Miami Dade College

Course Competencies Template - Form 112

GENERAL INFORMATION	
Name: Dr. Jose Diaz	Phone #: 7-3112
Course Prefix/Number: PHY 4424	Course Title: Geometrical & Physical Optics
Number of Credits: 3	
Degree Type	☐ B.A. ☒ B.S. ☐ B.A.S ☐ A.A. ☐ A.S. ☐ A.A.S. ☐ C.C.C. ☐ A.T.C. ☐ V.C.C
Date Submitted/Revised: 03/13/08	Effective Year/Term: Fall 2008-1
☐ New Course Competency ☒ Revised Course Competency	
Course to be designated as a General Education course (part of the 36 hours of A.A. Gen. Ed. coursework): ☐ Yes ☒ No	
The above course links to the following Learning Outcomes: ☐ Communication ☒ Numbers / Data ☒ Critical thinking ☐ Information Literacy ☐ Cultural / Global Perspective ☐ Social Responsibility ☐ Ethical Issues ☐ Computer / Technology Usage ☐ Aesthetic / Creative Activities ☒ Natural Systems/Environmental Responsibility	
Course Description (limit to 50 words or less, **must correspond with course description on Form 102**): This course is an intermediate study of topics in classical optics, as well as a conceptual introduction to modern optics. The student will learn the fundamental principles and applications of classical optics and optical instruments, and will gain an understanding of unfamiliar optical phenomena through inquiry activities.	
Prerequisite(s): PHY 2048, PHY 2049; MAP 2302	Corequisite(s): PHY 3504

Course Competencies: (for further instruction/guidelines go to: http://www.mdc.edu/asa/curriculum.asp)

Competency 1. The student will demonstrate knowledge, comprehension and the ability to analyze and apply principles of geometrical optics by:

a) Comparing the following classical models of light propagation: rays, wavefronts, Huygens' wavelets, and waves.
b) Describing the laws of reflection and refraction and relating them to classical models of light propagation.
c) Deriving the laws of reflection and refraction from Fermat's principle of least time.
d) Describing dispersion and total internal reflection and relating them to the laws of reflection and refraction.
e) Explaining, using optical principles, the occurrence of natural phenomena related to reflection, refraction, dispersion, and total internal reflection.
f) Solving problems involving reflection and refraction, dispersion and total internal reflection.

Competency 2. The student will demonstrate knowledge and comprehension of the applications of geometrical optics by:

a) Explaining the physics of glass prisms using dispersion and the laws of reflections and refraction.
b) Describing and explaining the uses of glass prisms.
c) Describing the process of image formation.
d) Describing the aberrations of optical systems.
e) Computing image formation characteristics of compound lens systems and thick lenses using computer simulation and matrix techniques.
f) Describing and explaining the uses of glass prisms.
g) Describing the design of telescopes and microscopes.
h) Calculating the optical quantities that characterize different telescopes and microscopes.
i) Explaining the image formation characteristics of the eye.
j) Explaining image formation defects of the eye and their correction.
k) Discussing the concept of resolution.
l) Calculating the resolution of optical systems.
m) Using the wave model to explain the amplitude and phase relations between incident waves and reflected or refracted waves.
n) Solving problems involving the formation of images by refracting surfaces, reflecting surfaces, and thin lenses.

Competency 3. The student will demonstrate knowledge, comprehension and the ability to analyze the electromagnetic theory of light by:

a) Stating Maxwell's equations in integral and differential form.
b) Relating the existence of electromagnetic waves to Maxwell's equations.
c) Distinguishing the different parts of the electromagnetic spectrum.
d) Deducing the properties of electromagnetic waves from Maxwell's equations.
e) Explaining the physical properties of light using the properties of electromagnetic waves.
f) Describing the emission of light from accelerated charges.
g) Solving problems involving light emission and propagation.

Competency 4. The student will demonstrate knowledge, comprehension and the ability to analyze and apply optical phenomena related to the speed of light by:

a) Describing various methods used throughout history for the measurement of the speed of light.
b) Analyzing light pulse propagation by means of Fourier techniques.
c) Distinguishing between phase and group velocity.
d) Describing and explaining the Doppler effect and its uses.
e) Explaining the Doppler effect using the wave theory of light.
f) Comparing and contrasting the Doppler effect for light and sound.
g) Solving problems involving the Doppler effect.

Competency 5. The student will demonstrate knowledge, comprehension and the ability to analyze and apply the phenomena of interference and diffraction by:

a) Describing the principle of superposition.
b) Explaining pictorially and mathematically the interference of waves from two or more sources.
c) Describing and explaining the design and uses of interferometers.
d) Solving problems involving wave interference.
e) Solving problems involving interferometers.
f) Describing the phenomenon of diffraction.
g) Explaining diffraction using Huygens' wavelets.
h) Explaining pictorially and mathematically the diffraction of electromagnetic waves.
i) Comparing and contrasting Fraunhofer and Fresnel diffraction.
j) Solving problems involving diffraction by a variety of targets.
k) Describing and explaining the double slit experiment when diffraction is taken into account.

l) Describing and explaining the design and uses of diffraction gratings.
m) Solving problems involving double slit interference/diffraction.
n) Solving problems involving the diffraction grating.

Competency 6. The student will demonstrate knowledge, comprehension and the ability to analyze and apply the phenomena of polarization and scattering of electromagnetic waves by:

a) Describing the polarization of light waves and the methods by which it can be achieved.
b) Describing and explaining uses of polarization.
c) Comparing and contrasting linear, elliptical, and circular polarization.
d) Describing pictorially and mathematically the propagation of light through anisotropic media.
e) Comparing and contrasting the different scattering processes.
f) Explaining the scattering of light from the atmosphere.
g) Solving problems involving multiple polarizers.

Competency 7. The student will demonstrate knowledge, comprehension and the ability to analyze the design and applications of lasers by:

a) Describing the photon model of light.
b) Relating interference to the photon model of light.
c) Comparing and contrasting the electromagnetic and photon models of light.
d) Describing the spontaneous and stimulated emission of electromagnetic radiation.
e) Describing spatial coherence and temporal coherence.
f) Describing population inversion.
g) Relating the functioning of lasers to coherence, population inversion and stimulated emission.
h) Describing and explaining the design and uses of different types of lasers.
i) Describing holographic imaging.

Competency 8. The student will demonstrate knowledge of modern optics by:

a) Describing experimental designs that illustrate nonlinear effects.
b) Preparing and delivering researched presentations on nonlinear optics effects, nano-optics, quantum optics, optical communication and their applications.

Competency 9. The student will demonstrate knowledge, comprehension, and the ability to apply the process of scientific inquiry by:

a) Designing an inquiry activity that facilitates the learning of the wave and particle properties of light, or the phenomena of polarization and scattering.
b) Describing a historically significant optics experiment (such as Young's double slit experiment) in a way that showcases it as an important example of scientific inquiry.

Revision Date: _____

Approved By Academic Dean Date: _____ Reviewed By Director of Academic Programs Date: _____