



University of Technology
Department of Applied Sciences
Final Exam 2015/2016



Subject: Optical Design
Branch: Laser Physics
Examiner: Dr. Hyder A. Salih

Class: 4th year
Time: 3 hours
Date: /9/2016

Answer only five questions

Q1-A: Show analytically that a beam entering a planar transparent plate emerges parallel to its initial direction. Derive an expression for the lateral displacement of the beam. (8 Marks)

B: Explain briefly and sketch the reflection and refraction of plane wavefronts at the boundary surfaces. (6 Marks)

Q2-A: Given a convex -planar glass lens, radius 100 mm, thickness 10 mm, and refractive index is 1.5. Use the ynu ray trace to find the location and height of the image for an object 20 mm height above the axis and located 300 mm to the left of the first surface. (8 Marks)

B: Explain briefly and sketch the cardinal points of a well-corrected optical system. (6 Marks)

Q3-A: Derive the system matrix for two thin lenses separated by a distance d in air and apply its equation for two thin convex lenses having equal focal length and separated by a distance equal four times their focal lengths. (8 Marks)

B: Find the position and size of the image formed by an optical system with positive focal length of 10 cm for an object 5 cm high which is located 50 cm to the left of the first focal length point of the system. (Use both the Newtonian and Gaussian equations) (6 Marks)

Q4-A: Design a Fraunhofer achromatic doublet of focal length 50 cm using crown glass and flint glass. The lenses have catalogued indices of ($n_c = 1.50763$, $n_d = 1.51009$, and $n_f = 1.51566$) for crown lens and ($n_c = 1.61503$, $n_d = 1.62004$, and $n_f = 1.63208$) for flint lens. (8 Marks)

B: Explain briefly and sketch the coma and astigmatism aberrations. (6 Marks)

Q5-A: Derive the numerical aperture equation for an optical fiber and apply it for a single mode optical fiber has a core index 1.65 and a clade index 1.55. What is its maximum acceptance angle? (8 Marks)

B: Explain briefly and sketch the eye and defects of eye vision. (6 Marks)

Q6-A: What range of motion should the 50 mm focal length lens of a 35-mm camera have, if the camera is to be capable of photographing objects as close as 50 cm from the lens? What is the aperture diameter when the diaphragm is set at f/2.8 and at f/16? (8 Marks)

B: Explain briefly and sketch the laser beam expander. (6 Marks)