

# SPECTROSCOPY

ATUL SINGH ARORA



Chemistry Lab III

Dr. K. S. Viswanathan and Dr. K. R. Shamasundar  
Indian Institute of Science Education and Research, Mohali

August-December, 2012



*Every honest researcher I know admits he's just a professional amateur.  
He's doing whatever he's doing for the first time. That makes him an  
amateur. He has sense enough to know that he's going to have a lot of  
trouble, so that makes him a professional.*

— Charles F. Kettering (1876-1958) (Holder of 186 patents)

## ACKNOWLEDGEMENTS

---

I express my sincere gratitude to our instructors, Dr. K. S. Viswanathan and Dr. K. R. Shamasundar, for bringing the subject to life and helping us discover, in depth, the science behind the procedures.

I also thank Vivek Sagar (MS11017) for his contribution to this report as my lab-partner, who made the task of performing experiments immensely comfortable and productive at the same time.



# CONTENTS

---

<b>I</b>	<b>EXPERIMENTS</b>	<b>1</b>
<b>1</b>	<b>INTRODUCTION TO INFRA RED AND ULTRA VIOLET - VIS-</b>	
	<b>IBLE SPECTROSCOPY</b>	<b>3</b>
1.1	Theory: Basic Concept	3
1.2	Style Options	4
1.3	Issues	4
1.4	Future Work	4
1.5	Beyond a Thesis	4
1.6	License	4
<b>II</b>	<b>THE SHOWCASE</b>	<b>5</b>
	<b>BIBLIOGRAPHY</b>	<b>7</b>

## LIST OF FIGURES

---

## LIST OF TABLES

---

## LISTINGS

---

## ACRONYMS

---

## Part I

### EXPERIMENTS





## INTRODUCTION TO INFRA RED AND ULTRA VIOLET - VISIBLE SPECTROSCOPY

---

August 9, 2012

For this session, both IR and UV-visible spectroscopy techniques were demonstrated to us in groups of two.

### 1.1 THEORY: BASIC CONCEPT

To find the presence of elements and/or compounds within a given substance, we can use spectroscopy techniques, specially when their concentrations are small and they satisfy certain requirements. The essential idea behind this measurement comes from the fact that elements/compounds absorb lights of certain frequencies to get to a higher energy state. These frequencies are mostly discrete as they correspond to quantized energy levels. This energy could be absorbed for, say, changing the rotational energy (IR Spectroscopy) or for exciting an electron in the substance to a higher energy level (UV-vis Spectroscopy). We note here that these quantized energy levels are properties of individual substances and are, for most practical purposes, unique.

For the analysis to be possible, the first condition is that the substance must *absorb* light incident to it. Granted this, we can obtain an absorption spectrum for the given substance, which behaves like a fingerprint of the substance. This can thus be used to not only identify the compound, but also to quantify it. For identification, in the simplest case, we simply need to observe the frequency corresponding to the peaks in the absorption spectrum and match it with the known/expected substance(s). Quantification harnesses a rather “obvious” law, termed *Beer-Lambert’s Law*. In the simplest form, the law quantifies the intuitive notion; higher the concentration of the analyte, higher is the absorption. The relation is given as

*How much absorption, well, the limit comes from the sensitivity of the experimental setup and concentration of substance given.*

$$T = \frac{I}{I_0} = 10^{-\alpha l} = 10^{-\epsilon lc} \quad (1)$$

where  $I$  is intensity of incident light,  $I_0$  is intensity of transmitted light,  $\epsilon$  is molar absorptivity,  $l$  is the optical path length, and  $c$  is molar concentration.

## 1.2 STYLE OPTIONS

There are a couple of options for `classicthesis.sty` that allow for a bit of freedom concerning the layout:

*...or your supervisor might use the margins for some comments of her own while reading. Modifications in classicthesis.sty*

Many other customizations in `classicthesis-config.tex` are possible, but you should be careful making changes there, since some changes could cause errors.

Finally, changes can be made in the file `classicthesis.sty`, although this is mostly not designed for user customization. The main change that might be made here is the text-block size, for example, to get longer lines of text.

## 1.3 ISSUES

This section will list some information about problems using

### *Compatibility with the glossaries Package*

If you want to use the `glossaries` package, take care of loading it with the following options:

```
\usepackage[style=long,nolist]{glossaries}
```

Thanks to Sven Staehs for this information.

### *Compatibility with the (Spanish) babel Package*

Spanish languages need an extra option in order to work with this template:

### *Compatibility with the pdfsync Package*

Using the `pdfsync` package leads to linebreaking problems with the `graffito` command

## 1.4 FUTURE WORK

So far, this is a quite stable version that served a couple of people

## 1.5 BEYOND A THESIS

It is easy to use the layout of `classicthesis.sty` without the

## 1.6 LICENSE

GNU GENERAL PUBLIC LICENSE: This program is free software;

## Part II

### THE SHOWCASE

You can put some informational part preamble text here. Illo principalmente su nos. Non message *occidental* anglo-romanian da. Debitas effortio simplicate sia se, auxiliar summarios da que, se avantiate publicationes via. Pan in terra summarios, capital interlingua se que. Al via multo esser specimen, campo responder que da. Le usate medical addresses pro, europa origine sanctificate nos se.



## COLOPHON

This document was typeset using the typographical look-and-feel `classicthesis` developed by André Miede, for  $\text{\LaTeX}$ .  
The style was inspired by Robert Bringhurst's seminal book on typography "*The Elements of Typographic Style*".

The latest version of this document is available online at:

[https://github.com/toAtulArora/IISER\\_repo](https://github.com/toAtulArora/IISER_repo)