```
%homework3
%exercise 4.4 page 180

gamma=1.4; %air heat coefficient
Mach=linspace(2.8,8,500); %array of mach numbers
n=length(Mach);
Cp1=zeros(1,n);
Cp2=zeros(1,n);
Cp3=zeros(1,n);
Cp4=zeros(1,n);
Cp5=zeros(1,n);
K1=zeros(1,n);
K2=zeros(1,n);
K3=zeros(1,n);
K4=zeros(1,n);
K5=zeros(1,n);
x1=zeros(1,n);
x2=zeros(1,n);
x3=zeros(1,n);
x4=zeros(1,n);
x5=zeros(1,n);
dx=zeros(1,n);
beta1=zeros(1,n);
beta2=zeros(1,n);
beta3=zeros(1,n);
beta4=zeros(1,n);
beta5=zeros(1,n);

%wedge half angles
theta1=5*pi/180;
theta2=10*pi/180;
theta3=15*pi/180;
theta4=20*pi/180;
theta5=30*pi/180;

for i=1:n
%calculatin the wave angles using newton_raphson numerical method
%function for beta (function beta-theta-m). Beta is represented by x
x1=@(x) 2*cot(x)*((Mach(i).^2*sin(x)^2-1)/(Mach(i).^2*(gamma
+cos(2*x))+2))-tan(theta1);
%derivative of the beta-theta-m function with respect to beta (x)
dx=@(x) ((4.*Mach(i).^2.*cos(x).^2)/(Mach(i).^2.*(gamma
+cos(2*x))+2))+((4.*Mach(i).^2.*sin(2*x).*cot(x).*(Mach(i).^2.*sin(x).^2-1))/
(Mach(i).^2.*(gamma+cos(2*x))+2).^2)-
((2.*csc(x).^2.*(Mach(i).^2.*sin(x).^2-1))/(Mach(i).^2.*(gamma
+cos(2*x))+2));
x2=@(x) 2*cot(x)*((Mach(i).^2*sin(x)^2-1)/(Mach(i).^2*(gamma
+cos(2*x))+2))-tan(theta2);
x3=@(x) 2*cot(x)*((Mach(i).^2*sin(x)^2-1)/(Mach(i).^2*(gamma
+cos(2*x))+2))-tan(theta3);
x4=@(x) 2*cot(x)*((Mach(i).^2*sin(x)^2-1)/(Mach(i).^2*(gamma
+cos(2*x))+2))-tan(theta4);
```

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x5=@(x) 2*cot(x)*((Mach(i).^2*sin(x)^2-1)/(Mach(i).^2*(gamma
+cos(2*x))+2))-tan(theta5);
x0=55*pi/180; %initial value for beta (guessed from fig. 2.3 p.45)
toll=10^-5; %precision value for iteration


beta1(i)=newton_raphson(x1,dx,x0,toll,1000);
beta2(i)=newton_raphson(x2,dx,x0,toll,1000);
beta3(i)=newton_raphson(x3,dx,x0,toll,1000);
beta4(i)=newton_raphson(x4,dx,x0,toll,1000);
beta5(i)=newton_raphson(x5,dx,x0,toll,1000);




%part a) plot Cp vs Mach no.

    %pressure coefficient calculation (eqn 2.14)
    Cp1(i)=(4/(gamma+1))*((sin(beta1(i))^2)-(1/(Mach(i)^2)));
    Cp2(i)=(4/(gamma+1))*((sin(beta2(i))^2)-(1/(Mach(i)^2)));
    Cp3(i)=(4/(gamma+1))*((sin(beta3(i))^2)-(1/(Mach(i)^2)));
    Cp4(i)=(4/(gamma+1))*((sin(beta4(i))^2)-(1/(Mach(i)^2)));
    Cp5(i)=(4/(gamma+1))*((sin(beta5(i))^2)-(1/(Mach(i)^2)));
end
figure(1)
plot(Mach,Cp1,Mach,Cp2,Mach,Cp3,Mach,Cp4,Mach,Cp5)
hold on

xlabel('Mach number')
ylabel('Pressure Coefficient')
title('Pressure coefficient related to Mach no. for different wedge
 angles')
legend('theta=5°','theta=10°','theta=15°','theta=20°','theta=30°')
axis([0 8 -0.5 1.2])
%part b) plotting Cp/theta^2 vs Mach/theta
figure(2)
plot(Mach*theta1,Cp1/theta1^2,'-',Mach*theta2,Cp2/theta2^2,'-
b',Mach*theta3,Cp3/theta3^2,'-m',Mach*theta4,Cp4/theta4^2,'-
g',Mach*theta5,Cp5/theta5^2,'-k')
xlabel('M*theta')
ylabel('Cp/theta^2')
title('Pressure coefficient related to Mach no. for different wedge
 angles')
legend('theta=5°','theta=10°','theta=15°','theta=20°','theta=30°')
hold on

%part c) plotting eq. 2.29 vs Mach no.
for j=1:n
    %hypersonic similarity parameter calculation
    K1(j)=Mach(j)*theta1;
    K2(j)=Mach(j)*theta2;
    K3(j)=Mach(j)*theta3;
    K4(j)=Mach(j)*theta4;
    K5(j)=Mach(j)*theta5;
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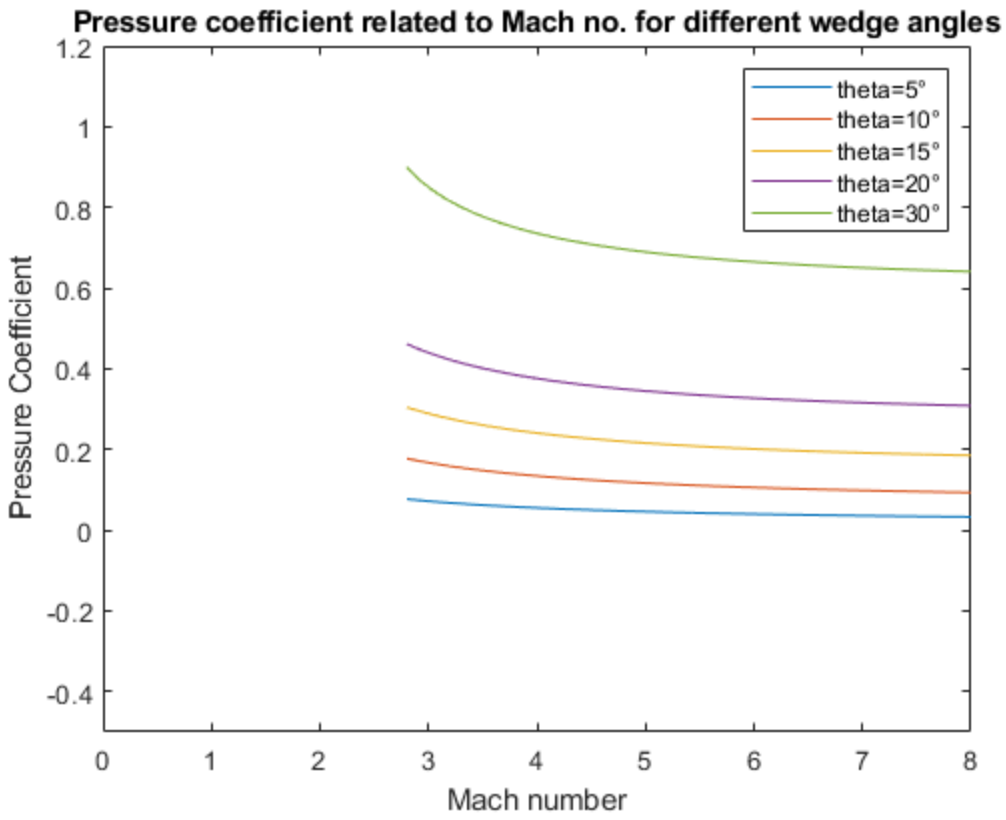
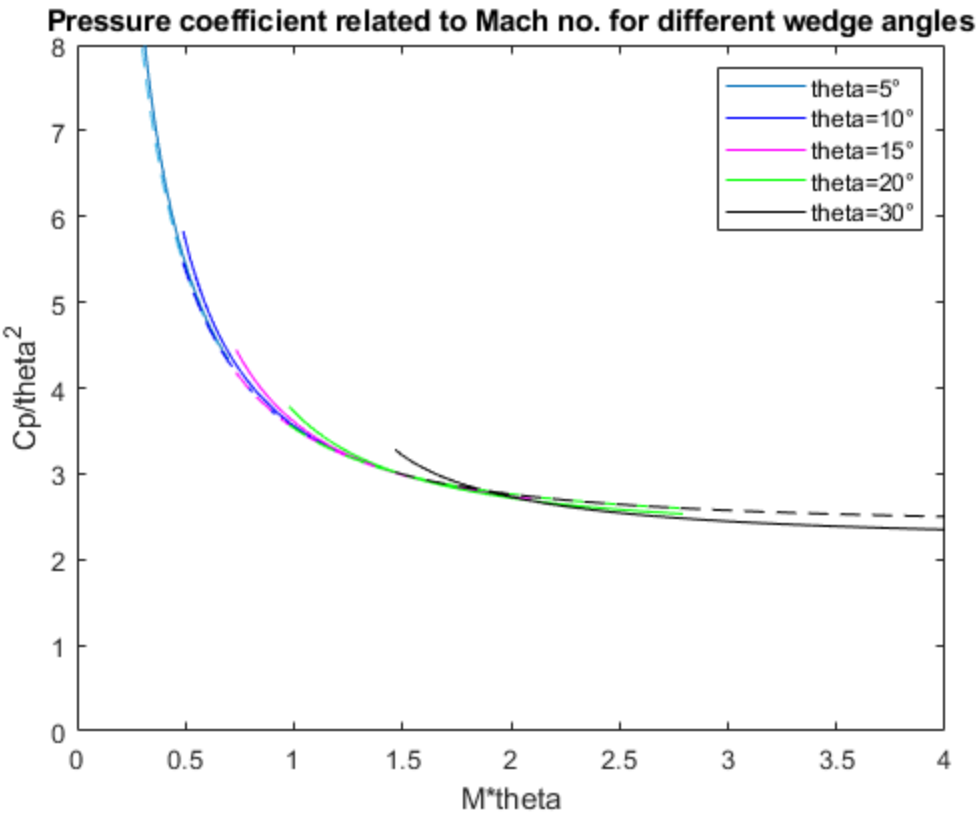
```
    %pressure coefficient calculation from eq 2.29
    Cp1(j)=2*theta1^2*(((gamma+1)/4)+sqrt(((gamma+1)/4)^2+(1/
K1(j)^2)));
    Cp2(j)=2*theta2^2*(((gamma+1)/4)+sqrt(((gamma+1)/4)^2+(1/
K2(j)^2)));
    Cp3(j)=2*theta3^2*(((gamma+1)/4)+sqrt(((gamma+1)/4)^2+(1/
K3(j)^2)));
    Cp4(j)=2*theta4^2*(((gamma+1)/4)+sqrt(((gamma+1)/4)^2+(1/
K4(j)^2)));
    Cp5(j)=2*theta5^2*(((gamma+1)/4)+sqrt(((gamma+1)/4)^2+(1/
K5(j)^2)));
end

    plot(Mach*theta1,Cp1/theta1^2,'--',Mach*theta2,Cp2/theta2^2,'--
b',Mach*theta3,Cp3/theta3^2,'--m',Mach*theta4,Cp4/theta4^2,'--
g',Mach*theta5,Cp5/theta5^2,'--k')
    legend('theta=5°','theta=10°','theta=15°','theta=20°','theta=30°')
    axis([0 4 0 8])
    hold on
```





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