```
%% Roshan Jaiswal-Ferri
%Section - 01
%Aero 356 Midterm 1: 4/23/25

%% Workspace Prep

%warning off
format long     %Allows for more accurate decimals
close all;      %Clears all
clear all;      %Clears Workspace
clc;            %Clears Command Window
```

Assumptions:

Assume sigma = 5.67e-8 W/m2, Radius of the earth = 6378 km, Solar Output is 1366 W/m2.

Question 3:

Determine the number of interior layers in a thermal blanket required to achieve an effective emittance of 0.005 if the interior, the inner and outer layers all have an emittance of 0.2. If you have a fraction number, round up

```
Ein = 0.2;
Eout = Ein;
Eint = Eout;
Etot = 0.005;

syms n
eq = Etot == ((1/Ein)+(1/Eout)-1 + ((2*n)/Eint)-n)^-1;
n2 = solve(eq,n);
disp(['Layers Rounded up: ', num2str(ceil(double(n2)))])
```

```
Layers Rounded up: 22
```

Question 4:

If the heat gain of a spherical spacecraft with a diameter of 1 meter is 5 W, what is the maximum external temperature? Assume the solar absorptance and emissivity are 0.1, SB = 5.67e-8 W/m2, Se = 1366 W/m2, Earth Temp = 255 K, Bond Albedo for Earth = 0.3, Altitude of dewer is 400 km, theta_s = 0, emissivity of Earth = 0.9 . Assume the spacecraft is orbiting at 1 AU from the sun. For this case, there is no internal source.

Report the temperature to the nearest K

```
abs = 0.1; %alpha s/c
Esc = abs; %emissivity s/c
Et = 255; %earth temp k
AlbEarth = 0.3; %earth albedo
Re = 6378*1000; %meters
Ee = 0.9; %earth emissivity
theta_s= 0;
AU = 1.496*10^11; %in meters
```

```
sb = 5.67*10^-8;
Se = 1366;
alt = 400*1000; %meters
d = 1; %1 meter wide
r = d/2;

Xc = pi*r^2; %cross sectional area
SAsc = 4*pi*r^2; %surf area s/c
SAe = (4*pi*(Re)^2); %surface area of earth

%Finding Q solar
Qsol = abs*Se*Xc;

%Finding Q IR
F = (SAsc/SAe)*(1/2)*(1-(1-(Re/(Re+alt))^2)^0.5);
Qir = Esc*Ee*sb*(Et^4)*SAe*F;

%Finding Q from earth albedo
rho = (Re+alt)/Re;
G = (2/3) * ((2*rho + rho^(-2)) - (2 + rho^(-2)) * sqrt(rho^2 - 1));
Qalb = abs*Se*AlbEarth*Xc*G*cosd(theta_s);

%Qhespace = -Esc*sb*SAsc*Tsc^4; -- Entered manually later in syms

Qhesurf = 0;
Qint = 0;
Qstored = 0; %b/c steady state

syms Tsc
eq2 = Qsol + Qir + Qalb + (-Esc*sb*SAsc*Tsc^4) + Qhesurf + Qint + Qstored == 5;
Temp = solve(eq2,Tsc);
Temp = double(Temp);
Temp = Temp(imag(Temp)==0 & Temp>0);

disp(['Max Temp of spacecraft: ',num2str(Temp), ' K'])
```

```
Max Temp of spacecraft: 311.1889 K
```

Question 5:

Determine the temperature of a flat plate in orbit around the Earth that has one side with solar absorption = 0.5 and the other side that faces the Earth is insulated with an emittance of 0.1. The angle between the normal to the plate and the sun (lamda) = 5 degs. Ignore heat transfer with the Earth. Hint: you don't need the area of the plate. Give the temperature to the nearest K.

```
Esc = 0.1;
abs = 0.5;
lamda = 5; %in deg
Rsun = 6.9634*10^8; %in meters
p = 1; AU/Rsun;
```

```
F = (cosd(lamda));

Qir = 0;
Qalb = 0;
Qsol = abs*Se*F; %deleted surface area because they cancelled out, added view factor
%0.5 because it only absorbs on one side.

syms Tsc2
eq3 = Qsol + Qir + Qalb + (-Esc*sb*Tsc2^4) + Qhesurf + Qint + Qstored == 0;
Temp2 = solve(eq3,Tsc2);
Temp2 = double(Temp2);
Temp2 = Temp2(imag(Temp2)==0 & Temp2>0);

disp(['Temp of spacecraft: ',num2str(Temp2), ' K'])
```

```
Temp of spacecraft: 588.5664 K
```