ECUACIONES DIFERENCIALES ORDINARIAS CON CONDICION INICIAL

Dada la siguiente ecuación diferencial:

$$y' + 2y = 2\text{sen}(2t) - 1 \quad , \qquad \frac{\pi}{4} \leq t \leq \frac{11\pi}{40} \quad , \quad y_{(\frac{\pi}{4})} = 0 \; , \quad \text{con } h = \frac{\pi}{160}$$

a) **Emplee el Método de Euler, para obtener la solución aproximada en los valores de "t".**

b) **Obtenga la solución exacta y evalúela en los valores de "t".**

```
>>E=EULER1('2*sin(2*t)-2*y-1','Dy=2*sin(2*t)-2*y-1','y(pi/4)=0',pi/4,11*pi/40,0,pi/160)

F =

-1/2*cos(2*t)+1/2*sin(2*t)-1/2


        T                     Wi+1                  y(t)

  0.785398163397448            0            -0.000000000000000
  0.805033117482384   0.019634954084936   0.019244425999896
  0.824668071567321   0.038468569650008   0.037688214730486
  0.844303025652257   0.056471810516144   0.055302927206382
  0.863937979737193   0.073616920729069   0.072061402817684
```

Dada la siguiente ecuación diferencial:

$$e^{-3t}\,dy - e^{2y}\,dt = 0 \qquad 0 \leq t \leq \frac{3}{80}, \quad y_{(0)} = 0 \; , \quad \text{con } h = \frac{1}{80}$$

a) **Emplee el Método de Taylor de orden 5, para obtener la solución aproximada en cada valor de "t".**

b) **Además aproxime el valor de $y_{(\frac{3}{100})}$ mediante Neville**

Método de TAYLOR DE ORDEN CINCO

introduzca la función f: exp(3*t+2*y)
introduzca la función primera derivada: exp(3*t+2*y)*(3+2*exp(3*t+2*y))
introduzca la función segunda derivada:
9*exp(3*t+2*y)+18*exp(6*t+4*y)+8*exp(9*t+6*y)
introduzca la función tercera derivada:
27*exp(3*t+2*y)+126*exp(6*t+4*y)+144*exp(9*t+6*y)+48*exp(12*t+8*y)
introduzca la función cuarta derivada:
81*exp(3*t+2*y)+810*exp(6*t+4*y)+1800*exp(9*t+6*y)+1440*exp(12*t+8*y)+384*exp(15*t+10*y)
introduzca el valor de a: 0
introduzca el valor de b: 3/80
introduzca el valor de h: 1/80
introduzca el valor inicial: 0
introduzca la ecuación diferencial entre comillas: 'Dy=exp(3*t+2*y)'
introduzca la condición inicial entre comillas: 'y(0)=0'
la solución exacta es:

F =

-1/2*log(-2/3*exp(3*t)+5/3)

solución aproximada y exacta

T	Wi+1	y(t)
0	0	0
0.012500000000000	0.012902380663554	0.012902381069363
0.025000000000000	0.026659654513987	0.026659655453374
0.037500000000000	0.041354776961472	0.041354778608486

```
>> X=E(:,1);Y=E(:,2);xo=3/100;
>> [Q]=neville(xo,X,Y)

Valor_aproximado =

   0.032420516158365


Q =

                   0                   0                   0                   0
   0.012902380663554   0.030965713592529                   0                   0
   0.026659654513987   0.032162564054160   0.032401934146486                   0
   0.041354776961472   0.032537703492981   0.032425161661334   0.032420516158365
```

Dada la siguiente ecuación diferencial:

$$(y - te^{t/y})dy + ye^{t/y}\, dt = 0 \quad , \quad 0 \leq t \leq \tfrac{1}{60} \quad , \quad y_{(0)} = 1 \; , \; \text{con } h = \tfrac{1}{300}$$

a) **Emplee el Método del Punto Medio, para obtener la solución aproximada en los valores de "t".**

b) **Obtenga la solución exacta y evalúela en los valores de "t".**

```
>> E=puntomedio('y*exp(t/y)/(t*exp(t/y)-y)','Dy=y*exp(t/y)/(t*exp(t/y)-y)','y(0)=1',0,1/60,1,1/300)
```

la solucion exacta es: $ln(y) + e^{t/y} = 1$

T	Wi+1	y(t)
0	1.000000000000000	1.000000000000000
0.003333333333333	0.996655504394494	0.996655487119788
0.006666666666667	0.993288372219750	0.993288337049865
0.010000000000000	0.989898176302976	0.989898122586200
0.013333333333333	0.986484475568174	0.986484402619556
0.016666666666667	0.983046814390986	0.983046721490178

Dada la siguiente ecuación diferencial:

$$tdy + ydt = \ln t\, dt - dy \quad , \quad 1 \leq t \leq \tfrac{126}{125} , \quad y_{(1)} = 10 \; , \; \text{con } h = \tfrac{1}{500}$$

a) **Emplee el Método de Euler Modificado, para obtener la solución aproximada en cada uno de los valores de "t".**

b) **Obtenga la solución exacta y evalúela en cada valor de "t"**

```
>> E=eulermodif2('(log(t)-y)/(t+1)','(t+1)*Dy=log(t)-y','y(1)=10',1,126/125,10,1/500)
solución exacta es
 F =  (t*log(t)-t+21)/(t+1)
```

T	Wi+1	y(t)
1.000000000000000	10.000000000000000	10.000000000000000
1.002000000000000	9.990010988013317	9.990010988345654
1.004000000000000	9.980043906200894	9.980043906863580
1.006000000000000	9.970098685004755	9.970098685995819
1.008000000000000	9.960175255159793	9.960175256477276

Dada la siguiente ecuación diferencial:

$$(2t\ \tan(y)+5)dt + (t^2\sec^2(y))dy=0,\ \frac{1}{2} \le t \le \frac{51}{100},\ y_{(\frac{1}{2})} = \frac{\pi}{4}\ ,\ \text{con } h=\frac{1}{500}$$

a) **Emplee el Método de Heun, para obtener la solución aproximada en los valores de " t ".**

b) **Obtenga la solución exacta y evalúela en los valores de " t ".**

```
>> E=heun('-(2*t*tan(y)+5)/(t^2*sec(t)^2)','(t^2*(sec(y))^2)*Dy=-
(2*t*tan(y)+5)','y(1/2)=pi/4',1/2,51/100,pi/4,1/500)

solución exacta es

F =   -atan(1/4*(20*t-11)/t^2)

            T                         Wi+1                        y(t)

   0.500000000000000   0.785398163397448   0.785398163397448
   0.502000000000000   0.748827573153433   0.761004827219763
   0.504000000000000   0.713015423909210   0.735820628336275
   0.506000000000000   0.677919287004450   0.709842111377003
   0.508000000000000   0.643502351318500   0.683070014699650
   0.510000000000000   0.609732370900305   0.655509797540574
```

Dada la siguiente ecuación diferencial:

$$(4t^2 + ty)dy - (y^2 + 3ty)dt = 0,\ 1 \le t \le \frac{7}{5},\ y_{(1)} = 1\ ,\ \text{con } h=\frac{1}{10}$$

a) **Emplee el Método de Runge-Kutta de orden cuatro, para obtener la solución aproximada en los valores de " t ".**

b) **Obtenga la solución exacta y evalúela en los valores de " t ".**

E=RK4('(y^2+3*t*y)/(4*t^2+t*y)','(4*t^2+t*y)*Dy=(y^2+3*t*y)','y(1)=1',1,7/5,1,1/10)

i = 0 **k1 = 0.080000000000000** **k2 = 0.079200290803344** **k3 = 0.079168326180239** **k4 = 0.078410369658154**	**i = 1** **k1 = 0.078412118982489** **k2 = 0.077694060763837** **k3 = 0.077667891710299** **k4 = 0.076984306930636**
i = 2 **k1 = 0.076985621388692** **k2 = 0.076335083586320** **k3 = 0.076313299486690** **k4 = 0.075691668598842**	**i = 3** **k1 = 0.075692679661765** **k2 = 0.075098836118084** **k3 = 0.075080444929732** **k4 = 0.074511161471814**

Solución exacta:

$$y = \sqrt[4]{t^3}\ e^{(t-y)/4t}$$

T	W_{i+1}	y(t)
1.000000000000000	1.000000000000000	1.000000000000000
1.100000000000000	1.079191267270887	1.079191231103970
1.200000000000000	1.156877989081119	1.156877925480075
1.300000000000000	1.233206998436712	1.233206913018329
1.400000000000000	1.308300732308247	1.308300628823234

Dada la siguiente ecuación diferencial:

$$t\,dy + y\,dt = e^{t}dt,\ 1 \le t \le \frac{6}{5},\ y_{(1)} = 2,\ \text{con } h = \frac{1}{20}$$

a) **Emplee el Método de Runge-Kutta-Fehlberg de orden cuatro, para obtener la solución aproximada en los valores de " t ".**

b) **Obtenga la solución exacta y evalúela en los valores de " t ".**

>> E=RKF4('(exp(t)-y)/t','t*Dy+y=exp(t)','y(1)=2',1,6/5,2,1/20)

i = 0	i = 1
k1 = 0.035914091422952	k1 = 0.039055074121569
k2 = 0.036715806511425	k2 = 0.039827652429702
k3 = 0.037106118749107	k3 = 0.040204914635723
k4 = 0.038818314297995	k4 = 0.041864640140144
k5 = 0.039057034379509	k5 = 0.042096687568724
i = 2	**i = 3**
k1 = 0.042094976483117	k1 = 0.045066569564106
k2 = 0.042847348101574	k2 = 0.045806005765760
k3 = 0.043215721427582	k3 = 0.046168895149946
k4 = 0.044840389467433	k4 = 0.047772810521689
k5 = 0.045068086279510	k5 = 0.047998071597655

La solución exacta es:

$$y = \frac{e^t - e + 2}{t}$$

T	W_{i+1}	Y(t)
1.000000000000000	2.000000000000000	2.000000000000000
1.050000000000000	2.037494561510207	2.037494561527731
1.100000000000000	2.078076541317855	2.078076541352171
1.150000000000000	2.121661809715337	2.121661809765846
1.200000000000000	2.168195911831698	2.168195911897918

Dada la siguiente ecuación diferencial:

$$ty' + (1 + t)y = e^{-t}\,\text{sen}(2t)\,, \quad 1 \leq t \leq \tfrac{201}{200}\,, \quad y_{(1)} = 0\,, \text{ con } h = \tfrac{1}{800}$$

a) **Emplee el Método de Runge-Kutta-Fehlberg de quinto orden, para obtener la solución aproximada en cada uno de los valores de "t".**
b) **Obtenga la solución exacta y evalúela en cada valor de "t".**

E=RKF5('(exp(-t)*sin(2*t)-y*(1+t))/t','t*Dy=exp(-t)*sin(2*t)-y*(1+t)','y(1)=0', 1, 201/200,0,1/800)

j = 0		**j = 1**	
k1 =	**4.181397865490778e-004**	**k1 =**	**4.155760553859744e-004**
k2 =	**4.174976447815090e-004**	**k2 =**	**4.149366011947896e-004**
k3 =	**4.171771272678411e-004**	**k3 =**	**4.146174249584197e-004**
k4 =	**4.157728823258132e-004**	**k4 =**	**4.132190568848642e-004**
k5 =	**4.155760513698947e-004**	**k5 =**	**4.130230496764402e-004**
k6 =	**4.168565779552022e-004**	**k6 =**	**4.142982171748611e-004**
j = 2		**j = 3**	
k1 =	**4.130230536707221e-004**	**k1 =**	**4.104807362158141e-004**
k2 =	**4.123862757304003e-004**	**k2 =**	**4.098466232641106e-004**
k3 =	**4.120684351218556e-004**	**k3 =**	**4.095301126654658e-004**
k4 =	**4.106759191711885e-004**	**k4 =**	**4.081434242302155e-004**
k5 =	**4.104807322432019e-004**	**k5 =**	**4.079490541349485e-004**
k6 =	**4.117505632169977e-004**	**k6 =**	**4.092135710204774e-004**

la solución exacta es:

F = (-1/2*exp(-t)*cos(2*t)+1/2*exp(-t)*cos(2))/t

T	Wi+1	y(t)
1.000000000000000	0	0
1.001250000000000	0.000416857024957	0.000416857024957
1.002500000000000	0.000831155687252	0.000831155687252
1.003750000000000	0.001242906693716	0.001242906693716
1.005000000000000	0.001652120706122	0.001652120706122

Dada la siguiente ecuación diferencial:

$$ty' - y = t, \quad 1 \leq t \leq 2, \quad y_{(1)} = 2, \quad \text{con } h = \tfrac{1}{5}$$

a) Emplee el Método de Adams-Bashforth de dos pasos, para obtener la solución aproximada en cada uno de los valores de "t".
b) Obtenga la solución exacta y evalúela en cada valor de "t".

```
>> E=Adams2('1+y/t','Dy=1+y/t','y(1)=2',1,2,2,1/5)
solución exacta es:
 F =    (log(t)+2)*t
```

T	Wi+1	y(t)
1.000000000000000	2.000000000000000	2.000000000000000
1.200000000000000	2.618785868152745	2.618785868152745
1.400000000000000	3.273482335190932	3.271061131269698
1.600000000000000	3.956710679909593	3.952005806793177
1.800000000000000	4.664773765593289	4.658015996823814
2.000000000000000	5.394941642364487	5.386294361119891

Dada la siguiente ecuación diferencial:

$$(1+y^2)e^{4t^2}y' = ty\,, \quad 0 \le t \le \frac{7}{800}\,, \quad y_{(0)} = 1\,, \text{ con } h = \frac{1}{800}$$

a) **Emplee el Método de Adams-Bashforth de tres pasos, para obtener la solución aproximada en cada uno de los valores de "t".**
b) **Obtenga la solución exacta y evalúela en cada valor de "t".**

```
E=Adams3('t*y*exp(-4*t^2)/(y^2+1)','Dy=t*y*exp(-4*t^2)/(y^2+1)','y(0)=1',0,7/800,1,1/800)
solución exacta es
```

$$\frac{y^2}{2} + lny = -\frac{1}{8}e^{-4t^2} + \frac{5}{8}$$

T	Wi+1	y(t)
0	1.000000000000000	1.000000000000000
0.001250000000000	1.000000390623779	1.000000390623779
0.002500000000000	1.000001562480469	1.000001562480469
0.003750000000000	1.000003515537110	1.000003515526125
0.005000000000000	1.000006249709480	1.000006249687510
0.006250000000000	1.000009764895052	1.000009764862100
0.007500000000000	1.000014060962018	1.000014060918087
0.008750000000000	1.000019137749297	1.000019137694390

Dada la siguiente ecuación diferencial:

$$y' + 5y = 5t^2 + 2t\,, \quad 0 \leq t \leq \frac{3}{10}\,, \quad y_{(0)} = \frac{1}{3}\,, \text{ con } h = \frac{1}{20}$$

a) **Emplee el Método de Adams-Bashforth de cuatro pasos, para obtener la solución aproximada en cada uno de los valores de "t".**

b) **Obtenga la solución exacta y evalúela en cada valor de "t".**

Método de Adams-Bashforth de cuatro pasos
introduzca la función f: 5*t^2+2*t-5*y
introduzca el valor de a: 0
introduzca el valor de b: 0.3
introduzca el valor de h: 1/20
introduzca la condición inicial: 1/3
introduzca la ecuación diferencial entre comillas: 'Dy=5*t^2+2*t-5*y'
introduzca la condición inicial entre comillas y(a): 'y(0)=1/3'
solución exacta es
F = t^2+1/3*exp(-5*t)

T	Wi+1	y(t)
0	0.333333333333333	0.333333333333333
0.050000000000000	0.262100261023802	0.262100261023802
0.100000000000000	0.212176886570878	0.212176886570878
0.150000000000000	0.179955517580338	0.179955517580338
0.200000000000000	0.162696904902031	0.162626480390481
0.250000000000000	0.158086522753281	0.158001598953397
0.300000000000000	0.164498985945518	0.164376720049477

Dada la siguiente ecuación diferencial:

$$(1 - ln(t))y' - \frac{y}{t} = 1 + ln(t)\ , \quad 1 \le t \le \frac{49}{40}\ , \quad y_{(1)} = 2\ , \text{ con } h = \frac{1}{40}$$

a) **Emplee el Método de Adams-Bashforth de cinco pasos, para obtener la solución aproximada en cada uno de los valores de "t".**

b) **Obtenga la solución exacta y evalúela en cada valor de "t".**

Método de Adams-Bashforth de cinco pasos
introduzca la función f: (1+log(t)+y/t)/(1-log(t))
introduzca el valor de a: 1
introduzca el valor de b: 49/40
introduzca el valor de h: 1/40
introduzca el valor inicial: 2
introduzca la ecuación diferencial entre comillas: 'Dy=(1+log(t)+y/t)/(1-log(t))'
introduzca la condición inicial entre comillas: 'y(1)=2'
la solución exacta es: F =(-log(t)*t-2)/(-1+log(t))

T	Wi+1	y(t)
1.000000000000000	2.000000000000000	2.000000000000000
1.025000000000000	2.076586268134665	2.076586268134665
1.050000000000000	2.156442874233771	2.156442874233771
1.075000000000000	2.239722957219273	2.239722957219273
1.100000000000000	2.326588794079171	2.326588794079171
1.125000000000000	2.417212525555872	2.417212546689181
1.150000000000000	2.511777030602901	2.511777076798139
1.175000000000000	2.610476763609475	2.610476837323128
1.200000000000000	2.713518743350746	2.713518849112717
1.225000000000000	2.821123631262955	2.821123773511497

Emplee el Método de Extrapolación, con una tolerancia 10^{-12}, para obtener la solución aproximada de la siguiente ecuación diferencial:

$$(te^{t/y} - y)dy = ye^{t/y}\,dt \quad , \qquad 0 \leq t \leq \tfrac{1}{50} \;, \quad y_{(0)} = 1 \;, \quad \text{con } h = \tfrac{1}{200}$$

Método de Extrapolación
para t=t1
introduzca la función f: y*exp(t/y)/(t*exp(t/y)-y)
introduzca el valor de a: 0
introduzca el valor de h: 1/200
introduzca el valor inicial: 1
introduzca el valor de precisión: 1e-12
introduzca la ecuación diferencial entre comillas: '(t*exp(t/y)-y)*Dy=y*exp(t/y)'
introduzca la condición inicial entre comillas: 'y(0)=1'

la solución exacta es:

$$\boldsymbol{ln(y) + e^{t/y} = 1}$$

ho=h/2

w1 = 0.997500000000000
w2 = 0.994974826931869
y11 = 0.994974738864462
Y = 0.994974768115196
tol = 2.925073339099527e-008

h1=h/4

w1 = 0.998750000000000
w2 = 0.997493728441313
w3 = 0.996237413386450
w4 = 0.994974782820561
y21 = 0.994974760802486
y22 = 0.994974768115161

tol = 3.519406988061746e-014

para t=t2
h = 2/200

ho=h/2

w1 = 0.995000000000000
w2 = 0.989898605776282
y11 = 0.989897883533781

Y = 0.989898122586200

tol = 2.390524188600196e-007

h1=h/4

w1 = 0.997500000000000
w2 = 0.994974826931869
w3 = 0.992449301594113
w4 = 0.989898243423752
y21 = 0.989898062822172
y22 = 0.989898122584969
tol = 1.231126312006836e-012

h2=h/6

w1 = 0.998333333333333
w2 = 0.996655504394494
w3 = 0.994977571931589
w4 = 0.993288372217976
w5 = 0.991598962004971
w6 = 0.989898176295077
y31 = 0.989898096024334
y32 = 0.989898122586064
y33 = 0.989898122586200

tol = 1.11e-016

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para t=t3
h = 3/200

ho=h/2

w1 = 0.992500000000000
w2 = 0.984770261368964
y11 = 0.984767761688408

Y = 0.984768586265757

tol = 8.245773492898678e-007

h1=h/4

w1 = 0.996250000000000
w2 = 0.992443163860583
w3 = 0.988635124017860
w4 = 0.984769005359524
y21 = 0.984768380113756
y22 = 0.984768586255539

tol = 1.021793760713763e-011

h2=h/6

w1 = 0.997500000000000
w2 = 0.994974826931869
w3 = 0.992449301594113
w4 = 0.989898243423752
w5 = 0.987346462847071
w6 = 0.984768772555879
y31 = 0.984768494642015
y32 = 0.984768586264623
y33 = 0.984768586265758

tol = 1.554312234475219e-015
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para t=t4
h = 4/200

ho=h/2

w1 = 0.990000000000000
w2 = 0.979588688053743
y11 = 0.979582609742005

Y = 0.979584608303394

tol = 1.998561389271458e-006

h1=h/4

w1 = 0.995000000000000
w2 = 0.989898605776282
w3 = 0.984794322582561
w4 = 0.979585629643298
y21 = 0.979584108627710
y22 = 0.979584608256278

tol = 4.711597778594978e-011

h2=h/6

w1 = 0.996666666666667
w2 = 0.993288477701840
w3 = 0.989909446823162
w4 = 0.986484694285570
w5 = 0.983058200161789
w6 = 0.979585062348098
y31 = 0.979584386222409
y32 = 0.979584608298168
y33 = 0.979584608303404

tol = 1.021405182655144e-014
</td>
</tr>
</table>

Dado el siguiente sistema diferencial:

$$7x' + 3x + 7y' - 4y = 25e^{-t} - 14e^{-2t} + 3\mathrm{sen}(t) + 7\cos(t) \quad , \quad x_{(0)} = 0$$

$$5x' - 4x + 5y' - 6y = 15e^{-t} - 4e^{-2t} - 4\mathrm{sen}(t) + 5\cos(t) \quad , \quad y_{(0)} = -1$$

Determine la solución aproximada para $0 \leq t \leq \frac{1}{40}$, con $h = \frac{1}{200}$

MÉTODO DE RUNGE KUTTA4 PARA SISTEMAS	
introduzca la función 1: (34*x-110*exp(-t)+152*exp(-2*t)-34*sin(t)+21*cos(t))/21	
introduzca la función 2: (34*y+165*exp(-t)-152*exp(-2*t))/21	
introduzca la condición inical x(a): 0	
introduzca la condición inical y(a): -1	
introduzca el valor a: 0	
introduzca el valor b: 1/40	
introduzca el paso h: 1/200	
Iteración No: 1	
k11= 0.015000000000000	k12= -0.005000000000000
k21= 0.014925354246939	k22= -0.004937828962311
k31= 0.014925052109367	k32= -0.004937577317635
k41= 0.014850807618875	k42= -0.004875807926638
Iteración No: 2	
k11= 0.014850809383199	k12= -0.004875809487104
k21= 0.014776967499843	k22= -0.004814442552035
k31= 0.014776668616029	k32= -0.004814194162059
k41= 0.014703223385817	k42= -0.004753224418638
Iteración No: 3	
k11= 0.014703225130751	k12= -0.004753225959920
k21= 0.014630177883032	k22= -0.004692654201377
k31= 0.014629882215601	k32= -0.004692409029974
k41= 0.014557227059761	k42= -0.004632230054651
Iteración No: 4	
k11= 0.014557228785523	k12= -0.004632231576958
k21= 0.014484967035909	k22= -0.004572446162280
k31= 0.014484674547875	k32= -0.004572204173697
k41= 0.014412800376558	k42= -0.004512807179952
Iteración No: 5	
k11= 0.014412802083361	k12= -0.004512808683489
k21= 0.014341316789894	k22= -0.004453800872492
k31= 0.014341027444658	k32= -0.004453562031352
k41= 0.014269925263115	k42= -0.004394938324671

T	x(t)	y(t)
0	0	-1.000000000000000
0.005000000000000	0.014925270055248	-1.004937770081088
0.010000000000000	0.029702154222041	-1.009752154636744
0.015000000000000	0.044332249620004	-1.014444751716289
0.020000000000000	0.058817135008279	-1.019017141621100
0.025000000000000	0.073158370977542	-1.023470887090408

Se tiene un circuito RLC serie, en el cual la resistencia es de 20Ω, la inductancia es de 500mH, el capacitor es de 20000μF, si se conecta a una fuente de 25V, aproxime el valor de la carga en el capacitor y la corriente del circuito para los siguientes valores de t: $0 \leq t \leq \frac{3}{20}$, con $h = \frac{1}{20}$, considere además lo siguiente: $q_{(0)} = 0$, $i_{(0)} = 2$

MÉTODO DE RUNGE KUTTA4 PARA SISTEMAS introduzca la función 1: y introduzca la función 2: (25-x/0.02-20*y)/0.5 introduzca la condición inical q(a): 0 introduzca la condición inical i(a): 2 introduzca el valor a: 0 introduzca el valor b: 0.15 introduzca el paso h: 0.05	
Iteración No: 1 k11= 0.100000000000000 k21= 0.062500000000000 k31= 0.093750000000000 k41= 0.029687500000000	 k12= -1.500000000000000 k22= -0.250000000000000 k32= -1.406250000000000 k42= 0.843750000000000
Iteración No: 2 k11= 0.066927083333333 k21= 0.053287760416667 k31= 0.062744140625000 k41= 0.041353352864583	 k12= -0.545572916666666 k22= -0.167317708333334 k32= -0.511474609375000 k42= 0.163655598958333
Iteración No: 3 k11= 0.052431233723958 k21= 0.046197255452474 k31= 0.049154281616211 k41= 0.040742524464925	 k12= -0.249359130859374 k22= -0.131078084309896 k32= -0.233774185180664 k42= -0.027582168579102

T	Q(t)	I(t)
0	0	2.000000000000000
0.050000000000000	0.073697916666667	1.338541666666667
0.100000000000000	0.130421956380208	1.048624674479167
0.150000000000000	0.177734761767917	0.880850368075901

SISTEMAS DE ECUACIONES NO LINEALES

Dado el siguiente sistema de ecuaciones no lineales:

$$5x_1^2 - x_2^2 = 0$$

$$sen(x_1) + cos(x_2) - 4x_2 = 0$$

$x^{(0)} = (0.121, 0.271)^T$, $\varepsilon = 10^{-7}$

Determine la solución aproximada empleando el método de Punto Fijo.
Utilice quince decimales.

```
>> syms x y
>> f1=sqrt(y^2/5);f2=(1/4)*(sin(x)+cos(y));
>> xo=[0.121 0.271];F=[f1   f2]; ∊ = 10^-7
>> x1=subs(F,{x,y},{xo(1),xo(2)})
x1 =
  0.121194884380489   0.271052159747864
>> error=norm(x1-xo,inf)
error =  1.948843804886191e-004
>> x2=subs(F,{x,y},{x1(1),x1(2)})
x2 =
  0.121218210928871   0.271097032987245
>> error=norm(x2-x1,inf)
error =    4.487323938107135e-005
>> x3=subs(F,{x,y},{x2(1),x2(2)})
x3 =
  0.121238278851597   0.271099817947808
>> error=norm(x3-x2,inf)
error =    2.006792272533919e-005
>> x4=subs(F,{x,y},{x3(1),x3(2)})
x4 =
  0.121239524323823   0.271104611662039
>> error=norm(x4-x3,inf)
error =    4.793714231177138e-006
>> x5=subs(F,{x,y},{x4(1),x4(2)})
x5 =
  0.121241668138000   0.271104599813072
>> error=norm(x5-x4,inf)
error =    2.143814177124614e-006
```

```
>> x6=subs(F,{x,y},{x5(1),x5(2)})
x6 =
  0.121241662838981   0.271105132625649
>> error=norm(x6-x5,inf)
error =    5.328125770032166e-007
>> x7=subs(F,{x,y},{x6(1),x6(2)})
x7 =
  0.121241901120009   0.271105095639335
>> error=norm(x7-x6,inf)
error =    2.382810282974823e-007
>> x8=subs(F,{x,y},{x7(1),x7(2)})
x8 =
  0.121241884579227   0.271105157248499
>> error=norm(x8-x7,inf)
error =    6.160916454778231e-008
```

Dado el siguiente sistema de ecuaciones no lineales:

$$x_1^2 + x_2^2 - 10x_1 + 8 = 0$$

$$x_1x_2^2 + x_1 - 10x_2 + 8 = 0$$

$x^{(0)} = (0.95, 0.95)^T$, $\varepsilon = 10^{-4}$

Determine la solución aproximada empleando el método de Punto Fijo. Utilice quince decimales.

```
>> syms x y
>> f1=(x^2+y^2+8)/10;f2=(x*y^2+x+8)/10;
>> xo=[0.95 0.95];F=[f1   f2];  ∊ = 10^-4
>> x1=subs(F,{x,y},{xo(1),xo(2)})
x1 =
  0.980500000000000   0.980737500000000
>> error=norm(x1-xo,inf)
error =   0.030737500000000
>> x2=subs(F,{x,y},{x1(1),x1(2)})
x2 =
  0.992322629390625   0.992359004605008
>> error=norm(x2-x1,inf)
error =   0.011822629390625
```

```
>> x3=subs(F,{x,y},{x2(1),x2(2)})
x3 =
   0.996948059482137   0.996953853006701
>> error=norm(x3-x2,inf)
error =   0.004625430091512
>> x4=subs(F,{x,y},{x3(1),x3(2)})
x4 =
   0.998782241833011   0.998783166898905
>> error=norm(x4-x3,inf)
error =   0.001834182350874
>> x5=subs(F,{x,y},{x4(1),x4(2)})
x5 =
   0.999513378108158   0.999513525996041
>> error=norm(x5-x4,inf)
error =    7.311362751476480e-004
>> x6=subs(F,{x,y},{x5(1),x5(2)})
x6 =
   0.999805428166622   0.999805451820799
>> error=norm(x6-x5,inf)
error =    2.920500584637775e-004
>> x7=subs(F,{x,y},{x6(1),x6(2)})
x7 =
   0.999922183568204   0.999922187352366
>> error=norm(x7-x6,inf)
error =    1.167554015815142e-004
>> x8=subs(F,{x,y},{x7(1),x7(2)})
x8 =
   0.999968875395135   0.999968876000568
>> error=norm(x8-x7,inf)
error =    4.669182693106677e-005
```

Dado el siguiente sistema de ecuaciones no lineales:

$$20x - 4x^2 - \frac{1}{4}y^2 = 8$$

$$5y - 2x - \frac{1}{2}xy^2 = 8 \quad ; \quad x^{(0)} = (0.2\,,1.5)^T \quad ; \quad \epsilon = 10^{-12}$$

Determine la solución aproximada empleando el método de Newton.
Utilice quince decimales.

ITERACIÓN No 1

```
>> f1=4*x^2-20*x+(1/4)*y^2+8;f2=(1/2)*x*y^2+2*x-5*y+8; xo=[0.2 1.5]';F=[f1   f2]';
>> J=[diff(f1,x) diff(f1,y);diff(f2,x) diff(f2,y)]
J =
[    8*x-20,     1/2*y]
[ 1/2*y^2+2,     x*y-5]
>> Jo=subs(J,{x,y},{xo(1),xo(2)})
Jo =
 -18.399999999999999   0.750000000000000
   3.125000000000000  -4.700000000000000
>> Fo=subs(F,{x,y},{xo(1),xo(2)})
Fo =
   4.722500000000000
   1.125000000000000
>> x1=xo-inv(Jo)*Fo
x1 =
   0.473835594051316
   1.921433240725609
>> error=norm(x1-xo,inf)
error =   0.421433240725609
```

ITERACIÓN No 2

```
>> J1=subs(J,{x,y},{x1(1),x1(2)})
J1 =
 -16.209315247589476   0.960716620362804
   3.845952849282658  -4.089556538950837
>> F1=subs(F,{x,y},{x1(1),x1(2)})
F1 =
   0.344345224374869
   0.215183149405155
>> x2=x1-inv(J1)*F1
x2 =
   0.499635962318028
   1.998314473753804
>> error=norm(x2-x1,inf)
error =   0.076881233028195
```

ITERACIÓN No 3

```
>> J2=subs(J,{x,y},{x2(1),x2(2)})
J2 =
 -16.002912301455776   0.999157236876902
   3.996630368006971  -4.001570224891974
>> F2=subs(F,{x,y},{x2(1),x2(2)})
```

```
F2 =
   0.004140317008775
   0.005287891179597
>> x3=x2-inv(J2)*F2
x3 =
   0.499999885115072
   1.999999401345461
>> error=norm(x3-x2,inf)
error =   0.001684927591657
```

ITERACIÓN No 4

```
>> J3=subs(J,{x,y},{x3(1),x3(2)})
J3 =
 -16.000000919079426   0.999999700672730
   3.999998802691100  -4.000000529097058
>> F3=subs(F,{x,y},{x3(1),x3(2)})
F3 =
  1.0e-005 *
   0.123950445551912
   0.193507867241038

>> x4=x3-inv(J3)*F3
x4 =
   0.499999999999987
   1.999999999999930
>> error=norm(x4-x3,inf)
error =    5.986544695524287e-007
```

ITERACIÓN No 5

```
>> J4=subs(J,{x,y},{x4(1),x4(2)})
J4 =
 -16.000000000000107   0.999999999999965
   3.999999999999860  -4.000000000000061
>> F4=subs(F,{x,y},{x4(1),x4(2)})
F4 =
  1.0e-012 *
   0.142996725571720
   0.226485497023532
>> x5=x4-inv(J4)*F4
x5 =
   0.500000000000000
   2.000000000000000
>> error=norm(x5-x4,inf) =    6.994405055138486e-014
```

Dado el siguiente sistema de ecuaciones no lineales:

$$x_1^3 + x_1^2 x_2 - x_1 x_3 = -6$$

$$e^{x_1} + e^{x_2} = x_3$$

$$x_2^2 - 2x_1 x_3 = 4 \quad , x^{(0)} = (-1.456, -1.664, 0.422)^T , \ \varepsilon = 10^{-12}$$

Determine la solución aproximada empleando el método de Broyden.

ITERACIÓN No 1

```
>> syms x y z
>> f1=x^3+x^2*y-x*z+6;
>> f2=exp(x)+exp(y)-z;
>> f3=y^2-2*x*z-4;
>> f=[f1 f2 f3]';
j=[diff(f1,x) diff(f1,y) diff(f1,z);diff(f2,x) diff(f2,y) diff(f2,z);diff(f3,x) diff(f3,y) diff(f3,z)]
j =
[ 3*x^2+2*x*y-z,          x^2,          -x]
[       exp(x),        exp(y),          -1]
[         -2*z,          2*y,        -2*x]
>> x0=[-1.456 -1.664 0.422]';
>> j0=subs(j,{x,y,z},{x0(1),x0(2),x0(3)})
j0 =
 10.783375999999999   2.119936000000000   1.456000000000000
   0.233167080198542   0.189379943266833  -1.000000000000000
  -0.844000000000000  -3.328000000000000   2.912000000000000
>> A0=inv(j0)
A0 =
   0.091070658228683   0.361419803602309   0.078578614430408
  -0.005412609520850  -1.070273068363215  -0.364832523661009
   0.020209639786957  -1.118417052634764  -0.050770016540032
>> F0=subs(f,{x,y,z},{x0(1),x0(2),x0(3)})
F0 =
   0.000231680000000
   0.000547023465374
  -0.002240000000000
>> x1=x0-A0*F0
x1 =
  -1.456042788267196
  -1.664230506376874
   0.422493393365471
>> tol=norm(x1-x0,inf)
tol =     4.933933654706069e-04
```

ITERACIÓN No 2

```
>> s1=x1-x0
s1 =
   1.0e-03 *
  -0.042788267195837
  -0.230506376874162
   0.493393365470607

>> F1=subs(f,{x,y,z},{x1(1),x1(2),x1(3)})
F1 =
   1.0e-07 *
  -0.186536199819898
   0.052442359343985
   0.953560848060420

>> y1=F1-F0
y1 =
  -0.000231698653620
  -0.000547018221139
   0.002240095356085

>> A1=A0+((s1-A0*y1)*s1'*A0/det(s1'*A0*y1))
A1 =
   0.091070469544802   0.361428064541930   0.078577179511267
  -0.005411620628289  -1.070316363962594  -0.364825003247220
   0.020209911750463  -1.118428959714914  -0.050767948288962

>> x2=x1-A1*F1
x2 =
  -1.456042795956628
  -1.664230466076545
   0.422493404448797

>> tol=norm(x2-x1,inf)
tol =     4.030032907387238e-08
```

ITERACIÓN No 3

```
>> s2=x2-x1
s2 =
   1.0e-07 *
  -0.076894322020848
   0.403003290738724
   0.110833261457444

>> F2=subs(f,{x,y,z},{x2(1),x2(2),x2(3)})
F2 =
   1.0e-11 *

  -0.005773159728051
  -0.162075908249903
  -0.892486085035671

>> y2=F2-F1
y2 =
   1.0e-07 *
   0.186535622503925
  -0.052458566934810
  -0.953650096668923

>> A2=A1+((s2-A1*y2)*s2'*A1/det(s2'*A1*y2))
A2 =
   0.091069972710856   0.361386343725864   0.078565824752624
  -0.005409701954542  -1.070155246480139  -0.364781153430774
   0.020210782307133  -1.118355856145746  -0.050748052384180

>> x3=x2-A2*F2
x3 =
  -1.456042795955336
  -1.664230466081535
   0.422493404446532

>> tol=norm(x3-x2,inf)
tol =     4.990452495690079e-12
```

ITERACIÓN No 4

```
>> s3=x3-x2
s3 =
   1.0e-11 *
   0.129207755605876
  -0.499045249569008
  -0.226435536987424

>> F3=subs(f,{x,y,z},{x3(1),x3(2),x3(3)})
F3 =
   1.0e-15 *
  -0.888178419700125
                   0
                   0

>> y3=F3-F2
y3 =
   1.0e-11 *
   0.005684341886081
   0.162075908249903
   0.892486085035671

>> A3=A2+((s3-A2*y3)*s3'*A2/det(s3'*A2*y3))
A3 =
   0.091069946426499   0.361384127311367   0.078565283436267
  -0.005409889515775  -1.070171062481649  -0.364785016183131
   0.020210783859032  -1.118355725282670  -0.050748020423406

>> x4=x3-A3*F3
x4 =
  -1.456042795955336
  -1.664230466081535
   0.422493404446532

>> tol=norm(x4-x3,inf)

tol =     0
```

Dado el siguiente sistema de ecuaciones no lineales:

$$x_1 + \cos(x_1 x_2 x_3) = 1$$

$$(1 - x_1)^{1/4} + x_2 + 0.05x_3^2 = 0.15x_3 + 1$$

$$-x_1^2 - 0.1x_2^2 + 0.01x_2 + x_3 = 1 \qquad , x^{(0)} = (0.01, 0.08, 0.95)^T \quad , \quad \varepsilon = 10^{-9}$$

Determine la solución aproximada empleando el método de Broyden.

```
>> syms x y z

>> F=[x+cos(x*y*z)-1;(1-x)^(1/4)+y+0.05*z^2-0.15*z-1;z-x^2-0.1*y^2+0.01*y-1];
 xo=[0.01 0.08 0.95]';

> J=[diff(F(1,1),x) diff(F(1,1),y) diff(F(1,1),z);diff(F(2,1),x) diff(F(2,1),y) diff(F(2,1),z);
diff(F(3,1),x) diff(F(3,1),y) diff(F(3,1),z)]

 J =
 [ 1-sin(x*y*z)*y*z,  -sin(x*y*z)*x*z,  -sin(x*y*z)*x*y]
[ -1/4/(1-x)^(3/4),              1,      1/10*z-3/20]
  [            -2*x,     -1/5*y+1/100,              1]
```

```
 Iteración No 1

 >> Fo=subs(F,{x,y,z},{0.01 0.08 0.95})
 Fo =
    0.009999711200014
   -0.019884430066319
   -0.049940000000000
 >> Jo=subs(J,{x,y,z},{0.01 0.08 0.95})
 Jo =
  0.999942240005560  -0.000007219999305  -0.000000607999941
   -0.251891558064061   1.000000000000000  -0.055000000000000
   -0.020000000000000  -0.006000000000000   1.000000000000000
 >> ao=inv(Jo)
 ao =
    1.000059603831911   0.000007226462594   0.000001005491623
    0.253090157082200   1.000331937773496   0.055018410456343
    0.021519733019131   0.006002136155893   1.000330130572571

 >> x1=xo-ao*Fo
 x1 =
   -0.000000113312778
    0.100107821399564
    0.999860644662142

 >> error=norm(x1-xo,inf)   =   0.049860644662142
```

Iteración No 2

```
>> s1=x1-xo
s1 =
  -0.010000113312778
   0.020107821399564
   0.049860644662142


>> F1=subs(F,{x,y,z},{x1(1,1) x1(2,1) x1(3,1)})
F1 =
  1.0e-003 *
  -0.000113312777716
   0.114818465645428
  -0.140434714412163

>> y1=F1-Fo
y1 =
  -0.009999824512792
   0.019999248531964
   0.049799565285588

>> A1=ao+((s1-ao*y1)*s1'*ao/det(s1'*ao*y1))
A1 =
   1.000059459020329   0.000007996565313   0.000002928830503
   0.253227859163195   0.999599643123803   0.053189497588177
   0.021339997057042   0.006957965453780   1.002717323355433

>> x2=x1-A1*F1
x2 =
  -0.000000000500106
   0.100000547248136
   1.000000664498260

>> error=norm(x2-x1,inf)  =    1.400198361184435e-004
```

Iteración No 3

```
>> s2=x2-x1
s2 =
  1.0e-003 *

   0.000112812671299
  -0.107274151427555
   0.140019836118443

>> F2=subs(F,{x,y,z},{x2(1,1) x2(2,1) x2(3,1)})
F2 =
  1.0e-006 *
  -0.000500106289714
   0.514148271957282
   0.659025748861453
```

```
>> y2=F2-F1
y2 =
  1.0e-003 *
   0.000112812671427
  -0.114304317373470
   0.141093740161025

>> A2=A1+((s2-A1*y2)*s2'*A1/det(s2'*A1*y2))
A2 =
   1.000059077291930   0.000006311003470   0.000005065498637
   0.253651905430010   1.001472063956438   0.050815961461784
   0.021853287540521   0.009224453499244   0.999844255954030

>> x3=x2-A2*F2
x3 =
  -0.000000000006554
   0.099999998980831
   1.000000000843343

>> error=norm(x3-x2,inf)  =    6.636549174654505e-007
```

```
Iteración No 4
>> s3=x3-x2
s3 =
  1.0e-006 *
   0.000493552749078
  -0.548267305236494
  -0.663654917465450
>> F3=subs(F,{x,y,z},{x3(1,1) x3(2,1) x3(3,1)})
F3 =
  1.0e-008 *
  -0.000655353549206
  -0.105969766295289
   0.085353435430591
>> y3=F3-F2
y3 =
  1.0e-006 *
   0.000493552754222
  -0.515207969620235
  -0.658172214507147
>> A3=A2+((s3-A2*y3)*s3'*A2/det(s3'*A2*y3))
A3 =
   1.000057722932819   0.000001398915521  -0.000001051758117
   0.253441293467129   1.000708201199382   0.049864686839208
   0.022027529321494   0.009856406240142   1.000631256759516

>> x4=x3-A3*F3
x4 =
   0.000000000000003
   0.100000000000379
   0.999999999999859

>> error=norm(x4-x3,inf)   =    1.019547848923885e-009
```

Iteración No 5

```
>> s4=x4-x3
s4 =
  1.0e-008 *
   0.000655629392054
   0.101954784892389
  -0.084348394935319
>> F4=subs(F,{x,y,z},{x4(1,1) x4(2,1) x4(3,1)})
F4 =
  1.0e-012 *
   0.002664535259100
   0.385247389544929
  -0.144995127016045
>> y4=F4-F3
y4 =
  1.0e-008 *
   0.000655620002732
   0.106008291034243
  -0.085367934943292
>> A4=A3+((s4-A3*y4)*s4'*A3/det(s4'*A3*y4))
A4 =
   1.000057348008936  -0.000000141056684   0.000000155280803
   0.253387985663733   1.000489243327309   0.050036307257204
   0.022047400438136   0.009938025386652   1.000567283211053

>> x5=x4-A4*F4
x5 =
   0.000000000000000
   0.100000000000000
   1.000000000000000

>> error=norm(x5-x4,inf)   =    3.788497293655269e-013
```