

第六章 三維空間繪圖 習題參考答案

6.1 基本三維繪圖

1. 試分別以 mesh 與 surf 函數繪出下列各函數的圖形：

(a) $\sin(x+y)$; $0 \leq x \leq 2\pi$, $0 \leq y \leq 2\pi$

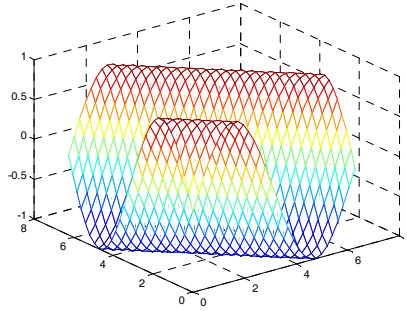
(b) $\sin(x+y)/\sqrt{x^2+y^2}$; $-\pi \leq x \leq \pi$, $-\pi \leq y \leq \pi$

(c) $x/\sqrt{x^2+y^2+1}$; $-4 \leq x \leq 4$, $-4 \leq y \leq 4$

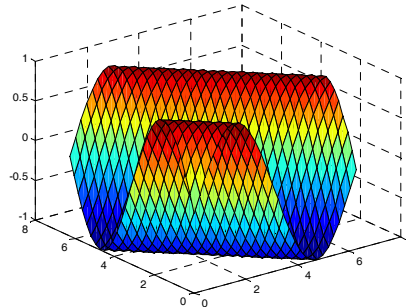
(d) $\sin(x \times y)/\sqrt{x^2+y^2+1}$; $-\pi \leq x \leq \pi$, $-\pi \leq y \leq \pi$

Ans:

```
(a) >> x=linspace(0,2*pi,30); y=linspace(0,2*pi,30);  
>> [xx,yy]=meshgrid(x,y); zz=sin(xx+yy);  
>> mesh(xx,yy,zz)
```

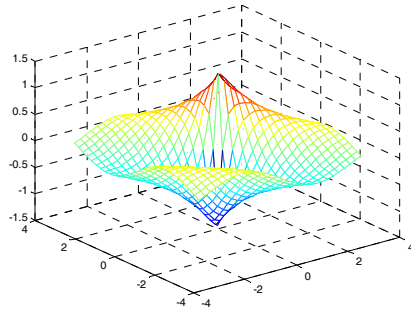


```
>> surf(xx,yy,zz)
```

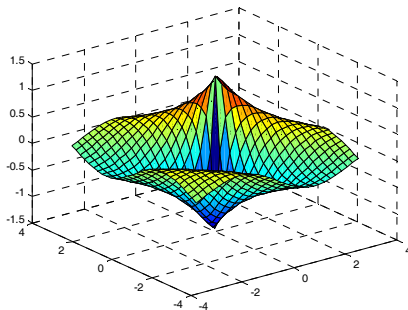




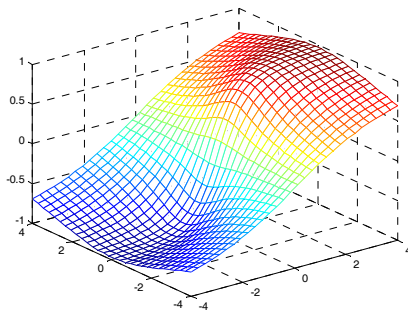
```
(b) >> x=linspace(-pi,pi,30); y=linspace(-pi,pi,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=sin(xx+yy)./sqrt(xx.^2+yy.^2);  
>> mesh(xx,yy,zz)
```



```
>> surf(xx,yy,zz)
```

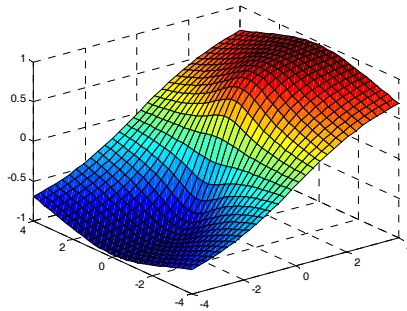


```
(c) >> x=linspace(-4,4,30); y=linspace(-4,4,30);  
>> [xx,yy]=meshgrid(x,y); zz=xx./sqrt(xx.^2+yy.^2+1);  
>> mesh(xx,yy,zz)
```

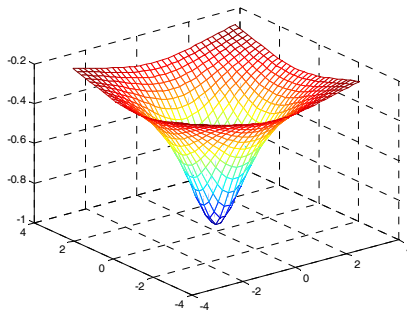




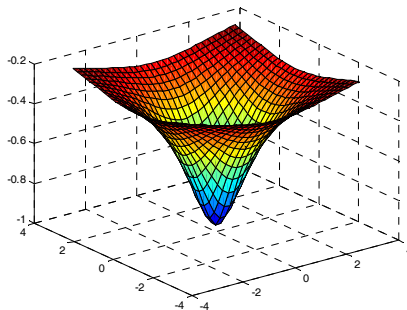
`surf(xx,yy,zz)`



```
(d) >> x=linspace(-pi,pi,30);  
>> y=linspace(-pi,pi,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=sin(xx*yy)./sqrt(xx.^2+yy.^2+1);  
>> mesh(xx,yy,zz)
```



```
>> surf(xx,yy,zz)
```

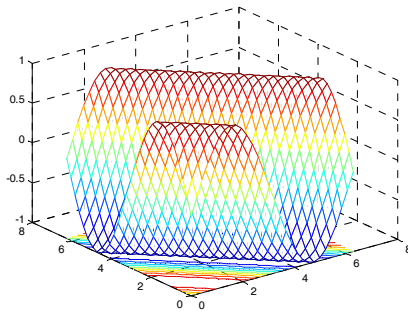




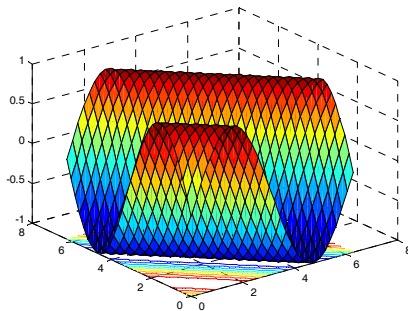
2. 試分別以 meshc 與 surfc 函數繪出習題 1 的函數圖。

Ans:

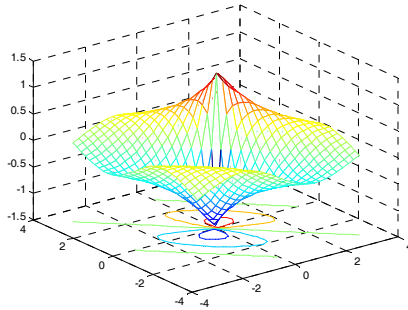
```
(a) >> x=linspace(0,2*pi,30);y=linspace(0,2*pi,30);  
>> [xx,yy]=meshgrid(x,y);zz=sin(xx+yy);  
>> meshc(xx,yy,zz)
```



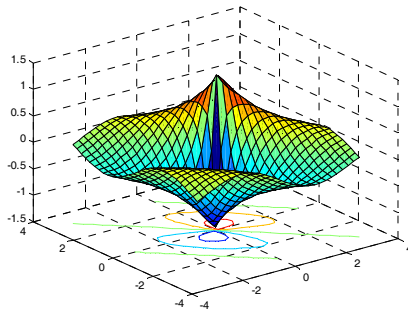
```
>> surfc(xx,yy,zz)
```



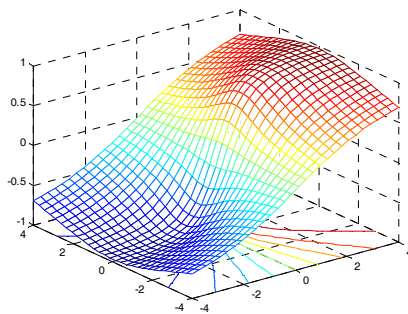
```
(b) >> x=linspace(-pi,pi,30);y=linspace(-pi,pi,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=sin(xx+yy)./sqrt(xx.^2+yy.^2);  
>> meshc(xx,yy,zz)
```



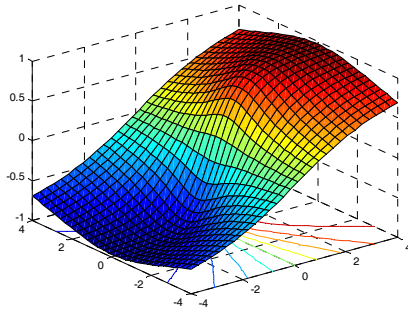
```
>> surfc(xx,yy,zz)
```



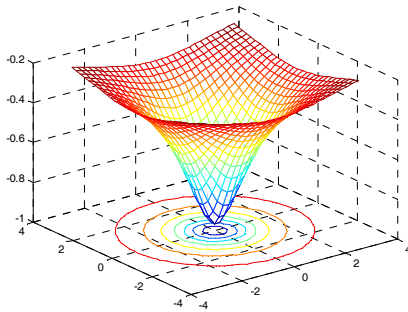
```
(c) >> x=linspace(-4,4,30); y=linspace(-4,4,30);  
>> [xx,yy]=meshgrid(x,y); zz=xx./(sqrt(xx.^2+yy.^2+1));  
>> meshc(xx,yy,zz)
```



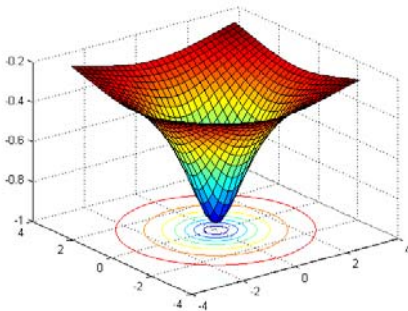
```
>> surfc(xx,yy,zz)
```



```
(d) >> x=linspace(-pi,pi,30); y=linspace(-pi,pi,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=sin(xx*yy)./sqrt(xx.^2+yy.^2+1);  
>> meshc(xx,yy,zz)
```



```
>> surfc(xx,yy,zz)
```

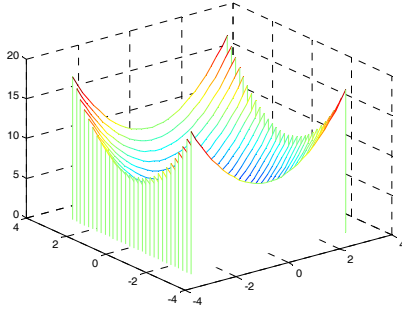




3. 試以 waterfall 函數繪出 $z = x^2 + y^2$ 的三維函數圖，範圍請用 $-3 \leq x \leq 3$, $-3 \leq y \leq 3$ 。

Ans:

```
>> x=linspace(-3,3,30); y=linspace(-3,3,30);  
>> [xx,yy]=meshgrid(x,y); zz=xx.^2+yy.^2;  
>> waterfall(xx,yy,zz)
```



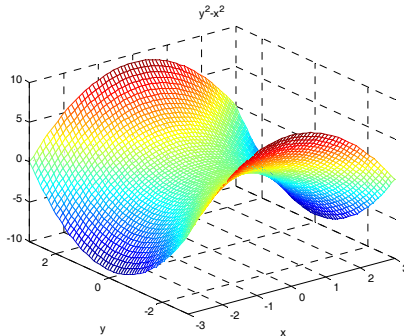
6.2 簡易的三維繪圖指令

4. 試分別以 ezmesh 與 ezsurf 函數繪出下列各函數的圖形：

- (a) $y^2 - x^2$; $-3 \leq x \leq 3$, $-3 \leq y \leq 3$
(b) $\sin(\sqrt{x^2 + y^2})$; $-\pi \leq x \leq \pi$, $-\pi \leq y \leq \pi$
(c) $(x^2 - y^2)e^{-x^2 - y^2}$; $-3 \leq x \leq 3$, $-3 \leq y \leq 3$

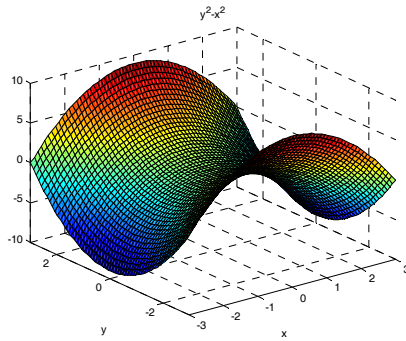
Ans:

- (a) >> ezmesh('y^2-x^2',[-3 3 -3 3])



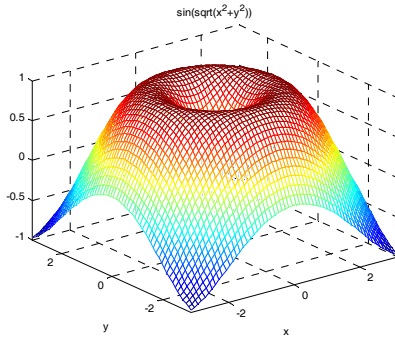


```
>> ezsurf('y^2-x^2',[-3 3 -3 3])
```

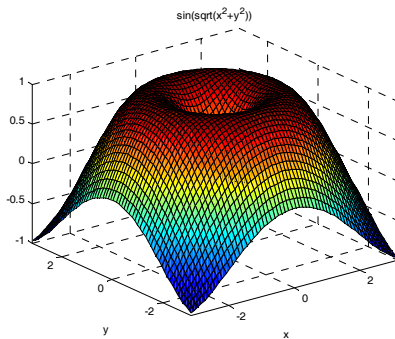


(b)

```
>> ezmesh('sin(sqrt(x^2+y^2))',[-pi pi -pi pi])
```

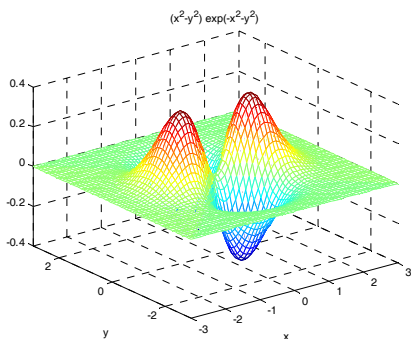


```
>> ezsurf('sin(sqrt(x^2+y^2))',[-pi pi -pi pi])
```

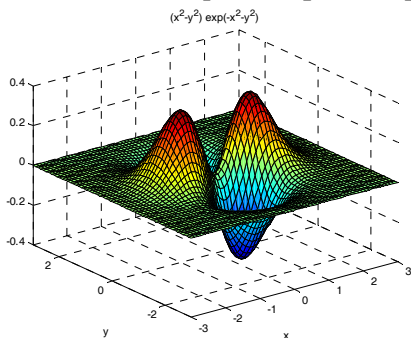


(c)

```
>> ezmesh('(x^2-y^2)*exp(-x^2-y^2)',[-3 3 -3 3])
```

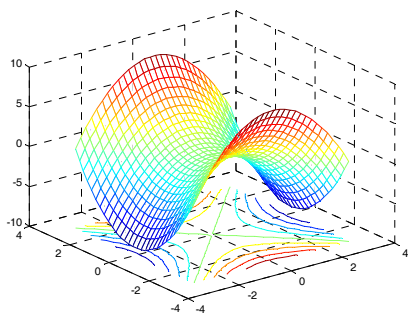
```
>> ezsurf('(x^2-y^2)*exp(-x^2-y^2)',[-3 3 -3 3])
```



5. 試分別以 meshc 與 surfc 函數繪出習題 4 的函數圖。

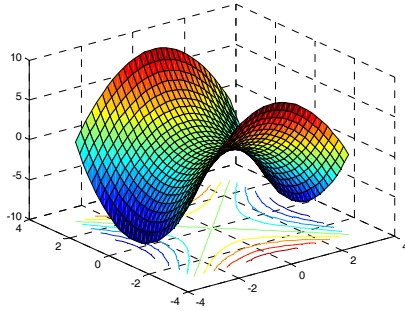
Ans:

```
(a) >> x=linspace(-3,3,30); y=linspace(-3,3,30);  
>> [xx,yy]=meshgrid(x,y); zz=yy.^2-xx.^2;  
>> meshc(xx,yy,zz)
```

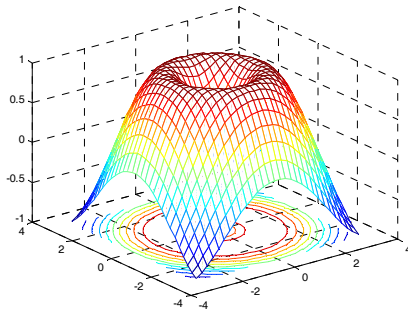




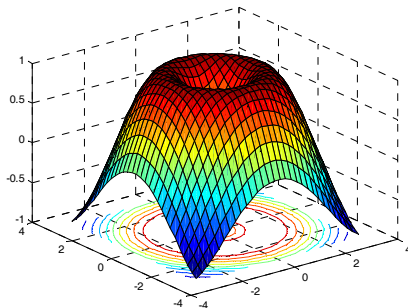
```
>> surfc(xx,yy,zz)
```



```
(b) >> x=linspace(-pi,pi,30);  
>> y=linspace(-pi,pi,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=sin(sqrt(xx.^2+yy.^2));  
>> meshc(xx,yy,zz)
```

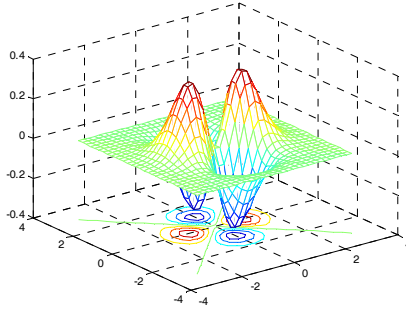


```
>> surfc(xx,yy,zz)
```

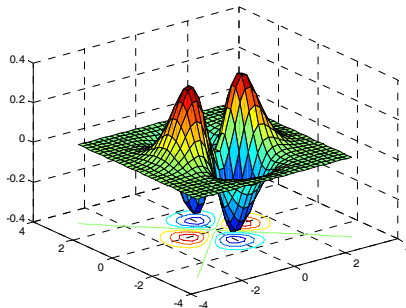




```
(c) >> x=linspace(-3,3,30); y=linspace(-3,3,30);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=(xx.^2-yy.^2).*exp(-(xx.^2+yy.^2));  
>> meshc(xx,yy,zz)
```



```
>> surfc(xx,yy,zz)
```

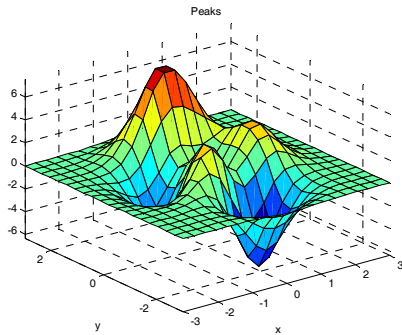


6.3 內建的三維圖形展示函數—peaks

6. 試以 20×20 個資料點繪出數學函數 peaks 的圖形。

Ans:

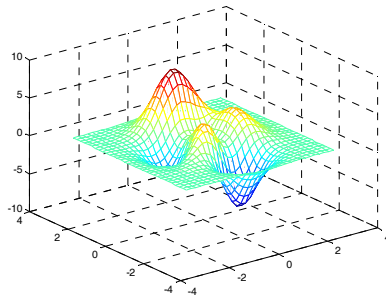
```
>> peaks(20);
```



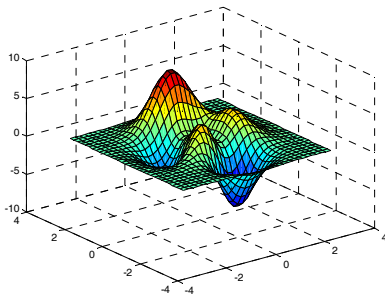
7. 試以 peaks 計算 32×32 個數學函數 peaks 資料點的值，再分別以 mesh 指令與 surf 指令繪製其圖形。

Ans:

```
>> [xx,yy,zz]=peaks(32);  
>> mesh(xx,yy,zz)
```



```
>> surf(xx,yy,zz)
```

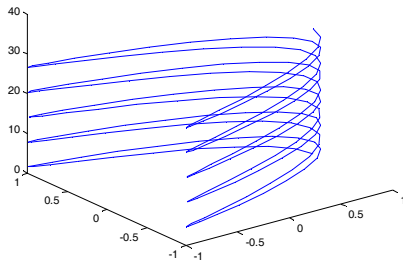


**6.4 空間曲線繪圖**

8. 試繪出 $[\cos 2t, \sin t, t]$ 的三維曲線圖，其中 $t = 0 \sim 10\pi$ 。請用 200 個資料點繪圖。

Ans:

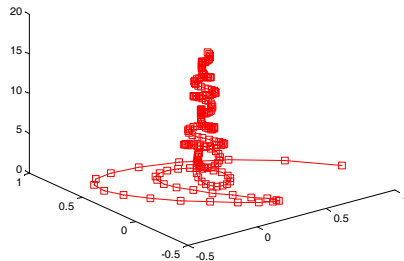
```
>> t=linspace(0,10*pi,200);  
>> plot3(cos(2*t),sin(t),t)
```



9. 試繪出 $[\frac{\cos 4t}{2t+1}, \frac{\sin 3t}{t+1}, t]$ 的三維曲線圖，其中 $t = 0 \sim 6\pi$ 。請用紅色、200 個資料點繪圖，資料點請用正方形來表示。

Ans:

```
>> t=linspace(0,6*pi,200);  
>> plot3(cos(4*t)./(2*t+1),sin(3*t)./(t+1),t,'-rs')
```





6.5 等高線繪圖

10. 試繪出下列各函數的等高線圖：

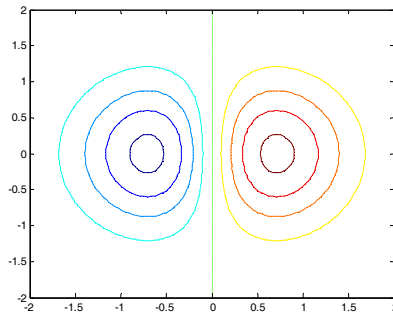
(a) $x \cdot e^{-y^2 - x^2}$; $-2 \leq x \leq 2$, $-2 \leq y \leq 2$

(b) $3(x^2 + 3y^2) \cdot e^{-x^2 - y^2}$; $-2.5 \leq x \leq 2.5$, $-3 \leq y \leq 3$

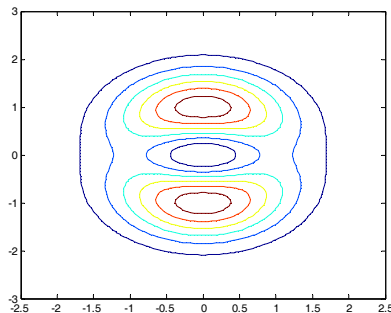
(c) $\cos\sqrt{x^2 + y^2}$; $-10 \leq x \leq 10$, $-10 \leq y \leq 10$

Ans:

```
(a) >> x=linspace(-2,2,100); y=linspace(-2,2,100);
>> [xx,yy]=meshgrid(x,y); zz=xx.*exp(-yy.^2-xx.^2);
>> contour(xx,yy,zz)
```

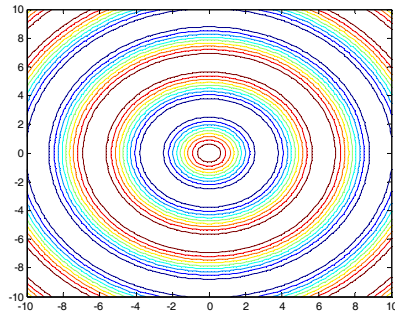


```
(b) >> x=linspace(-2.5,2.5,100);
>> y=linspace(-3,3,100);
>> [xx,yy]=meshgrid(x,y);
>> zz=3*(xx.^2+3*yy.^2).*exp(-xx.^2-yy.^2);
>> contour(xx,yy,zz)
```





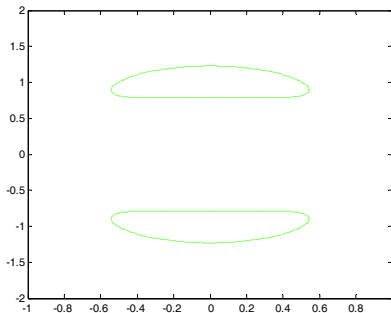
```
(c) >> x=linspace(-10,10,100);  
>> y=linspace(-10,10,100);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=cos(sqrt(xx.^2+yy.^2));  
>> contour(xx,yy,zz)
```



11. 試繪出 $(2x^2 + 3y^2) \cdot e^{-x^2 - y^2}$ ，高度為 1 的等高線圖，範圍請用 $-1 \leq x \leq 1$ ， $-2 \leq y \leq 2$ 。

Ans:

```
>> x=linspace(-1,1,100); y=linspace(-2,2,100);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=(2*xx.^2+3*yy.^2).*exp(-xx.^2-yy.^2);  
>> contour(xx,yy,zz,[1 1])
```

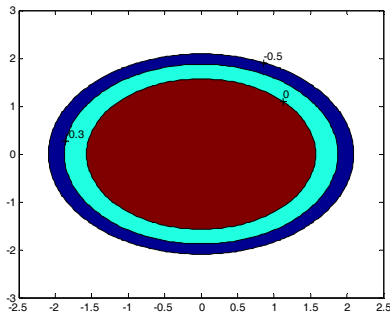


12. 試繪出 $\cos\sqrt{x^2 + y^2}$ ，高度為 -0.5 、 0 與 -0.3 的等高線圖，並將圖形上色，且加上高度標記， $-10 \leq x \leq 10$ ， $-10 \leq y \leq 10$ 。



Ans:

```
>> x=linspace(-2.5,2.5,100);  
>> y=linspace(-3,3,100);  
>> [xx,yy]=meshgrid(x,y);  
>> zz=cos(sqrt(xx.^2+yy.^2));  
>> cmat=contourf(xx,yy,zz,[-0.5,0,-0.3]);  
>> clabel(cmat,'manual')
```

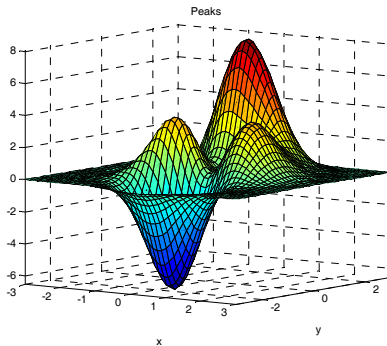


6.6 編修三維繪圖

13. 試繪製 peaks 函數的圖形，並設定圖形的視角，方位角為 36° ，仰角為 8° 。

Ans:

```
>> peaks;  
>> view(36,8);
```



14. 試繪製 peaks 函數的圖形，顏色對應表使用 6 個顏色的 winter colormap。



Ans:

```
>> peaks;  
>> colormap(winter(6));  
>> colorbar;
```

