Name: _____MASTER_____ **Partner:** _____ Rev. 0
30 September 2025

Earth Orbital Mechanics & Solar Irradiance; Part I – Theoretical Model [5] (MATLAB Programming Assignment)

Experiment 3: Questions

Link for the NASA Julian Day time calculator → https://www-air.larc.nasa.gov/tools/jday.htm
Answer the following questions:

1. Consider the equation for the solar declination angle: $\delta_s = \Phi_r \cos[2\pi(time - 173.0)/T_{ORBIT}]$

[½] a. Solve this equation for the *time* variable when the argument of the cosine function is 0.

By inspection: *time* = 173.0

[1] b. Using the NASA Julian Day time calculator, report the calendar date for this *time* and confirm the approximate correct value for solar declination angle on the data plot.

Date: __22 June__ δ_S = ___+ 23.45°__ degrees Summer Solstice

[½] c. Solve this equation for the *time* variable when the argument of the cosine function is π/2.

$\pi/2 = 2\pi(time - 173.0)/T_{ORBIT}$; $time = T_{ORBIT}/4 + 173$

$time = 365.2564/4 + 173 = 264.3141$ Autumnal Equinox

[1] d. Using the NASA Julian Day time calculator, report the calendar date for this *time* and confirm the approximate correct value for solar declination angle on the data plot.

Date: _21 September_7:30 am___ δ_S = ____0.0____ degrees

[2] b. Consider the definition of solar zenith angle provided in the lecture notes, what is the *physical interpretation* of a **negative** value for the cosine for the solar zenith angle?

- Solar zenith angles are greater than 90°
- The Sun is below the horizon → no solar irradiance at the top of the atmosphere