BROWARD COLLEGE
COURSE OUTLINE

LAST REVIEW: **2009-2010** **NEXT REVIEW:** **2014-2015** **STATUS:** **A**

COURSE TITLE: PHYSICAL AND GEOMETRICAL OPTICS

COMMON COURSE NUMBER: OPT 1110

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN

Lecture: 48 Lab:

Clinic: Other:

PREREQISITE(S):
COREQUISITE(S):
PRE or COREQISITE: OPT 1330, OPT1210 and OPT 1110L

COURSE DESCRIPTION:
This course provides a review of light energy as it passes through air, plastic, glass and water with emphasis on how light is modified by prisms and curved lens surfaces. These principles relate to the effect these ophthalmic devices have in correcting the errors of human vision.

UNIT TITLES

1 REVIEW OF ELEMENTARY MATHEMATICAL PRINCIPLES
2 OPTICS, LIGHT, AND VISION
3 REFRACTION OF A SINGLE LIGHT RAY
4 REFRACTION OF MULTIPLE LIGHT RAYS
5 LENS FORM AND ANALYSIS
6 OPTICAL CONSIDERATIONS WITH INCREASING LENS POWER
7 ABERRATIONS
8 OPTICAL PRISM
9 THE NEAR ADDITION

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Unit 1: REVIEW OF ELEMENTARY MATHEMATICAL PRINCIPLES

General Outcome:

1.0: The student shall be able to solve elementary mathematical problems involving percentages, basic algebra, and trigonometry. Application to optics will be stressed**.**

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

1.1 Demonstrate an understanding of the basic units of measurement the metric system
1.2 Convert English to Metric and Metric to English units of measurement.
1.3 Calculate algebraic transformations
1.4 Demonstrate the use of positive and negative numbers.
1.5 Calculate the reciprocal value of a number.
1.6 Explain the Cartesian coordinate system.
1.7 Describe triangular forms
1.8 Demonstrate the use of trigonometry in solving optical problems.
1.9 Explain vector analysis as it is used in optics.

Unit 2: OPTICS, LIGHT, AND VISION

General Outcome.

2.0 The student will gain knowledge in the actions of light and lenses and how these concepts can be applied to the vision correction.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

2.1 Explain the three theories of light.
2.2 Describe the wave theory of light and its shortcomings
2.3 Explain the concept of velocity of light.
2.4 Explain the theory of rectilinear propagation of light.
2.5 Describe how a corrective lens can be used in vision correction

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Unit 3: REFRACTION OF A SINGLE LIGHT RAY

General Outcome:
3.0 The student shall have an understanding of lens optics as applied to a single ray of light and how the ray is affected when passing into or through a transparent optical surface.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

3.1 Define the different types of reflection.
3.2 Trace the angle of reflection
3.3 Calculate Snell's Law and the angle of refraction.
3.4 Solve problems involving objects and images in a plane and curved mirror surface.
3.5 Differentiate between normal and oblique incidence of light.
3.6 Define the action of a prism on light.
3.7 Describe the path of light as it strikes and passes through a thin prism
3.8 Define and calculate prism diopters.
3.9 Differentiate between prism diopters and prism degrees.
3.10 Calculate image displacement
3.11 Describe practical applications of Snell's Law and prism displacement

Unit 4: REFRACTION OF MULTIPLE LIGHT RAYS

General Outcome:
4.0 The student shall gain an understanding of the visual process when rays of light from an object are brought together in focus on the retina of the eye. Again the process of refraction is involved. Discussion will concentrate on a curved refracting surface directing multiple rays of light toward or away from a specific point in space. Understanding the action of a curved surface on more than one ray of light is the basis for comprehending the optics of light

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

4.1 Diagram the focal power of a lens.
4.2 Describe how a lens can focus light
4.3 Convert focal length to dipodic power.
4.4 Convert dipodic power to focal length.
4.5 Explain sign convention when quantifying a lens
4.6 Describe surface curvature
4.7 Calculate units of lens power
4.8 Differentiate between lens power and surface power

Unit 4 REFRACTION OF MULTIPLE LIGHT RAYS **continued**

4.9 Describe the actions of a lens on other than parallel light rays
4.10 Apply the vergence theory to lens powers
4.11 Describe the actions of spheres on light rays
4.12 Describe the actions of cylinders on light rays
4.13 Describe the actions of spherocylinder lenses on light rays
4.14 Differentiate between plus and minus cylinder lenses

Unit 5: LENS FORM AND ANALYSIS

General Outcome:

5.0 The student shall gain a familiarity with the different forms that a lens may take. Surface curvature, toric surfaces and relative power will be emphasized.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

5.1 Differentiate between the different forms a sphere may take.
5.2 Diagram seven (7) spherical lens forms.
5.3 Differentiate between the different forms a cylinder may take.
5.4 Calculate the ocular and base curves of plus and minus cylinder lenses.
5.5 Explain the optical difference between plus and minus SPHEROCYLINDER lenses.
5.6 Define toric transposition.
5.7 Calculate toric transpositions.
5.8 Describe cross cylinder lens form.
5.9 Calculate the base curves of single vision lenses.
5.10 Describe multi-focal lenses
5.11 Explain the use of the Lens Measure to determine the base and ocular curves of a lens.
5.12 Demonstrate the use of the Sag Formula.
5.13 Explain how to use the Lens Measure to determine the Nominal Power of a lens
5.14 Explain the use of the Lens Measure with a multi-focal lens.
5.15 Calculate the Nominal Power of a lens using materials of different refractive indexes.

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Unit 6: OPTICAL CONSIDERATIONS WITH INCREASING LENS POWER

General Outcome:

6.0 The student shall have an understanding of how the properties of a lens change as its power increases. Power, vertex and thickness as well as index of refraction will be discussed.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

6.1 Explain lens power as it is related to position.
6.2 Discuss effective lens power as it relates to position.
6.3 Calculate effective power as related to vertex distance changes.
6.4 Describe the vengeance of light as it travels through a lens.
6.5 Explain how refractive index can change perceived distance.
6.6 Calculate how vengeance can change the relative power of a lens.
6.7 Calculate front and back vertex power.
6.8 Calculate the nominal power when given surface power of both surfaces.
6.9 Explain when it is necessary to use vertex power equations.
6.10 Differentiate between back vertex and neutralizing power.

Unit 7: ABERRATIONS

General Outcome:

7.0 The student shall have an understanding of the various ways that aberrations can degrade image quality. Theoretical and practical application of aberrations will be explored.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

7.1 Differentiate between dispersion and chromatic aberration
7.2 Explain longitudinal and lateral chromatic aberration.
7.3 Explain refractive efficiency.
7.4 Explain thick lenses and chromatic aberration
7.5 Define monochromatic wavefront aberration.
7.6 Differentiate between spherical aberration and coma
7.7 Explain how curvature of field can affect vision and distortion.
7.8 Explain how lens design can limit aberrations.

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Unit 8: OPTICAL PRISM

General Outcome:

8.0 The student shall learn to differentiate between resolving and adverse prism. Calculation of effective prism power will be emphasized

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:.

8.1 Differentiate between a centered and a decentered lens.
8.2 Explain Prentice's Rule
8.3 Calculate prism base directions
8.4 Differentiate between horizontal and vertical prism components
8.5 Calculate induce prism in lenses that have been decentered incorrectly.
8.6 Calculate compound prism
8.7 Calculate resolving prism
8.8 Determine when to use prism and how it corrects for strabismus.
8.9 Calculate the power of a spherocylinder in any meridian.

Unit 9 THE NEAR ADDITION

General Outcome:

9.0 The student shall have an understanding of a lens can correct for vision deficiencies at different distances. Modification of the lens to provide for a localized change in power will be discussed.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

9.1 Explain the concept of a near addition
9.2 Determine which patients would need a trifocal intermediate
9.3 Calculate the amount of image jump if the power of the bifocal and the segment type is given.
9.4 Discuss the prismatic effect of lens pairs
9.5 Define vertical imbalance
9.6 Calculate the amount of bicentric grinding needed to correct for vertical imbalance
9.7 Explain how to check the amount of slab off in a given lens.
9.8 Differentiate between different types of segments to compensate for vertical imbalance.
9.9 Determine how much vertical imbalance should be corrected.
9.10 Calculate the imbalance for spheres, cylinders, and spherocylinders
9.11 Explain the purpose of lateral decent ration of near sags.