refraction of Light; Reflecting Prisms; Refraction at Spherical Surfaces; Lateral Magnification Longitudinal Magnification; Smith-Helmholtz Equation and Lagrange Law; Abbe's Sine Condition; Aplanatic Points of a Spherical Surface

CH4. Lenses

Introduction; Lenses; Terminology; Conjugate Points, Planes and Distances; Image Tracing; Location of the Image; Sign Convention; Thin Lens; Lens Equation; Lens Maker's Equation; Newton's Lens Equation; Magnification; Smallest Separation of Object and Real Image; Displacement of Lens when Object and Screen are fixed; Deviation by a Thin Lens; Power; Equivalent Focal Length of Two Thin Lenses, Thick Lens; Thick Lens Equation; Behaviors of Lens as Thickness increases; Glass Sphere as a Lens; Combination of Two Thick Lenses; Principal Planes in a Two-Lens System Move out when the Lenses are Separated;

CH5. Dispersion

Dispersion by a Prism; Refraction through a Prism; Angular Dispersion; Dispersive Power; Angular and Chromatic Dispersions

CH6. Lens Aberrations

Introduction; Aberrations; Spherical Aberration; Coma; Astigmatism; Distortion; Chromatic Aberration; Chromatic Aberration in a Lens; Achromatic Lenses; Conclusion; Gradient-Index Lenses

CH7. Optical Instruments

Introduction; The Eye; Camera; Objective and Eyepiece; Kellner's Eyepiece; Huygens Eyepiece; Ramsden Eyepiece; Comparison of Ramsden Eyepiece with Huygens Eyepiece; Gauss Eyepiece; Telescopes; Reflecting Telescope; Constant Deviation Spectrometer; Pulfrich Refractometer

CH8. Velocity of Light

Introduction; Galileo's Experiment; Romer's Astronomical Method; Fizeau's Method; Michelson's Method (Rotating Mirror Null Method); Kerr Cell Method; Anderson's Method; Houston's Method (Piezoelectric Grating Method)

18. Practical Topics (If there is any)

In this section, The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture

19. Examinations:

Q_1\ Choose the correct answer: **(16M.)**

1- When the angle between two plane mirrors is 30º the number of images will be:

(a) 12 (b) 10 (c) zero (d) 11

2- For a concave mirror, when the object is lies on focal point the magnification is:

(a) M=1 (b) M<1 (c) M=zero (d) M=∞

3- In case of a convex surface:

(a) R is negative, f_1 is negative and f_2 is positive (b) R is positive, f_1 is negative and f_2 is positive

(c) R is positive, f_1 is positive and f_2 is negative (d) R is negative, f_1 is positive and f_2 is negative

Q_2\ Answer the following: ***(12M.)***

A- Explain two of the following: **(8M.)**

1- Why an eyepiece should consist of two lenses?
2- The reasons which make Fizeau's method not very accurate for measuring the light velocity.
3- The main Fresnel assumptions for diffraction phenomena.

B- Write the important applications of: **(4M.)**

a. Zone plate
b. Thin film

Q_3\ Answer the following: **(8M.)**

A- Write the differences between each of the following: **(6M.)**

1- Photopic and Scotopic.
2- Kellner's and Huygens eyepiece in terms of cross wire.

B- Draw a diagram for Coude's and Cassegrain's reflecting telescope. **(2M.)**

20. Extra notes:

- Google Classroom Web site:
  https://classroom.google.com/c/MTU2NzQyNzAyMDcw?cjc=i4dkbuq

This site will reflect the latest changes and contain homework and reading assignments. Slides used for classes will be available for download before each class. If you want a hard copy of the slides, print them. You are required to read the notes prior to class.

- Per university policy and classroom etiquette;
  1- Mobile phones, iPods, etc. must be silenced during all classroom lectures. Those not heeding this rule will be asked to leave the classroom immediately so as to not disrupt the learning environment.
  2- Please arrive on time for all class meetings.
  3- Students who habitually disturb the class by talking, arriving late, etc., and have been warned may suffer a reduction in their final class grade.

21. Peer review

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing a few sentences in this section.

(A peer is a person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەرۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەرۆکی کۆرسەکە و واژووی لەسەر بکات.
هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.