STUDY GUIDE

FOR

VISUAL OPTICS

(UNIT 1-9)

C.Code: 2430
Level: B.Sc

Credit: HALF

Prepared by:
Dr. Khadija N. Abdullah
Pakistan Institute of Community Ophthalmology
Hayatabad Medical Complex, Peshawar

Vision Sciences Programme
- Diploma in Vision Sciences for ophthalmic technicians
- B.Sc Vision Sciences
- B.Sc. Honours in Vision Sciences

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Course Team

Chairperson	:	Prof. Dr. Perveen Liaqat
Course Coordinator	:	Mrs. Hajra Ahmed
Field Worker Optometry	:	Muhammad Aafaque Amin
Writer	:	Dr. Khadija N. Abdullah
Editor	:	Zia Ullah Khan

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WELCOME FROM THE COURSE COORDINATOR

Dear students, you have opted to serve your community as refractionists in future. It is very important for you to learn the skills involved in refraction. However, to master these skills, you need to know the optics involved in the physiological functioning of the human eye. You ought to know the optical basis of different refractive errors before correcting those. This study guide has been designed to facilitate your understanding of the subject. Each study unit in the study guide focuses on the individual topics included. It will make you aware of the knowledge and skills that you are to attain after studying each unit. The learning process will be augmented by the self-assessment exercises at the end of each study unit. As always, the prescribed reading given at the end of each study unit is what you should go through while the suggested reading is for the true knowledge seekers.

I hope, the study guide will serve your purpose.

Course Coordinator

INTRODUCTION TO THE COURSE

Dear Students,

This course has been designed in such a way that you will have a clear knowledge of the optics involved in the process of vision. It will also discuss the abnormalities of the optical system in detail. Unit No 1 gives you a brief idea about the optical system of the eye. Unit No 2 focuses on formation of retinal images while unit No 3 explains different types of physiological defects and their consequences. Unit No 4 focuses on the optics of Emmetropic and Ammetropic eye. Unit No 5 discusses certain concepts and clinical tests related to advanced visual functions. Different types of Ammetropia are discussed in unit No 6. Unit No 7 discusses Myopia and Hypermetropia in detail while unit No 8 discusses astigmatism. Unit No 9 deals with Aphkia, Pseudophakia, practical problems associated with them and their management. Once you have understood these, the course will provide you with the knowledge and skills involved in correcting the defects as well. Once you have understood all these, refraction will become a very interesting task for you to perform.

OBJECTIVES OF THE COURSE:

After going through this course, you should be able to:

1. Show the optical system of a normal eye.
2. Diagnose different types of optical defects and understand their optics.
3. Explain the causes, clinical features and management of different types of optical defects.
4. Assess advanced visual functions.

STRUCTURE OF THE COURSE

The course "Visual Optics" has been structured to make it as easy as possible for you to do the required work. Like a half credit course, this course consists of nine units One unit is the study work of two weeks, thus the total study period will be of 18 weeks.

We have organized this course to enable you to acquire the skills of self-learning. For each unit, an introduction is given to help you to develop an objective analysis of the major and sub-themes, discussed in the prescribed reading material. Beside this, objectives of each unit are very specifically laid down to facilitate you in developing a clear logical approach. We have also given you Self-Assessment Exercises, which are present at end of each unit. Questions in the Self Assessment Exercise are not only meant to facilitate you in understanding the required readings but to provide you with an opportunity to assess yourself. Since the course work of one unit includes studying the prescribed reading material and carrying out the self-assessment questions, activities assignments and practicals, you are required to spend two weeks on each unit.

For this course "Fortnightly Tutorials" are arranged in the university's selected regional study centers. They provide you the facility of meeting with one another for discussion and mutual help and for group and individual discussion with fellows and tutors.

a) How to use reading material:

As this is a distance education course, we have organized the required course work in the following manner to help you in evolving a self-learning process in the absence of formal class room teaching.

1) a detailed course introduction.
2) Introduction to each unit.
3) The major theme of the unit is listed along with readings. A list of suggested and proscribed reading is given at the end each unit.
4) Self assessment exercises given at end of each unit are not only meant to facilities you in understanding, but will also suggest a direction in which we expect you to think and analyze.

b) How to attend tutorials:

Tentative tutorial and practical schedule is provided to you in your study packs and 70% attendance in the tutorials is compulsory in order to appear in the exam. Before attending the tutorial, you are required to prepare yourself by reading the topics to be taught in the next tutorial carefully and mark the points which you cant understand yourself in order to discuss them with your tutor and your colleagues.

UNIT NO. 1

OPTICAL SYSTEM OF THE EYE – THE SCHEMATIC AND REDUCED EYE

UNIT NO. 1

OPTICAL SYSTEM OF THE EYE – THE SCHEMATIC AND REDUCED EYE

INTRODUCTION

The optical system of the eye is a very complex one to understand as such. Therefore, for the sake of its better understanding, the concept of a reduced and a schematic eye has been introduced. This unit will make these concepts clear and in turn will enable you to understand the optical system of the human eye with relative ease.

LEARNING OBJECTIVES

After studying this unit, the students should be able to:

1. Have knowledge about the optical system of a normal eye/ Emmetropic eye.
2. Explain the concepts of a reduced and a schematic eye.

INDICATIVE CONTENTS

1.1 Optical system of the eye – the schematic and reduced eye

RECOMMENDED READING LIST:

PRESCRIBED READINGS

- Duke Elder's. The refraction of the eye-physiological optics. Practice of Refraction. Tenth edition, p 29-32.

SUGGESTED READING

1 Theodore P. Grosvenor. Anomalies of refraction. Primary Care Optometry. Second edition, p 3-11.

2 Bannett and Rabbetts. The eye's optical system. Clinical visual optics. Third edition, p 7-18.

SELF-ASSESSMENT EXERCISES

Q.1 : What do you know about the optical system of an Emmetropic eye?

Q.2 : Describe Schematic and reduced eye with the help of a diagramme.

UNIT NO 2 :

PHYSIOLOGICAL OPTICS

UNIT NO 2 :

PHYSIOLOGICAL OPTICS

INTRODUCTION

This unit will focus on the details of the formation of the images on the retina. It will describe different important definitions and concepts vital to understand the physiological optics. You must concentrate while studying these. Once you have understood the optics of a normally functioning eye, you will be in a position to understand the optics of different optical defects of the eye.

LEARNING OBJECTIVES

After studying this unit, you should be able to:

1. Understand the process of formation of retinal images.
2. Define and understand optical axis and visual axis.
3. Explain angle alpha, gamma and kappa.
4. Point out what are the optical defects of the eye.

INDICATIVE CONTENTS

2.1 The formation of retinal images

2.2 The optical axis and the visual axis

2.3 Angle alpha, gamma and kappa

2.4 The optical defects of the eye

PRESCRIBED READINGS

1. Duke-Elder's Practice of Refraction. The refraction of the eye-physiological optics. Tenth edition , p 31.

2. Duke-Elder's Practice of Refraction. The refraction of the eye-physiological optics. Tenth edition , p 37-41.

SUGGESTED READINGS

1. Theodore P. Grosvenor. Anomalies of refraction. Primary Care Optometry. Second Edition. P 6-11.

2. Bannett and Rabbetts. The eye's optical system. Clinical visual optics. Third edition, p 13-14.

SELF ASSESSMENT EXERCISES

Q.1: Discuss the process of retinal image formation.

Q.2: Define the following terms.

a) Optical Axis
b) Visual Axis
c) Angle Alpha
d) Angle Gamma
e) Angle Kappa

Q.3: Describe optical defects of the eye.

UNIT NO. 3

ABERRATIONS OF THE OPTICAL SYSTEM

UNIT NO. 3

ABERRATIONS OF THE OPTICAL SYSTEM

INTRODUCTION

Once you have understood the optics involved in the functioning of a normal eye, it is time to talk about the physiological defects of the optical system of the eye. This unit will explain different types of these defects and their consequences as well.

AIMS AND OBJECTIVES

After studying this unit, you are expected to be able to:

1. Define and explain different optical aberrations of the optical system of the eye.
2. Show the effects of these aberrations.

INDICATIVE CONTENTS

3.1 Aberrations of optical systems

3.2 Aberrations of the optical system of the eye and their effects

- 3.2.1 Diffraction of light
- 3.2.2 Chromatic aberrations
- 3.2.3 Spherical aberrations
- 3.2.4 Natural decentring
- 3.2.5 Peripheral aberrations

PRESCRIBED READINGS

1. Duke-Elder's Practice of Refraction. The refraction of the eye-physiological optics. Tenth edition , p 31-36.

2. Harold A. Stein, Bernard J. Slatt,Raymond M. Stein. Optics.The Ophthalmic Assistant, A Guide for Ophthalmic Medical Personnel. Seventh Edition, p 50.

SUGGESTED READINGS

1. Theodore P. Grosvenor. Anomalies of refraction. Primary Care Optometry.Second edition, p 10-11.

2. Bannett and Rabbetts. Ocular aberrations. Clinical visual optics. Third edition, p 275-298.

SELF-EVALUATION EXERCISES

Q.1: What do you understand by the term optical aberrations?

Q.2: Describe the effects of optical aberrations.

UNIT NO. 4:

OPTICS OF EMMETROPIA AND AMETROPIA

UNIT NO. 4:

OPTICS OF EMMETROPIA AND AMETROPIA

INTRODUCTION

Now, when you have gone through the general principles of optics, the types of optical defects and their consequences, you will be introduced to different refractive statuses of the eye and the optics of these.

This study unit talks about Emmetropia-the normal refractive status of the eye where the light rays from a distant object are focused sharply on the retina by the relaxed lens without the need of any accommodative effort.

Another refractive state that the unit will address is the one where the relaxed and unaccommodated eye is not able to focus light from a distant object on the retina-this is called ametropia. This can be a result of different conditions.

LEARNING OBJECTIVES

After studying this unit, you should be able to:

1. Have acquaintance with the optics of emmetropia and ametropia.
2. Explain the concept of ocular dominance.
3. Point out changes in the refractive status of the eye with aging.

INDICATIVE CONTENTS

4.1 Optics of Emmetropia and Ametropia and ocular dominance.

4.2 Changes in the refractive status of the eye with aging.

RECOMMENDED READING LIST:

PRESCRIBED READINGS

1. Duke-Elder's. Physiological optics. Practice of refraction.10th edition, p 36-37.

2. Duke-Elder's. Hypermetropia.. Practice of refraction.10th edition, p 46-48.

3. Duke-Elder's. Myopia. Practice of refraction.10th edition, p 58.

4. Duke-Elder's. Astigmatism. Tenth edition, p 66.

5. Harold A. Stein, Bernard J. Slatt, Raymond M. Stein. Refractive errors and how to correct them. The Ophthalmic Assistant, a Guide for Ophthalmic Medical Personnel. Seventh Edition. p 208-209.

SUGGESTED READINGS

1. Theodore P. Grosvenor. Anomalies of refraction. Primary Care Optometry.Second edition, p 16-24.

2. Bannett and Rabbetts. Spherical ametropia. Clinical visual optics. Third edition, p 62-66.

3. Bannett and Rabbetts. Astigmatism. Clinical visual optics. Third-edition, p 78-80.

SELF-EVALUATION EXERCISES

Q.1: Give the optics of Emmetropic and Ammetropic eye.

Q.2: Which changes take place in the refractive state of the eye with increasing age?

UNIT NO. 5:

ADVANCE VISUAL FUNCTION'S ASSESSMENT

UNIT NO. 5:

ADVANCE VISUAL FUNCTION'S ASSESSMENT

INTRODUCTION

Dear students, this unit will discuss certain concepts and clinical tests related to advance visual functions. Most of these like visual acuity, colour vision, binocular vision etc are not new to you and you have already studied them in your course 2428- Introduction to skills in visual functions. Therefore, you will find it easier to follow.

LEARNING OBJECTIVES

After studying this unit, you should be able to:

1. Have acquaintance with the physiological basis of advance visual functions including Visual acuity, colour vision, visual fields and binocular single vision.
2. Perform tests to assess these visual functions.

INDICATIVE CONTENTS

5.1 Physiological principles of VA, colour vision, visual fields and binocular single vision.

5.2 Tests for visual functions' assessment.

RECOMMENDED READING LIST

PRESCRIBED READINGS

1. Notes given in the study guide of course 2428- Introduction to skills in visual functions (already with the students).

2. Harold.A.Stein, Bernard.J.Slatt, Raymond.M.Stein. *Preliminary Examination.* In the Ophthalmic Assistant, A guide for Ophthalmic Medical Personnel, 7th edition: 1994; p129-135, 139

3. Harold.A.Stein, Bernard.J.Slatt, Raymond.M.Stein. *Ocular Motility and Binocular Vision.* In the Ophthalmic Assistant, A guide for Ophthalmic Medical Personnel, 7th edition: 1994; p 662-664.

4. Harold.A.Stein,.Bernard.J.Slatt, Raymond.M.Stein. Physiology of the eye. In the Ophthalmic Assistant, A guide for Ophthalmic Medical Personnel, 7th edition: 1994; p 31.

5. Harold.A.Stein, Bernard.J.Slatt, Raymond.M.Stein. Visual fields. In the Ophthalmic Assistant, A guide for Ophthalmic Medical Personnel, 7th edition: 1994; p 377-396.

SUGGESTED READINGS

1. Theodore.P.Grosvenor. Anomalies of refraction. Primary Care Optometry.Second edition, p 11-16.

2. Bannett and Rabbetts. Visual acuity and contrast sensitivity. Third edition, p 26-38.

3. Bannett and Rabbetts. Astigmatism. Ocular motility and binocular vision. Third edition, p 7142-157.

SELF- EVALUATION EXERCISES

Q.1: Give the physiological basis of advanced visual function.

Q.2: How would you perform confrontation test to assess gross visual field defects?

UNIT NO. 6:

ERRORS OF REFRACTION

UNIT NO. 6:

ERRORS OF REFRACTION

INTRODUCTION

Dear students, by now you must have understood that an ammetropic eye have some refractive errors. This category of ocular optical dysfunction is further divided into different types. Since, these are quite common, this unit is included in the study guide so that you can imagine the burden of these on the eye care services.

LEARNING OBJECTIVES

After studying this unit, you should be able to;

1. Explain what are refractive errors.
2. Point out the types of refractive errors.
3. Show the prevalence of refractive errors.
4. Assess the role of inheritance in the distribution of refractive errors.

INDICATIVE CONTENTS

6.1 Prevalence of refractive errors.

6.2 Inheritance of refractive errors.

6.3 Types.

RECOMMENDED READING LIST

PRESCRIBED READING

1. Duke-Elder's. Hypermetropia. Practice of refraction.Tenth edition, p 45.

2. Duke-Elder's. Astigmatism. Practice of refraction .Tenth edition, p 66.

3. Harold A. Stein, Bernard J. Slatt,Raymond M. Stein. Refractive errors and how to correct them. The Ophthalmic Assistant, A Guide for Ophthalmic Medical Personnel. Seventh Edition. p 208.

SUGGESTED READINGS

1. Theodore P. Grosvenor. Epidemiology of ametropia. Primary Care Optometry.Second edition, p 29-54.

2. Bannett and Rabbetts. Spherical ametropia. Clinical visual optics. Third edition, p 62.

3. Bannett and Rabbetts. Astigmatism. Clinical visual optics. Third edition, p 78.

4. Borish's Clinical refraction. Incidence and distribution of refractive anomalies. 1998, p 30-46.

SELF- ASSESSMENT EXERCISES

Q.1: Define Emmetropia and Ammetropia

Q.2: Name different types of Ammetropia.

Q.3: What is the role of inheritance in the distribution of refractive errors?

UNIT NO. 7

HYPERMETROPIA
AND
MYOPIA

UNIT 7:

HYPERMETROPIA AND MYOPIA

INTRODUCTION

You are now well aware of the different types of refractive errors. It is now time to study these one by one in detail as you will be managing these in your professional life. This study unit will give you relevant information regarding causes, clinical features, consequences and management of myopia and hypermetropia. Some of the information you have already studied may be repeated but you will find this repetition very useful.

LEARNING OBJECTIVES

After studying this unit, you should be able to:

1. Have practical knowledge of the causes, types, clinical features , complications , treatment and prognosis of myopia.
2. Point out the aetiology, types, clinical features and management of hypermetropia.

INDICATIVE CONTENTS

7.1 Hypermetropia

- 7.1.1 Causes
- 7.1.2 Optics
- 7.1.3 Accommodation in hypermetropia, latent, manifest, facultative and total hypermetropia
- 7.1.4 Clinical features

7.1.5 The hypermetropic fundus

7.1.6 Correction

- In children and young adults
- In adults

7.2 Myopia

7.2.1 Aetiology

7.2.2 Optics

7.2.3 Progression

7.2.4 Clinical features

7.2.5 Clinical types

7.2.6 The myopic funds

7.2.7 Complications of pathological myopia

7.2.8 Treatment

UNIT NO. 8:

ASTIGMATISM

RECOMMENDED READING LIST

PRESCRIBED READINGS

1. Duke-Elder's. Myopia. Practice of refraction.Tenth edition , p 53-64.

2. Duke-Elder's. Hypermetropia. Practice of refraction.Tenth edition , p 45-52.

3. Harold A. Stein, Bernard J. Slatt,Raymond M. Stein. Refractive errors and how to correct them. The Ophthalmic Assistant, A Guide for Ophthalmic Medical Personnel. Seventh Edition. p 208-214.

SUGGESTED READINGS

1. Theodore P. Grosvenor. Myopia and its development. Primary Care Optometry. Second edition, p 57-90..

2. Bannett and Rabbetts. Spherical ametropia. Clinical visual optics. Third edition, p 62-76..

SELF- ASSESSMENT EXERCISES

Q.1: Define Myopia and give its signs and symptoms. How will you treat Myopia?

Q.2: Define Hypermetropia. Also give its different types.

UNIT NO. 8:

ASTIGMATISM

INTRODUCTION

Astigmatism is another type of refractive error where the rays of light fail to focus on a point at retina as these are not refracted equally in all directions. This unit will discuss the important aspects of this type.

LEARNING OBJECTIVES

At the end of this unit, you should be able;

- Have acquaintance with the types, causes, optics, clinical features and treatment of astigmatism.

INDICATIVE CONTENTS

8.1 Aetiology
8.2 Optics
8.3 Types
8.4 Clinical features
8.5 Treatment

RECOMMENDED READING LIST

PRESCRIBED READINGS

4. Duke-Elder's. Astigmatism. Practice of refraction.Tenth edition , p 65-70.

5. Harold A. Stein, Bernard J. Slatt,Raymond M. Stein. Refractive errors and how to correct them. The Ophthalmic Assistant, A Guide for Ophthalmic Medical Personnel. Seventh Edition. p 214-216.

SUGGESTED READINGS

3. Theodore P. Grosvenor. Anomalies of refraction. Primary Care Optometry. Second edition, p 21-24.

4. Bannett and Rabbetts. Astigmatism .Clinical visual optics. Third edition, p 78-90.

SELF- ASSESSMENT EXERCISES

Q.1: Define astigmatism. Also give its types, signs, symptoms and options for treatment.

UNIT NO. 9:

APHAKIA
AND
PSEUDOPHAKIA

UNIT NO. 9:

APHAKIA AND PSEUDOPHAKIA

INTRODUCTION

Dear students, you are aware of the fact that cataract is the most common cause of blindness globally. In past, simple cataract extractions were done. Now cataract extraction with IOL implantation is done as the treatment of choice. The treatment of past and present has led to the condition of aphakia and pseudophakia respectively, with which you are already much familiar. This unit will talk about these conditions, the practical problems associated with these and their management.

LEARNING OBJECTIVES

After studying this unit, you should be able to :

1. Explain the optics, associated problems and management of aphakia.
2. Point out the optics, possible consequences and management of pseudophakia

INDICATIVE CONTENTS

9.1 Aphakia

9.1.1 Optics of aphakia and the quality of vision with disadvantages of aphakia.

- Image enlargement and aniseikonia

- Loss of all accommodation
- Problems of unilateral aphakia

9.1.2 Treatment options

9.2 Pseudophakia

9.2.1 Pseudophakia calculations and biometry

9.2.2 Optics of Pseudophakia

9.2.3 Management of Pseudophakic optical problems

9.2.4 Reading correction with Pseudophakia

9.2.5 Surgically induced refractive errors and their management

9.2.6 Anisometropia

RECOMMENDED READING LIST

PRESCRIBED READING

1. Duke-Elder's. Aphakia and pseudohakia. Practice of refraction.Tenth edition , p 71-78.

2. Harold A. Stein, Bernard J. Slatt,Raymond M. Stein. Refractive errors and how to correct them. The Ophthalmic Assistant, A Guide for Ophthalmic Medical Personnel. Seventh Edition. p 222-225.

SUGGESTED READINGS

1. Bannett and Rabbetts. Anisometropia and aniseikonia. Clinical visual optics. Third edition, p 259-272.

2. Borish's Clinical refraction. Patients with Anisometropia and aneseikonia. 1998, p 1148-1155.

3. Borish's Clinical refraction. Patients with high refractive error. Incidence and distribution of refractive anomalies. 1998, p 1168-1169.

SELF- ASSESSMENT EXERCISES

Q.1: What is the difference between Aphakia and Pseudophakia?

Q.2: What problems an Aphakic person will face?