LAPORAN AKHIR

HIBAH PENILISAN BAHAN AJAR PROGRAM PGSBI

JURUSAN PENDIDIKAN MIPA

FKIP UNSRI

BASIC OPTICS

Penulis

Taufiq, M. Pd

Apit Fathurahman, S. Pd., M. Si

Dibiayai dari DIPA No. 007/23-04.2/VI/2011 tanggal 20 Desember 2010

Universitas Sriwijaya sesuai dengan Surat Perjanjian Pelaksanaan Kegiatan Hbah Penulisan Bahan Ajar Program Hibah Pendidikan Guru Sekolah Bertaraf Internasional

Nomor : 30/PGSBI/UNSRI/2010

Tanggal : 11 Oktober 2011

Program Studi Pendidikan Fisika

JURUSAN PENDIDIKAN MIPA

FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN

UNIVERSITAS SRIWIJAYA

2011

LAPORAN AKHIR

HIBAH PENILISAN BAHAN AJAR PROGRAM PGSBI

JURUSAN PENDIDIKAN MIPA

FKIP UNSRI

BASIC OPTICS

Penulis

Taufiq, M. Pd
Apit Fathurahman, S. Pd., M. Si

Dibiayai dari DIPA No. 007/23-04.2/VI/2011 tanggal 20 Desember 2010

Universitas Sriwijaya sesuai dengan Surat Perjanjian Pelaksanaan Kegiatan Hbah

Penulisan Bahan Ajar Program Hibah Pendidikan Guru Sekolah Bertaraf Internasional

Nomor : 30/PGSBI/UNSRI/2010

Tanggal : 11 Oktober 2011

Program Studi Pendidikan Fisika

JURUSAN PENDIDIKAN MIPA

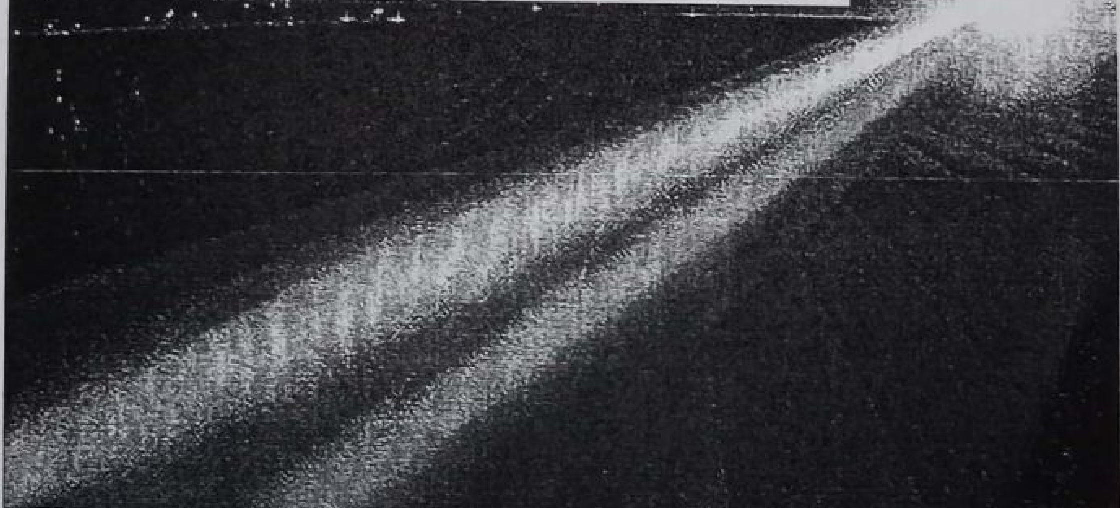
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN

UNIVERSITAS SRIWIJAYA

2011

BASIC OPTICS

PENULIS
TAUFIQ
APIT FATHURAHMAN



PROGRAM STUDI PENDIDIKAN FISIKA
JURUSAN PENDIDIKAN MIPA
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
UNIVERSITAS SRIWIJAYA
2011

LAPORAN HIBAH BAHAN AJAR

1.	Judul Bahan Ajar	: Basic Optics
2.	Ketua Penulis a. Nama Lengkap b. Jenis Kelamin c. Pangkat/Golongan dan NIP d. Fakultas/Jurusan e. Institut/Universitas f. Alamat Rumah g. Nomor Telepon/HP h. Email	 : Taufiq, M. Pd : Laki-laki : Penata Muda Tk I/III-b/197805252003121003 : KIP/P.MIPA : Sriwijaya : Jl. Insp. Marzuki Lr. Duku No. 2572 : 081271175243 : taufiq_pfisunsri@yahoo.com
3.	Jumlah Anggota Penulis	: 1 (satu)
4.	Lama Penulisan	: 3 Bulan/ dari Bulan Oktober sampai bulan Desember 2011
5.	Biaya yang diperlukan a. Sumber dari PGSBI b. Sumber lainnya Jumlah	 : Rp. 15.000.000 : - : Rp. 15.000.000 (Lima Belas Juta Rupiah)

Inderalaya, 2011

Menyetujui
Ketua UPPM

Dr. Ratu Ilma Indra Putri, M. Si
NIP 196908141993032001

Ketua Penulis

Taufiq, M. Pd
NIP 197805252003121003

Mengetahui

p. Dekan FKIP UNSRI

Prof. Drs. Tatang Suhery, M. A., Ph. D
NIP 195904121984031002

Direktur PGSBI

Dr. Hartono, M.A
NIP 196710171993011001

PREFACE

Short description: Optics is the branch of physics that deals with the origin and propagation of light, how to generate light, studying physical phenomena that are associated with it until the application-the application that can be explored from such phenomena.

The purpose of the courses: courses provide knowledge of optical production of light, optics, geometry, optical appliances, interference, coherence, polarization, diffraction, diffraction and laser level.

Standards of Competence: undergraduate students physics education expected to apply the concept of Optics in life everyday.

Enhanced Problem Solving

To help students learn how to solve problems, the number of worked Examples that correspond to intermediate-level problems has been greatly increased. Especially notable is a new two-column side-by-side example format that has been developed to better display the text and equation s in worked examples. Care has been ta ken to show the students a logical method of solving problems. Examples begin with strategies, and often diagrams, in a Picture the Problem prologue. When possible, the first step gives an equation relating the quantity asked for the other quantities. This is usually followed by a statement of the general physical principle that applies. Examples usually conclude with Remarks that discuss the problem and solution, and in many cases there are additional Check the Result sections that teach the student how to check the answer, as well as Exercises that present additional related problems, which students can solve on their own. Also new are innovative, interactive types of examples, each labeled Try it yourself. In these, students are told in the left column how to proceed with each step of the problem-solving process, but in the right column are given only the answer. Thus, students are guided through the problem, but must independently work through the actual derivations and calculations. A Problem-Solving Guide appears at the end of each chapter in the form of a summary of the worked examples in the chapter. The Problem-Solving Guide is designed to help students recognize types of problems and find the

right conceptual strategy for solving them. Concluding each chapter is a selection of approximately one
hundred Problems. The problems are grouped by type, which may or may not coincide with the section title s in the chapter. Each problem is designated easy, intermediate, or chal lenging. Qualitative questions and problems are integrated with quantitative problems within each group, in the hope that this organization will elevate the stature of qualitative problems in the minds of students (and instructors). At the back of the book, Answers are given to the odd-numbered problems. receding the answers for each chapter is a Problem Map that charts which odd-numbered intermediate-level problems correspond with worked exa mples in the text. Complete solutions to every other odd-numbered problem, worked out in the two-column example format, are available in the Solutions Manual for Students.

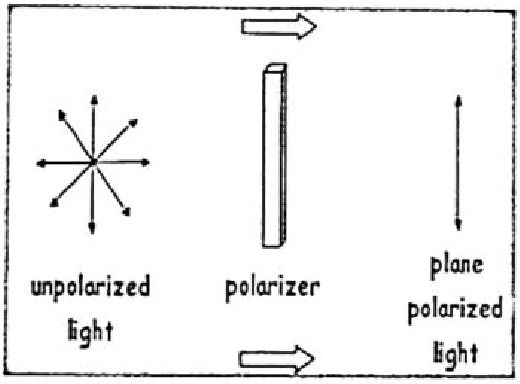
problems take students step by step through a problem without doing the math for them. The Problem-Solving Guide gives an overview of the techniques that have been demonstrated in the chapter. The Problem Map shows students who are having di fficulty where help may lie in the chapter but gives no other assistance. Student Interest Much effort has gone into making the written te xt more lively and informal. Students build their understanding of physics on the physics they've already learned, each concept serving as a building block that will provide the foundation for further inquiry. Over one hundred enthusiastic student reviews indicate that the changes in the fourth edition will successfully reach the widest range of students and will help them to enjoy learning and doing physics rather than focusing on the difficulty of the subject. To further stimulate th e interest of students, supplemental, brief " Exploring ..." sections offer essays on various topics of interest to science and engineering undergraduates.

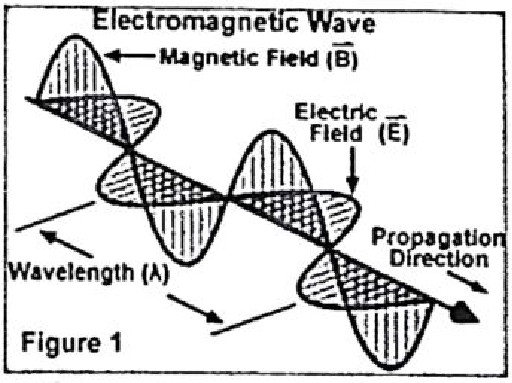
CONTENTS

Chapter 1. Light as an Electromagnetic Wave

The dual nature of light and the EM spectrum

Light can be described in two complementary ways: as particles, "photons", with the energy **E = hf** (see Atomic physics) or as electromagnetic waves which can travel i vacuum with "the speed of light", **c = fλ**. Different frequency or wavelength intervals represent different types of EM waves, such as radio waves, microwaves, infrared (heat) radiation, visible light (colours red -> violet), ultraviolet radiation, X-rays and gamma rays (see Waves, section 4.1.). The light as a wave motion can be described as oscillations of a magnetic field B and electric field E perpendicular to the direction of travel. For unpolarised light, these oscillations occur in all directions perpendicular to the direction of travel.





Sumber gambar: http://www.google.co.id/imgres

Fig 01a: E- and B-oscillations, unpolarised light

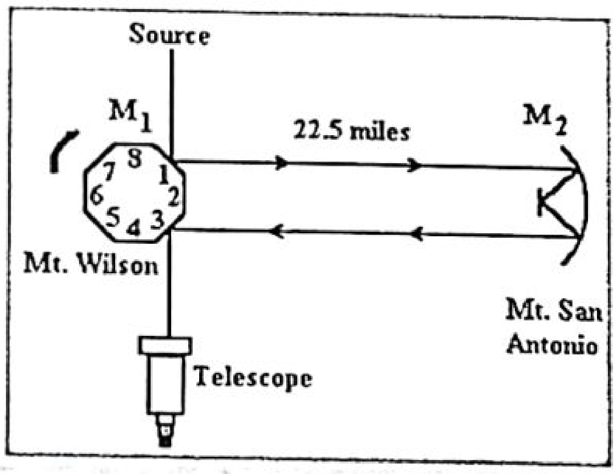
Experimental measurements of the speed of light c

- **Römer's method: relative motion of Earth and Jupiter.**

In the 1600s a rather "good" value for the speed of light was obtained by studying the time period for a moon of Jupiter to revolve around its planet. This time was slightly shorter when the earth was getting closer to Jupiter and longer when earth was receding from Jupiter. The relative motion of the planets -would of the order of magntiude of planetary orbital speeds (e.g. 30 kms^{-1} for earth) which is a small part - about 1/10000 - of the speed of light (c = 300 000 kms^{-1}) but a change of 1/10000 in the time for a moon to revolve Jupiters (e.g. about 40 h) makes several dozens of seconds which was measurable.

- **Michelson's experiment with rotating mirrors** (not to be confused with Michelson-Morley's experiment in relativity)

In the 1800s, a more precise measurement of c was made using the equipment below:



Sumber gambar: http://www.google.co.id/imgres

Fig. o01b: Michelson's rotating mirror experiment

The eight-sided rotating mirror M1 reflects light from a source S towards a stationary mirror M2 back to another side of M1 and into the telescope of an observer O. From the difference in rotating speed of M1 between ones which make the ray of light visible for O one can find the time for M1 to turn 1/8 of a revolution; this is then the time needed for the light to travel twice the distance between M1 and M2. Michelson placed M2 on a mountain top about 35 km from M1.

Ex. If the distance from M1 to M2 was 30 km then twice the distance is 60 km, which light travels in s = vt = ct =>t = s/c = 60km/300 000 kms^{-1} = 0.0002 s. The mirror must turn 1/8 of a revolution faster or slower in that time or once in 0.0016s; that is the difference in rotating speed is 1/0.0016 = 625 revolutions per second.

Example

1. Average intensity of sunlight on a sunny day around $1kW / m^2$.. Suppose that an electromagnetic wave sinusoidal wave form of light is constant. How many solar cells should be required to capture and collect the sun's energy to heat water equivalent to 5 kW? Assume each cell has an area of 2 m^2. and the efficiency of 50% and facing perpendicular to the sun

Answer

$$S = \frac{E_o^2}{2\, c\, \mu o}$$

$$E_o = \sqrt{2\mu_o c S}$$

$$E_o = \sqrt{24\, \pi . 10^{-7} . 3 . 10^8 1 . 10^3}$$

$$E_o = \frac{900V}{m}$$

$$Bo = \frac{E_o}{c} = \frac{900}{3.10^8} = 3.10^{-6}\, T$$

At 1 kw / m^2 solar cell area of 5 Necessary m^2. With 100% efficiency for producing 5 kw. If only 50% efficiency, then require 10 m^2

Area of solar cells. . Since each cell area of 2 m^2

. Thus the number of solar cells = 10 / 2 = 5 cells

2. Light emitted from the laser leads to the Z axis amplitude of electric field in light waves is 6103 V / m, and the direction of the electric field direction of the axis X. what direction and how the amplitude of the magnetic field?

answer

When the direction of motion of light waves in the Z axis, the direction of E on the X axis direction of B on the Y axis

$$Bo = \frac{E_o}{c} = \frac{6.10^3}{3.10^8} = 2.10^{-5}\,T$$

Exercise

1. A radio wave has $Em = 10^{-4}$ V/m. How large a magnetic field Bm and intensity of the wave.
2. Sunlight striking the earth with an intensity of 20 cal / cm^2 minutes. Calculate the magnitude of the electric field and magnetic field Bm Em for the light.
3. A radio station receives sinusoidal electromagnetic waves from a satellite transmitter with the power of 50 KW. What is the maximum amplitude E and B are accepted if the distance between the satellite antenna and satellite radio stations 100 km.
4. Why are electromagnetic waves of light is said to be
5. A radio station mentranmisikan 10 KW signal with frequency 100 MHz. Look at the distance of 1 km:

   a.Amplitudo electric field and magnetic field.

   b.Energi received by a panel measuring 10 cm x 10 cm in 5 minutes

PREFERENCE

Michael Bass. 1995. Handbook of Optics Volume I Fundamentals , Techniques , And Design Mcgraw-Hill , INC. New York

Tipler, Paul A. 1991. *Fisika untuk Sains dan Teknik Edisi Ketiga.* Diterjemahkan oleh Lea Prasetio dan Rahmad W. Aldi. Jakarta: Erlangga.

Giancoli, Douglas C. 2001. *Fisika Edisi Kelima.* Diterjemahkan oleh Yuhilza Hanum. Jakarta: Erlangga.

Fishbane, Gasiorowicz, Thornton. 2005. *Physics for Scientist and Engineers with Modern Physics.* USA: Pearson Prentice Hall.

Serway, Jewett. 2004. *Physics for Scientist and Engineers 6th Edition.* USA: Thomson Brooks/Cole