Subject Description Form

Subject Code	AP30007
Subject Title	Optical Design
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The objectives of this subject are to provide an up-to-date treatment of the optical design at an introductory level to students in the fields of applied optics, optical instrumentation and optoelectronics.
Intended Learning Outcomes	On completing the subject, students will be able to (a) use the ray tracing method to solve the image formation problems; locate stops and pupils of an optical system consisting of lenses, mirrors, and prisms; (b) explain the formation of the first-order aberration and the third-order aberration; identify and calculate various types of monochromatic aberrations and chromatic aberrations; (c) calculate the optical transfer function (OTF) and use the OTF to evaluate the quality of an optical system; select proper sets of aberrations and variables to construct the merit function; (d) explain the laws of illumination; calculate luminancy and optimize illumination design; (e) develop merit functions to set the tolerances; use computer program to mechanize the approach to tolerancing; (f) use the computer software, Zemax, to design an optical system (singlet/doublet, spectrometer, beam expander, double Gauss camera lenses, Newtonian telescope, Maksutov telescope, zoom lens, and chromatic prism); to correct aberration and to analyze image quality; and (g) be able to analyze, evaluate, and propose solutions to practical problems related to optics and light illumination.
Subject Synopsis/ Indicative Syllabus	paraxial optics; ray tracing; lens system, physical optics, optical materials. first-order aberrations, third-order aberrations, chromatic aberrations, image quality measures, optical transfer function (OTF), OTF computation. merit function, optical design procedures, lens design optimization, tolerance analysis. radiation, color and color rendering, practical light sources and laws of illumination, interior and exterior illumination designs, methods for calculating illumination. mini-projects on the design and optimization of singlet/doublet, spectrometer, beam expander, double Gauss camera lenses, Newtonian telescope, Maksutov telescope, zoom lens, and chromatic prism.
Teaching/Learning	**Lecture**: The course contents will be delivered through lecture in class. Active

Methodology

participation in discussion by students will be encouraged. Tests and quizzes will be given to class at appropriate intervals to consolidate students' understanding of the acquired knowledge as well as to enhance their problem-solving skills.

Practical assignment: Students will be given opportunities for hands-on operations on advanced optical design software. They are expected to gain direct experience in making independent optical design. Through the process students can enhance their analytical power, problem solving skills, conceptual understanding, critical thinking and desire for life-long learning.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
(1) Continuous assessment	40	✓	✓	✓	✓	✓	✓	✓
(2) Examination	60	✓	✓	✓	✓	✓	✓	✓
Total	100							

Continuous assessment including assignments, laboratory exercises, quizzes and test. The continuous assessment is designed to monitor the study progress of the student. They also serve to provide student with a mechanism of self-evaluation of learning achievement. The final written examination will be used to assess the knowledge acquired by the students; as well as to determine the level of attainment of the prescribed learning outcomes.

Student Study Effort Expected

Class contact:	
• Lecture	22 h
• Laboratory	24 h
Other student study effort:	
• Self-study	74 h
Total student study effort	120 h

Reading List and References

Eugene Hecht, "Optics", 4th Edition, Pearson Addison Wesley.

Robert E. Fischer, "Optical system design", 2nd Edition, McGraw-Hill 2008.

D. Malacara and Z. Malacara, "Handbook of Optical Design", Marcel Dekker, Inc, 2004.

M.J. Kidger, "Fundamental Optical Design", SPIE Press, 2002.

Optical design software used: Zemax SE