

Chapter 10

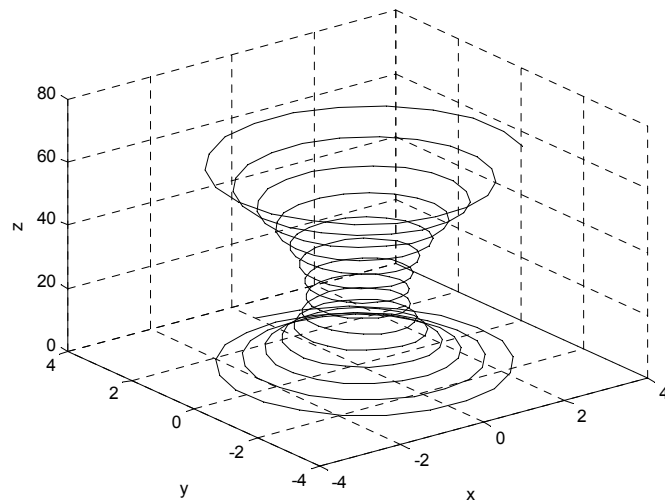
Solved Problems

Problem 1

Script file:

```
t=0:0.1:30;  
r=0.01*(t-15).^2+1;  
x=r.*sin(3*t);  
y=r.*cos(3*t);  
z=0.4.*t.^(3/2);  
plot3(x,y,z,'k','linewidth',1)  
grid on  
xlabel('x'); ylabel('y'); zlabel('z')
```

Figure:

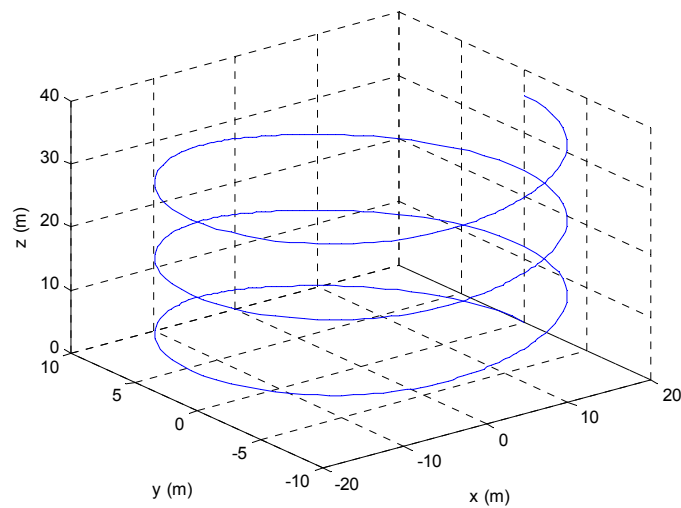


Problem 2

Script file:

```
aa=20; b=10; h=18;  
n=3;  
t=linspace(0,2*pi*n,400);  
r=a*b./sqrt((b*cos(t)).^2+(a*sin(t)).^2);  
x=r.*cos(1*t);  
y=r.*sin(1*t);  
z=h*t/(1*pi*n);  
plot3(x,y,z)  
grid on  
xlabel('x (m)'); ylabel('y (m)'); zlabel('z (m)')
```

Figure:

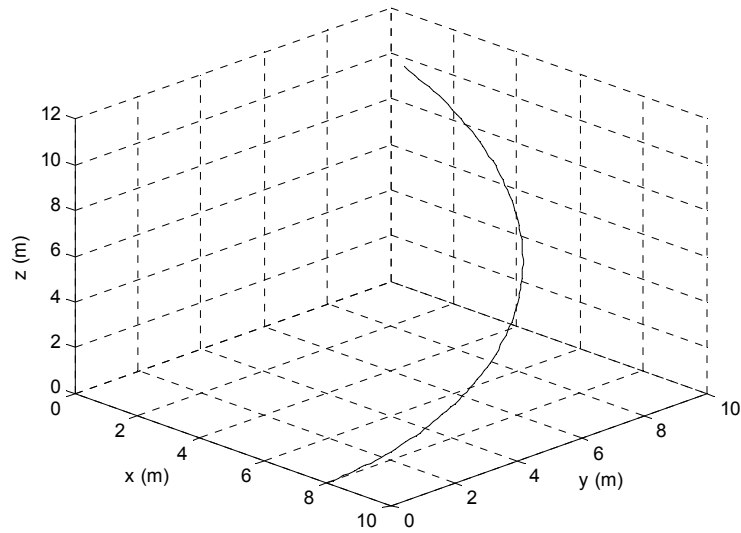


Problem 3

Script file:

```
t=linspace(0,10,100);  
r=8+0.6*t;  
phi=5*pi*t/180;  
theta=8*pi*t/180;  
x=r.*cos(phi).*cos(theta);  
y=r.*cos(phi).*sin(theta);  
z=r.*sin(phi);  
plot3(x,y,z,'k','linewidth',1)  
grid on  
xlabel('x (m)'); ylabel('y (m)'); zlabel('z (m)')  
view(45,30)
```

Figure:

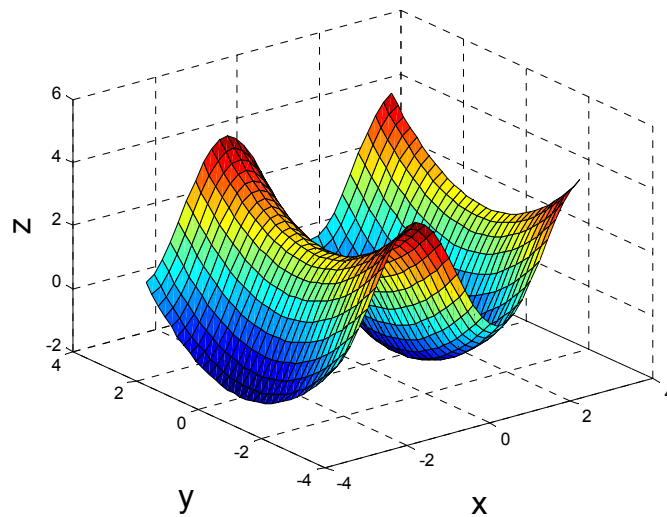


Problem 4

Script file:

```
x=-3:0.2:3;  
y=-3:0.2:3;  
[X,Y]=meshgrid(x,y);  
Z=Y.^2/4-2*sin(1.5*X);  
surf(X,Y,Z)  
xlabel('x','fontsize',18);  
ylabel('y','fontsize',18);  
zlabel('z','fontsize',18)
```

Figure:

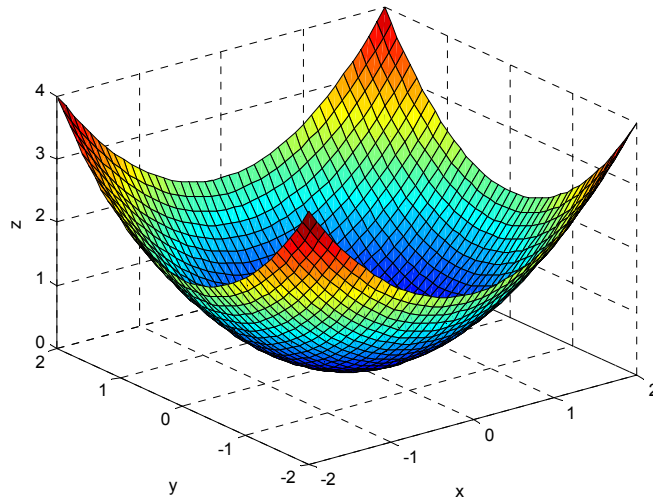


Problem 5

Script file:

```
x=-2:0.1:2;  
y=-2:0.1:2;  
[X,Y]=meshgrid(x,y);  
Z=0.5*X.^2+0.5*Y.^2;  
surf(X,Y,Z)  
xlabel('x'); ylabel('y'); zlabel('z')
```

Figure:

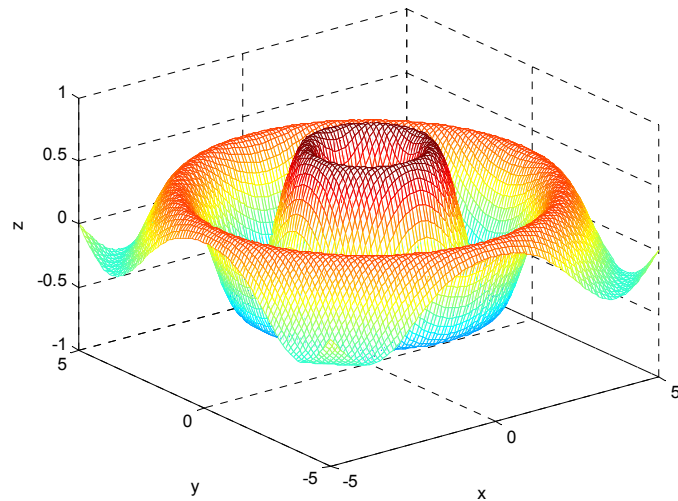


Problem 6

Script file:

```
x=-5:0.1:5;  
y=-5:0.1:5;  
[X,Y]=meshgrid(x,y);  
R=sqrt(X.^2+Y.^2);  
Z=-cos(2*R)./exp(0.2*R);  
mesh(X,Y,Z)  
xlabel('x'); ylabel('y'); zlabel('z')
```

Figure:

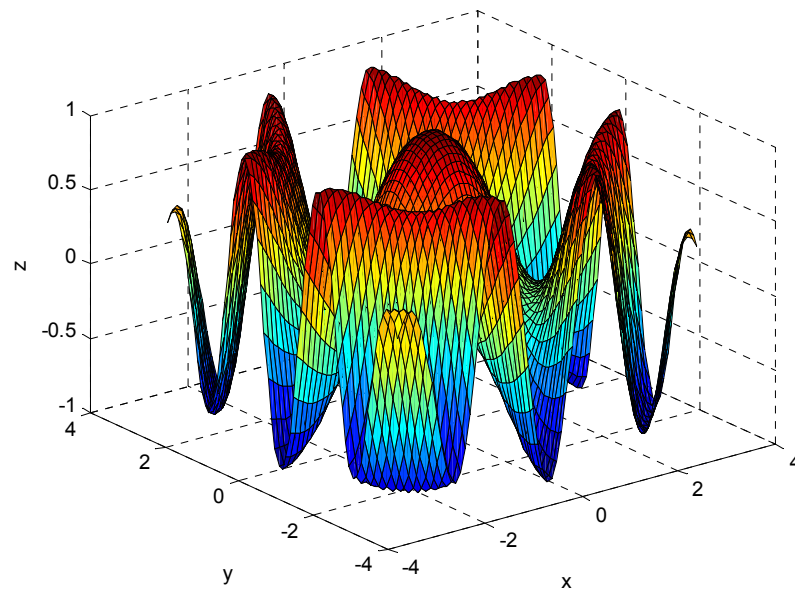


Problem 7

Script file:

```
x=-pi:0.1:pi;  
y=-pi:0.1:pi;  
[X,Y]=meshgrid(x,y);  
R=sqrt(X.^2+Y.^2);  
Z=cos(X.*Y).*cos(R);  
surf(X,Y,Z)  
xlabel('x'); ylabel('y'); zlabel('z')
```

Figure:

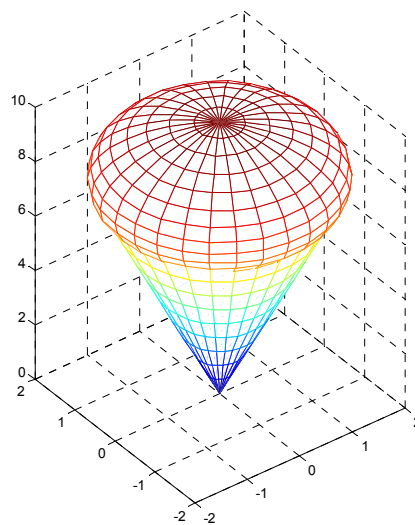


Problem 8

Script file:

```
r=[0:0.2:2];  
theta=[0:pi/15:2*pi];  
[R,THETA]=meshgrid(r,theta)  
X=R.*cos(THETA);  
Y=R.*sin(THETA);  
Z=4*R;  
mesh(X,Y,Z)  
clear  
theta=[0:pi/15:2*pi];  
phi=[0:pi/16:pi];  
hold on  
[THETA,PHI]=meshgrid(theta,phi);  
radius=2;  
X=radius*sin(PHI).*cos(THETA);  
Y=radius*sin(PHI).*sin(THETA);  
Z=radius*1*cos(PHI)+8;  
mesh(X,Y,Z)  
hold off
```

Figure:

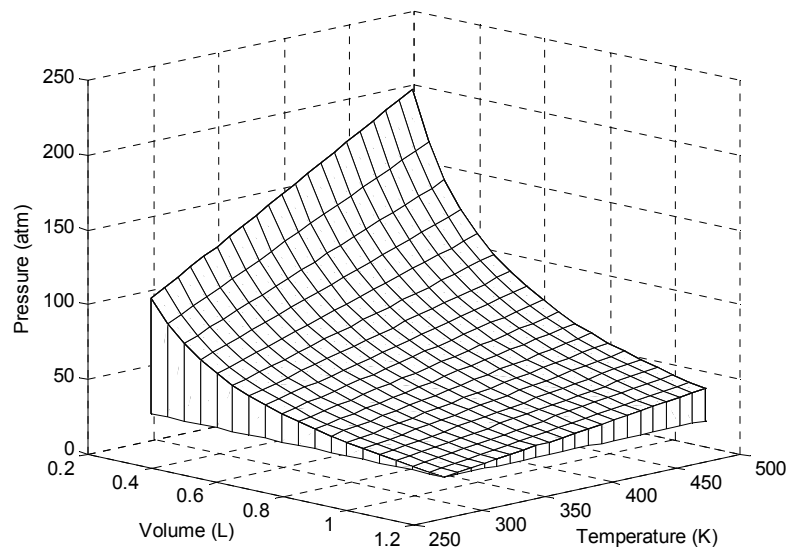


Problem 9

Script file:

```
R=0.08206; n=1.5; a=1.39; b=0.03913;  
v=0.3:0.05:1.2;  
t=273:10:473;  
[V,T]=meshgrid(v,t);  
P=n*R*T./(V-n*b)-n^2*a./V.^2;  
meshz(V,T,P)  
ylabel('Temperature (K)')  
xlabel('Volume (L)')  
zlabel('Pressure (atm)')  
view(45,15)  
colormap([0,0,0])
```

Figure:

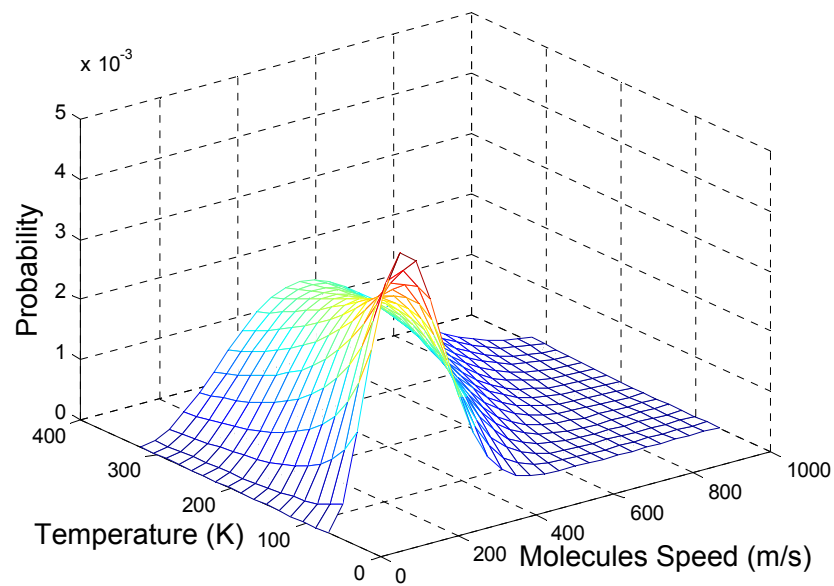


Problem 10

Script File:

```
R=8.31; M=0.032;
x=linspace(0,1000,28);
y=linspace(70,320,16);
[X,Y]=meshgrid(x,y);
Z=4*pi*(M./(2*pi*R*Y)).^(3/2).*X.^2.*exp(-M*X.^2./(2*R*Y));
mesh(X,Y,Z)
xlabel('\fontsize{14}Molecules Speed (m/s)')
ylabel('\fontsize{14}Temperature (K)')
zlabel('\fontsize{14}Probability')
```

Figure:

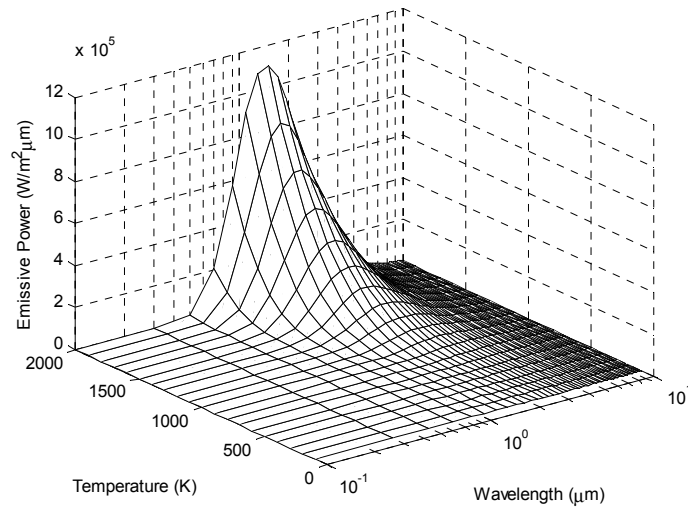


Problem 11

Script file:

```
C1=3.742E8; C2=1.439E4;
L=0.1:0.2:10;
T=100:100:2000;
[W,D]=meshgrid(L,T);
LL=log10(W);
E=C1./(W.^5.*(exp(C2./(W.*D))-1));
%surf(X,Y,Z)
mesh(W,D,E,'EdgeColor','k')
set(gca,'xscale','log')
xlabel('Wavelength (\mu m)'); ylabel('Temperature (K)');
zlabel('Emissive Power (W/m^2\mu m)')
```

Figure:

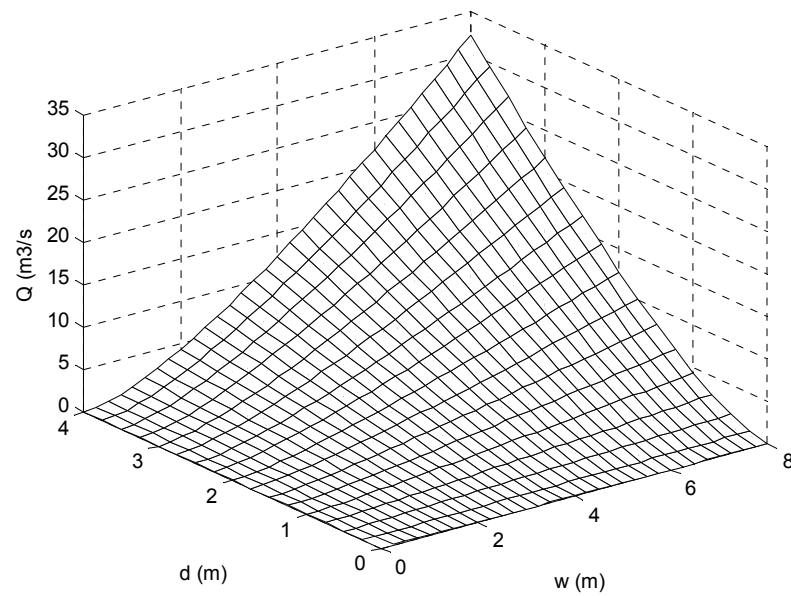


Problem 12

Script file:

```
n=0.05; S=0.001;
Ssr=sqrt(S);
w=0:0.25:8; %x
d=-0:0.25:4; %y
[W,D]=meshgrid(w,d);
Q=(D.*W)/n.*((W.*D)./(W+2*D)).^(2/3)*Ssr;
mesh(W,D,Q,'EdgeColor','k')
xlabel('w (m)'); ylabel('d (m)'); zlabel('Q (m3/s)')
```

Figure:



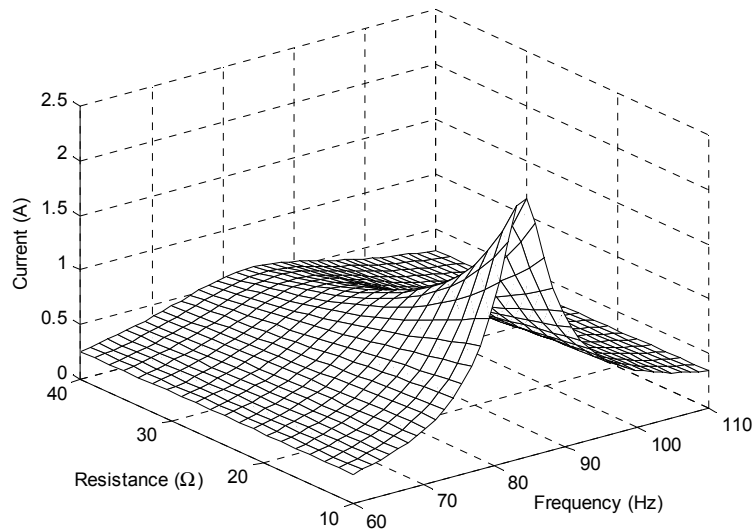
Problem 13

10.a

Script file:

```
Em=24; L=240e-3; C=15e-6;
w0=1/sqrt(L*C)
f=linspace(60,110,40);
r=linspace(10,40,20);
[F,R]=meshgrid(f,r);
I=Em./sqrt(R.^2+(2*pi*f*L-1./(2*pi*f*C)).^2);
mesh(F,R,I)
colormap([0 0 0])
xlabel('Frequency (Hz)')
ylabel('Resistance (\Omega)')
zlabel('Current (A)')
```

Figure:

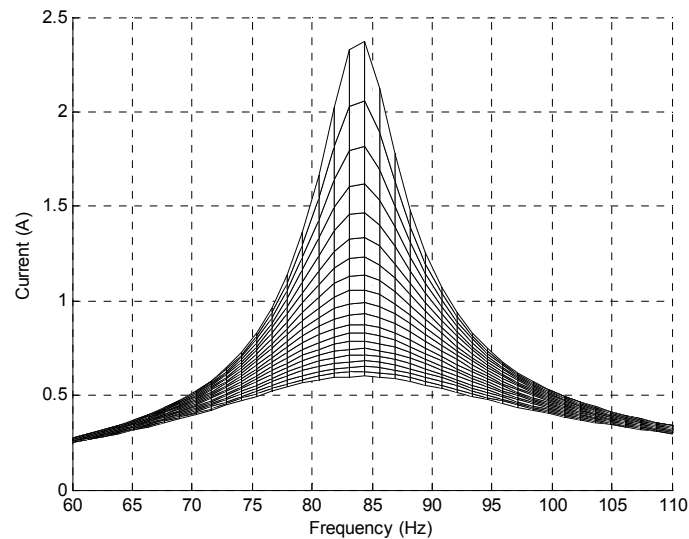


10.b

Script file:

```
Em=24; L=240e-3; C=15e-6;
f=linspace(60,110,40);
r=linspace(10,40,20);
[F,R]=meshgrid(f,r);
I=Em./sqrt(R.^2+(2*pi*f*L-1./(2*pi*f*C)).^2);
mesh(F,R,I)
view(0,0)
colormap([0 0 0])
xlabel('Frequency (Hz)')
ylabel('Resistance (\Omega)')
zlabel('Current (A)')
```

Figure:



Calculating the natural frequency:

Command Window:

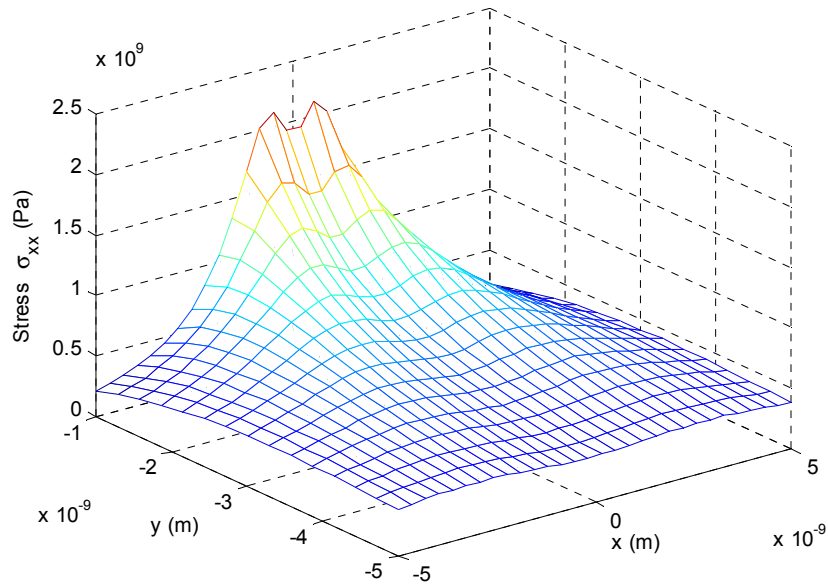
```
>> f0=1/(2*pi*sqrt(240e-3*15e-6))
>> f0 =
    83.8820
```

Problem 14

Script file for σ_{xx} :

```
G=27.7e9; neu=0.334; b=0.286e-9;
K=G*b/(2*pi*(1-neu));
x=linspace(-5.0e-9,5.0e-9,30);
y=linspace(-5e-9,-1e-9,15);
[X,Y]=meshgrid(x,y);
Z=-K*Y.*(3*X.^2+Y.^2)./(X.^2+Y.^2).^2;
mesh(X,Y,Z)
xlabel('x (m)'), ylabel('y (m)')
zlabel('Stress \sigma_x_x (Pa)')
```

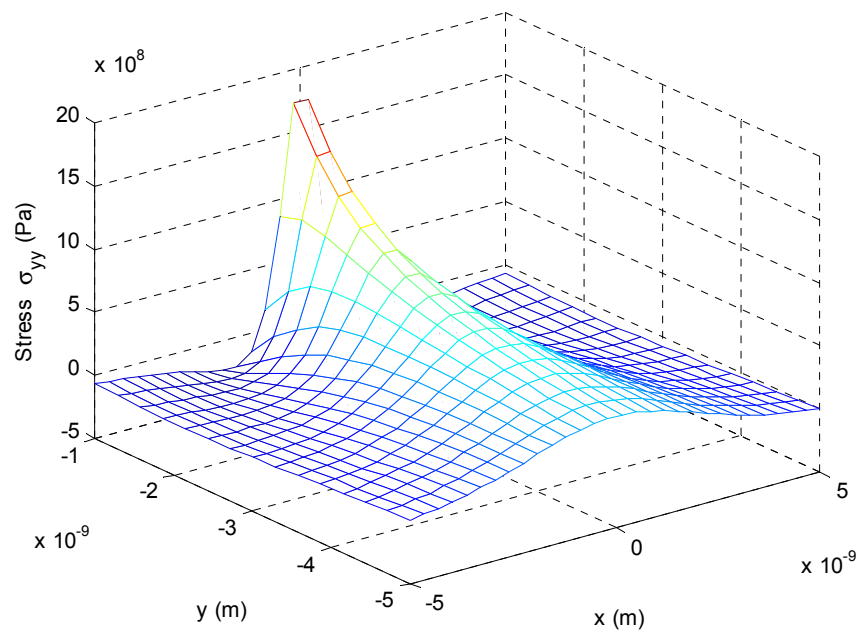
Figure:



Script file for σ_{yy} :

```
% HW9_12 Sigma yy
G=27.7e9; neu=0.334; b=0.286e-9;
K=G*b/(2*pi*(1-neu));
x=linspace(-5.0e-9,5.0e-9,30);
y=linspace(-5e-9,-1e-9,15);
[X,Y]=meshgrid(x,y);
Z=K*Y.*(X.^2-Y.^2)./(X.^2+Y.^2).^2;
mesh(X,Y,Z)
xlabel('x (m)'), ylabel('y (m)')
zlabel('Stress \sigma_y_y (Pa)')
```

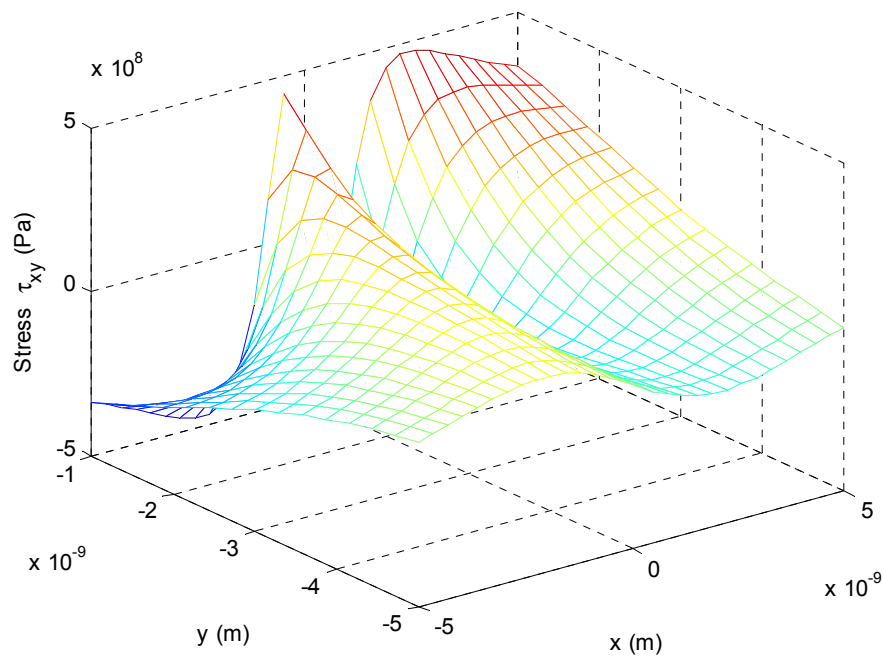
Figure:



Script file for τ_{xy} :

```
% HW9_12 Sigma xy
G=27.7e9; neu=0.334; b=0.286e-9;
K=G*b/(2*pi*(1-neu));
x=linspace(-5.0e-9,5.0e-9,30);
y=linspace(-5e-9,-1e-9,15);
[X,Y]=meshgrid(x,y);
Z=K*X.*(X.^2-Y.^2)./(X.^2+Y.^2).^2;
mesh(X,Y,Z)
xlabel('x (m)'), ylabel('y (m)')
zlabel('Stress \tau_{xy} (Pa)')
```

Figure:

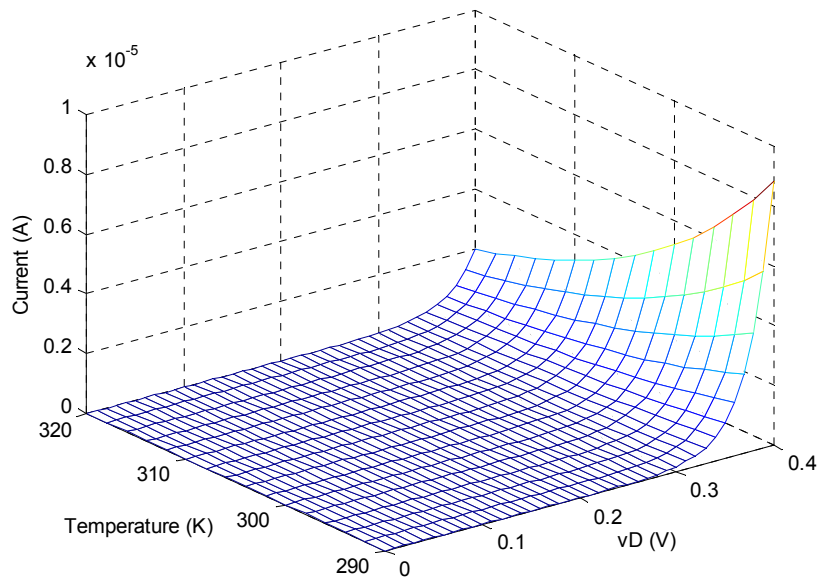


Problem 15

Script file:

```
Is=1E-12; q=1.6E-19; k=1.38E-23;
T=290:2:320;
vD=0:0.01:0.4;
[X,Y]=meshgrid(vD,T);
I=Is*(exp((X*q)/(k*Y))-1);
mesh(X,Y,I)
xlabel('vD (V)')
ylabel('Temperature (K)')
zlabel('Current (A)')
```

Figure:

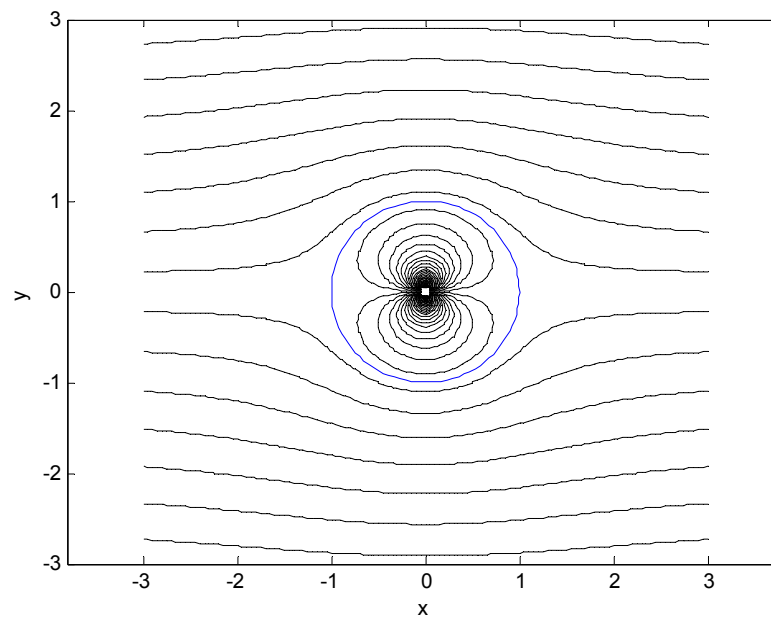


Problem 16

Script file:

```
x = -3:0.05:3;  
y = -3:0.05:3;  
[X,Y] = meshgrid(x,y);  
Z = Y-Y./(X.^2+Y.^2);  
contour(X,Y,Z,100,'k')  
xlabel('x'); ylabel('y')  
zlabel('z')  
hold on  
th=linspace(0,2*pi,100);  
r(1,1:100)=1;  
polar(th,r)  
axis equal  
hold off
```

Figure:

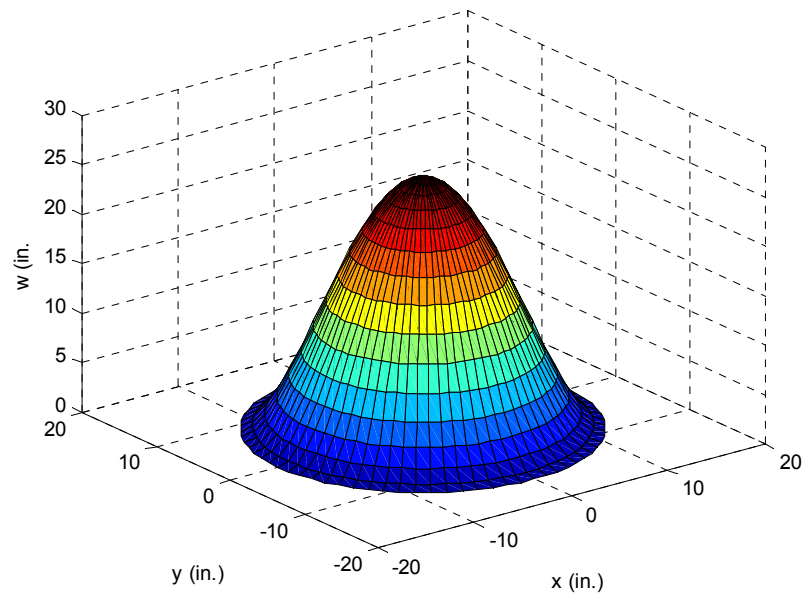


Problem 17

Script file:

```
p=15; rd=15;
E=10E6; t=0.08; nu=0.3;
K=E*t^3/(12*(1-nu^2));
C=p*rd^4/(64*K);
[th,r] = meshgrid((0:5:360)*pi/180,0:1:rd);
[X,Y] = pol2cart(th,r);
%R = sqrt(X.^2 + Y.^2);
w=C*(1-(r/rd).^2).^2;
surf(X,Y,w)
xlabel('x (in.)'); ylabel('y (in.)'); zlabel('w (in.)')
```

Figure:

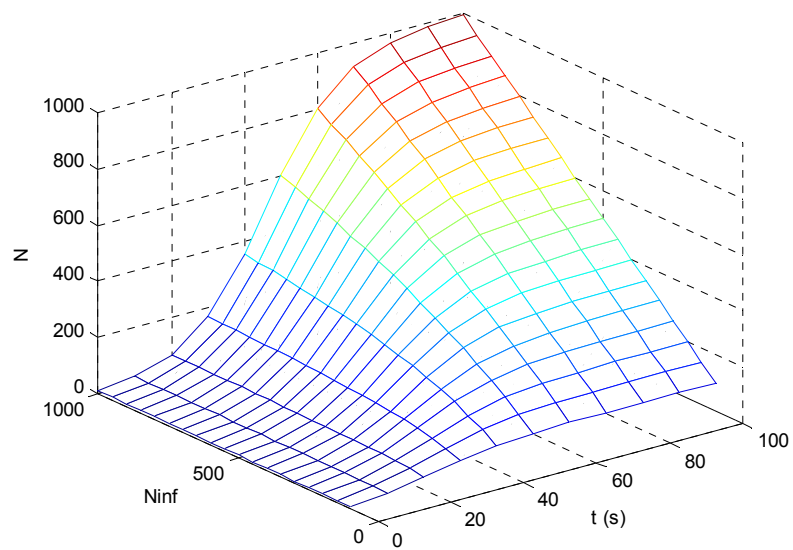


Problem 18

Script file:

```
r=0.1; N0=10;  
t=0:10:100;  
Ninf=100:50:1000;  
[X,Y]=meshgrid(t,Ninf);  
N=Y./(1+(Y/N0-1).*exp(-r*X));  
mesh(X,Y,N)  
xlabel('t (s)')  
ylabel('Ninf')  
zlabel('N')
```

Figure:

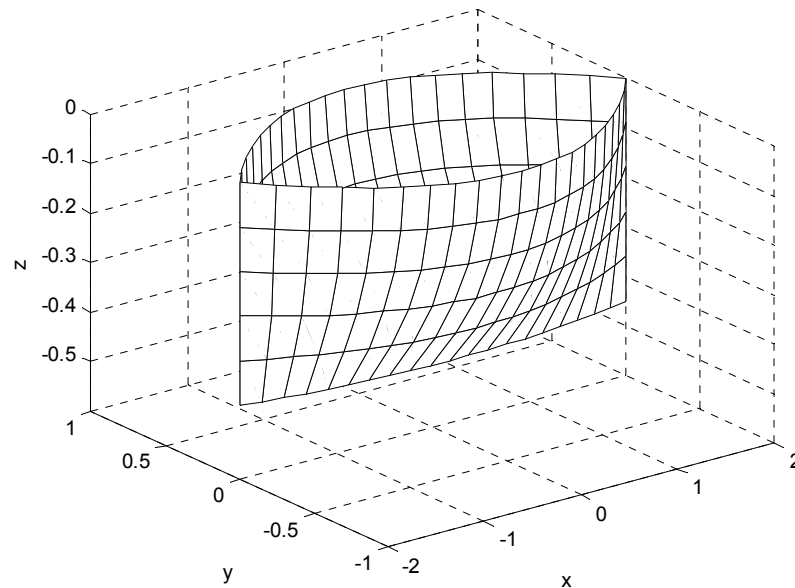


Problem 19

Script file:

```
T=0.5; B=1.2;L=4;
x=-2:0.2:2;
z=0:-0.09:-0.45;
[X,Z]=meshgrid(x,z);
Y=B/2*(1-(2*X/L).^2).*(1-(Z/T).^2);
C=[0 0 0];
mesh(X,Y,Z)
xlabel('x'); ylabel('y'); zlabel('z')
axis([-2 2 -1 1 -0.6 0])
hold on
Y=-B/2*(1-(2*X/L).^2).*(1-(Z/T).^2);
mesh(X,Y,Z)
colormap(C)
```

Figure:

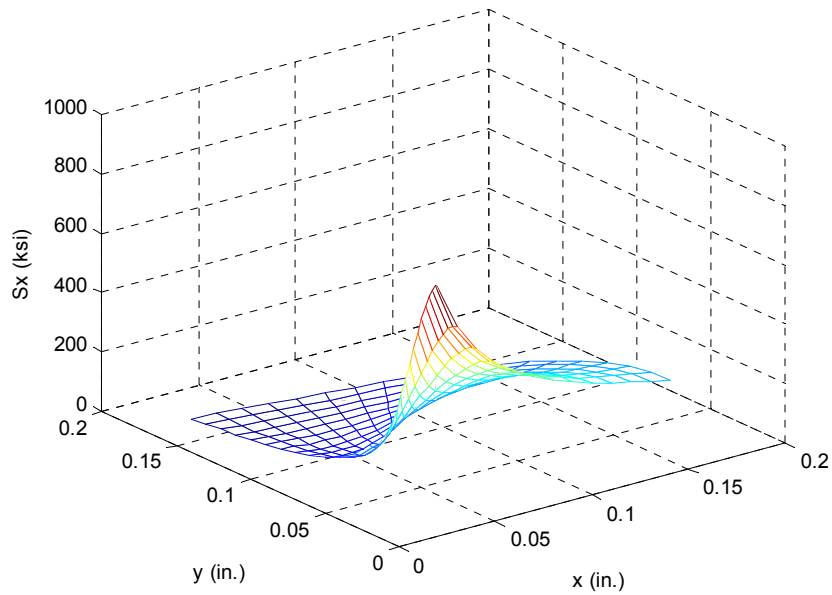


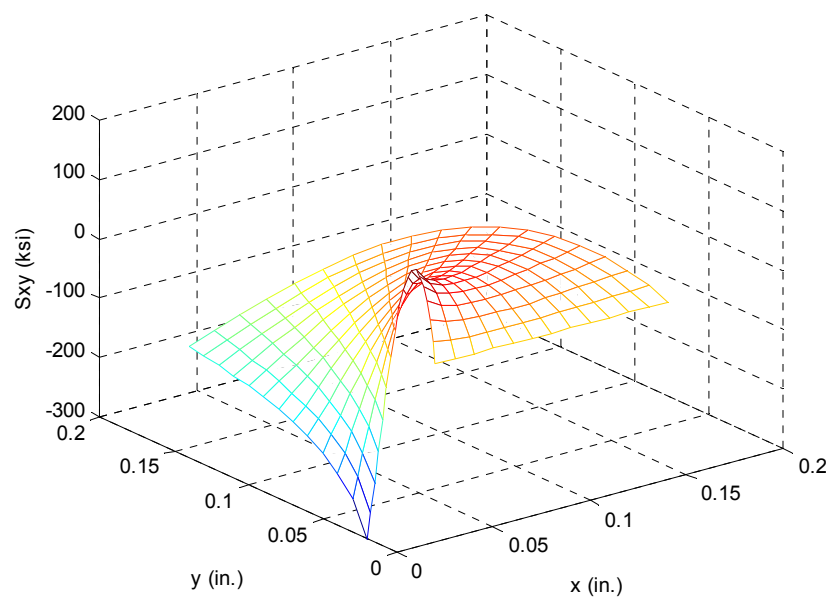
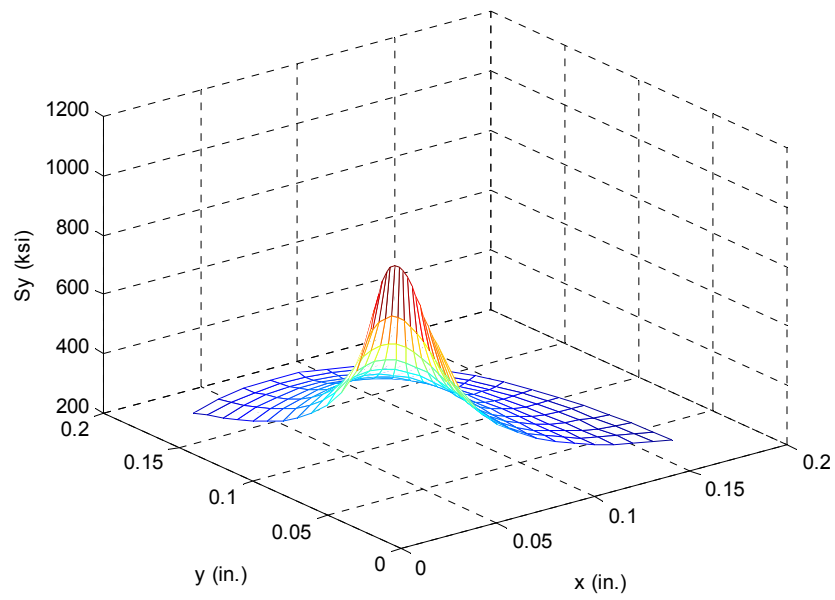
Problem 20

Script file:

```
p=15; rd=3;
E=10E6; t=0.08; nu=0.3;
K=E*t^3/(12*(1-nu^2));
K1=300;
C=p*rd^4/(64*K);
[th,r] = meshgrid((0:5:90)*pi/180,0.02:0.01:0.14);
[X,Y] = pol2cart(th,r);
%R = sqrt(X.^2 + Y.^2);
Sx=K1./sqrt(2*pi*r).*cos(th/2).*(1-sin(th/2).*sin(3*th/2));
Sy=K1./sqrt(2*pi*r).*cos(th/2).*(1+sin(th/2).*sin(3*th/2));
Sxy=K1./sqrt(2*pi*r).*cos(th/2).*sin(th/2).*cos(3*th/2);
mesh(X,Y,Sx)
xlabel('x (in.)'), ylabel('y (in.)'), zlabel('Sx (ksi)')
```

Figures:





Problem 21Script file:

```
g=9.81;
V=20; thz=30; thx=25; thy=65;
Vz=V*cosd(thz);
Vx=V*sind(thz)*cosd(thx); Vy=V*sind(thz)*sind(thx);
n=5
k=11;
X(1)=0; Y(1)=0;
for i=1:5
    tb(i)=2*Vz/g;
    tbn=linspace(0,tb(i),k)
    Zn=Vz*tbn-g*tbn.^2/2;
    length(Zn);
    Xn=Vx*tbn;
    Yn=Vy*tbn;
    in=(i-1)*10+1;
    jn=in+k-1;
    Z(in:jn)=Zn;
    X(in:jn)=Xn+X(in);
    Y(in:jn)=Yn+Y(in);
    Vz=Vz*0.8;
end
plot3(X,Y,Z)
axis([0,120,0,150,0,12])
grid on
xlabel('x (m)'); ylabel('y (m)'); zlabel('z (m)')
```

Figures:

