Contents


```
clear all
clc
```

INPUT

Code compiled by Roshan R Rao

```
year=2022;                  %   (from MEASUREMENT) (user input)
month=03;                   %   (from MEASUREMENT) (user input)
date=17;                    %   (from MEASUREMENT) (user input)
hour=10;                    %   (from MEASUREMENT) (user input)
minu=30;                    %   (from MEASUREMENT) (user input)
sec=0;                      %   (from MEASUREMENT) (user input)
beta=0;                     %   tilt angle (degrees)from horizontal
lat=13;                     %   (from MEASUREMENT) (user input)
lon=77;                     %   (from MEASUREMENT) (user input)

t1=0.004;
t2=0.0005;
t3=1e-7;
t4=0.0000;
t5=0.0005;
t6=0.0003;
thickness=[t1;t2;t3;t4;t5;t6]; % thickness of layers (order : glass,eva,arc,si,eva,tedlar) (in meters)
azim_w=0;                      % wall azimuth angle (degrees)
```

Angle of incidence calculation

```
d=datetime(year,month,date,hour,minu,sec);
doy = day(d,'dayofyear');                           % day of the year
clocktime=hour+(minu./60)+(sec./3600);              % local clock time in decimal (24 h format)
timezone=5.5;                                       % time zone of the location
[theta,decl,h_angle]=in_angle(doy,clocktime,timezone,lat,lon,beta,azim_w);
if theta > 90
    warning_message=["ALERT ! inclination angle greater than 90 "]
end
```

Read optical properties

```
locat=pwd;
locatn=[pwd '/data_base_files'];

glass=xlsread([locatn '/Glass_1.xlsx']);
wv=glass(:,1) ;                         % wavelength (nm)
gl_n=glass(:,2) ;                       % real part of refractive index
gl_k=glass(:,3);                        % imaginary part of refractive index
gl_ac=(4.*pi.*gl_k)./(wv.*10^-9);       % absorption coefficient (4*pi*k/lamda) (per meter)


eva=xlsread([locatn '/EVA_3.xlsx']);
eva_n=eva(:,2);
eva_k=eva(:,3);
eva_ac=(4.*pi.*eva_k)./(wv.*10^-9);

arc=xlsread([locatn '/GlassARC_2.xlsx']);
arc_n=arc(:,2);
arc_k=arc(:,3);
arc_ac=(4.*pi.*arc_k)./(wv.*10^-9);

sicell=xlsread([locatn '/si_cell_dummy.xlsx']);
si_n=sicell(:,2);
si_k=sicell(:,3);
si_ac=(4.*pi.*si_k)./(wv.*10^-9);

bs=xlsread([locatn '/backsheet.xlsx']);
```

```
bs_n=bs(:,2);
bs_k=bs(:,3);
bs_ac=(4.*pi.*bs_k)./(wv.*10^-9);

ri=[gl_n eva_n arc_n si_n eva_n bs_n];
ac=[gl_ac eva_ac arc_ac si_ac eva_ac bs_ac];
```

Calculate transmittance based on ray tracing method

```
for wav=1:length(ri)
refr=[ri(wav,1);ri(wav,2);ri(wav,3);ri(wav,4);ri(wav,5);ri(wav,6)];
absc=[ac(wav,1);ac(wav,2);ac(wav,3);ac(wav,4);ac(wav,5);ac(wav,6)];
[tau_pv_wv,rho_pv_wv,abs_pv_wv]=optical(6,refr,absc,thickness,doy,clocktime,lat,lon,beta,azim_w);
rho_pv(wav,1)=rho_pv_wv.*100;
abs_pv(wav,1)=abs_pv_wv.*100;
tau_pv(wav,1)=tau_pv_wv.*100;
end

wav_wei_st=trapz(wv,tau_pv)/2250

%%------banded calculation-------------------------

band_250_400=trapz(wv(1:16),tau_pv(1:16))/150
band_310_400=trapz(wv(7:16),tau_pv(7:16))/90
band_310_700=trapz(wv(7:46),tau_pv(7:46))/390
band_380_780=trapz(wv(14:54),tau_pv(14:54))/400
band_380_1400=trapz(wv(14:116),tau_pv(14:116))/1020
band_700_1400=trapz(wv(46:116),tau_pv(46:116))/700
band_250_2500=trapz(wv(1:226),tau_pv(1:226))/2250
band_model=[band_250_400;band_310_400;band_310_700;band_380_780;band_380_1400;band_700_1400;band_250_2500]
%--------------------------------------------------
band_short=[{'(250-400nm)'};{'(310-400nm)'};{'(310-700nm)'};{'(380-780nm)'};{'(380-1400nm)'};{'(700-1400nm)'};{'(250-2500nm)'}]
```

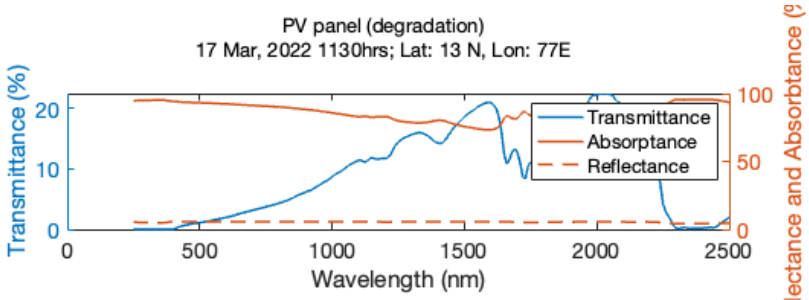
```
wav_wei_st =

    9.8034


band_250_400 =

   4.1944e-06


band_310_400 =

   6.9907e-06


band_310_700 =

    1.2212


band_380_780 =

    1.9128


band_380_1400 =

    7.0829


band_700_1400 =

    9.6404


band_250_2500 =

    9.8034


band_model =

    0.0000
    0.0000
    1.2212
    1.9128
```

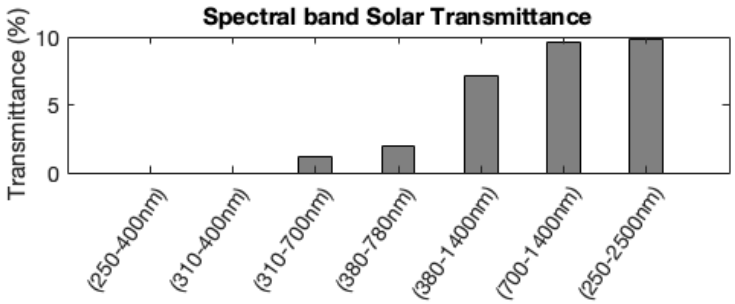
```
    7.0829
    9.6404
    9.8034


band_short =

  7×1 cell array

    {'(250-400nm)' }
    {'(310-400nm)' }
    {'(310-700nm)' }
    {'(380-780nm)' }
    {'(380-1400nm)'}
    {'(700-1400nm)'}
    {'(250-2500nm)'}
```

RESULT

```
f1=figure
subplot(2,1,1)
yyaxis left
plot(wv,tau_pv,'LineWidth',1.5)
ylabel('Transmittance (%)')
xlabel('Wavelength (nm)')
set(gca,'FontSize',14)
yyaxis right
plot(wv,abs_pv,wv,rho_pv,'LineWidth',1.5)
ylabel('Reflectance and Absorbtance (%)')
xlabel('Wavelength (nm)')
legend('Transmittance','Absorptance','Reflectance')
set(gca,'FontSize',14)

%  sgtitle ({'300 um Backsheet (TPT)','17 Mar, 2022 1130hrs; Lat: 13 N, Lon: 77E'})
%  sgtitle ({'0.1 um Glass ARC','17 Mar, 2022 1130hrs; Lat: 13 N, Lon: 77E'})
%  sgtitle ({'500um EVA (above and below cell each)','17 Mar, 2022 1130hrs; Lat: 13 N, Lon: 77E'})
%  sgtitle ({'4mm Glass','17 Mar, 2022 1130hrs; Lat: 13 N, Lon: 77E'})
sgtitle ({'PV panel (degradation)','17 Mar, 2022 1130hrs; Lat: 13 N, Lon: 77E'})
subplot(2,1,2)
bar(band_model,0.4,'FaceColor',[0.5 .5 .5])
set(gca,'xtick',1:7,'xticklabel',band_short)
set(gca,'FontSize',14)
xtickangle(55)
title('Spectral band Solar Transmittance')
ylabel('Transmittance (%)')
set(gca,'FontSize',14)
```

```
f1 =

  Figure (1) with properties:

      Number: 1
        Name: ''
       Color: [0.9400 0.9400 0.9400]
    Position: [440 278 560 420]
       Units: 'pixels'

  Use GET to show all properties
```





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