MID-TERM EXAM

This exam is 1:15 hours in duration. This is a closed-book exam – you are not allowed to consult your notes or any books. I strongly encourage you to draw figures if it helps. Best of luck!

Problem 1. (40 points)

Short Questions & Answers.

(a) (10 points) Since the latitude of College Park is \( \sim 39^\circ \) North, what is the zenith angle of a star with declination \(-40^\circ\) observed on the meridian from the UMD Observatory?

(b) (10 points) What is the local (College Park) sidereal time (LST) at midnight (eastern standard time) on March 21/22, date of the vernal equinox. Explain your answer.

(c) (10 points) Determine the exposure time needed to reach a signal/noise ratio of 1000 for a star with flux rate of 10 counts/second. Assume pure Poisson noise.

(d) (10 points) Define airmass. What is the airmass of a star at zenith observed from the UMD Observatory?

Problem 2. (30 points)

Telescope Designs & Aberrations.

(a) (10 points) Describe the optical design of Schmidt-Cassegrain telescopes (like the C14 at the UMD Observatory) in terms of the approximate shapes of the lens(es) and/or mirror(s). A drawing would be useful.

(b) (10 points) Describe chromatic aberration. Which telescopes are afflicted of this type of aberration. Why?

(c) (10 points) What is spherical aberration? Give an example of mirror afflicted with this type of aberration.
Problem 3. (20 points)

Geometrical Optics.

(a) (10 points) Consider a refracting telescope consisting of an objective lens with focal length $f_1 = 2$ meters followed by an eyepiece lens with focal length $f_2 = 1$ meter. The distance between the objective and eyepiece is 2.5 meters. Using the formula $1/f = 1/s_o + 1/s_i$, find the image location (with respect to the eyepiece) of an object positioned 5 meters in front of the objective lens. Is the image real or virtual?

(b) (10 points) Use ray tracing to confirm your answer in (a).

Problem 4. (10 points)

Atmosphere.

(a) (5 points) Explain in your own words the origin of *astronomical seeing* and *scintillation*.

(b) (5 points) Describe how *adaptive optics* works.