Using Matlab to determine prayer times for any date and any geographic location

Matlab program will be written to evaluate the times of prayer in Islam according to the date in the year and geographic location using the following equations:−

$$\delta = 23.45^{o}\sin\left[\frac{360}{365}(n + 284)\right]$$

Where (δ) is the declination angle and (n) is the location number of the day in the year.

$$h = 15[ST - 12]$$

$$EQT = 9.87\sin(2\beta) - 7.53\cos\beta - 1.5\sin\beta$$

$$\beta = \frac{360}{364}(n - 81)$$

$$ST = LT + \frac{Long - TZ}{15} + \frac{EQT}{60}$$

$$\cos(h_s) = -\tan(L)\tan(\delta)$$

$$\sin(\alpha) = \sin(L)\sin(\delta) + \cos(L)\cos(\delta)\cos(h)$$

(L) represents the latitude angle and (Long) is the longitude angle. TZ=45^{o} for the time region of Iraq. (h) is the hour angle that represents time in terms of angles relative to a reference point at the solar noon where (h=0^{o}). (h_s) is the hour angle at sunrise which is equal to the hour angle at sunset. (h_s) has a negative value at sunrise and a positive value at sunset. When (h_s) is divided by 15^{o} the result will be in hours.

At the beginning, the day number (n) is calculated then the factor (β) and (EQT) are found. The declination angle (δ) is then found. The angle of sunrise and sunset (h_s) is determined, converted to hours and corrected to get the Local Time (LT) at sunrise and sunset. The dawn and night prayers times are determined by subtracting and adding 1.5 hours to the sunrise and sunset times respectively. The noon prayer is located at the solar noon where ST=12. The afternoon prayer time is the time that makes the length of a rod shadow equals twice the rod length. The sunset prayer time is exactly the sunset time.

The Matlab program making the above calculations is listed below:−

```
clear,clc
Mo=input('Enter Month number = ');
Day=input('Enter Day number = ');
M=[0,31,59,90,120,151,181,212,243,273,304,334];
n=M(Mo)+Day;
Lat=input('Enter Latitude = ');
Long=input('Enter Longitude = ');
Beta=(360/364)*(n-81);
EQT=9.87*sind(2*Beta)-7.53*cosd(Beta)-1.5*sind(Beta);
Del=23.45*sind((360/365)*(n+284));
hs=acosd(-tand(Lat)*tand(Del));
sunset=hs/15;
Aft=atand(0.5);
Numir=sind(Aft)-sind(Lat)*sind(Del);
Denom=cosd(Lat)*cosd(Del);
cosalf=Numir/Denom;
After_Noon=acosd(cosalf)/15;
Correction=(Long-45)/15+EQT/60;

P1=12-sunset-1.5-Correction;  % Dawn Prayer
P2=12-Correction;             % Noon Prayer
P3=12+After_Noon-Correction;  % After Noon Prayer
P4=12+sunset-Correction;      % Sunset Prayer
P5=12+sunset+1.5-Correction;  % Night Prayer

hr1=fix(P1);mnt1=round((P1-fix(P1))*60);
hr2=fix(P2);mnt2=round((P2-fix(P2))*60);
hr3=fix(P3);mnt3=round((P3-fix(P3))*60);
hr4=fix(P4);mnt4=round((P4-fix(P4))*60);
hr5=fix(P5);mnt5=round((P5-fix(P5))*60);

if mnt1==60;hr1=hr1+1;mnt1=0;end
if mnt2==60;hr2=hr2+1;mnt2=0;end
if mnt3==60;hr3=hr3+1;mnt3=0;end
if mnt4==60;hr4=hr4+1;mnt4=0;end
if mnt5==60;hr5=hr5+1;mnt5=0;end

fprintf('\n')
fprintf('Dawn Prayer Time = %2.0f:%2.0f \n',[hr1,mnt1])
fprintf('Noon Prayer Time = %2.0f:%2.0f \n',[hr2,mnt2])
fprintf('Afternoon Prayer Time = %2.0f:%2.0f \n',[hr3,mnt3])
fprintf('Sunset Prayer Time = %2.0f:%2.0f \n',[hr4,mnt4])
fprintf('Night Prayer Time = %2.0f:%2.0f \n',[hr5,mnt5])
```